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Road vehicles — Modular vehicle communication interface (MVCI) —

Part 2: Diagnostic protocol data unit application programming interface (D-PDU API)

Véhicules routiers — Interface de communication modulaire du véhicule (MVCI) —

Partie 2: Interface de programmation d'application d'unité de données du protocole de diagnostic (D-PDU API)

Reference number
ISO 22900-2:2009(E)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 22900-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 22900 consists of the following parts, under the general title *Road vehicles — Modular vehicle communication interface (MVCI)*:

— *Part 1: Hardware design requirements*

— *Part 2: Diagnostic protocol data unit application programming interface (D-PDU API)*

— *Part 3: Diagnostic server application programming interface (D-Server API)*

Introduction

ISO 22900 is applicable to vehicle electronic control module diagnostics and programming.

This part of ISO 22900 was established in order to more easily exchange software and hardware of vehicle communication interfaces (VCIs) among diagnostic applications. It defines a generic and protocol independent software interface towards the modular vehicle communication interface (MVCI) protocol module, such that a diagnostic application based on this software interface can exchange the MVCI protocol module or add a new MVCI protocol module with minimal effort. Today, the automotive after market requires flexible usage of different protocol modules for vehicles of different brands. Many of today's protocol modules are incompatible with regard to their hardware and software interface, such that, depending on the brand, a different protocol module is required.

The objective of this part of ISO 22900 is to specify the diagnostic protocol data unit application programming interface (D-PDU API) as a generic software interface, and to provide a “plug and play” concept for access onto different MVCI protocol modules from different tool manufacturers. The D-PDU API will address the generic software interface, the protocol abstraction, its exchangeability as well as the compatibility towards existing standards such as SAE J2534-1 and RP1210a.

The implementation of the modular VCI concept facilitates co-existence and re-use of MVCI protocol modules, especially in the after market. As a result, diagnostic or programming applications can be adapted for different vehicle communication interfaces and different vehicles with minimal effort, thus helping to reduce overall costs for the tool manufacturer and end user.

Vehicle communication interfaces compliant with ISO 22900 support a protocol-independent D-PDU API as specified in this part of ISO 22900.

Road vehicles — Modular vehicle communication interface (MVCI) —

Part 2: Diagnostic protocol data unit application programming interface (D-PDU API)

1 Scope

This part of ISO 22900 specifies the diagnostic protocol data unit application programming interface (D-PDU API) as a modular vehicle communication interface (MVCI) protocol module software interface and common basis for diagnostic and reprogramming software applications.

This part of ISO 22900 covers the descriptions of the application programming interface (API) functions and the abstraction of diagnostic protocols, as well as the handling and description of MVCI protocol module features. Sample MVCI module description files accompany this part of ISO 22900.

Migration from and to the existing standards SAE J2534-1 and RP1210a is addressed. This part of ISO 22900 contains a description of how to convert between the APIs. Corresponding wrapper APIs accompany this part of ISO 22900.

The purpose of this part of ISO 22900 is to ensure that diagnostic and reprogramming applications from any vehicle or tool manufacturer can operate on a common software interface, and can easily exchange MVCI protocol module implementations.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9141-2, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

ISO 14230 (all parts), *Road vehicles — Diagnostic systems — Keyword Protocol 2000*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*

ISO 15765 (all parts), *Road vehicles — Diagnostics on Controller Area Networks (CAN)*

ISO 22901-1, *Road vehicles — Open diagnostic data exchange (ODX) — Part 1: Data model specification*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
application
way of accessing the diagnostic protocol data unit application programming interface (D-PDU API)

NOTE From the perspective of the D-PDU API, it does not make any difference whether an application accesses the software interface directly, or through an MVCI D-Server. Consequently, in this part of ISO 22900, the term “application” represents both ways of accessing the D-PDU API.

3.2
ComLogicalLink
logical communication channel towards a single electronic control unit (ECU) or towards multiple electronic control units

3.3
COMPARAM-SPEC
protocol-specific set of predefined communication parameters (ComParams), the value of which can be changed in the context of a layer or specific diagnostic service

NOTE This part of the model can also contain OEM-specific ComParams.

3.4
ComPrimitive
smallest aggregation of a communication service or function

EXAMPLE A request message to be sent to an ECU.

3.5
Ethernet
physical network media type

4 Symbols and abbreviated terms

API	Application Programming Interface
ASCII	American Standard for Character Information Interchange
CAN	Controller Area Network
CDF	Cable Description File
CLL	ComLogicalLink
ComParam	Communication Parameter
COP	Communication Primitive
CRC	Cyclic Redundancy Check
DLC	Data Link Connector
DLL	Dynamic Link Library
D-PDU	Diagnostic Protocol Data Unit
D-Server	Diagnostic Server
ECU	Electronic Control Unit

HDD	Hard Disk Drive
HI	Differential Line — High
HW	Hardware
IEEE 1394	Firewire serial bus
IFR	In-Frame Response
IGN	Ignition
IOCTL	Input/Output Control
K	UART K-Line
KWP	Keyword Protocol
L	UART L-Line
LOW	Differential Line — Low
MDF	Module Description File
MVCI	Modular Vehicle Communication Interface
ODX	Open Diagnostic Data Exchange
OEM	Original Equipment Manufacturer
OSI	Open Systems Interconnection
PC	Personal Computer
PCI	Protocol Control Information
PGN	Parameter Group Number
PROGV	Programmable Voltage
PWM	Pulse Width Modulation
RDF	Root Description File
RX	UART uni-directional receive
SCI	Serial Communications Interface
SCP	Standard Corporate Protocol
TX	UART uni-directional transmit
USB	Universal Serial Bus
USDT	Unacknowledged segmented data transfer[1)]
UUDT	Unacknowledged un-segmented data transfer[2)]

1) ISO 15765-2 network layer includes protocol control information for segmented data transmission, which results in a maximum of 7 data bytes for normal addressing and 6 data bytes for extended addressing.

2) Single CAN frames do not include protocol control information, which results in a maximum of 8 data bytes for normal addressing and 7 data bytes for extended addressing.

VCI Vehicle Communication Interface

VPW Variable Pulse Width

XML Extensible Markup Language

5 Specification release version information

5.1 Specification release version location

Specification release version information is contained in each modular VCI release document specification under the same clause title “Specification release version information”. It is important to check for feature support between modular VCI release specifications if the most recent API features shall be implemented. The D-PDU API supports the reading of version information by the API function call PDUGetVersion.

Release version information is also contained in the following files:

— root description file (RDF);

— module description file (MDF);

— cable description file (CDF);

— D-PDU API library file.

5.2 Specification release version

The specification release version of this part of ISO 22900 is: 2.2.0.

6 Modular VCI use cases

6.1 OEM merger

In the past, several OEMs in the automotive industry have merged into one company.

All companies try to leverage existing (legacy) components and jointly develop new products, which are common across different vehicle types and badges.

If OEMs already had modular VCI compliant test equipment, it would be simple to connect MVCI protocol modules from merged OEMs into one chassis or device. All protocols would be supported by a single MVCI protocol module configuration without any replacement of MVCI protocol module hardware at the dealer site. The same applies for engineering and some of this concept might also work for production plants (end of line).

6.2 OEM cross vehicle platform ECU(s)

OEMs specify requirements and design electronic systems to be implemented in multiple vehicle platforms in order to avoid re-inventing a system for different vehicles. The majority of design, normal operation, and diagnostic data of an electronic system are re-used if installed in various vehicles. The engineering development centres are located worldwide. A great amount of re-authoring of diagnostic data is performed to support different engineering test tools.

Providing diagnostic data in an industry standard format like ODX and XML will avoid re-authoring into various test tool specific formats at different system engineering locations. The D-PDU API supports this re-use concept by fully abstracting vehicle protocols into the industry supported ComParam descriptions.

6.3 Central source diagnostic data and exchange during ECU development

Single source origin of diagnostic data (as depicted in Figure 1 — Example of central source engineering diagnostic data process), combined with a verification and feedback mechanism and distribution to the end users, is highly desirable in order to lower engineering expenses. Engineering, manufacturing, and service specify which protocol and data shall be implemented in the ECU. This information will be documented in a structured format like XML. Furthermore, the same structured data files can be used to setup the diagnostic engineering tools to verify proper communication with the ECU and to perform functional verification and compliance testing of the ECU. Once all quality goals are met, these structured data files shall be released to the OEM database. An Open Diagnostic data eXchange (ODX) schema has been developed for the purpose of supporting these structured formatted files used for ECU diagnosis and validation.

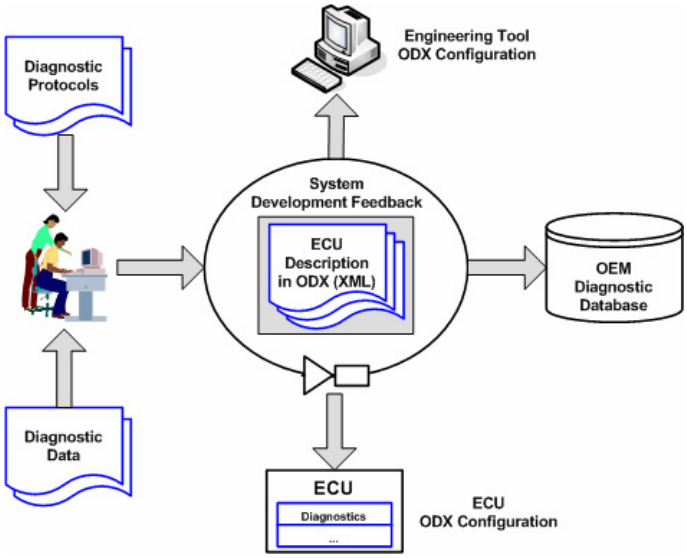


Figure 1 — Example of central source engineering diagnostic data process

6.4 OEM franchised dealer and aftermarket service outlet diagnostic tool support

The service shop uses the modular VCI hardware and software for vehicle diagnosis and enhanced procedural testing. By using the same engineering, manufacturing, and service functions as those used for individual ECU testing, the reliability of the data is maintained. A modular VCI protocol module can be used with any PC (handheld or stationary) and can be utilised as an embedded device.

7 Modular VCI software architecture

7.1 Overview

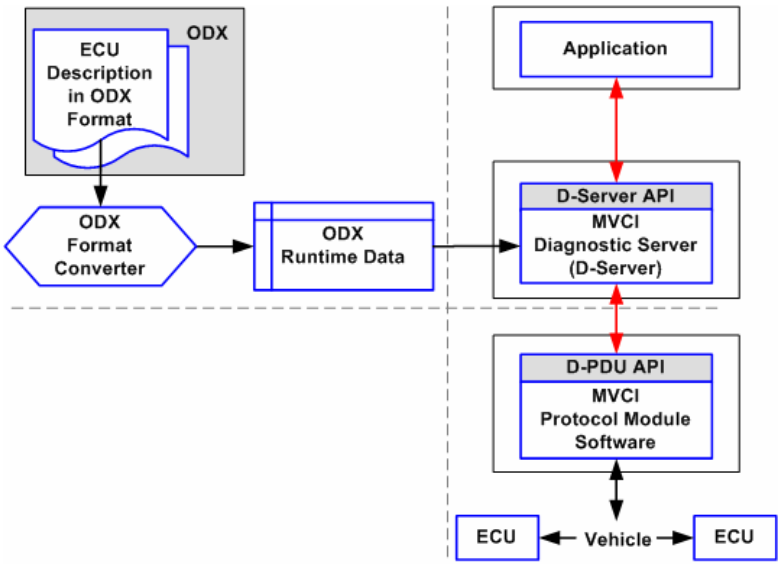
The modular VCI concept is mainly based on three software components (see Figure 2 — MVCI software architecture):

— MVCI D-Server software;

— runtime data based on ODX;

— MVCI protocol module software.

The application accesses the MVCI D-Server through the MVCI D-Server API. The D-Server obtains all required information about the ECU(s) out of the ODX runtime data. Using the ODX runtime data information, the D-Server converts the application's request into a byte stream, which is called a diagnostic protocol data unit (D-PDU). The D-PDU is handed over to the MVCI protocol module through the D-PDU API. The MVCI protocol module transmits the D-PDU to the vehicle's ECU(s). The other way around, the MVCI protocol module receives the vehicle's response(s) and reports the response data to the D-Server. Again using the ODX runtime data, the D-Server interprets the D-PDU and provides the interpreted symbolic information to the application.



NOTE The grey shading of symbols indicates reference to the following International Standards:

— ODX: ISO 22901-1;

— D-Server API: ISO 22900-3;

— D-PDU API: ISO 22900-2;

— MVCI protocol module: ISO 22900-1.

Figure 2 — MVCI software architecture

7.2 Modular VCI D-Server software

The MVCI D-Server is accessible through the MVCI D-Server API. By accessing this API, the application may browse the available features for each ECU and initiate a request towards an ECU using simple symbolic expressions. If the request requires input parameters, they can be specified using symbolic expressions as well. The MVCI D-server takes the symbolic request, including input parameters, and converts them into a diagnostic request message as defined at the protocol level. The diagnostic request message represents the diagnostic protocol data unit (D-PDU) as passed to the MVCI protocol module through the D-PDU API. Vice versa, the D-Server converts diagnostic response messages as retrieved from the MVCI protocol module back to symbolic information and provides it to the application.

For a detailed description and the complete MVCI D-Server API definition, see ISO 22900-3.

7.3 Runtime format based on ODX

For every conversion from symbolic requests to diagnostic request messages, and vice versa for responses, the MVCI D-Server obtains the required information from the runtime database. The database defines the structure of every diagnostic request and response as supported by an ECU. The database defines byte and bit positions, width, and type of every input and output parameter.

Even though the MVCI D-Server obtains its information from a runtime database, the runtime database and format are not specified by the MVCI standard. Instead, the MVCI standard defines an exchange format to import and export the ECU description across OEMs and tool suppliers. The runtime format is left up to the system designers.

The exchange format is called open diagnostic data exchange format (ODX format). For a detailed description, see ISO 22901-1.

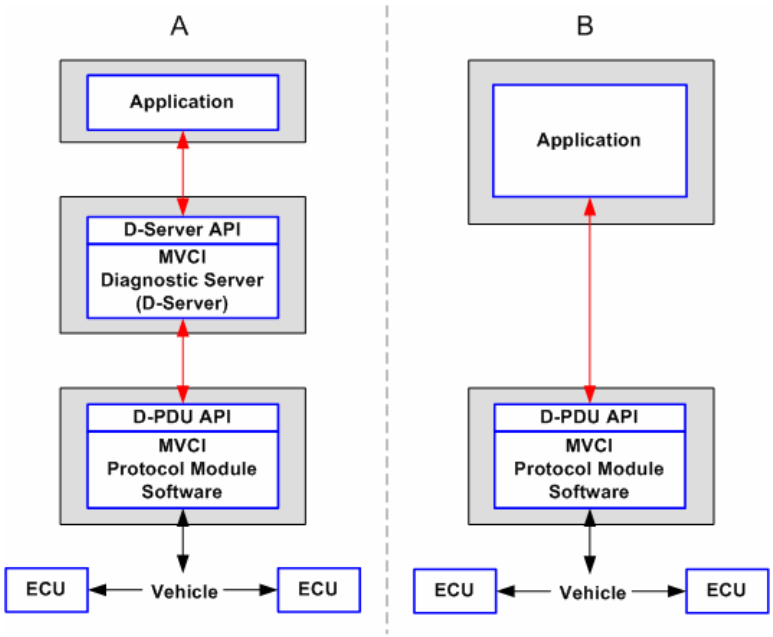
7.4 MVCI protocol module software

The MVCI protocol module is accessible through the D-PDU API. The application issues diagnostic requests through the D-PDU API. The MVCI protocol module takes the request D-PDU and transmits it to the vehicle's ECU(s) according to the vehicle communication protocol. Header type, checksum information, and D-PDU segmentation depend on the vehicle communication protocol, and shall be handled transparently by the MVCI protocol module. Also, the MVCI protocol module observes the timing between message frames and requests and responses on the physical interfaces. After completion, the MVCI protocol module simply has to deliver the response back to the application or report an error condition.

7.5 MVCI protocol module configurations

The D-PDU API and MVCI protocol modules work in many configurations. A MVCI D-Server is not required as the application interface to the D-PDU API.

Figure 3 — MVCI configurations shows two such configurations to point out the differences.



Key

A application with MVCI D-Server

B application without MVCI D-Server

NOTE From the perspective of the D-PDU API, it does not make a difference whether an application accesses the software interface directly, or through an MVCI D-Server. Consequently, in this part of ISO 22900, the term “application” represents both ways of accessing the D-PDU API.

Figure 3 — MVCI configurations

8 D-PDU API use cases

8.1 Overview

The MVCI protocol module is the key component to exchange implementations of diagnostic protocols among OEMs and tool suppliers without re-engineering already implemented software. By relying on the D-PDU API, the application may easily access other or additional MVCI protocol module implementations. In a similar way to existing standards like SAE J2534-1 and RP1210a, applications compliant to the MVCI standard are basically independent of the underlying device as long as the required physical interface is supported and no tool supplier specific feature is required.

Even though the D-PDU API extends the capabilities beyond the definitions of SAE J2534-1 and RP1210a, the existing standards and their related devices and applications do not become obsolete by introducing the D-PDU API. Instead, the transition and co-existence of all standards are facilitated to save development and investment costs. The definition of the D-PDU API is closely related to SAE J2534-1 and RP1210a to allow mapping of functionality in both directions. However, it extends their definitions to cover the full width of enhanced diagnostics.

The fulfilment of the following use cases is crucial for the inter-exchange of protocol module implementations according to MVCI, SAE J2534-1 and RP1210a.

NOTE In the use case figures below, the grey boxes suggest a specific software component architecture. This representation is not intended to be construed as the only possible architectural solution. Depending on the situation, there can be more software components, or fewer software components.

8.2 Use case 1: Single MVCI protocol module

The single MVCI protocol module configuration (see Figure 4 — MVCI configuration with single MVCI protocol module) is the simplest configuration where the D-PDU API implementation and the MVCI protocol module hardware are obtained from the same vendor. The application will access the single MVCI protocol module through a single D-PDU API. Parallel access onto multiple D-PDU APIs is not required. Resource handling is completely covered inside the D-PDU API implementation.

This use case applies to basically all stand-alone MVCI protocol module device configurations.

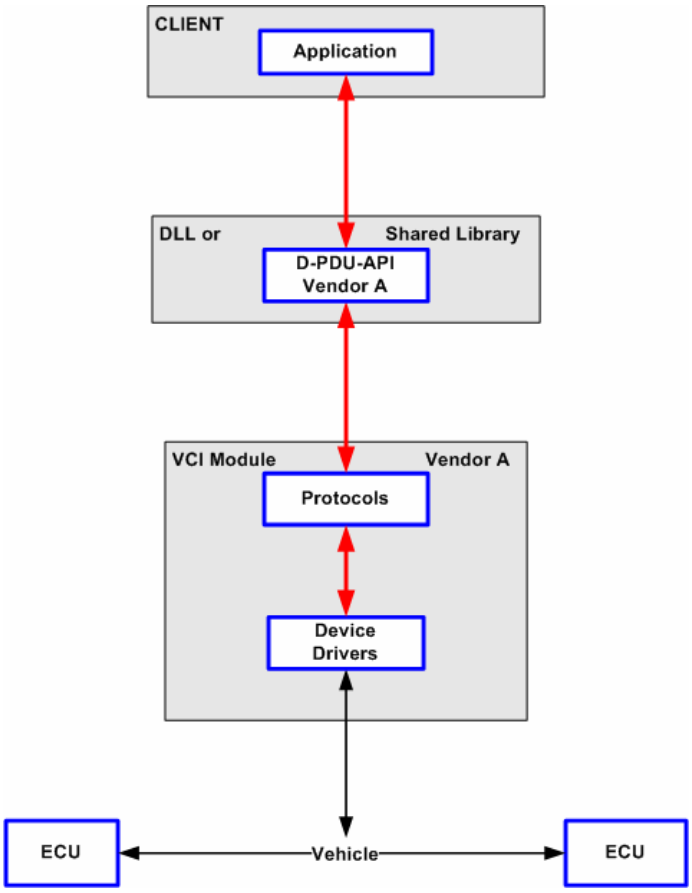


Figure 4 — MVCI configuration with single MVCI protocol module

8.3 Use case 2: Multiple MVCI protocol modules supported by same D-PDU API implementation

There are different configurations with multiple MVCI protocol modules. In this use case, a D-PDU API implementation may support more than one MVCI protocol module at a time, where both modules and D-PDU API implementations are from a single vendor (see Figure 5 — Multiple MVCI protocol modules supported by same D-PDU API implementation). The application will access the MVCI protocol modules through a single D-PDU API. Parallel access onto multiple D-PDU APIs is not required. However, the application may access and operate the MVCI protocol modules at the same time in parallel if the D-PDU API implementation provides the capabilities. Resource handling is completely covered inside the D-PDU API implementation.

This use case applies to MVCI protocol module device configurations where the vendor integrates support for multiple MVCI protocol modules into one software package.

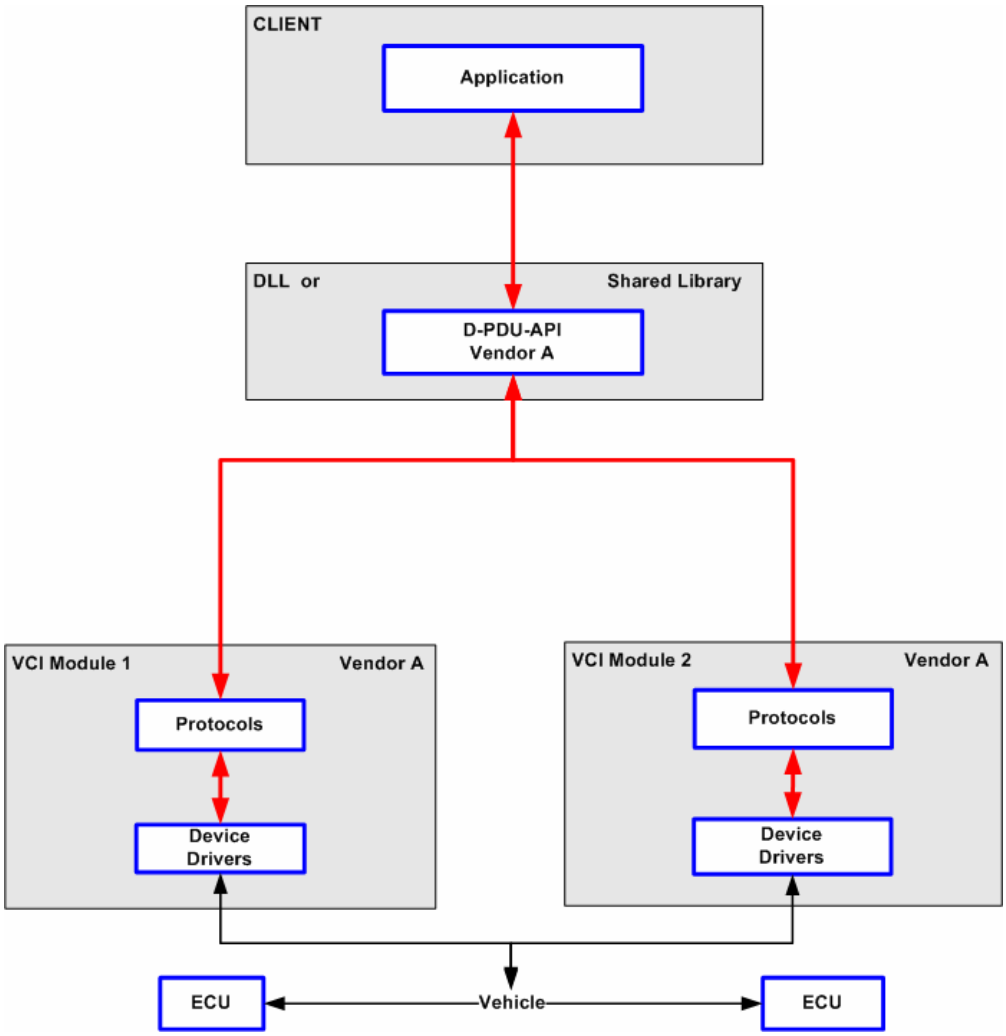


Figure 5 — Multiple MVCI protocol modules supported by same D-PDU API implementation

8.4 Use case 3: Multiple MVCI protocol modules supported by different D-PDU API implementations

In most cases, when combining MVCI protocol modules of different suppliers, the MVCI protocol modules are not accessed through the same D-PDU API implementation (see Figure 6 — Multiple MVCI protocol modules supported by different D-PDU API implementations). Neither of the implementations knows about the other suppliers' MVCI protocol modules. It cannot communicate with them, since the D-PDU API does not define an explicit interface hardware type, nor the communication protocol on the interface. Therefore, MVCI protocol modules of different suppliers will be addressed through separate D-PDU API implementations. Each D-PDU API implementation may support more than one MVCI protocol module at a time, and more than one D-PDU API implementation may co-exist on the same runtime environment at the same time.

The application may access multiple D-PDU APIs (and their MVCI protocol modules) in parallel, if it needs to use resources of more than one D-PDU API. As a result, each D-PDU API implementation shall be able to run concurrently with other D-PDU API implementations. As in use case 2, resource handling is completely covered inside the D-PDU API implementation with respect to one implementation. As use case 3 assumes multiple D-PDU API implementations not knowing each other, the application is required to handle the resources across D-PDU API implementations.

This use case applies to MVCI protocol module device configurations where a tool supplier integrates support for multiple MVCI protocol modules of different vendors into one software package.

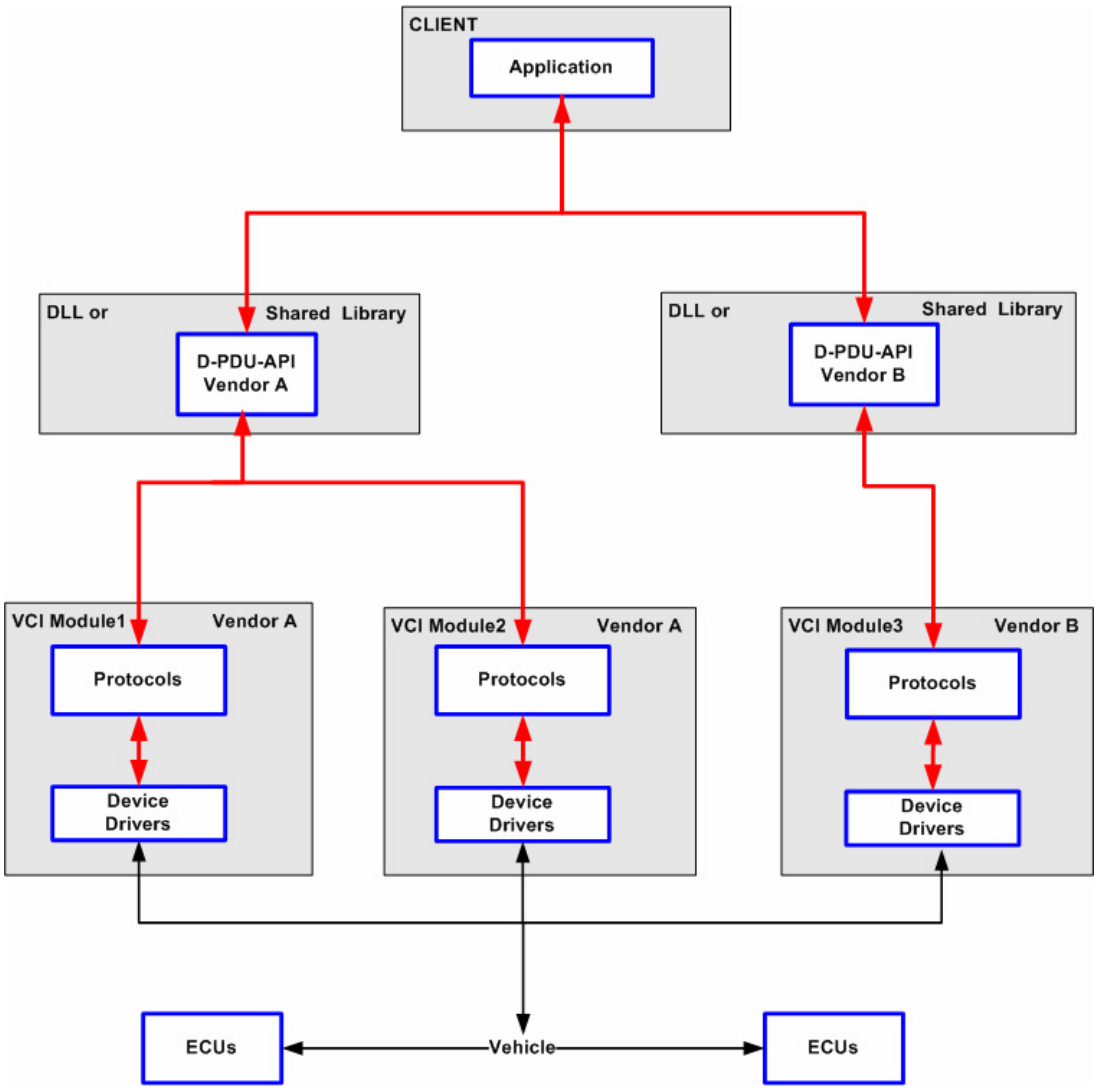


Figure 6 — Multiple MVCI protocol modules supported by different D-PDU API implementations

9 Diagnostic protocol data unit (D-PDU) API

9.1 Software requirements

9.1.1 General requirements

The MVCI devices shall be accessed through dynamically linkable software modules, i.e. dynamic link libraries for Windows systems (DLLs) and/or library modules for Linux systems. The linkable software module will be referred to as the D-PDU API implementation. It queries the available MVCI protocol modules, takes care of device identification (e.g. reading firmware version, etc.) and low-level communication with all MVCI Protocol modules supported by the respective library. However, the device query and identification does not contain any functionality of the system level driver, as it is required for USB, Ethernet and wireless communication. The system low-level driver is responsible for the detection and enumeration of the device interface. The system level driver is considered a part of the delivery from the MVCI protocol module supplier, but its interface is proprietary and not part of this part of ISO 22900.

Multiple MVCI protocol modules may be separately accessible by the application using the same D-PDU API implementation. This could typically apply to MVCI protocol module variants from a single supplier. However, MVCI protocol modules may also be accessible through separate D-PDU API implementations. Such cases would typically occur when combining multiple MVCI protocol modules from different suppliers.

In order to declare the capabilities of a D-PDU API implementation, a MVCI protocol module vendor shall provide a module description file (MDF) in XML. The MDF shall contain all information about supported MVCI protocol module types, bus types, protocols, and communication links, as well as all related information regarding parameters and I/O controls. The application may parse the file for resources and use them dynamically. It may also make use of static information. In the latter case, the application developer could create a C header file containing and statically matching all necessary resource Ids. For a detailed description and structure of the files, see Clause F.2.

All API functions return a SNUM32 value representing the function result.

The D-PDU API implementation shall not be restricted to a dedicated operating system or programming language and shall be portable. However, for unique and clear definition, C was chosen as the programming language to describe the API.

In general, the D-PDU API implementation shall be made available as a dynamically linkable software module independent of the target operating system. The approach of a separate software module guarantees easy exchange. However, in some cases, it may be useful or more appropriate to link the software module statically. Those cases are considered as proprietary solutions and shall not be the main target of this part of ISO 22900.

The D-PDU API implementation shall support, at a minimum, single clients and asynchronous, multi-thread operation. Multi client support is not a requirement, but may be offered as an additional feature by an MVCI protocol module vendor. A multi client implementation shall support multiple sessions and links in parallel. For every communication link, the implementation shall take care of queuing communication requests.

The D-PDU API implementation shall cover full duplex and event-driven communication, enabling coverage of advanced vehicle communication principles (e.g. response on event, periodic transmission, etc).

9.1.2 Vehicle protocol requirements

The D-PDU API functions shall be protocol independent. Since protocol standards have frequently changed in the past and new protocols will be released in the future, the D-PDU API needs to be flexible and generic enough to easily cover additional protocols not taken into account at time of definition. In order to provide the application the capability to use any protocol and any of its tool supplier specific implementations, all protocol-related ComParams have to be documented in a standardized and generic manner. The documentation is stored in a module description file (MDF) in XML and shall be provided by the MVCI protocol module supplier.

In general, there is no minimum set of protocols with respect to the D-PDU API. However, in order to provide the required SAE J2534-1 and RP1210a compatibility, and to avoid interference of D-PDU API implementations of different suppliers, minimal protocol naming conventions are necessary. For all protocols and ComParams defined in SAE J2534-1 and RP1210a, appropriate definitions will be specified for the D-PDU API to achieve full compatibility.

9.1.3 Timing requirements for protocol handler messages

There can be unexpected results if two requests are made to the same ECU “simultaneously”. Most ECUs will ignore the second request, but some ECUs will ignore both requests. As a result, the protocol handler has to properly serialize requests across multiple CLLs, while still allowing valid parallel communication.

It should also be emphasized that for the cases where CLLs are sharing a physical serial bus, all timing requirements (CP_P3Min, CP_P3Phys and CP_P3Func) shall be satisfied before subsequent transmissions can occur.

Message serialization is also required for some complex single CLL scenarios. Consider the case where Tester Present messages, functionally addressed ComPrimitives and physically addressed ComPrimitives are all occurring on one bus. Message serialization may be required to assure that the protocol handler adheres to proper inter-transmit timing and receive timing. All standard Protocols have their timing individually defined using ComParams. This allows for minor changes in the timing behaviour of a protocol in order to satisfy the unique attributes of an installed vehicle ECU.

NOTE For functional Tester Presents, it is sent regardless of the P3 physical delay value. The protocol handler is careful to not wait for a P3Phys delay (see CP_P3Phys) when sending a functional request where the previous request was a physical message (no delay should occur). A protocol handler waits a P3Func delay (See CP_P3Func) if the previous message was a functional request. This rule is applicable only for CAN protocols at this time.

Timing between message requests on the serial bus is the responsibility of the MVCI Protocol Handlers. The MVCI protocol module shall ensure that the inter-message timing is correctly managed (see Table 1 — Functional and physical address handling).

Table 1 — Functional and physical address handling

New request addressing type	Previous request addressing type	Handling in the tester
Physical with response		
physical with response	physical with response	Wait until the completion of the previous physical request (pos. response or negative response other than 0x78) before transmitting a new physical request. There is no timing applied to this rule, the tester can transmit the physically addressed request immediately after the previous physically addressed service has been finished (final response received).
physical with response	functional with response	Wait until the completion of the previous functional request that requires a response (pos. response or negative response other than 0x78) before transmitting the physical request. There is no timing applied to this rule, the tester can transmit the physically addressed request immediately after the previous functionally addressed service has been finished (final response received).
physical with response	functional without response	The tester is allowed to transmit the physical request immediately (e.g. functional Tester Present followed by any physical request).
Functional without response		
functional without response	physical with response	The tester is allowed to transmit the functional request that does not require a response immediately (e.g. any physical request followed by a functional Tester Present). NOTE For physical cyclic responses, the tester waits for the first response before sending a functional Tester Present).
functional without response	functional with response	Wait CP_P3Func after the transmission of the functional request that requires a response before transmitting the functional request that does not require a response.
functional without response	functional without response	Wait CP_P3Func after the transmission of the functional request that does not require a response before transmitting the next functional request that does not require a response.
Functional with response		
functional with response	physical with response	Wait until the completion of the previous physical request (pos. response or negative response other than 0x78) before transmitting the functional request that requires a response. There is no timing applied to this rule, the tester can transmit the functionally addressed request immediately after the previous physically addressed service has been finished (final response received).
functional with response	functional with response	Wait until the completion of the previous functional request that requires a response (pos. response or negative response other than 0x78) before transmitting the next functional request that requires a response. There is no timing applied to this rule, the tester can transmit the functionally addressed request immediately after the previous functionally addressed service has been finished (final response received).
functional with response	functional without response	Wait CP_P3Func after the transmission of the functional request that does not require a response before transmitting the functional request that requires a response.

Table 1 (*continued*)

New request addressing type	Previous request addressing type	Handling in the tester
Physical with response		
physical with response	physical without response	Wait CP_P3Phys after the completion of the previous physical request without response before transmitting a new physical request.
Physical without response		
physical without response	physical with response	Wait until the completion of the previous physical request (pos. response or negative response other than 0x78) before transmitting a new physical request. There is no timing applied to this rule, the tester can transmit the physically addressed request immediately after the previous physically addressed service has been finished (final response received).
physical without response	physical without response	Wait CP_P3Phys after the completion of the previous physical request without response before transmitting a new physical request.
physical without response	functional with response	Wait until the completion of the previous functional request that requires a response (pos. response or negative response other than 0x78) before transmitting the physical request. There is no timing applied to this rule, the tester can transmit the physically addressed request immediately after the previous functionally addressed service has been finished (final response received).
physical without response	functional without response	The tester is allowed to transmit the physical request immediately (e.g. functional Tester Present followed by any physical request).
Functional without response		
functional without response	physical without response	The tester is allowed to transmit the functional request that does not require a response immediately (e.g. any physical request followed by a functional Tester Present).
Functional with response		
functional with response	physical without response	Wait CP_P3Func after the completion of the previous physical request before transmitting a new functional request.

9.1.4 Serialization requirements for protocol handler messages

Many vehicle serial bus protocols require serialization of messages sent on the bus, e.g. sending functional and physical messages on a shared physical serial bus can be accomplished if the physically addressed ECU is not in the functional group (i.e. a group of ECUs which can be addressed with the same functional address). For this case, the CLLs share the ECU being addressed, and the messages/frames need to be serialized. See Figure 7 — Example: CLLs sharing physical bus with message serialization.

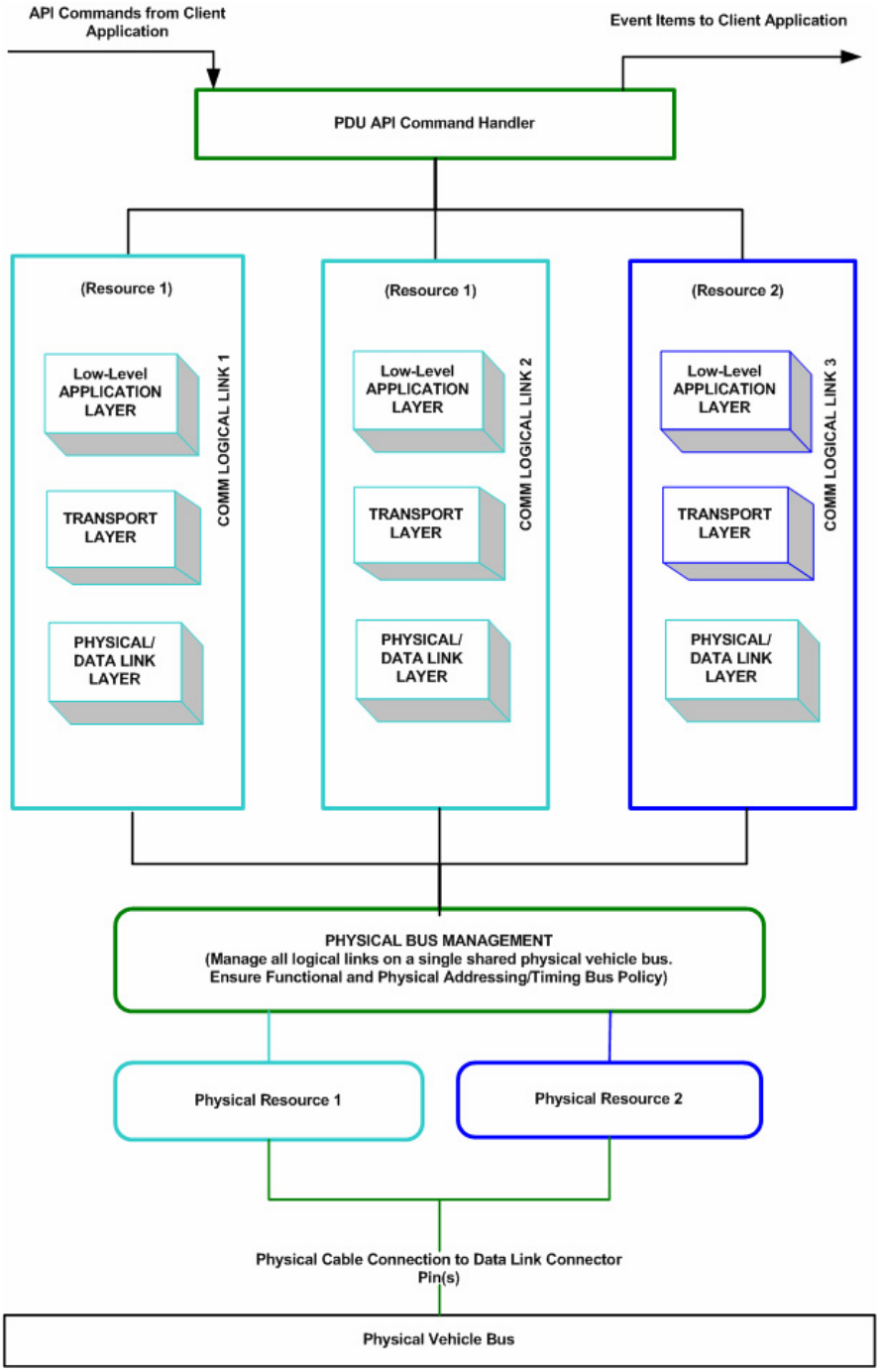


Figure 7 — Example: CLLs sharing physical bus with message serialization

9.1.5 Compatibility requirements

In order to provide a smooth migration path for existing applications onto the MVCI architecture, the D-PDU API shall define all functionality necessary to implement compatibility layers for SAE J2534-1 and RP1210a interfaces. Existing applications can use these compatibility layers to easily migrate to the MVCI architecture, such that they may be preserved without any porting efforts. Clause 10 shows applications based on both SAE J2534-1 and RP1210a, and how their migration could be accomplished using compatibility layers.

Per definition, the D-PDU API shall support, at a minimum, only one client at a time. However, the RP1210a standard defines multi-client communication at its API level. Therefore, the compatibility layer for RP1210a shall handle all multi-client requirements.

In the opposite direction, a new MVCI-compliant application shall also run on existing SAE J2534-1 or RP1210a compliant hardware with minimal porting effort. This implies that the D-PDU API would have to be implemented on top of the SAE J2534-1 or RP1210a API. The resulting D-PDU API implementation would have the same limitations as the APIs it is based on.

Summarizing all compatibility requirements, the D-PDU API shall be defined as close as possible to the existing standards SAE J2534-1 and RP1210a. Additional naming conventions shall be included to facilitate exchange of software.

9.1.6 Timestamp requirements

9.1.6.1 General information

This subclause describes the requirements of the timestamp mechanism that shall be used for the D-PDU API.

The unit of all timestamps is the microsecond and is defined in a 32 Bit value. The granularity of the timestamp is limited by the capability of the device. The time base is reset to zero within the PDU_IOCTL_RESET function and after boot-up. All of the logical links, events, and errors of one device derive their timestamps from the same time base.

The D-PDU API does not have any mechanism to detect a timestamp overflow. The application shall take care of an overflow.

9.1.6.2 Timestamp for transmitted messages

For all UART-based protocols, the timestamp will be taken at the end (last Bit) of the message. In the case of a controller-based protocol, the timestamp will be taken when the controller indicates the successful transmission of the message or the last frame of a message.

9.1.6.3 Timestamp for received messages

For all UART-based protocols, the timestamp will be taken at the end (last Bit) of the message. In the case of a controller-based protocol, the timestamp will be taken when the controller indicates the successful reception of the message, or the last frame of a message. Indication of the start of a message or first frame is handled as an event, and is described below.

9.1.6.4 Timestamp for events, errors and indications

For events and errors, the timestamp will be taken when the event or error is detected.

9.1.6.5 Timestamp for start of message indication

The indication of the start of message (see Table D.5 — RxFlag) will be handled as outlined below.

— For UART-based protocols, the timestamp will be taken at the first bit of the received message. In this case, the timestamp shall be calculated (see example below).

EXAMPLE To calculate the timestamp for the first bit of a 9 600 baud line running 8N1, the equation would be:

$$\text{First bit timestamp} = \text{first byte timestamp} - \left[\left(\frac{1}{9\,600}\frac{\text{seconds}}{\text{bit}}\right)\times 10\,\text{bits}\right]$$

— For controller-based protocols, the timestamp will be taken when the controller indicates the reception of the first frame of the message.

9.2 API function overview and communication principles

9.2.1 Terms used within the D-PDU API

9.2.1.1 Resource

A resource defines a communication channel towards a single ECU or towards multiple ECUs. It covers diagnostic protocols, and MVCI protocol module hardware (transceivers, UART, multiplexer, etc.), including the Diagnostic Link Connector (DLC) of the MVCI protocol module.

9.2.1.2 ComLogicalLink

A ComLogicalLink (CLL) defines a logical communication channel towards a single ECU or towards multiple ECUs. The configuration of the CLL is based on the selected Bustype, pins, and protocol. A CLL can be created on an existing and available resource. The protocol for the CLL is configured using ComParams. The D-PDU API is not restricted in the number of CLLs opened on a single resource, unless there are limitations for the protocol. The client-application shall be aware of conflicts on resources.

9.2.1.3 ComPrimitive

A ComPrimitive (CoP) is a basic communication element holding data and controlling the exchange of data between the D-PDU API implementation and the ECU.

9.2.1.4 ComParam

A ComParam is a protocol communication parameter used to define the functionality of the vehicle communication protocol selected for a ComLogicalLink. Each protocol has a set of applicable ComParams that are set to a default value upon creation of a ComLogicalLink. A set of ComParams is used to individually define communication to a single ECU, or a functional group of ECUs.

9.2.2 Function overview

Table 2 — D-PDU API functions overview lists all D-PDU API functions, and classifies them in functional groups.

Table 2 — D-PDU API functions overview

Function	Description
General Functions	
PDUConstruct	Constructor with optional, manufacturer-specific arguments. Required to call for each D-PDU API implementation prior to any other D-PDU API function call.
PDUDestruct	Destructor required as last D-PDU API function call to free all resources.
PDUModuleConnect	Connect to a specific MVCI protocol module.
PDUModuleDisconnect	Disconnect from a specific MVCI protocol module.
PDURegisterEventCallback	Register or unregister a callback function for event notification.
PDUIoCtl	Invokes I/O control functions of an MVCI protocol module or ComLogicalLink.

Table 2 (*continued*)

Function	Description
Information Functions	
PDUGetVersion	Obtains version information for a specified MVCI protocol module and its D-PDU API implementation.
PDUGetStatus	Obtains runtime information (status, life sign, etc.) from an MVCI protocol module, ComLogicalLink or ComPrimitive.
PDUGetLastError	Obtains the code for the last error that occurred in an MVCI protocol module or ComLogicalLink.
PDUGetTimestamp	Obtains the Timestamp information for a specific MVCI protocol module.
PDUGetObjectId	Obtains an Id for a given shortname for a PDUObjectType. This is in addition to the possibility of parsing the MDF file.
Resource Management	
PDUGetResourceIds	Obtains all resource Ids that match the requested resource information.
PDUGetResourceStatus	Obtains the status of the requested resource Id.
PDUGetConflictingResources	Obtains a list of resource Ids that are in conflict with the given resource Id (e.g. 2 resources sharing the same physical controller).
PDUGetModuleIds	Obtains the Ids of all MVCI protocol modules currently connected to the D-PDU API.
PDULockResource	Obtains a lock on the requested resource Id.
PDUUnLockResource	Releases the lock on the requested resource Id.
ComLogicalLink Handling	
PDUCreateComLogicalLink	Create a ComLogicalLink for a given D-PDUResource.
PDUDestroyComLogicalLink	Destroy a ComLogicalLink.
PDUConnect	Physically connects the previously created ComLogicalLink to the communication line.
PDUDisconnect	Physically disconnects the previously connected ComLogicalLink from the communication line.
Link and ComParam Handling	
PDUGetComParam	Obtains current value of specified ComParam.
PDUSetComParam	Sets specified ComParam to given value. Overwrites previous values.
PDUGetUniqueRespIdTable	Obtains a table of Unique Response Identifiers. Each Unique Response Identifier is associated with a set of ComParams used to uniquely define an ECU response
PDUSetUniqueRespIdTable	Set a table of Unique Response Identifiers. Each Unique Response Identifier value is assigned by the application.
Message Handling	
PDUStartComPrimitive	Start the operation of given ComPrimitive (e.g. sending/receiving data).
PDUCancelComPrimitive	Cancel current execution of given ComPrimitive (e.g. cancel a running periodic send operation or an operation which has not yet been executed).
PDUGetEventItem	Retrieve item data (e.g. received data) for given event source (i.e. MVCI protocol module, ComLogicalLink and ComPrimitive).
PDUDestroyItem	Destroy given item.

9.2.3 General usage

The sequences of function calls differ between the D-PDU API and existing APIs like for SAE J2534-1 and RP1210a. Therefore, the following subclauses show a minimal sequence of calls in order to facilitate understanding. Also, the terms “asynchronous” and “synchronous” communication are defined in the subsequent subclauses.

In order to initialize the D-PDU API implementation and to prepare communication for one channel, the application needs to go through the following minimal sequence of API function calls.

Table 3 — General usage of D-PDU API function calls lists the D-PDU API functions in a sequential order to facilitate better understanding.

Table 3 — General usage of D-PDU API function calls

Action #	Function Call from application	D-PDU API
Initial connection to D-PDU API Library		
1	PDUConstruct	Initialize D-PDU API library. This does not necessarily connect to an MVCI protocol module. This begins the process of figuring out what MVCI protocol modules are available. Information about the available modules is retrieved via the PDUGetModuleIds function.
	PDUGetModuleIds	Retrieve the list of available MVCI protocol modules and their handles and modules types.
	PDURegisterEventCallback	(optional) Register global system callback.
Initial connection to an MVCI protocol module		
2	PDUModuleConnect	Connect the D-PDU API library to one or more MVCI protocol modules.
	PDURegisterEventCallback	(optional) Register module callback.
Setting up a ComLogicalLink		
3	PDUCreateComLogicalLink	Create a ComLogicalLink (based on protocol, pins and Bustype).
	PDURegisterEventCallback	(optional) Register ComLogicalLink callback.
	PDUGetUniqueRespIdTable	Retrieve the applicable set of ComParams for unique identification of ECUs determined by the specific protocol for the ComLogicalLInk.
	PDUGetComParam	Get ComParam item structures initialized with the default ComParams for the selected protocol.
	PDUSetComParam	Set the ComParams for the ComLogicalLink.
	PDUSetUniqueRespIdTable	Configure the Unique Response Identifier Table for all possible ECU Responses to be received on the ComLogicalLink.
	PDUConnect	Connect the ComLogicalLink to the communication line.

Table 3 (*continued*)

Action #	Function Call from application	D-PDU API
Starting vehicle communications on a ComLogicalLink		
4	PDUStartComPrimitive (PDU_COPT_STARTCOMM or PDU_COPT_SENDRECV)	A PDU_COPT_STARTCOMM ComPrimitive is required for certain protocols as the first ComPrimitive (e.g. ISO 14230). A PDU_COPT_STARTCOMM ComPrimitive is also used to control the ability to start sending tester present messages (See CP_TesterPresentHandling). Once tester present handling is enabled the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime) For all other vehicle bus communications a PDU_COPT_SENDRECV ComPrimitive is used to begin vehicle communications.
Using a ComLogicalLink for vehicle communications		
5	PDUStartComPrimitive (PDU_COPT_SENDRECV)	Set up and start ComPrimitives for vehicle bus activity: Send only, Send Receive, or Receive only.
	PDUSetComParam	Change ComParams (temporary changes per ComPrimitive or permanent changes per PDU_COPT_UPDATEPARAM type of ComPrimitive)
	PDUGetEventItem	Retrieve event items
	PDUDestroyItem	Destroy event item memory from D-PDU API memory.
Stopping vehicle communications on a ComLogicalLink		
6	PDUStartComPrimitive (PDU_COPT_STOPCOMM)	A PDU_COPT_STOPCOMM ComPrimitive will stop all communication on a ComLogicalLink.
Connecting to a newly available MVCI protocol module		
7	Receive callback indicating new MVCI protocol module detected by D-PDU API	Receive a system event callback with an information type PDU_IT_INFO indicating the list of modules has changed: PDU_INFO_MODULE_LIST_CHG
	PDUGetModuleIds	Retrieve the new list of available MVCI protocol modules and their handles and modules types. Any previously detected MVCI protocol modules will return the same hMod handles. NOTE If detection of an MVCI protocol module was lost and then detection is re-established, the module handle (hMod) will not be the same as the previous handle. This ensures that any event items stored in the initial connection will still be available for reading prior to a PDUModuleDisconnect.
	PDUModuleConnect	Connect to the new MVCI protocol module.
	PDURegisterEventCallback	(optional) Register module callback.

Table 3 (*continued*)

Action #	Function Call from application	D-PDU API
Loss of communication to an MVCI protocol module and reconnection		
8	Receive callback indicating communications to an MVCI protocol module has been lost.	Receive a module event callback indicating communication is lost to an MVCI protocol module. (See PDU_ERR_EVT_LOST_COMM_TO_VCI). The hMod information is part of the callback. The client application should call PDUModuleDisconnect after all items have been retrieved from the module event queue. NOTE 1 All ComPrimitives active for all ComLogicalLinks on the Module will generate a PDU_COPST_CANCELLED status event item. All ComLogicalLinks on the Module will generate a PDU_CLLST_OFFLINE status event item. NOTE 2 If the MVCI protocol module still maintains power after it has lost communication with a client session, it disconnects from all vehicle buses associated with that client session and self cleans up all resources associated with the client session. NOTE 3 The module handle (hMod) is preserved until a PDUModuleDisconnect is called.
	PDUModuleDisconnect	Once PDUModuleDisconnect is called, the hMod handle is no longer valid, all event items in the queues are freed, and any related Module memory reserved by the D-PDU API library is unreserved.
	Wait for a Callback indicating status change of MVCI protocol module.	Receive a system event callback with an information type PDU_IT_INFO indicating the list of modules has changed: PDU_INFO_MODULE_LIST_CHG.
	PDUGetModuleIds	Retrieve the new list of available MVCI protocol modules and their handles and modules types. Observe that the hMod from the MVCI Protocol module that had a communication loss is no longer listed as an available hMod. NOTE See Step 7 (above) for steps to reconnect to a module after a loss of communications event.
Disconnect from a MVCI protocol module		
9	PDUDisconnect	Disconnect the ComLogicalLink from the communication line.
	PDUDestroyComLogicalLink	Destroy the ComLogicalLink.
	PDURegisterEventCallback(NULL)	(optional) Unregister the module event callback. From now on no events will be signalled to the application for the module.
	PDUModuleDisconnect	Disconnect a specific MVCI protocol module from the D-PDU API library and free all reserved memory resources.
Disconnection from the D-PDU API library		
10	PDUDestruct	De-initialize the D-PDU API and destroy/free any internal resources.

9.2.4 Asynchronous and synchronous communication

9.2.4.1 General information

The asynchronous communication operation of the D-PDU API implies that calls to the API are immediately returned even though the requested activity might still be running or is still waiting for execution inside the D-PDU API implementation. The D-PDU API uses asynchronous calls to support all types of vehicle communication requirements (e.g. non-cyclic, cyclic, event driven communication, etc.), as well as status changes and error detection events.

The synchronous communication operation of the D-PDU API implies that calls to the API are returned with the requested information to the application (e.g. PDUGetComParam).

In order to cover synchronous and blocking function calls, as specified for SAE J2534-1 and RP1210a, the application has to operate the D-PDU API in polling mode, or needs to provide a simple event callback function. For SAE J2534-1 and RP1210a, synchronous calls will be transparently mapped onto the asynchronous D-PDU API calls. This is done by the respective compatibility layers.

The D-PDU API functions allow the application to use both event callback (asynchronous) and polled (synchronous) communication principles to exchange data with the D-PDU API.

9.2.4.2 Event callback (asynchronous mode)

In this case, the communication between application and the D-PDU API implementation is completely event driven. The application may register an application-specific event callback function by calling PDURegisterEventCallback. Any events queued into an empty ComLogicalLink Event queue or the events that are already queued at the point in time the callback function is registered will cause the callback function to be invoked. The callback function will be called on the thread of the D-PDU API. It is the responsibility of the application to minimize the time spent in this callback. This specification suggests that the application callback function post an event to wake another thread to do the reading of the event data. If the application shall make a D-PDU API function call in the callback routine, then PDUGetEventItem is the only permitted call.

9.2.4.3 Polling (synchronous mode)

In this case, the application does not make use of the event callback mechanism. The application initiates the D-PDU API functions (just as in asynchronous mode) and uses the PDUGetStatus and PDUGetEventItem functions to detect status changes, and to read event items from the event queues.

9.2.5 Usage of resource locking and resource unlocking

A ComLogicalLink has the ability to lock different elements of a physical resource it is connected to, using the D-PDU API function PDULockResource. Through locking, a ComLogicalLink can prohibit all other ComLogicalLinks access to the resource if necessary. For example, if there are two ComLogicalLinks sharing a vehicle bus, and an ECU needs to be reprogrammed, the physical resource (the vehicle bus) can be locked during the reprogramming sequence. The API function PDUUnlockResource is used to release the lock on a physical resource.

9.2.6 Usage of ComPrimitives

9.2.6.1 ComPrimitive overview

To provide a generic data exchange mechanism for different communication principles, several ComPrimitive types are specified. The behaviour and usage of each ComPrimitive type depends on the specific communication protocol used with a ComLogicalLink. These issues have to be described for each specific communication protocol implementation.

Table 4 — ComPrimitives overview describes the different ComPrimitive types.

Table 4 — ComPrimitives overview

ComPrimitive type	Description
PDU_COPT_STARTCOMM	Start communication with ECU by sending an optional request. The detailed behaviour is protocol dependent. For certain protocols (e.g. ISO 14230), this ComPrimitive is required as the first ComPrimitive. This ComPrimitive is also required to put the ComLogicalLink into the state PDU_CLLST_COMM_STARTED which allows for tester present messages to be enabled (see CP_TesterPresentHandling). Once tester present handling is enabled the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime)
PDU_COPT_STOPCOMM	Stop communication with ECU by sending an optional request. The detailed behaviour is protocol dependent. After successful completion of this ComPrimitive type, the ComLogicalLink is placed into PDU_CLLST_ONLINE state and no further tester presents will be sent. A PDU_COPT_STARTCOMM ComPrimitive might be required by some protocols (e.g. ISO 14230) to begin communications again.
PDU_COPT_UPDATEPARAM	Copies ComParams and the UniqueRespIdTable related to a ComLogicalLink from the working buffer to the active buffer. Prior to update, the values need to be passed to the D-PDU API by calling PDUSetComParam and/or PDUSetUniqueRespIdTable, which modifies the working buffer. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.
PDU_COPT_SENDRECV	Send request data and/or receive corresponding response data (single or multiple responses). See 11.1.4.17 for detailed settings.
PDU_COPT_DELAY	Wait the given time span before executing the next ComPrimitive.
PDU_COPT_RESTORE_PARAM	Converse functionality of PDU_COPT_UPDATEPARAM. Copies ComParams related to a ComLogicalLink from active buffer to working buffer.

9.2.6.2 ComPrimitive send/receive cycle overview

9.2.6.2.1 General information

Each ComPrimitive is controlled by a PDU_COP_CTRL_DATA structure (see 11.1.4.17). Table 5 — ComPrimitives send/receive cycles describes how the send and receive cycles are used. For more examples, see also Figure 8 — Single request – single response (master/slave communication) to Figure 16 — No request/single or multiple responses.

Table 5 — ComPrimitives send/receive cycles

PDU_COPT_SENDRECV, PDU_COPT_STARTCOMM, PDU_COPT_STOPCOMM		
	NumSendCycles	**NumReceiveCycles**
SEND and RECEIVE	# of send cycles to be performed; -1 for infinite send operation.	# of expected responses per request; -1 for infinite receive operation, -2 for multiple responses.
SEND ONLY	# of send cycles to be performed; -1 for infinite send operation	0
RECEIVE ONLY	0	# of receive cycles to be performed; -1 for infinite receive operation, -2 for multiple responses.
No Data to transmit or receive (e.g. PDU_COPT_STARTCOMM with no pPduData message)	0	0

9.2.6.2.2 NumReceiveCycles description

The NumReceiveCycles is the number of expected complete responses for a ComPrimitive. An infinite receive ComPrimitive (-1) will usually never finish (i.e. never generate a PDU_COPST_FINISHED status item, see PDU_STATUS_DATA) unless timing is enabled for cyclic responses (see ComParam CP_CyclicRespTimeout) and therefore shall usually be cancelled (see 9.4.18).

9.2.6.2.3 NumSendCycles description

The NumSendCycles is the number of periodic transmits to be sent on the vehicle bus. The periodic time interval is specified in milliseconds in the PDU_COP_CTRL_DATA structure (see 11.1.4.17). If NumSendCycles is equal to -1, it is considered an infinite send ComPrimitive. An infinite send ComPrimitive will never finish, and shall always be cancelled (see 9.4.18). A periodic send ComPrimitive will have state transitions to and from PDU_COPST_EXECUTING to PDU_COPST_WAITING for each periodic interval.

Table 6 — ComPrimitives combinations shows some possible combinations of ComPrimitive types and cycle types.

Table 6 — ComPrimitives combinations

NumSendCycles	NumReceiveCycles	Description
1	1	Send one request and look for one response. If a response is not received before a receive timeout occurs (e.g. P2Max), then the ComPrimitive will complete and set a receive timeout error event.
-1	1	Continuously send requests and look for one response per request. If the response is not received before a receive timeout occurs (e.g. P2Max), the ComPrimitive will set a receive timeout error event (PDU_ERR_EVT_RX_TIMEOUT) and proceed to the next send interval.
1	3	Send one request and look for three responses. The ComPrimitive is completed when three responses are received or a receive timeout occurs (e.g. P2Max).
1	-1	Send one request and look for continuous responses. This case is equivalent to ODX IS-CYCLIC = TRUE. The application shall cancel this ComPrimitive since it will never finish. A cyclic receive timeout can be used if the NumReceiveCycles is set to infinite (-1). (See CP_CyclicRespTimeout ComParam.) In the case of a cyclic receive timeout the ComPrimitive will transition to PDU_COPST_FINISHED.

Table 6 (*continued*)

NumSendCycles	NumReceiveCycles	Description
1	-2	Send one request and wait for a receive timeout (e.g. P2Max). Should be used for functional addressing when number of responses is unknown or with physical addressing with possible unknown number of responses. This case would be appropriate for ODX IS-MULTIPLE = TRUE.
1	0	Send one message and ignore any responses.
-1	0	Continuously send messages and ignore any responses.
0	1	Look for a single received message.
0	-1	Continuously look for received messages. A cyclic receive timeout will be used if the NumReceiveCycles is set to infinite (-1). (See CP_CyclicRespTimeout ComParam.)

NOTE If cyclic time is set to 0 in the PDU_COP_CTRL_DATA, then the ComPrimitive is put on the transmit queue after each completion cycle, but is at a lower priority than other ComPrimitives and Tester Present Messages.

9.2.6.3 ComPrimitive principles

9.2.6.3.1 General information

The following subclauses describe how to use ComPrimitives for different communication principles known from automotive communication protocols. All of the described actions assume the D-PDU API has been initialized and a ComLogicalLink has been created (for details, see Table 3 — General usage of D-PDU API function calls). In addition to the D-PDU API function calls shown in the tables, additional API calls can be used for additional functions (like status requests, etc.). Any memory allocation or de-allocation initiated by create, start, and destroy calls is handled within the D-PDU API.

9.2.6.3.2 Starting communication

To initiate communication between a tester and an ECU, different initialization methods exist for various communication protocols. For OBD Initialization handling, see Annex J. The list below describes different standard initialization use cases.

a) **No initialization (using PDU_COPT_SENDRECV)**

Directly start sending a request to the ECU using a PDU_COPT_SENDRECV ComPrimitive. This method is used for protocols like CAN and SAE J1850 which do not require an initialization sequence.

b) **No initialization (using PDU_COPT_STARTCOMM)**

— Directly start sending a request to the ECU after a PDU_COPT_STARTCOMM ComPrimitive. This method is used for protocols like CAN and SAE J1850 which do not require an initialization sequence, but might use a ComPrimitive message to enter diagnostic mode (e.g. StartDiagnosticSession service). An optional message can be sent for the PDU_COPT_STARTCOMM ComPrimitive for these protocols.

— **No initialization response** If an optional message is sent with NumReceiveCycles != 0, then the D-PDU API waits for a response message. If an optional message is not sent, the ComPrimitive finishes right away and no result data is returned. The internal state of the ComLogicalLink changes accordingly (PDU_CLLST_COMM_STARTED).

c) **5 baud initialization (using PDU_COPT_STARTCOMM)**

- Initialize the communication link to the ECU by sending a 5 baud initialization sequence. This method is used for many K-Line protocols, e.g. KWP2000. During 5 baud initialization the tester sends the ECU address on the bus and then calculates the baud rate to be used for further communication. See ComParams (CP_InitializationSettings, CP_5BaudMode, CP_5BaudAddressFunc, CP_5BaudAddressPhys)

- **5 baud initialization response** The NumReceiveCycles shall be set to 1 for the ECU key bytes to be returned to the client application, in this case a result message data structure (see 11.1.4.11.4 PDU_RESULT_DATA) will contain the key bytes in the following order:

  - PDU[0]=key byte 1

  - PDU[1]=key byte 2

- A PDUGetComParam can be called to read the CP_Baudrate ComParam which will contain the calculated baud rate.

- No optional message will be allowed for a 5-baud initialization start communication request. The client application should send a new SendRecv ComPrimitive for communication after a 5-baud init completes.

- After a 5-baud initialization sequence completes, the protocol handler will begin sending keep-alive messages (See CP_TesterPresent ComParams) if enabled.

- If the ECU key bytes indicate that extended timing is supported, the ComParam CP_ExtendedTiming can be used to override the default values of ISO 14230-2.

d) **Fast initialization (using PDU_COPT_STARTCOMM)**

- Initialize the communication link to the ECU by sending a wakeup pattern optionally followed by a service request provided in the ComPrimitive request data.

- **Fast initialization response** The PDU_COPT_STARTCOMM ComPrimitive behaves like a normal SendRecv ComPrimitive if an optional request message is contained in the data. Therefore any ECU responses that match the expected response structure will be returned to the client application.

- If the ECU key bytes indicate that extended timing is supported, the ComParam CP_ExtendedTiming can be used to override the default values of ISO 14230-2.

e) **Tester Present Messages (ComLogicalLink State = PDU_CLLST_COMM_STARTED)**

Tester Present messages will only be enabled when the ComLogicalLink is in the state PDU_CLLST_COMM_STARTED. A successful PDU_COPT_STARTCOMM ComPrimitive is required to enter this state (pCoPData for this ComPrimitive is optional). See CP_TesterPresentHandling for more information on tester present message enabling. Once tester present handling is enabled the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime).

See Table 7 — Starting communications for a generic approach to starting communications on a ComLogicalLink.

Table 7 — Starting communications

Sequence	Action	Description
1	PDUCreateCommLogicalLink	Create a logical link on a physical resource. The state is PDU_CLLST_OFFLINE until connected.
2	PDUSetComParam	Set ComParams required for ECU communication, like ECU target address, Initialization Settings, etc.
3	PDUSetUniqueRespIdTable	Set of ComParams required for uniquely identifying different ECUs. A unique identifier that will be provided by the application during this function call is returned to the client application indicating which ECU response matched the ComPrimitive. The unique identifier is returned to the client application in a PDU_RESULT_DATA structure.
4	PDUConnect	Physically connect the resource to the vehicle bus. The state of the ComLogicalLink is now PDU_CLLST_ONLINE. The vehicle bus can now be monitored with receive only type of ComPrimitives. A transmit on the vehicle bus is possible via a PDU_COPT_STARTCOMM or PDU_COPT_SENDRECV ComPrimitive.
5	Optional: PDUStartComPrimitive (PDU_COPT_STARTCOMM)	This ComPrimitive is placed on the ComPrimitive queue. Upon execution, the ECU communication will be initialized using the configured initialization method. An optional Start Communication Message can be sent to the ECU. ComParams are used to define the type of initialization to perform and the addressing type (physical/functional). In case of fast initialization the request message, which is defined in the message data structure (pCopData), will be sent after the wakeup pattern. Immediately after successful initialization the following occurs: Any ECU responses matching the CoP expected response structure are returned as result items (PDU_IT_RESULT). If tester present handling is enabled (see CP_TesterPresentHandling), the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime). After initial transmission, the periodic intervals are started. The ComLogicalLink is set to PDU_CLLST_COMM_STARTED. The ComPrimitive status is set to PDU_COPST_FINISHED.
6	PDUStartComPrimitive (PDU_COPT_SENDRECV)	Continue with ECU communication using ComPrimitives. NOTE Tester Present messages can only be enabled if the ComLogicalLink is in the state PDU_CLLST_COMM_STARTED (see sequence step 5 above).

9.2.6.3.3 Stopping communication

The recommended approach for stopping communication can be found in Table 8 — Stopping communication.

Table 8 — Stopping communication

Sequence	Action	Description
1	….	Running ECU communication using ComPrimitives
2	PDUStartComPrimitive (PDU_COPT_STOPCOMM)	This ComPrimitive is placed on the ComPrimitive queue. Upon execution, all ECU communication will be terminated. An optional Stop Communication Message can be sent to the ECU. If no message is sent to the ECU, the ComPrimitive status directly changes to PDU_COPST_FINISHED. Immediately after successful stopping of ECU communications the following occurs: Any ECU responses matching the CoP expected response structure are returned as result items (PDU_IT_RESULT). The ComLogicalLink is set to PDU_CLLST_ONLINE. All currently queued ComPrimitives and currently executing ComPrimitives are cancelled (PDU_COPST_CANCELLED). Periodic Tester Present Messages are stopped.

9.2.6.3.4 Send and receive handling

The recommended approach for send and receive message handling can be found in Table 9 — ComPrimitive Send/Receive Handling.

Table 9 — ComPrimitive Send/Receive Handling

Function	Description
Sending Message Handling	A ComLogicalLink shall be in the state PDU_CLLST_COMM_STARTED for Tester Present messages to be periodically sent. A ComLogicalLink can only be placed in a Comm Started state after a successful completion of a PDU_COPT_STARTCOMM ComPrimitive (see 9.2.6.3.2). When a protocol running on a ComLogicalLink has been properly configured using the ComParams for the selected protocol type, then the D-PDU API can correctly construct a full D-PDU to be sent to the vehicle's ECU. Proper construction of a message is based on raw mode configuration of the ComLogicalLink (see D.2.3) and is protocol specific. Therefore proper construction could consist of message header bytes, transport layer handling, and checksumming features. Furthermore, messages are constructed based on the type of addressing scheme selected (physical or functional addressing defined as a ComParam. In non-Raw mode the first byte of the pCopData of the ComPrimitive received from the application would usually consist of the service ID (if applicable to the protocol).

Table 9 (*continued*)

Function	Description
Receive Message Handling	Every message received from the vehicle bus will first be subjected to the Pass/Block filters (if configured). Initially the D-PDU API configures the filters based on the Unique Response Identifier Table. The client application can override this auto configuration of the filters by using any of the PDUIoctl commands PDU_ioctl_xxx_MSG_FILTER. Next, the ECU message will be checked for correctness (checksum, PCI information, etc). The UniqueRespIdTable is then referenced to determine a match to a known ECU identifier. The UniqueRespIdentifer table can be configured to pass all ECU identification (see 9.4.28.7). The UniqueRespIdentifier will be used in the PDU_IT_RESULT event item to indicate to the application which ECU the message belongs to. Finally the D-PDU API will determine a match of the ECU message to a ComPrimitive Expected Response Structure (See Structure for expected response). The D-PDU API will first compare the ECU message to the current active Send/Receive ComPrimitive and if not matched it will search through the Receive Only list. The message is considered bound when it matches to the first ComPrimitive and no further ComPrimitive matching is continued after the initial match. If the response cannot be bound to any ComPrimitive's ExpectedResponseStructure, the message is discarded. NOTE A transport layer uses the UniqueRespIdentifer table and the ComParams from the currently active SendRecv ComPrimitive for initial receive handling of frames/messages. If the ComLogicalLink does not have an active SendRecv ComPrimitive, then the ComLogicalLinks active ComParam buffer is used. Once the frame/message is bound to a ComPrimitive, the set of ComParams attached to the ComPrimitive is used for any further processing (e.g. receive timing).
SEND ONLY **NumReceiveCycles = 0** **(PDU_COPT_SENDRECV)**	If the NumReceiveCycles is equal to zero and the NumSendCycles is not equal to zero, then the ComPrimitive is considered to be a send only ComPrimitive. This type of ComPrimitive can still be periodic by setting the delay time interval in the PDU_COP_CTRL_DATA structure (see 11.1.4.17). The D-PDU API will construct the proper message to be transmitted, but will not set up any receive timers for responses from an ECU(s). Any ComParams defined for “time between transmits” (e.g. CP_P3Min) will be used to ensure proper vehicle bus timing. If the protocol type allows for an immediate transmit of another message, then any pending ComPrimitives would be available for immediate execution. Once the ComPrimitive has completed all transmission send cycles (NumSendCycles), the status of the ComPrimitive is set to PDU_COPST_FINISHED and the status item (see Structure for status) is placed on the ComLogicalLink's Event Queue.
RECEIVE ONLY **NumSendCycles = 0** **(PDU_COPT_SENDRECV)**	If the NumSendCycles is equal to zero and the NumReceiveCycles is not equal to zero, then the ComPrimitive is considered to be a receive only ComPrimitive. The NumReceiveCycle count is used to *monitor* the vehicle bus for messages that match the ExpectedResponseStructure (see 11.1.4.18). When the receive count has been reached, the ComPrimitive transitions to PDU_COPST_FINISHED. Once all the expected responses have been received the status of the ComPrimitive is set to PDU_COPST_FINISHED and the status item (see Structure for status) is placed on the ComLogicalLink's Event Queue. NOTE 1 A cyclic receive timeout can be used if the NumReceiveCycles is set to infinite (-1) (See CP_CyclicRespTimeout ComParam.) In the case of a cyclic receive timeout the ComPrimitive will transition to PDU_COPST_FINISHED. Otherwise, the application cancels the ComPrimitive via PDUCancelComPrimitive. NOTE 2 No pCopData bytes are supplied in this ComPrimitive type.

Table 9 (*continued*)

Function	Description
SEND AND RECEIVE **NumReceiveCycles != 0** **NumSendCycles != 0** **(PDU_COPT_SENDRECV)**	When both the NumSendCycles and the NumReceiveCycles are not equal to zero, the ComPrimitive will attempt to deliver the number of responses specified in NumReceiveCycles each time the ComPrimitive is sent. If the number of responses specified by NumReceiveCycles is not found before a receive timeout occurs (e.g. P2Max), the ComPrimitive will generate an error event, indicating that a receive timeout occurred. If the ComPrimitive is periodic, it will NOT transition to PDU_COPST_FINISHED even on a receive timeout, the cyclic transmissions will continue. The D-PDU API will construct the proper message to be transmitted. Once the message has been properly transmitted the receive timers for the ComLogicalLink will be enabled waiting for matching ECU responses. See ExpectedResponseStructure and PDU_COP_CTRL_DATA (11.1.4.17). Multiple Expected Responses (IS-MULTIPLE) (11.1.4.17 PDU_COP_CTRL_DATA – NumReceiveCycles = -2), Each received message will reset the receive timer (e.g. P2Max) on a matching response. A receive timeout with no matching responses from any ECU will generate an error event (PDU_ERR_EVT_RX_TIMEOUT). The ComPrimitive will end without an error when a receive timeout has occurred (e.g. P2Max), and at least one valid response has been received. All functional requests with expected responses should set the NumReceiveCycles to IS-MULTIPLE (-2). Infinite Responses (IS-CYCLIC) (11.1.4.17 PDU_COP_CTRL_DATA – NumReceiveCycles = -1), When the ComLogicalLink completes the transmit and receives the first positive response, the ComPrimitive is placed into a receive only mode. This allows other ComPrimitives to be transmitted on the ComLogicalLink while still receiving responses from the cyclic ComPrimitive. A cyclic receive timeout can be used if the NumReceiveCycles is set to infinite (-1). (See CP_CyclicRespTimeout ComParam.) In the case of a cyclic receive timeout the ComPrimitive will transition to PDU_COPST_FINISHED. Otherwise, the application shall cancel the ComPrimitive via PDUCancelComPrimitive. Once all the expected responses have been received and all transmission send cycles have been completed, the status of the ComPrimitive is set to PDU_COPST_FINISHED and the status item (see Structure for status) is placed on the ComLogicalLink's Event Queue.

Table 9 (*continued*)

Function	Description
7F Handling	This level of protocol message handling has been moved to the D-PDU API to ensure proper low-level real-time requirements. This functionality can be handled in RawMode if the Response Code Offset ComParam is correctly configured and the number of header bytes can be determined by the protocol handler (some protocols allow configuration of header byte count via ComParams). Negative response (0x7F) handling can be enabled or disabled by properly setting the correct ComParams in a ComLogicalLink. (See ComParam CP_RCxxHandling in Annex B). Only response codes 0x21, 0x23 and 0x78 are configurable to be handled by the D-PDU API. Not all protocol implementations support all negative responses codes. The ComLogicalLink shall actively process a ComPrimitive with expected responses to a request to proceed with any 0x7F handling (i.e. negative response handling is not enabled for receive only ComPrimitives). The D-PDU API will bypass any addressing information (based on protocol) to determine if an ECU has responded with a 0x7F. The 0x7F code is typically contained in the first byte of the payload data, followed by the requested service id, and the Response Code (See CP_RCByteOffset for configurable response code byte offset processing). The Response Code is extracted from the payload data and used to determine if further 0x7F handling is necessary by the D-PDU API. Based on the type of Response Code, the D-PDU API will begin the timing/retry handling. The D-PDU API is protected from infinite retries by CP_RCxx CompletionTimeout ComParam. If the ECU fails to generate a positive response in the specified Completion Timeout time, then the D-PDU API will generate an error event item indicating no responses received PDU_ERR_EVT_RX_TIMEOUT. If negative response handling is not enabled or the response code is not recognized by the D-PDU API, then the negative response message is placed in a result item and added to the ComLogicalLink's Event Queue.

9.2.6.3.5 ComPrimitives in non-raw mode

The idea of Non-RawMode, is that everything about an ECU or a functional group of ECUs is known and can be configured using ComParams for the selected protocol. The ComParam information would normally be contained in a database. A database schema such as ODX, and a COMPARAM-SPEC have been developed to support the concept of fully abstracting ComParams to be used by the D-PDU API.

Each ComLogicalLink is directed to a single ECU and/or a functional group of ECUs. The ECU information can be configured initially and not changed during the course of ECU communication. If switching between ECUs is necessary on a single vehicle serial bus, then it is suggested that the application create another ComLogicalLink for the additional ECU communication.

It shall be noted that an additional ComLogicalLink cannot be created if it would result in the use of a non-shareable resource (e.g. DLC pins have already been reserved by another ComLogicalLink with a different protocol id). Also, if a second ComLogicalLink requires a “Start Communication Message” which causes the vehicle bus pins to be driven into a different impedance state, this situation would have an undeterminable behaviour on the vehicle bus. All other ComLogicalLinks that are sharing the resource would begin to report errors because communication has been lost to their specific ECU (e.g. ISO 14230/ISO 9141-2 initialization sequence would cause another ComLogicalLink using the same protocol and pins to lose communication to an ECU).

9.2.6.3.6 ComPrimitives in raw mode (PassThru)

The idea of Raw Mode is that everything about an ECU or a functional group of ECUs, and the protocol is known by the Client application. The application takes on the responsibility over the entire protocol message structure, including header bytes and checksums. The only exception would be the necessary requirements of things like the transport layer (ISO 15765-2) and inter-byte/inter-message timing (ISO 9141-2/ISO 14230).

The application shall handle all knowledge about protocol header byte configuration, CAN IDs, extended addressing, negative responses, receive timeout timing (e.g. P2Max), tester present handling, and the binding of response(s) to the request. Therefore, the application cannot be protocol-independent (abstract) in its use of the D-PDU API.

Raw Mode has been added by the D-PDU API to support pass-through programs such as SAE J2534-1 and RP1210a. It is not the intended default use of the D-PDU API.

For ISO 15765, SAE J1939, and ISO 11898, the first 4 bytes of the pCopData shall be the CAN ID (11 bit or 29 bit). If extended addressing is enabled (see D.2.1), then the byte following the CAN ID contains the extended address byte.

9.2.6.4 ComPrimitive sequence diagrams

9.2.6.4.1 Single request/single response (master/slave communication) — Event notification

This communication principle is used for classic master/slave communication (e.g. ISO 14230 KWP 2000 standard services).

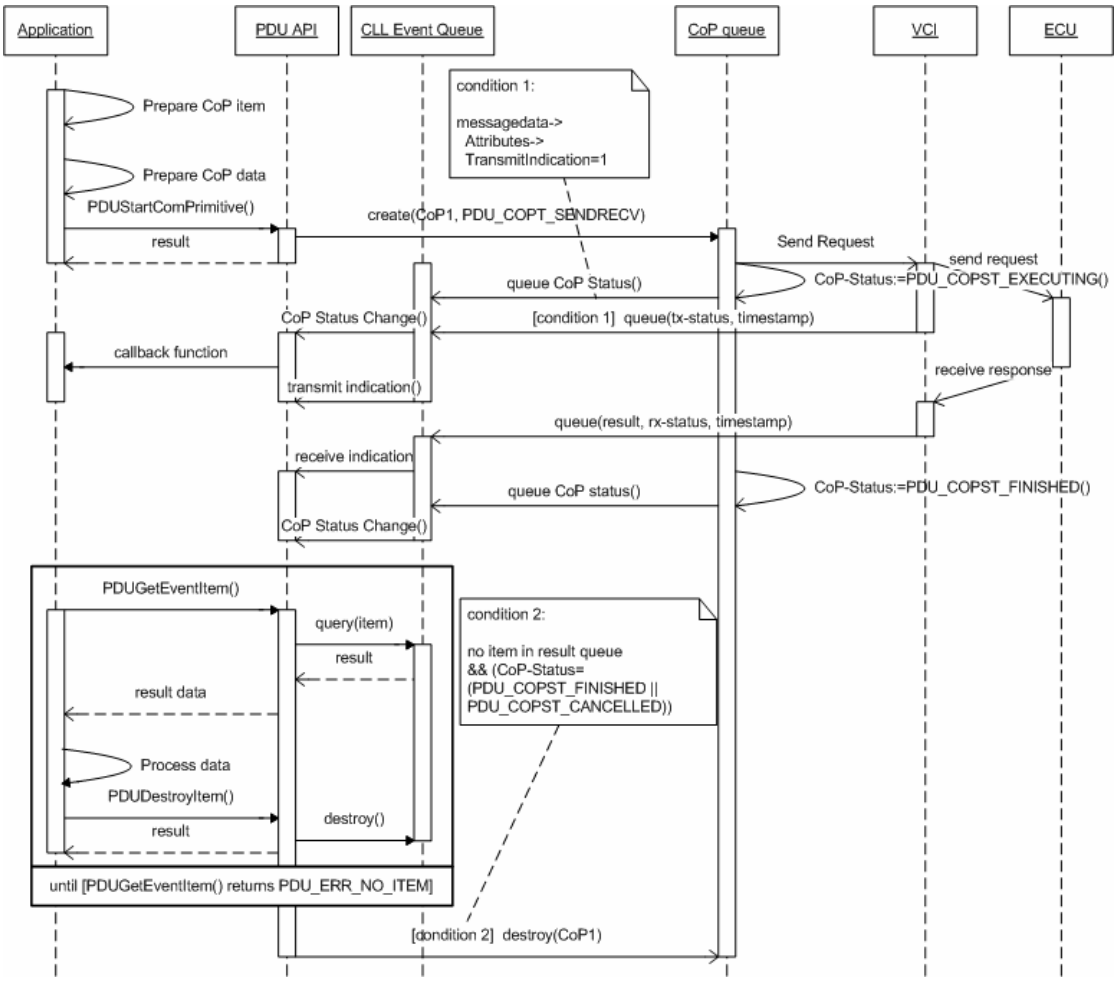


Figure 8 — Single request – single response (master/slave communication)

NOTE A callback is only initiated when an event is placed into an empty queue.

9.2.6.4.2 Single request/single response (master/slave communication) — Polling mode

Applications working without event notification can poll for results related to a specific ComPrimitive by calling PDUGetStatus. In this case, the callback function will not be called as depicted in Figure 9 — Single request – single response (master/slave communication) — Polling mode.

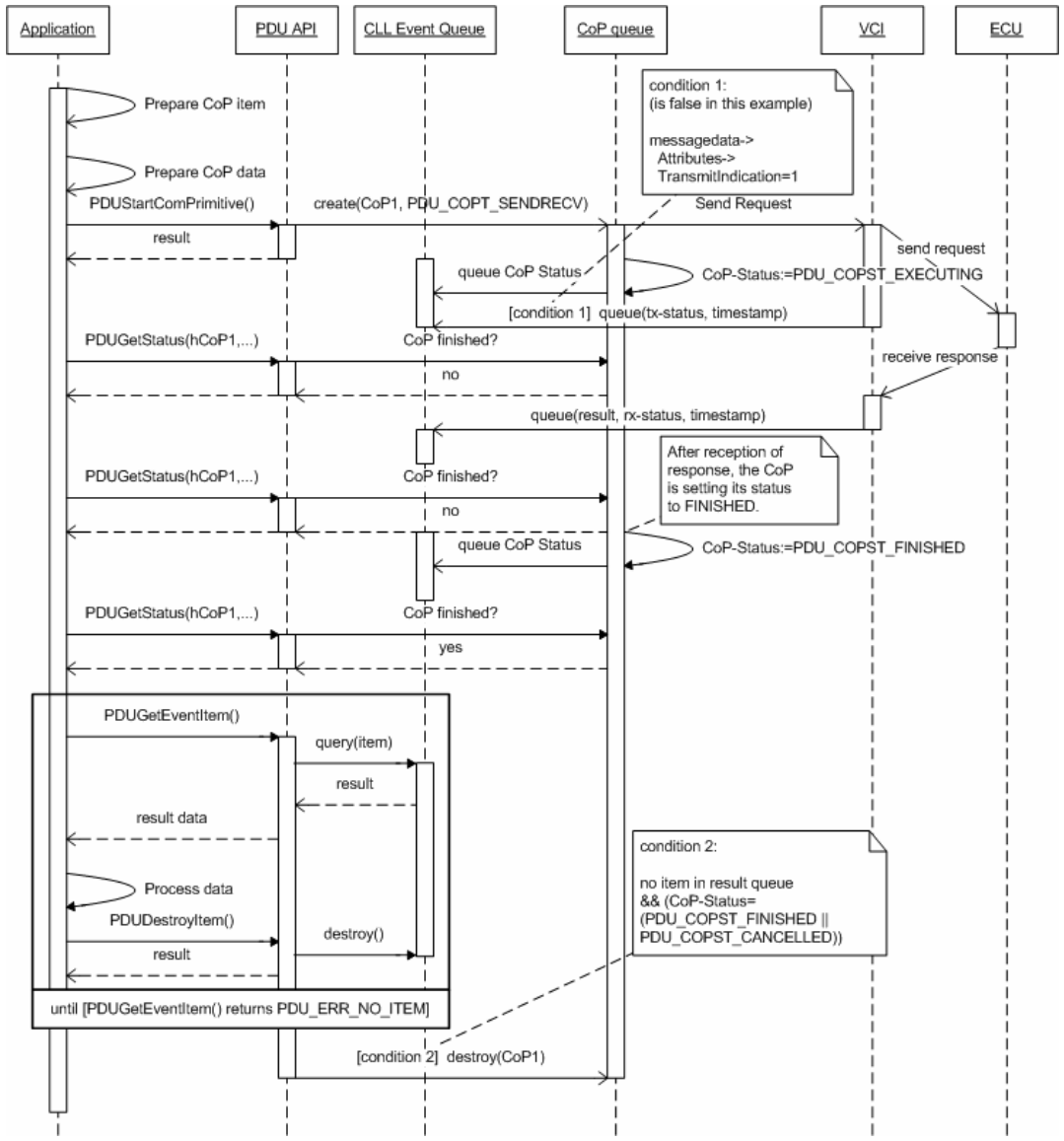


Figure 9 — Single request – single response (master/slave communication) — Polling mode

9.2.6.4.3 Single request/multiple responses

This communication principle is used in many protocols for finite and infinite communication sequences. The basic principle for this ComPrimitive type is shown in Figure 10 — Single request/multiple responses.

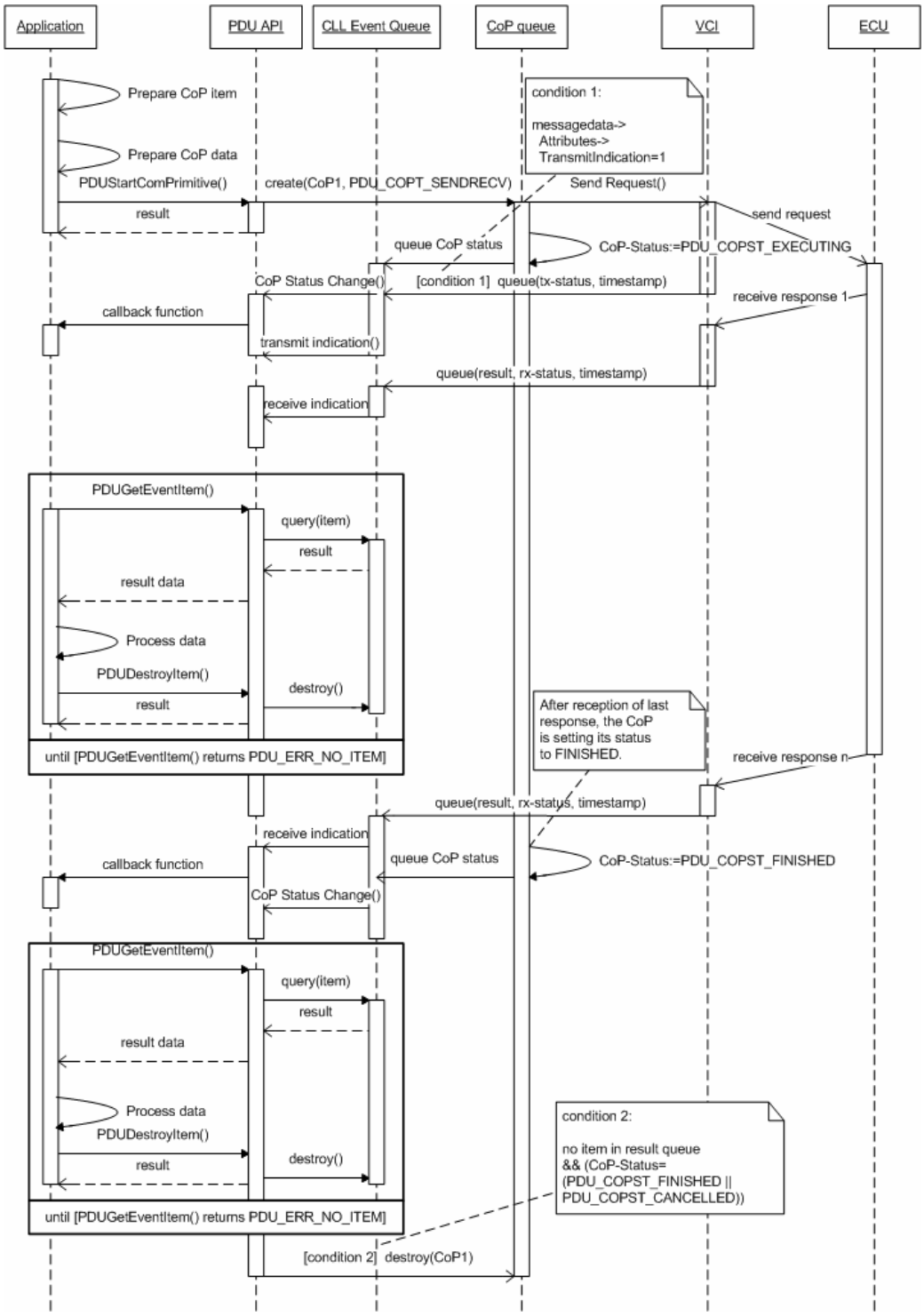


Figure 10 — Single request/multiple responses

NOTE 1 The API function calls PDUGetEventItem and PDUDestroyItem as well as the result data processing by the application can be executed overlapped to the D-PDU API's receiving process of ECU responses.

NOTE 2 An event callback does not have to be called for each data item. It is up to the callback routine to check for further event items before returning. A callback is initiated either when an event is placed into an empty queue or when events are already queued when the PDURegisterEventCallback function is called that registers a callback function.

PDUGetEventItem actions may also be mixed with event callback function actions.

9.2.6.4.4 Single request/multiple responses — Functional Addressing

Figures 11 to 14 show examples of single request/multiple response ComPrimitives for specific protocol implementations. The API calls are not shown in detail, because they are already described in the figures above.

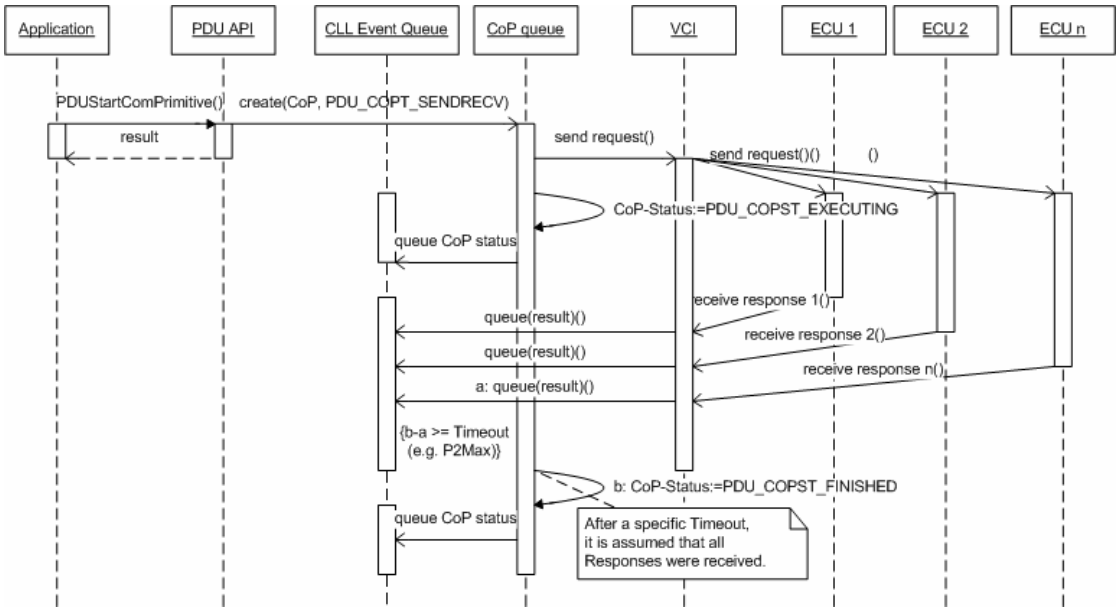


Figure 11 — Example of single request/multiple responses (ISO 14230-3 KWP2000, functional addressing)

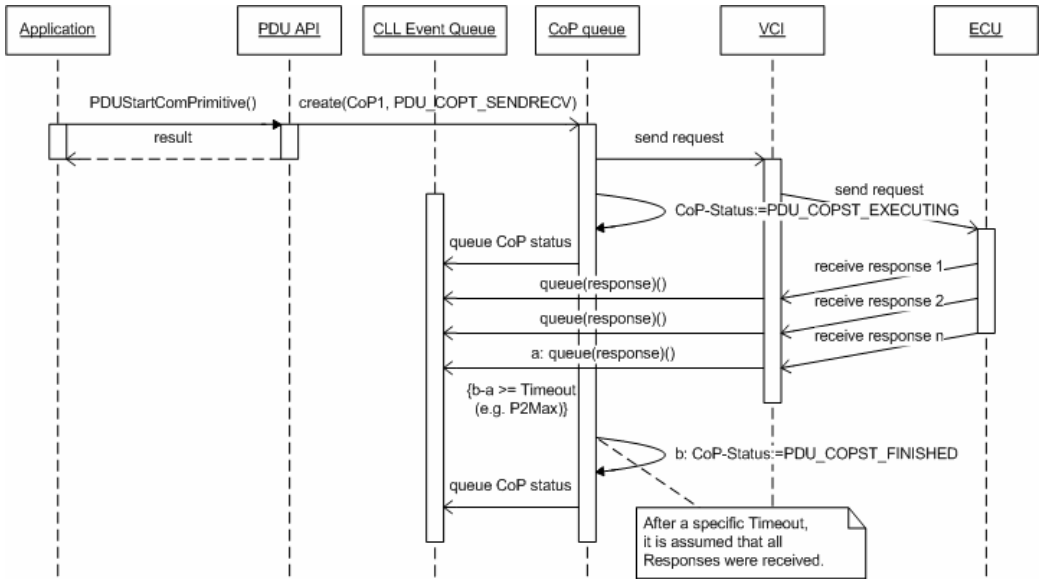


Figure 12 — Example of single request/multiple responses (ISO 14229-1 UDS, finite periodic mode (e.g. time window))

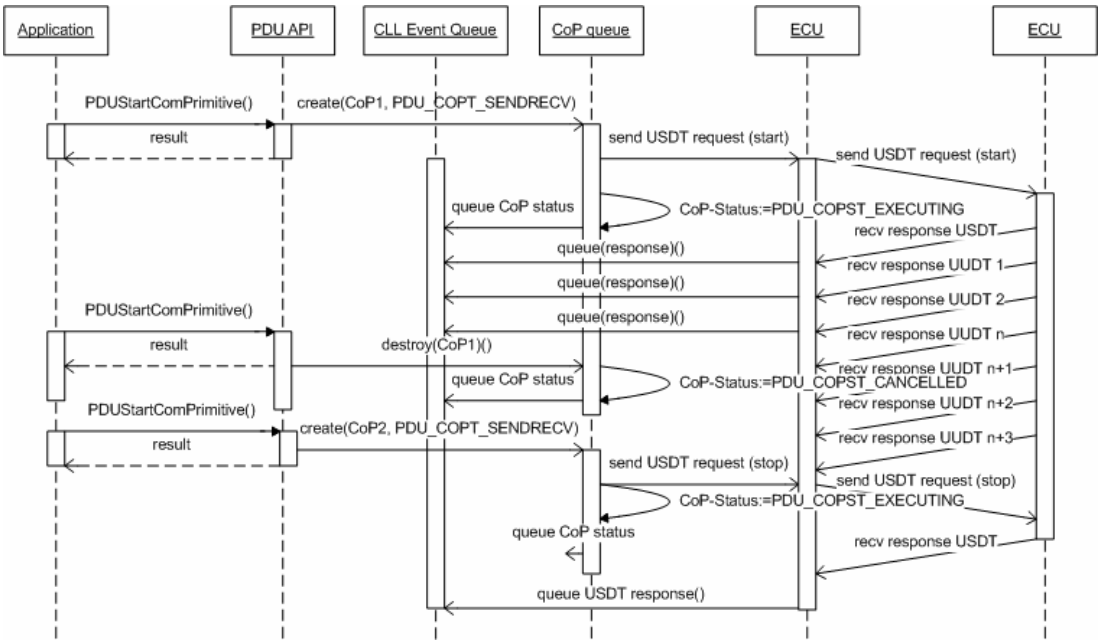


Figure 13 — Example of single request/multiple responses (ISO 14229-1 UDS, ReadDataByPeriodic-Identifier, type #2)

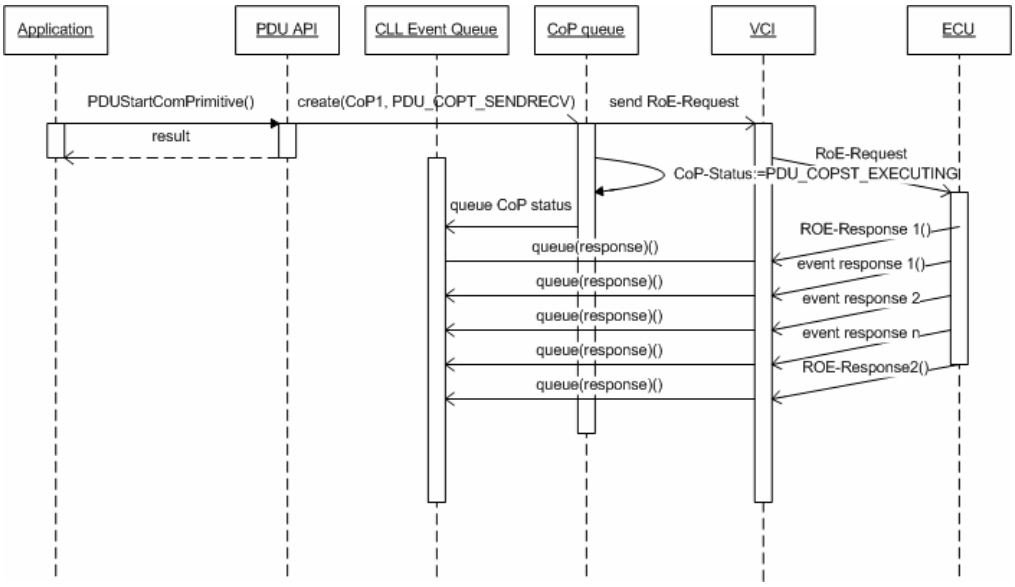


Figure 14 — Example of ISO 14229-1 UDS, ResponseOnEvent (RoE)

9.2.6.4.5 Single or multiple requests/no responses

This communication principle is used especially in on-board communication (e.g. CAN).

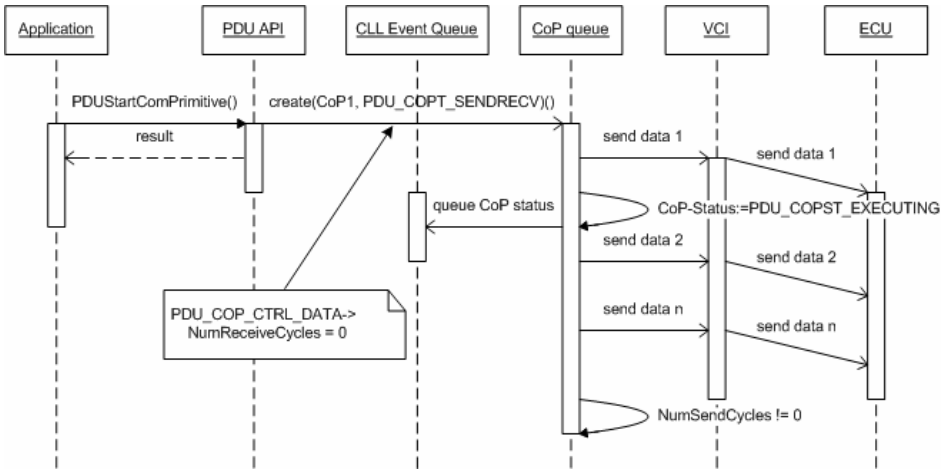


Figure 15 — Single or multiple requests / no responses

9.2.6.4.6 No request/single or multiple responses

This communication principle is used especially in on-board communication (e.g. CAN).

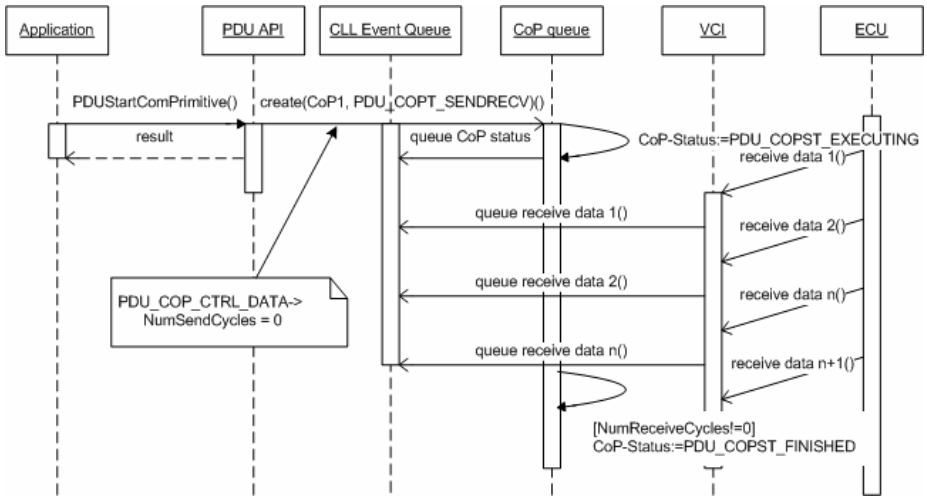


Figure 16 — No request/single or multiple responses

9.2.6.5 Parallel execution of ComPrimitives

When the application starts a ComPrimitive with PDUStartComPrimitive, the ComPrimitive is put into the ComLogicalLink's internal ComPrimitive queue. Several ComPrimitives may be put into the queue sequentially. On the other end of the queue, the internal protocol driver fetches the ComPrimitives sequentially from the queue. The protocol driver decides at which moment it is possible to start executing the next ComPrimitive. Depending on the type of protocol, it may be possible that one or more ComPrimitives can be executed in parallel by the protocol driver, according to certain rules, which are defined for the protocol.

EXAMPLE While a ComPrimitive delivering cyclic responses from the ECU is being executed, another single request/single response ComPrimitive can be executed.

NOTE It is advisable that the protocol driver be able to generally execute cyclic send/receive ComPrimitives in parallel. It depends on the implementation and how many of such ComPrimitives can be executed in parallel.

9.2.6.6 Cancelling a running ComPrimitive

It is possible to cancel a ComPrimitive using PDUCancelComPrimitive. If the ComPrimitive is still in the ComLogicalLink's internal ComPrimitive queue, it will just be removed from the queue. If it is already executing in the protocol driver, execution will be cancelled without any further interaction towards the ECU. The ComPrimitive status changes to PDU_COPST_CANCELLED. If the ComPrimitive has already reached a PDU_COPST_FINISHED state, no further action will be taken. A running ComPrimitive is never cancelled by starting a new ComPrimitive.

9.2.6.7 Destruction of ComPrimitives

A ComPrimitive completes when it has reached either the PDU_COPST_FINISHED state or the PDU_COPST_CANCELLED state, this status event item is placed on the ComLogicalLink event queue. Once a ComPrimitive has reached the FINISHED or CANCELLED state, no more result items will be queued for the ComPrimitive in the ComLogicalLink's event queue. The D-PDU API will destroy a ComPrimitive internally as soon as the last ComPrimitive status item is read from the event queue. After internal destruction of a ComPrimitive, no more operations can be executed related to this ComPrimitive (a PDU ERROR PDU_ERR_INVALID_HANDLE will be returned for a function call referencing the destroyed ComPrimitive.)

9.3 Tool integration

9.3.1 Requirement for generic configuration

The requirements to keep the D-PDU API close to existing standards on the one hand, and to take a generic and open approach on the other hand, make it difficult to limit the capabilities and therefore simplify the API. The configuration is not restricted to a predefined number of protocols, bus types and ComParams for SAE J2534-1. Instead, the D-PDU API shall support any protocols, bus types and ComParams as needed, independent of any definitions in a standard. Even the way equivalent protocols are implemented shall not be predefined by this part of ISO 22900, i.e. there is no limitation in terms of which protocol and bus type ComParams to use (the only exception would be protocols and ComParams defined in SAE J2534-1).

Since the D-PDU API is kept open and generic, there is a major requirement to describe the MVCI protocol module's capabilities. Furthermore, once multiple MVCI protocol modules are bought and combined into one setup, the application running on the same setup requires a well-defined process to determine what's installed and what capabilities it has. There shall be a standardized entry point (similar to SAE J2534-1) and a navigation path through the configuration of the overall setup.

9.3.2 Tool integrator – use case

An MVCI configuration used by an application may contain MVCI protocol modules and cables from different vendors. A client may purchase different MVCI protocol modules for their different implemented features (e.g. one MVCI protocol module has SAE J1850 support, the other MVCI protocol module has ISO 15765 support). Each MVCI protocol module vendor shall supply the following items: one or more module description files (MDF) (see Clause F.2), one or more cable description files (CDF) (see Clause F.3), and a D-PDU API DLL/Shared Library (see Clause F.1). The application relies on the “Tool Integrator” to have knowledge of the overall system. Since there is no real plug-and-play functionality between different vendors, a knowledgeable Configuration Person would be required to use the Tool Integration Program to configure the overall system.

Figure 17 — Use case reflecting a typical integration process for an MVCI setup reflects a use case where two MVCI protocol modules are developed and introduced to the market by two independent vendors A and B at different times. A tool integrator, who is not necessarily one of the previous vendors, takes the MVCI protocol module A and its respective *MVCI protocol module Description File* from vendor A. The tool integrator adds information describing where to find the D-PDU API implementation A and its description file. This information is stored in a file called *D-PDU API root description file*. In addition, the tool integrator knows what kind of cables shall be used, and therefore, adds information on all potential cables and how to map them onto the MVCI protocol module's resources. This information is stored in a file called *cable description file.*

At some point later in time, there is a need to extend this tool's capabilities, e.g. due to a merger or new vehicle protocols. The tool integrator adds the MVCI module description file B to his system and adapts the information describing where to find the D-PDU API implementation B and its description file. However, the integrator also has to adapt his cable information to reflect the correct mapping.

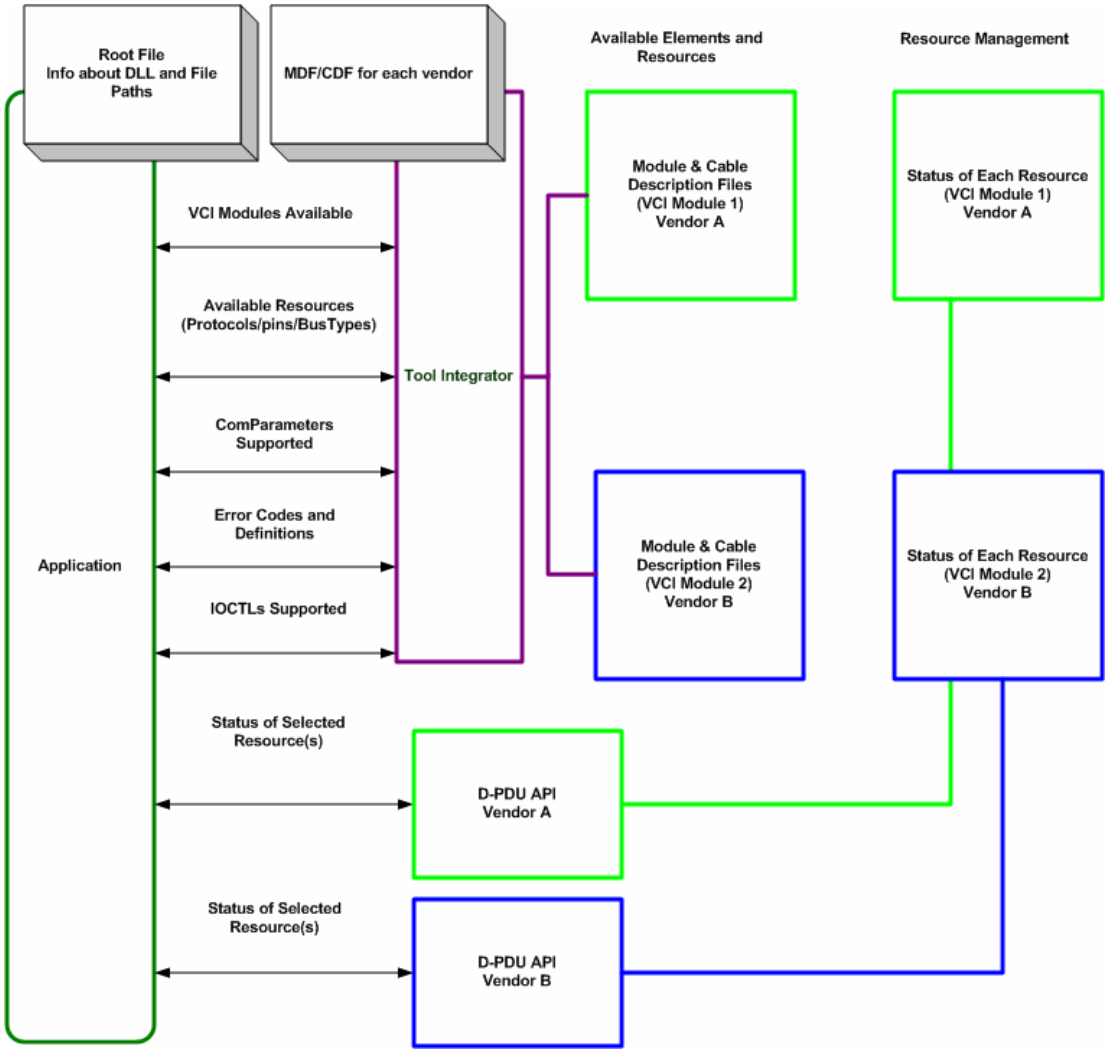


Figure 17 — Use case reflecting a typical integration process for an MVCI setup

Figure 18 — Example: Mapping MVCI protocol module pins to DLC pins shows an example where the mapping of MVCI protocol module pins to the DLC (Data Link Connector) pins are depicted. In addition, examples of the usage of these pins are shown, e.g. “K-Line 1” stands for an ISO 9141 connection. The tool integrator has to define whether a resource of an MVCI protocol module may be mapped onto a certain pin of his cable. For example:

— “K-Line 2” of MVCI protocol module A and “K-Line 1” of MVCI protocol module B may both be mapped onto pin “K-Line 1” of the DLC;

— “K-Line 1” of MVCI protocol module A may not be mapped onto pin “1” of the DLC;

— “SAEJ1850” of MVCI protocol module B may be mapped onto pin “2” of the DLC.

As a result, the tool integrator is free to choose any kind of MVCI protocol module, but it is responsible for the overall system configuration. Since there is no real plug-and-play functionality available, the tool integrator has to take care of extending the configuration file deliverables.

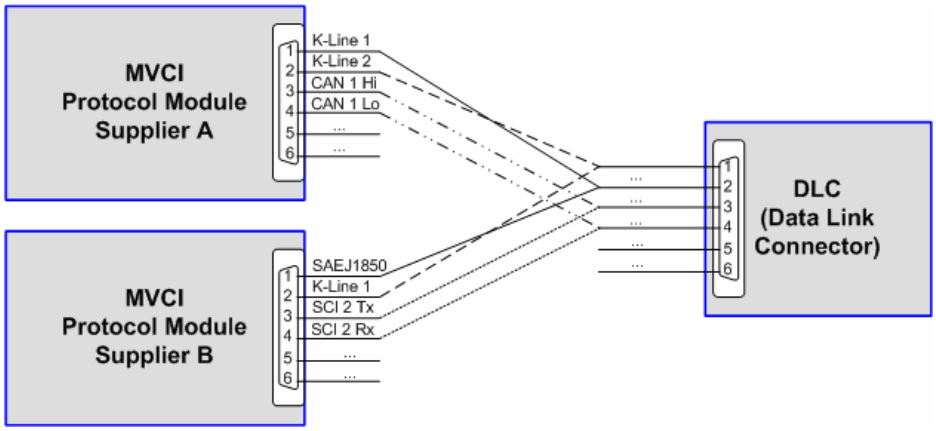


Figure 18 — Example: Mapping MVCI protocol module pins to DLC pins

9.4 API functions – interface description

9.4.1 Overview

This subclause describes all functions the D-PDU API offers to the application. For a description of the data types used, see 11.1.1 Abstract basic data types. Definitions for the C/C++ qualifier are contained in 11.1.2. The function return values T_PDU_ERROR are listed in Clause D.3.

9.4.2 PDUConstruct

9.4.2.1 Purpose

Initialize the PDU API library. The D-PDU API library determines the list of all available MVCI protocol modules and their supported resources. The D-PDU API library creates internal structures, including a resource table. The communication state is offline, i.e. no allocation of resources and no communication over vehicle interfaces take place.

9.4.2.2 Behaviour

a) Validates OptionStr.

b) Detects all known and accessible MVCI protocol modules.

c) Assigns Module IDs to all properly initialized MVCI protocol modules.

d) Creates a PDU_MODULE_DATA list containing MVCI protocol modules, their module types, module handles, module status and additional vendor information strings. This function call will succeed even if no MVCI protocol modules are detected. In the case of no detection of any MVCI protocol modules, the call to PDUGetModuleIds will return a PDU_MODULE_ITEM with the number of entries set to zero (NumEntries = 0).

e) All detected resources will be stored inside an internal resource table. This table will be the source for any resource query using the functions PDUGetModuleIds, PDUGetConflictingResources, PDUGetResourceIds, PDUGetResourceStatus, PDULockResource, and PDUUnlockResource.

9.4.2.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUConstruct(**CHAR8*** OptionStr, **void** *pAPITag)

9.4.2.4 Parameters

OptionStr — String containing a list of attributes and their values. An attribute and its corresponding value are to be separated by an >=< sign. The value needs to be put inside two >'< signs. Between pairs of attribute and value shall be at least one space character. Attributes and values are specific to a D-PDU API implementation.

When no option is to be set, the OptionStr can either be an empty string or NULL.

pAPITag — An application defined tag value. Used in event callbacks which indicate status and errors and results for the PDU API library being used. This information can aid an application in determining which library is making the callback. For a more detailed description of using tags see Clause E.1.

9.4.2.5 Example

OptionStr = “UseCaching='TRUE' InterfaceCheck='FALSE' ”

9.4.2.6 Return values

Table 10 — PDUConstruct return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_SHARING_VIOLATION	Function called again without a previous destruct.
PDU_ERR_INVALID_PARAMETERS	At least one of the option attributes has invalid parameters.
PDU_ERR_VALUE_NOT_SUPPORTED	At least one of the option values is not being supported by the D-PDU driver.

9.4.3 PDUDestruct

9.4.3.1 Purpose

Closes all open communication links and frees communication resources. Internal memory segments shall be freed and system-level drivers disconnected. Execution of PDUDestruct does not result in any communication on the vehicle interfaces. After execution of PDUDestruct, PDUConstruct may be called again.

9.4.3.2 Behaviour

a) Checks internal resource table, determines any open communication links and closes them.

NOTE No communication (e.g. sending a “StopCommunication” request) takes place.

b) De-initializes all MVCI protocol modules detected before with PDUConstruct.

c) Closes all connections to connected MVCI protocol modules (See PDUModuleDisconnect).

d) Frees all internal memory resources.

9.4.3.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUDestruct()

9.4.3.4 Parameters

There are no parameters for this function.

9.4.3.5 Return values

Table 11 — PDUDestruct return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.

9.4.4 PDUIoCtl

9.4.4.1 Purpose

Generic approach to execute functions or set values related to an MVCI protocol module. An ID number identifies the function to be executed. The input and output values are defined as demanded by the function.

The I/O controls supported by a specific MVCI protocol module are defined within the MVCI module description file (see MVCI module description file).

9.5.1 gives a detailed view on the IOCTL API functions.

9.4.4.2 Behaviour

a) Validates all input parameters.

   NOTE Required pointer parameters cannot be NULL.

b) Function takes an input data structure as allocated by the application.

c) Extracts required information from the input data structure and executes command.

d) Allocates and fills the output data in the call-by-reference variable pOutputData. The structure OutputData has to be freed by calling PDUDestroyItem from the application.

9.4.4.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUIoCtl(**UNUM32** hMod, **UNUM32** hCLL, **UNUM32** IoCtlCommandId, **PDU_DATA_ITEM** *pInputData, **PDU_DATA_ITEM** **pOutputData)

9.4.4.4 Parameters

hMod	Handle of the MVCI protocol module to be controlled by the specified I/O control command. hCLL shall be set to PDU_HANDLE_UNDEF to specify module related commands (see 9.5.1).
hCLL	Handle of the ComLogicalLink to be controlled by the specified I/O control command.
IoCtlCommandId	ID identifying the I/O control command. All IDs supported by a specific MVCI protocol module have to be defined within the MVCI module description file (see MVCI module description file).
pInputData	Input data item for specified command or NULL if no input data is required. The input data item shall be created and managed by the application. The structure of the data item is described in 11.1.4.3.
pOutputData	Call-by-reference place for storing the output data item pointer. If NULL, then no output data item will be allocated and filled by the D-PDU API implementation. If a valid address is provided, the D-PDU API implementation will allocate a PDU_DATA_ITEM item and fill in the output data of the specified command. A reference is stored in *pOutputData. After usage, the application shall free the allocated data item by calling PDUDestroyItem. The structure of the data item is described in 11.1.4.3.

9.4.4.5 Examples

PDUIoCtl may be used to set programming voltages, reset the MVCI protocol module, or run a software update.

9.4.4.6 Return values

Table 12 — PDUIoctl return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_ID_NOT_SUPPORTED	ID of I/O control not supported by this MVCI protocol module.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) reference pointer for an IOCTL Command that expects one or both of the reference pointers to be valid (pInputData or pOutputData).
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.

9.4.5 PDUGetVersion

9.4.5.1 Purpose

Function obtains version information from an MVCI protocol module.

9.4.5.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Fill out the PDU_VERSION_DATA structure allocated by the client application.

9.4.5.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetVersion(**UNUM32** hMod, **PDU_VERSION_DATA** *pVersionData)

9.4.5.4 Parameters

hMod	Handle of the MVCI protocol module, for which the version information is to be requested.
pVersionData	Call-by-reference place for storing the version information. The structure of the data item is described in 11.1.4.14.

9.4.5.5 Return values

Table 13 — PDUGetVersion return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) pVersionData parameter.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.

9.4.6 PDUGetStatus

9.4.6.1 Purpose

Function obtains runtime information (status, life sign, etc.) from an MVCI protocol module, ComLogicalLink or ComPrimitive.

9.4.6.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Get the latest status information for the specified handle (Module or CLL or CoP) and store the information in the memory allocated by the client application.

c) If the D-PDU API detects a PC software version out-of-date with the MVCI protocol module firmware, the status returned will be PDU_MODST_NOT_READY.

9.4.6.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetStatus(**UNUM32** hMod, **UNUM32** hCLL, **UNUM32** hCoP, **T_PDU_STATUS** *pStatusCode, **UNUM32** *pTimestamp, **UNUM32** *pExtraInfo)

9.4.6.4 Parameters

hMod	Handle of MVCI protocol module for which the status code is to be requested. hCLL and hCoP shall be set to PDU_HANDLE_UNDEF to return status of only the module.
hCLL	Handle of ComLogicalLink for which the status code is to be requested. hCop shall be set to PDU_HANDLE_UNDEF to return status of only the ComLogicalLink.
hCoP	Handle of ComPrimitive for which the status code is to be requested.
pStatusCode	Call-by-reference place for storing the status code (see D.1.4).
pTimestamp	Call-by-reference place for storing timestamp in microseconds.
pExtraInfo	Call-by-reference place for storing additional information. For ComPrimitives, pExtraInfo returns 0. For MVCI protocol modules and ComLogicalLinks, pExtraInfo contains additional information which is defined by the MVCI protocol module supplier. If no information is available, it shall return 0.

9.4.6.5 Return values

Table 14 — PDUGetStatus return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) pStatusCode, pTimestamp or pExtraInfo.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module, ComPrimitive or ComLogicalLink handle.

9.4.7 PDUGetLastError

9.4.7.1 Purpose

Function obtains the code for the last error from an MVCI protocol module or ComLogicalLink. This function only returns the LAST error that occurred for the handle, and has been added to this specification for SAE J2534-1 support. For proper error handling, a client application should be reading the error events stored in the respective event queues to retrieve a precise chronological order of events (see PDUGetEventItem for more information on retrieving event items).

By the time this function is called, the LAST error may already have been removed from the event queue. This also means that the provided hCoP handle may no longer be valid because the hCoP might already be finished and its associated resources freed.

9.4.7.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Get the last error information for the specified handle (Module or CLL) and store the information in the memory allocated by the client application.

c) In the case of an error being associated with a ComPrimitive, the ComPrimitive handle is returned with the error code.

9.4.7.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetLastError(**UNUM32** hMod, **UNUM32** hCLL, **T_PDU_ERR_EVT** *pErrorCode, **UNUM32** *phCoP**, UNUM32** *pTimestamp, **UNUM32** *pExtraErrorInfo)

9.4.7.4 Parameters

hMod	Handle of MVCI protocol module for which the error code is to be requested. hCLL shall be set to PDU_HANDLE_UNDEF to return the last error of the MVCI protocol module.
hCLL	Handle of ComLogicalLink for which the error code is to be requested.
phCoP	If the last error pertained to a ComPrimitive then phCoP will contain the handle of the ComPrimitive, or else phCoP is set to PDU_HANDLE_UNDEF.
pErrorCode	Call-by-reference place for storing the error code (see Clause D.4). If no last error has been stored for the specified handle, then pErrorCode will contain PDU_ERR_EVT_NOERROR.
pTimestamp	Call-by-reference place for storing timestamp.
pExtraErrorInfo	Call-by-reference place for storing extra error information. The ExtraErrorInfo code can be referenced from the MDF file.

9.4.7.5 Return values

Table 15 — PDUGetLastError return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) pErrorCode, phCoP, pTimestamp or pExtraErrorInfo.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.

9.4.8 PDUGetResourceStatus

9.4.8.1 Purpose

Obtain resource status information from the D-PDU API. All resources whose status is to be retrieved are specified in the pResourceStatus structure. For each requested resource id, the corresponding resource status is reported back in the same structure.

The caller supplies a reference to a memory object that is an input/output resource status item (pResourceStatus). The caller-supplied memory object is of the type PDU_RSC_STATUS_ITEM. The caller shall provide a pointer to the data item object, specifying the correct type (i.e. == PDU_IT_RSC_STATUS), and the number of PDU_RSC_STATUS_DATA objects for which status is to be retrieved. The D-PDU API shall validate the object and then fill in the output portions of the structure.

9.4.8.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Function takes pResourceStatus structure as allocated by the application.

c) Fills in the status information for each requested resource id.

9.4.8.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetResourceStatus(**PDU_RSC_STATUS_ITEM** *pResourceStatus)

9.4.8.4 Parameters

pResourceStatus	Call-by-reference place for storing the status of all requested resource ids. The caller pre-fills the data structure prior to the call with the resource ids of interest. Data structure is described in 11.1.4.4.

9.4.8.5 Return values

Table 16 — PDUGetResourceStatus return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle contained in the pResourceStatus structure.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) pResourceStatus, or one or more invalid resource ids.

9.4.9 PDUCreateComLogicalLink

9.4.9.1 Purpose

9.4.9.1.1 General

Function creates a ComLogicalLink for a given resource id. After creation, internal resources for this link are reserved and the communication state is offline, i.e. no vehicle communication is performed. However, the MVCI protocol module hardware shall be ready for communication at this point.

The most appropriate scheme for determining conflicting resources is to make use of MDF and CDF content that describes which resources conflict with one another. The D-PDU API gives additional support to the application by supplying a list of conflicts for a given resource (PDUGetConflictingResources) across multiple MVCI protocol modules of a single vendor.

The D-PDU API supports two schemes to create a ComLogicalLink. In the first scheme, the D-PDU API is provided with a set of resource items (bus type, protocol, and pins), but no resource id. In the second scheme, the D-PDU API is provided with a known available resource for an MVCI protocol module.

9.4.9.1.2 Unknown Resource Id Scheme

For the unknown resource id scheme, the application is allowed to call PDUCreateComLogicalLink with a set of resources for that link (protocol id, bus type id, pin ids), without having previously checked whether that set of resources is supported by this device, whether the resources are available, or whether this request might conflict with another.

Although this scheme avoids the need for applications to check for availability and conflicts, it is expected that multi-connection applications can be supported. When an application requires multiple ComLogicalLinks, it may call PDUCreateComLogicalLink multiple times followed by corresponding calls to PDUConnect. The D-PDU API implementation has the opportunity to rearrange the resource requests implied by calls to PDUCreateComLogicalLink in order to avoid resource conflicts.

9.4.9.1.3 Specific Resource Id Scheme

For the specific resource id scheme, only the ResourceId parameter is used in PDUCreateComLogicalLink. This id would be obtained by either reading the MDF file or calling PDUGetResourceIds, and could optionally be checked for availability and conflicts, at the discretion of the application (PDUGetResourceStatus and PDUGetConflictingResources).

9.4.9.2 Behaviour

a) Validate all input parameters.

   NOTE Required pointer parameters cannot be NULL.

b) Check if resource is still available.

c) If available, mark resource as “in use” in the resource table.

d) Only the ComLogicalLink which uses PDULockResource will get exclusive rights to modify the physical ComParams for the resource (See PDULockResource). Therefore, the default behaviour for ComLogicalLinks which share a physical resource is that they may all modify the physical ComParams. Since there is only one set of physical ComParams, each ComLogicalLink sharing a physical resource will read the last values set.

e) The event status item (PDU_CLLST_OFFLINE) will NOT be generated on creation of a ComLogicalLink. It shall be assumed by the application that OFFLINE is the initial status after creation. This is required since the event callback function has not yet been defined by the application for the ComLogicalLink.

9.4.9.2.1 Behaviour — Use Cases

When a ComLogicalLink changes status, a status event item is generated (see Status code values). The following list describes each status change use case.

a) **Use Case: CLL State = PDU_CLLST_OFFLINE**

This is the initial state of the ComLogicalLink on creation (PDUCreateComLogicalLink). NO status event item is generated on the initial creation of a ComLogicalLink because the callback registration requires the ComLogicalLink handle (hCll) (See PDURegisterEventCallback). The ComLogicalLink shall be in the state PDU_CLLST_ONLINE to allow any ComPrimitive queuing (See PDUConnect and PDUStartComPrimitive).

b) **Use Case: CLL State Change = (any state -> PDU_CLLST_OFFLINE)**

The ComLogicalLink transitions to PDU_CLLST_OFFLINE from any other ComLogicalLink state on a successful function call to PDUDisconnect or on a loss of communication to a module. All ComPrimitives currently executing (i.e. periodic) and all ComPrimitives in the CoP queue will be cancelled (PDU_COPST_CANCELLED). A status event item, PDU_COPST_CANCELLED, is generated for each active CoP for the ComLogicalLink. The orders of events under the case of losing communications to a module are: PDU_ERR_EVT_LOST_COMM_TO_VCI, PDU_COPST_CANCELLED, PDU_CLLST_OFFLINE, and PDU_MODST_NOT_AVAIL.

c) **Use Case: CLL State Change = (PDU_CLLST_OFFLINE -> PDU_CLLST_ONLINE)**

The ComLogicalLink changes state from PDU_CLLST_OFFLINE to PDU_CLLST_ONLINE after a successful call to PDUConnect.

d) **Use Case: CLL State Change = (PDU_CLLST_ONLINE -> PDU_CLLST_COM_STARTED)**

The ComLogicalLink changes state from PDU_CLLST_ONLINE to PDU_CLLST_COM_STARTED after successful execution of the ComPrimitive of type PDU_COPT_STARTCOMM (See PDUStartComPrimitive). If tester present handling is enabled (see CP_TesterPresentHandling), the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime). After initial transmission the periodic tester present cycles begin.

NOTE Tester Present messages are only enabled in the state PDU_CLLST_COM_STARTED.

e) **Use Case: CLL State Change = (PDU_CLLST_COM_STARTED -> PDU_CLLST_ONLINE)**

The ComLogicalLink changes state from PDU_CLLST_COM_STARTED to PDU_CLLST_ONLINE after successful execution of the ComPrimitive of type PDU_COPT_STOPCOMM.

9.4.9.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUCreateComLogicalLink(**UNUM32** hMod, **PDU_RSC_DATA** *pRscData, **UNUM32** resourceId, **void** *pCllTag, **UNUM32** *phCLL, **PDU_FLAG_DATA** *pCllCreateFlag)

9.4.9.4 Parameters

hMod	Handle of MVCI protocol module
pRscData	Resource Data Objects used to define the settings for a ComLogicalLink. Data structure described in 11.1.4.8. Unknown Resource Scheme: The pRscData shall not be NULL. All elements in pRscData are checked for validity. The resourceId parameter shall be set to PDU_ID_UNDEF. Specific Resource Id Scheme: pRscData shall be set to NULL. The resourceId parameter is used instead and shall be valid.

resourceId	Resource Id which maps to the resource data objects defined in the D-PDU API Resource Table. This information is used to define the settings for the ComLogicalLink. Unknown Resource Scheme: The resourceId parameter shall be set to PDU_ID_UNDEF. The pRscData shall not be NULL. Specific Resource Id Scheme: The resourceId parameter shall be valid. The Resource Objects are selected from the D-PDU API Resource Table using the "resourceId" parameter. pRscData shall be set to NULL.
pCllTag	An application defined tag value. Used in event callbacks which indicate status and errors and results for the ComLogicalLink. For a more detailed description of using tags see Clause E.1.
phCLL	Call-by-reference place for storage of ComLogicalLink handle.
pCllCreateFlag	Call-by-reference place for storage of flag bits used in creating a ComLogical Link. See 11.1.4.13 and Table D.6 — CllCreateFlag.

9.4.9.5 Return values

Table 17 — PDUCreateComLogicalLink return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid NULL pointer for phCLL, invalid NULL pointer for pCllCreateFlag, or invalid resource id.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_RESOURCE_BUSY	Resource busy. Resource already in use.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.

9.4.10 PDUDestroyComLogicalLink

9.4.10.1 Purpose

Destroys the given ComLogicalLink.

9.4.10.2 Behaviour

a) Validate all input parameters.

b) This function destroys all unread items in the ComLogicalLink's event queue.

c) All ComPrimitives for the ComLogicalLink are cancelled without generating a PDU_COPST_CANCELLED event (because the handle of the ComLogicalLink is no longer valid).

d) Any items that have been previously "read" by using PDUGetEventItem are still "reserved" by the application. A call to PDUDestroyItem is still necessary to release any "reserved" memory.

e) The ComLogicalLink is disconnected from the physical resource.

f) The D-PDU API releases the physical resource from the ComLogicalLink.

1) Shared resource behaviour:

— If the resource is shared by another ComLogicalLink, then the physical ComParams remain unchanged.

— The physical resource remains connected to the physical bus if the sharing ComLogicalLinks are NOT in the PDU_CLLST_OFFLINE state.

— If the ComLogcialLink had a lock on the physical ComParams and/or the physical transmit queue, the lock will automatically be removed. When the change of lock status occurs, an information callback is made to the shared ComLogicalLinks indicating a change in lock status (See PDULockResource and PDUUnlockResource and PDU_IT_INFO).

2) Not shared resource behaviour:

— If the resource is not shared by other ComLogicalLinks, then it becomes available to the whole system (PDU_RSCST_AVAIL_NOT_IN_USE).

g) The hCLL handle is no longer valid. No event items are queued during this function call.

9.4.10.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUDestroyComLogicalLink(**UNUM32** hMod**, UNUM32** hCLL)

9.4.10.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink to be destroyed.

9.4.10.5 Return values

Table 18 — PDUDestroyComLogicalLink return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.

9.4.11 PDUConnect

9.4.11.1 Purpose

Physically connect a ComLogicalLink to the vehicle interface. The ComLogicalLink shall be in the communication state “offline” when the function is called. After execution, the communication state changes from “offline” to “online”. This function call is required before any communication to the vehicle ECU can take place.

9.4.11.2 Behaviour

a) Validate all input parameters.

b) Put working buffer ComParams into the active buffer. Locked physical ComParams are not changed. When the condition occurs that any physical ComParam is different than the locked physical ComParam an error event item is generated for the CLL (PDU_ERR_EVT_RSC_LOCKED) indicating that one or more physical ComParams do not match the actual list of physical ComParams. The ComLogicalLink will still transition to the ONLINE state even if the physical ComParams do not match.

c) Put the working table of Unique Response Identifiers into the active table.

d) Configure and enable the ComLogicalLink filters. Use the URID table for the filter configuration unless the client application has configured filters prior to PDUConnect using any of the PDUIoCTL function calls: PDU_START_MSG_FILTER, PDU_CLEAR_MSG_FILTER, and PDU_STOP_MSG_FILTER. The configuration by the client application overrides any D-PDU API internal configuration using the URID table.

e) Physically connect to the vehicle bus.

NOTE A physical connection to the vehicle bus is not done at the time of PDUConnect when a PDU_COPT_STARTCOMM is required to determine proper physical bus parameters, e.g. connection for ISO_OBD_on_ISO_15765_4 (OBD on CAN). (See J.1.3.4.). Improper configuration of physical ComParams could cause significant bus errors.

f) Set the state of the CLL to PDU_CLLST_ONLINE and generate an event indicating the new state.

9.4.11.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUConnect(**UNUM32** hMod, **UNUM32** hCLL)

9.4.11.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink to be connected to the vehicle interface.

9.4.11.5 Return values

Table 19 — PDUConnect return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_CLL_CONNECTED	CLL is already in the “online” state.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.

9.4.12 PDUDisconnect

9.4.12.1 Purpose

Physically disconnect ComLogicalLink from vehicle interface. The ComLogicalLink shall be in the communication state “online” or “com_started” when the function is called. After execution, the communication state changes to “offline”. After calling the function, no more communication to the vehicle ECU may take place.

9.4.12.2 Behaviour

a) Validate input parameters.

b) Prevent initiation of new ComPrimitives by marking ComLogicalLink as “disconnected” in the internal resource table.

c) Cancel all active (executing) ComPrimitives. Cancel all idle ComPrimitives from the ComPrimitive queue.

d) All ComParam values and ComLogicalLink filters are preserved for a future reconnection (i.e. they are not returned to their default values).

e) Physically disconnect the ComLogicalLink from the resource. The resource is still reserved by the ComLogicalLink until a PDUDestroyComLogicalLink function call has been completed.

Shared resource behaviour:

— if the resource is shared by another ComLogicalLink, then the physical ComParams remain unchanged;

— if the resource is shared by another ComLogicalLink, then the physical resource remains connected to the physical bus if the sharing ComLogicalLinks are NOT in the PDU_CLLST_OFFLINE state;

— if the ComLogcialLink had a lock on the physical ComParams and/or the physical transmit queue, the lock will automatically be removed. When the change of lock status occurs, an information callback is made to the shared ComLogicalLinks indicating a change in lock status. (See PDULockResource and PDUUnlockResource and PDU_IT_INFO.)

9.4.12.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUDisconnect(**UNUM32** hMod**, UNUM32** hCLL)

9.4.12.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink to be disconnected from vehicle interface.

9.4.12.5 Return values

Table 20 — PDUDisconnect return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_CLL_NOT_CONNECTED	ComLogicalLink is not connected.

9.4.13 PDULockResource

9.4.13.1 Purpose

PDULockResource will allow exclusive privileges for a ComLogicalLink on a physical resource. This function can be used by an application which wants to have physical bus protection from multiple ComLogicalLinks which share the physical resource.

If the function call is successful, the ComLogicalLink has been granted exclusive rights to the physical resource based on the lockMask value (see Table D.2 — Resource lock/unlock values (bit encoded)).

Monitoring or receiving messages from a physical resource is not influenced nor affected by locking.

The call to PDULockResource will fail if another ComLogicalLink already has acquired the requested lock type on the same resource.

9.4.13.2 Behaviour

a) Validate all input parameters.

b) Check for other locks and currently active transmissions on the resource. Resume with c) if this is not the case. Otherwise, return with value PDU_ERR_RSC_LOCKED or PDU_ERR_FCT_FAILED.

c) Set the status of the ComLogicalLink's resource.

9.4.13.3 Behaviour — Use Cases

a) **Transmit Queue Lock** A lock on the transmit queue will force a SUSPEND_TX_QUEUE to all other ComLogicalLinks sharing the physical resource. Any new ComLogicalLink are assumed to have their ComPrimitive queue in the SUSPEND_TX_QUEUE mode. See PDUIoctl function PDU_IOCTL_SUSPEND_TX_QUEUE. When the lock on the transmit queue is released a RESUME_TX_QUEUE is sent to all ComLogicalLinks sharing the physical resource (See PDU_IOCTL_RESUME_TX_QUEUE).

   NOTE When a ComPrimitive queue is suspended, tester present messages will also be stopped if enabled (see CP_TesterPresentHandling).

b) **Physical ComParam Lock** A lock on the physical ComParams (ComParam ActiveBuffer) will not terminate any ongoing transmissions. However, calls to PDU_COPT_UPDATEPARAM for physical ComParams on a 2nd ComLogicalLink will cause an error event for the 2nd CLL (PDU_ERR_EVT_RSC_LOCKED).

c) **Automatic unlocking** An automatic unlock occurs during a PDUDestroyComLogicalLink and PDUDisconnect function calls.

d) **Change of lock status** When the lock status of a resource changes an information callback (PDU_IT_INFO) is made to other ComLogicalLinks that are sharing the physical resource, informing them that a lock status has changed. A client application can then call PDUGetResourceStatus to determine the current lock state of the physical resource (see Table D.1 — Resource status values (bit encoded)).

9.4.13.4 C/C++ prototype

EXTERNC T_PDU_ERROR PDULockResource(**UNUM32** hMod**, UNUM32** hCLL, **UNUM32** LockMask)

9.4.13.5 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink to be granted exclusive access to its resource.
LockMask	Bit encoded mask to request a type of exclusive privilege to a physical resource (see Table D.2 — Resource lock/unlock values (bit encoded)).

9.4.13.6 Return values

Table 21 —PDULockResource return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_RSC_LOCKED	The requested resource is already in the “locked” state.

9.4.14 PDUUnlockResource

9.4.14.1 Purpose

PDUUnlockResource releases the lock type on the resource the ComLogicalLink is connected to as long as the lock type has previously been locked by the same ComLogicalLink.

If the function call is successful, the lock will be released for the resource.

9.4.14.2 Behaviour

a) Validate all input parameters.

b) Set the status of the ComLogicalLink's resource.

c) When the lock status of a resource changes, an information callback (PDU_IT_INFO) is made to other ComLogicalLinks that are sharing the physical resource, informing them that a lock status has changed. A client application can then call PDUGetResourceStatus to determine the current lock state of the physical resource (see Table D.1 — Resource status values (bit encoded)).

9.4.14.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUUnlockResource(**UNUM32** hMod**, UNUM32** hCLL, **UNUM32** LockMask)

9.4.14.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink unlocking the resource.
LockMask	Bit encoded mask to release the type of exclusive privilege to a physical resource (see Table D.2 — Resource lock/unlock values (bit encoded)).

9.4.14.5 Return values

Table 22— PDUUnlockResource return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_RSC_LOCKED_BY_OTHER_CLL	The requested resource is locked by a different ComLogicalLink.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_RSC_NOT_LOCKED	The resource is already in the unlocked state.

9.4.15 PDUGetComParam

9.4.15.1 Purpose

PDUGetComParam obtains a communication or bus ComParam out of the working buffer. The values in the working buffer correspond to the values that would be set in the MVCI protocol module when it has executed all previous Communication Primitives that currently exist in the ComPrimitive queue and any changes previously made by this logical link via PDUSetComParam. The sequence diagrams in Figure 19 — Example for ComParam buffer operation on a PDUConnect (1/5), Figure 20 — Example for ComParam buffer operation using TempParamUpdate flag (2/5), Figure 21 — Example for ComParam buffer operation using PDU_COPT_UPDATEPARAM (3/5) and the buffer diagram in Figure 22 — Example Buffer Diagram for ComParam buffer operation example (4/5), illustrate the relationship between the active buffer, working buffer and communication primitives.

9.4.15.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Allocate memory for the PDU_PARAM_ITEM result.

c) Fill out the ComParam information from the ComParam working buffer.

9.4.15.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetComParam(**UNUM32** hMod, **UNUM32** hCLL, **UNUM32** ParamId, **PDU_PARAM_ITEM** **pParamItem)

9.4.15.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink for which the ComParam is to be requested.
ParamId	ID value of the ComParam, which is to be requested. The MVCI protocol module supplier provides the ComParam ID values in the MDF.
pParamItem	Call-by-reference place for storing the Item with the requested ComParam from the MDF, according to the specified ParamId. The item is allocated by the D-PDU API and has to be released after use from the application by calling the function PDUDestroyItem(). Data structure described in 11.1.4.5.

9.4.15.5 Return values

Table 23 — PDUGetComParam return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module Handle or ComLogicalLink handle.
PDU_ERR_INVALID_PARAMETERS	Invalid ComParam ID or Invalid NULL pointer for pParamItem.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_COMPARAM_NOT_SUPPORTED	ComParam is not supported, e.g. because it is of type PDU_PS_ECU, PDU_PS_OPTIONAL or PDU_PC_UNIQUE_ID.

9.4.15.6 Example for ComParam Buffer Operation

Table 24 — Example for ComParam Buffer Operation describes example operations of ComParam buffer control. Diagram representations of the sequence steps are reflected in Figure 19 — Example for ComParam buffer operation on a PDUConnect (1/5) to Figure 23 — Example Diagram for ComPrimitive Queuing (5/5).

Table 24 — Example for ComParam Buffer Operation

Sequence (figure)	Action	Working Buffer (P2)	Active Buffer (P2)	Notes
1 (1/5)	PDUCreateCommLogicalLink	Defaults	Defaults	This will be the state of the ComParams. (P2 will equal the default value in both buffers.)
2 (1/5)	PDUGetComParam	Defaults	Defaults	Obtains ComParam out of the Working Buffer.
3 (1/5)	PDUSetComParam (P2=50 ms)	50 ms	Defaults	Modifies the ComParam in the Working Buffer.
4 (1/5)	PDUConnect	50 ms →	50 ms	This function call copies the ComParams in the Working Buffer to the Active Buffer.
5 (1/5)	PDUStartCom Primitive1 (PDU_COPT_STARTCOMM)	50 ms	50 ms	This Com Primitive is now placed on the queue with an association to the Active Buffer settings (P2=50 ms).
6 (2/5)	PDUSetComParam (P2=30 ms)	30 ms	50 ms	Modifies the ComParam in the Working Buffer.
7 (2/5)	PDUStartComPrimitive2 PDU_COPT_SENDRECV) with TempParamUpdate flag set	30 ms	50 ms	This Com Primitive is now placed on the queue with an association to the Working Buffer settings (P2=30 ms).
7.1 (2/5)	Return of function call PDUStartComPrimitive2	50 ms	← 50 ms	This specification requires that the Working Buffer is restored to Active Buffer upon the return of the PDUStartComPrimitive function call with the TempParamUpdateFlag set to 1. (Working Buffer P2 is reset to 50 ms.)
8 (2/5)	PDUGetComParam	50 ms	50 ms	Gets the ComParam from the Working Buffer (P2=50 ms).
9 (3/5)	PDUSetComParam (P2=20 ms)	20 ms	50 ms	Modifies the ComParam in the Working Buffer (P2=20 ms).
10 (3/5)	PDUGetComParam	20 ms	50 ms	Gets the ComParam from the Working Buffer (P2=20 ms).
11 (3/5)	PDUStartCom Primitive3 (COPT_SENDRECV)	20 ms	50 ms	This Com Primitive is now placed on the queue with an association to the Active Buffer settings (P2=50 ms).
12 (3/5)	PDUStartCom Primitive4 (COPT_UPDATEPARAM)	20 ms →	20 ms	This function call copies the Working Buffer into the Active Buffer after which it is placed on the queue. (Active Buffer P2 is set to 20 ms.)
13 (3/5)	PDUSetComParam (P2=40 ms)	40 ms	20 ms	Modifies the ComParam in the Working Buffer (P2=40 ms).
14 (3/5)	PDUGetComParam	40 ms	20 ms	Gets the ComParam from the Working Buffer (P2=40 ms).
15 (3/5)	PDUStartCom Primitive5 (COPT_SENDRECV)	20 ms	20 ms	This Com Primitive is now placed on the queue with an association to the Active Buffer settings (P2=20 ms).
16 (5/5)	PDUStartCom Primitive6 (COPT_SENDRECV) with TempParamUpdate flag set	40 ms	20 ms	This Com Primitive is now placed on the queue with an association to the Working Buffer settings (P2=40 ms).

9.4.15.7 Example for ComParam buffer operation for PDUConnect

Figure 19 — Example for ComParam buffer operation on a PDUConnect (1/5) shows the sequence between a PDUCreateComLogical function call and a PDUConnect function call. All PDUSetComParam calls store the ComParam information in the working buffer. The working buffer is copied to the active buffer when a PDUConnect function is called. In the example, the P2 ComParam was set to its initial default value when the ComLogicalLink was created. The value was changed by a PDUSetComParam function and moved to the active buffer on a PDUConnect. The first ComPrimitive (CoP1) gets the active buffer of ComParams attached to it (i.e. the P2 ComParam value is 50 ms).

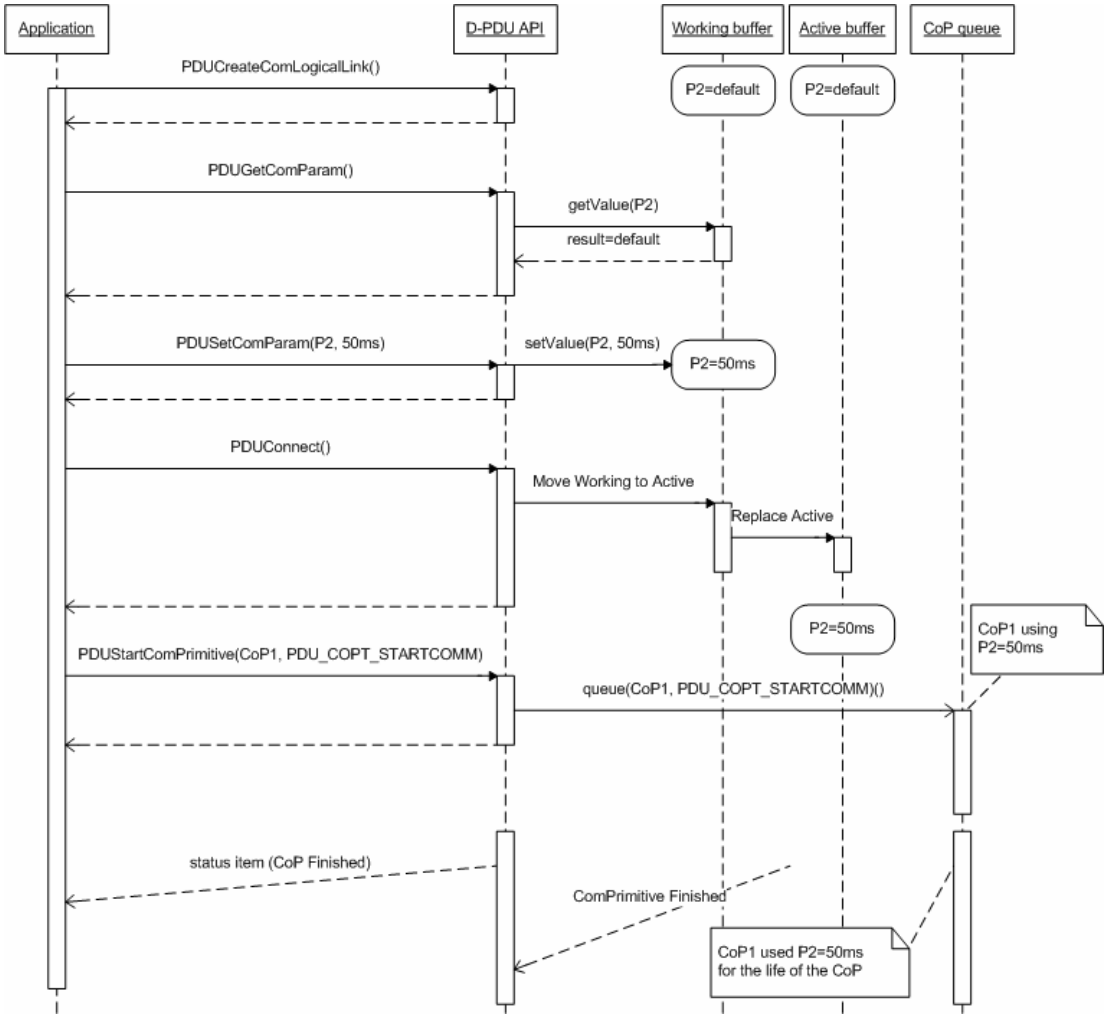


Figure 19 — Example for ComParam buffer operation on a PDUConnect (1/5)

9.4.15.8 Example for ComParam buffer operation using TempParamUpdate flag

Figure 20 — Example for ComParam buffer operation using TempParamUpdate flag (2/5) shows the sequence of operations when the TempParamUpdate flag is set to 1 in PDU_COP_CTRL_DATA for a ComPrimitive. In the example, the P2 ComParam is set to 50 ms in the active buffer. The working buffer contains a P2 ComParam value of 30 ms. When the ComPrimitive (CoP2) is started with the TemParamUpdate flag set to 1, the ComPrimitive gets the working buffer of ComParams attached to it. The ComPrimitive (CoP2) uses the P2 ComParam value of 30 ms until it is finished (i.e. status is set to PDU_COPST_FINISHED). But, the working buffer gets restored to the active buffer settings immediately after the ComPrimitive was placed on the CoP Queue (i.e. any changes made to the working buffer are cleared immediately after the PDUStartComPrimitive function is called with the TempParamUpdate flag set to 1).

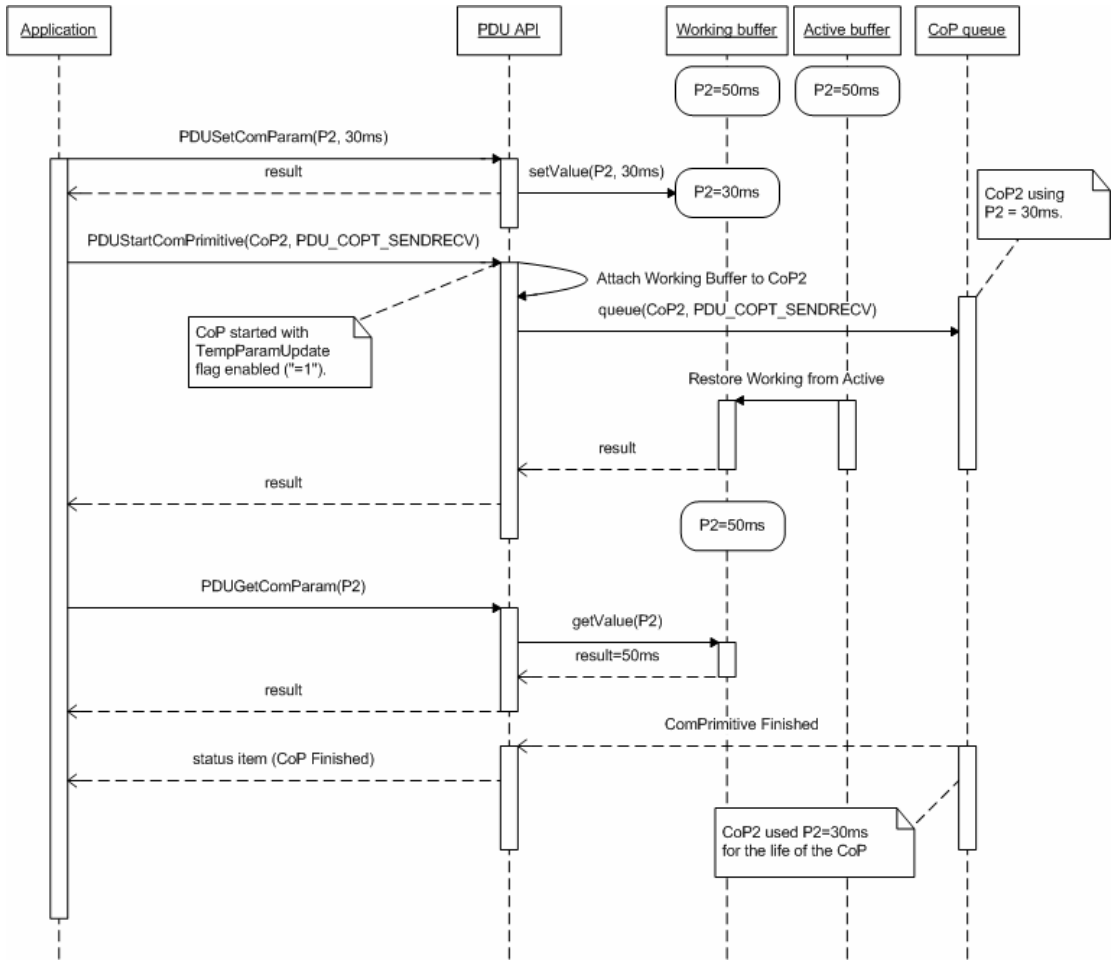


Figure 20 — Example for ComParam buffer operation using TempParamUpdate flag (2/5)

9.4.15.9 Example for ComParam buffer operation using PDU_COPT_UPDATEPARAM

Figure 21 — Example for ComParam buffer operation using PDU_COPT_UPDATEPARAM (3/5) shows the sequence of operations to permanently move a ComParam from the working buffer to the active buffer, and how this move does NOT affect other ComPrimitives which are currently executing or already in the CoP queue. In the example, ComPrimtive (CoP3) is using a set of ComParams with P2 set to 50 ms. The application wants to change this value for all future ComPrimitives to 20 ms. The working buffer gets set with P2 ComParam value of 20 ms. When the ComPrimitive (CoP4) is started with the CopType of PDU_COPT_UPDATEPARAM, the working buffer is moved to the active buffer. This change does not affect the CoP3 ComPrimitive. The CoP4 ComPrimitive finishes immediately (i.e. status is set to PDU_COPST_FINISHED). Therefore, when the next ComPrimitive is started (CoP5), it will use a P2 ComParam value of 20 ms.

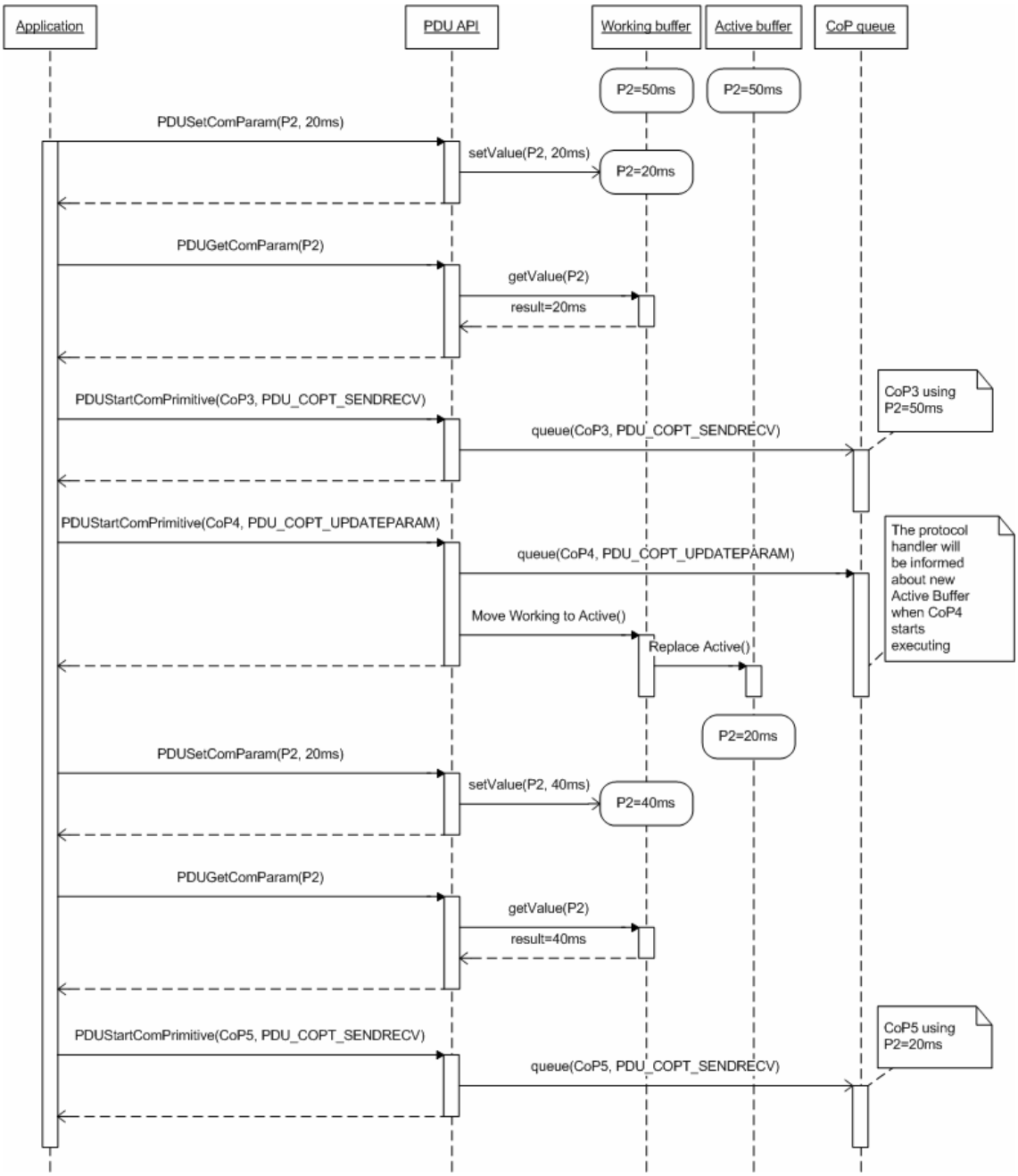


Figure 21 — Example for ComParam buffer operation using PDU_COPT_UPDATEPARAM (3/5)

9.4.15.10 Example for ComParam buffer attachment to a ComPrimitive

Figure 22 — Example Buffer Diagram for ComParam buffer operation example (4/5) shows that each ComPrimitive gets its own ComParam buffer set at the time the ComPrimitive is placed in the CoP queue (i.e. at the time of the PDUStartComPrimitive function call). A ComParam buffer is “tied” to a ComPrimitive of types PDU_COPT_SENDRECV, PDU_COPT_STARTCOMM, and PDU_COPT_STOPCOMM for the life of the ComPrimitive (i.e. PDU_COPST_FINISHED or PDU_COPST_CANCELLED). A queued active buffer is temporarily used for a ComPrimitive of type PDU_COPT_UPDATEPARAM until the ComPrimitive goes to executing (PDU_COPST_EXECUTING). At the time the ComPrimitive goes to executing the queued active buffer is permanently moved to the active buffer used by the ComLogicalLink and ComPrimitives.

The physical ComParams are handled uniquely such that all ComLogicalLinks sharing a physical resource will read the same physical ComParam values. Any ComLogicalLink may modify the physical ComParams unless a ComLogicalLink has requested exclusive privilege to control the physical ComParams (See PDULockResource function).

NOTE Physical ComParams cannot be changed using the TempParamUpdate flag in a PDUStartComPrimitive function call.

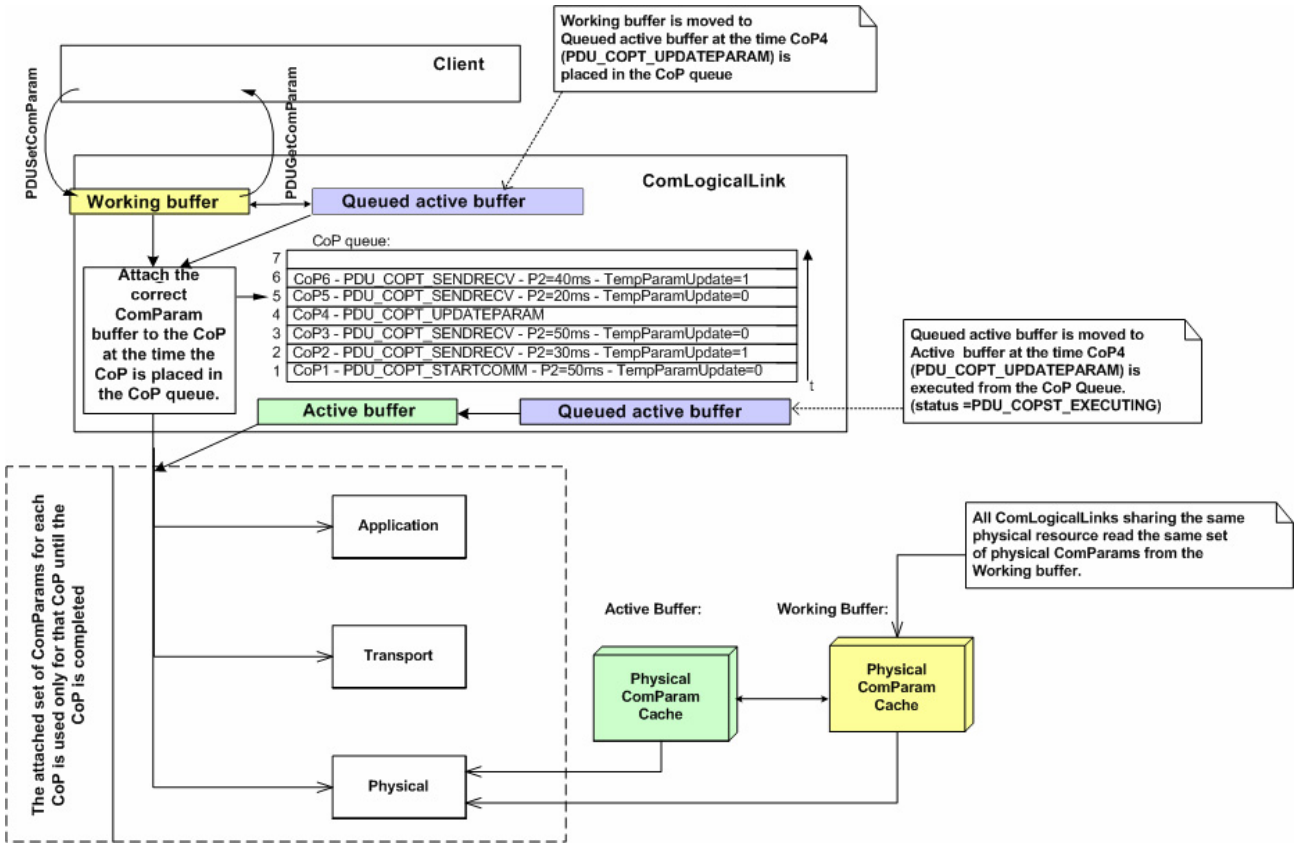


Figure 22 — Example Buffer Diagram for ComParam buffer operation example (4/5)

9.4.15.11 Additional example for ComPrimitive queuing

Figure 23 — Example Diagram for ComPrimitive Queuing (5/5) gives an additional example of the order of ComPrimitive queuing for the above ComPrimitive sequence operation.

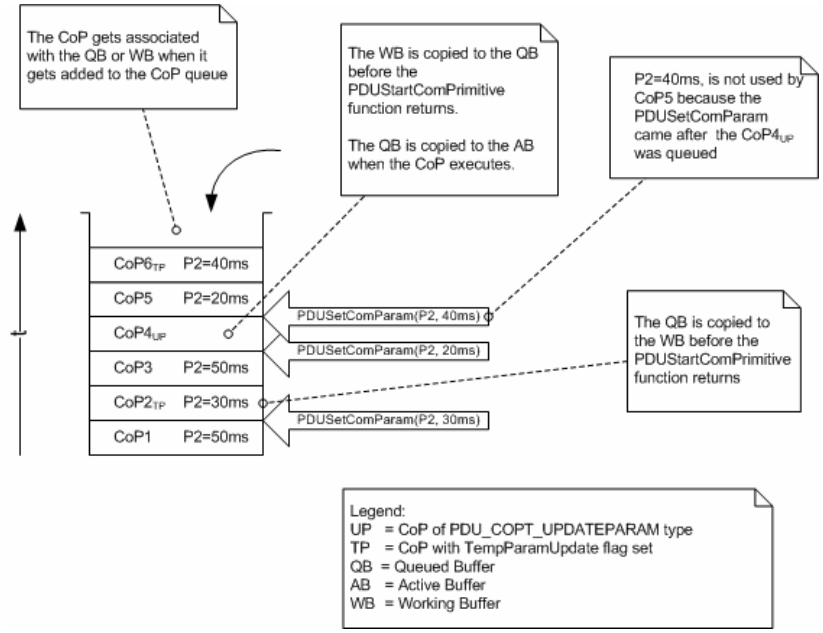


Figure 23 — Example Diagram for ComPrimitive Queuing (5/5)

9.4.16 PDUSetComParam

9.4.16.1 Purpose

The PDUSetComParam function transfers a ComParam setting to the D-PDU API for the given ComLogicalLink. The ComParam will be stored in a working buffer ComParam set. Thus, multiple ComParam changes can be achieved by multiple sequential calls of the PDUSetComParam function. The working buffer ComParam set of all ComParam changes will become active for the ComLogicalLink on a PDUConnect or when a ComPrimitive of type PDU_COPT_UPDATEPARAM is issued. A temporary set of ComParam changes can also be used for individual ComPrimitives (See PDUStartComPrimitive function).

9.4.16.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Copy the parameter data to the ComParam working buffer.

9.4.16.2.1 Behaviour — Use Cases

a) **Use Case: "ComLogicalLink, not connected"** The ComParam working buffer will be moved to the ComParam active buffer after calling the function PDUConnect.

b) **Use Case: "ComLogicalLink, connected"** Initiating a PDUStartComPrimitive function of type PDU_COPT_UPDATEPARAM will copy the working buffer to the queued active buffer and queue the ComPrimitive in the ComLogicalLink's internal ComPrimitive Queue. The ComParam queued active buffer will be moved to the ComLogicalLinks active buffer when the ComPrimitive starts execution (i.e. the ComPrimitive PDU_COPST_EXECUTING event occurs).

NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time.

NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.

c) **Use Case: "ComLogicalLink, connected" and ComPrimitive (with TempParamUpdate-Flag set to '1')** This ComPrimitive will use the ComParams contained in the working buffer, NOT the active buffer. These ComParams shall be in effect for the ComPrimitive until it is finished. The ComParams for the ComPrimitive will not change even if the "Active" or "Working" buffers are modified by any subsequent calls to PDUSetComParam.

NOTE 1 The ComParam Working Buffer is restored to the Active Buffer when the PDUStartComPrimitive function call returns.

NOTE 2 Physical ComParams cannot be changed using the TempParamUpdate Flag.

d) **Use Case: Physical BusType ComParam Change** A ComParam of type ComParamType = PDU_PC_BUSTYPE is a physical type of ComParam. There is only one set of physical ComParams per each physical resource (therefore they cannot be changed temporarily using the TempParamUpdate Flag). The default behaviour is that any ComLogicalLink which shares the physical resource may modify the physical ComParams. The ComLogicalLink which uses the PDULockResource to lock the physical ComParams will get exclusive rights to modify the physical ComParams for the resource (see PDULockResource function). If a "non-owning" ComLogicalLink attempts to modify a physical ComParam, after a PDU_COPT_UPDATEPARAM, the D-PDU API will generate an error event item (PDU_ERR_EVT_RSC_LOCKED) indicating the requested change is not possible. If one or more ComParams cannot be set, PDU_COPT_UPDATEPARAM CoP generates ONE PDU_ERR_EVT_RSC_LOCKED error event. The other ComParams are set. The CLL generates a PDU_COPST_FINISHED event, indicating that the CoP completed. The CLL continues with the next CoPs. (The CoPs already queued at the moment the error occurs are not cancelled.)

e) **Use Case: Unique ID Type ComParam Change** Changes to any ComParam of type PDU_PC_UNIQUE_ID are prohibited using PDUSetComParam. A ComParam of type PDU_PC_UNIQUE_ID is used only by the functions PDUSetUniqueRespIdTable and PDUGetUniqueRespIdTable.

f) **Use Case: Tester Present (PDU_PC_TESTER_PRESENT) Type ComParam Change** Changes to any ComParam of type PDU_PC_TESTER_PRESENT cannot be changed temporarily using the TempParamUpdate flag in the PDU_COP_CTRL_DATA structure. (See Structure to control a ComPrimitive's operation (used by PDUStartComPrimitive).) Once tester present handling is enabled the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime). After initial transmission the periodic tester present interval begins.

9.4.16.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUSetComParam(**UNUM32** hMod, **UNUM32** hCLL, **PDU_PARAM_ITEM** *pParamItem)

9.4.16.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink for which the given ComParam is to be set.

pParamItem — ComParam item structure with the ComParam element to be set. The structure can be allocated from the D-PDU API by calling the function PDUGetComParam(). It has to be filled with the desired ComParam value by the application before calling this function. The value information (min value, max value, default value) can be extracted from the MDF by the application. The data structure is described in 11.1.4.5.

NOTE If the application is using the structure allocated by the D-PDU API from the PDUGetComParam() function, it is only allowed to alter the value of the data in this structure, and should not increase or decrease the data length.

9.4.16.5 Return values

Table 25 — PDUSetComParam return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_COMPARAM_NOT_SUPPORTED	ComParam is not supported, e.g. because it is of type PDU_PC_UNIQUE_ID.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_PARAMETERS	One of the following conditions is invalid: — Invalid ComParam ID — Invalid ComParam structure — NULL pointer for pParamItem — ComParam value specified cannot be supported by the MVCI protocol module hardware/software.

9.4.17 PDUStartComPrimitive

9.4.17.1 Purpose

The PDUStartComPrimitive function creates a ComPrimitive (used for sending/receiving data) of a given type, and initiates its execution. The execution depends on the ComPrimitive type and the protocol implementation. The D-PDU data to be sent is referenced by pCoPData. The PDU_COP_CTRL_DATA structure provides additional control over the execution (see 11.1.4.17). The phCoP is a call-by-reference place where the ComPrimitive handle (assigned by the D-PDU API) will be stored for further API function calls. The ComPrimitive's status (see Status code values and 11.1.4.11.1 for further descriptions) can be requested via the API function PDUGetStatus() or can be retrieved as an event item.

NOTE The D-PDU API will destroy a ComPrimitive internally as soon as the ComPrimitive has reached the status PDU_COPST_FINISHED or PDU_COPST_CANCELLED. Once a ComPrimitive has reached the FINISHED or CANCELLED state, no more result items will be queued for the ComPrimitive in the ComLogicalLink's event queue. After internal destruction of a ComPrimitive, no more operations can be executed related to this ComPrimitive. (A PDU ERROR PDU_ERR_INVALID_HANDLE will be returned for a function call referencing the destroyed ComPrimitive.)

9.4.17.2 Behaviour

a) Validate all input parameters.

NOTE 1 Required pointer parameters cannot be NULL.

b) Check the state of the resource used by the ComLogicalLink and return an error if it is currently unavailable (i.e. reserved by another ComLogicalLink).

c) Place the ComPrimitive into the CoP Queue and “tie” the correct set of ComParams to the ComPrimitive.

— The ComPrimitive shall use the ComParams from the “Active” buffer if TempParamUpdate is set to 0.

NOTE 2 At the time the ComPrimitive is queued, the set of ComParams “tied” to the ComPrimitive will be a copy of the queued active buffer. The queued active buffer will be an exact match to the active buffer for the ComLogicalLink if there is no ComPrimitive previously queued of type PDU_COPT_UPDATEPARAM. This ensures that the set of active ComParams for a ComPrimitive is deterministic at the time the ComParam buffer is “tied” to the ComPrimitive. See Figure 23 — Example Diagram for ComPrimitive Queuing (5/5) for example handling of ComPrimitive queuing.

— The ComPrimitive shall use the ComParams from the “Working” buffer if TempParamUpdate is set to 1 (See PDU_COP_CTRL_DATA structure in 11.1.4.17).

NOTE 3 If TempParamUpdate is set to 1, the ComParam Working Buffer is restored to the Active Buffer when this PDUStartComPrimitive function call returns.

NOTE 4 Physical ComParams (ComParamType = PDU_PC_BUSTYPE) are not affected by the TempParamUpdate flag. Only one set of physical ComParams exist for a physical resource and they cannot be changed temporarily by a ComPrimitive. If the physical ComParams are locked by another ComLogicalLink, then a PDU_COPT_UPDATEPARAM will generate an error event (PDU_ERR_EVT_RSC_LOCKED) if physical ComParams are to be modified.

— The set of ComParams “tied” to a ComPrimitive shall be in effect for the ComPrimitive until it is finished or cancelled. The ComParams for the ComPrimitive will not change even if the “Active” or “Working” buffer is modified by any subsequent calls to PDUSetComParam or PDUStartComPrimitive of type PDU_COPT_UPDATEPARAM.

— The ComPrimitive shall use the UniqueRespIdTable from the “Active” table. Temporary UniqueRespIdTables are not supported. The UniqueRespIdTable shall be in effect for the ComPrimitive until it is finished. The UniqueRespIdTable for the ComPrimitive will not change even if the “Active” table is modified by any subsequent calls to PDUSetUniqueRespIdTable or PDUStartComPrimitive of type PDU_COPT_UPDATEPARAM.

d) Set status of ComPrimitive to PDU_COPST_IDLE as it is placed in the queue.

9.4.17.2.1 Behaviour — Use Cases

a) See 9.2.6 for detailed description on the different ComPrimitive types and how they are used in the different states of the ComLogicalLink.

b) **Use Case: Initial receive handling** A transport layer should use the UniqueRespIdentifer table and ComParams from the currently active SendRecv ComPrimitive for initial receive handling of frames/messages. If the ComLogicalLink does not have an active SendRecv ComPrimitive, then the current active ComParam buffer should be used. Once the frame/message is bound to a ComPrimitive, the set of ComParams attached to the CoP should be used for any further processing (e.g. receive timing).

c) **Use Case: CLL State = PDU_CLLST_OFFLINE** This is the initial state of the ComLogicalLink on creation (PDUCreateComLogicalLink) and when the ComLogicalLink has been disconnected from the vehicle bus (PDUDisconnect or on loss of communication to a module). No ComPrimitives can be added to the CLL queue while in this state (result = PDU_ERR_CLL_NOT_CONNECTED). The ComLogicalLink shall be in the state PDU_CLLST_ONLINE to allow any ComPrimitive queuing (See PDUConnect).

d) **Use Case: CLL State Change = (any state -> PDU_CLLST_OFFLINE)** The ComLogicalLink transitions to PDU_CLLST_OFFLINE from any other ComLogicalLink state on a successful function call to PDUDisconnect or on a loss of communication to a module. All ComPrimitives currently executing (i.e.

periodic) and all ComPrimitives in the CoP queue will be cancelled. A status event item, PDU_COPST_CANCELLED, is generated for each active CoP for the ComLogicalLink. The orders of events under the case of losing communications to a module are: PDU_ERR_EVT_LOST_COMM_TO_VCI, PDU_COPST_CANCELLED, PDU_CLLST_OFFLINE, and PDU_MODST_NOT_AVAIL.

e) **Use Case: CLL State Change = (PDU_CLLST_OFFLINE -> PDU_CLLST_ONLINE)** The ComLogicalLink changes state from PDU_CLLST_OFFLINE to PDU_CLLST_ONLINE after a successful call to PDUConnect. Some vehicle protocols require an initialization sequence (e.g. ISO 14230). Therefore, for those protocols, the ComLogicalLink shall be in the state PDU_CLLST_COM_STARTED to allow for regular transmits on the vehicle bus (i.e. ComPrimitives of type PDU_COPT_SENDRECV with NumSendCycles != 0 will not be allowed (result = PDU_ERR_CLL_NOT_STARTED)). Receive only ComPrimitives can be used to monitor the vehicle bus in this ComLogicalLink state (i.e. PDU_COPT_SENDRECV with NumSendCycles = 0 and NumReceiveCycles != 0).

f) **Use Case: CLL State Change = (PDU_CLLST_ONLINE -> PDU_CLLST_COM_STARTED)** The ComLogicalLink changes state from PDU_CLLST_ONLINE to PDU_CLLST_COM_STARTED after successful execution of the ComPrimitive of type PDU_COPT_STARTCOMM. If tester present handling is enabled (see CP_TesterPresentHandling), the message is sent immediately, prior to the initial tester present cyclic time (CP_TesterPresentTime). After initial transmission the tester present periodic interval is started.

NOTE Tester Present messages are only enabled in the state PDU_CLLST_COM_STARTED.

g) **Use Case: CLL State Change = (PDU_CLLST_COM_STARTED -> PDU_CLLST_ONLINE)** The ComLogicalLink changes state from PDU_CLLST_COM_STARTED to PDU_CLLST_ONLINE after successful execution of the ComPrimitive of type PDU_COPT_STOPCOMM. All ComPrimitives currently executing (i.e. periodic) and all ComPrimitives in the CoP queue will be cancelled when this ComPrimitive successfully executes or when the ComLogicalLink transitions to PDU_CLLST_OFFLINE. A status event item, PDU_COPST_CANCELLED, is generated for each active CoP for the ComLogicalLink.

9.4.17.2.2 Behaviour — ComPrimitive status events

When a ComPrimitive changes status, a status event item is generated (see Status code values). The following list describes each status change use case.

a) **Use Case: CoP State Change (IDLE -> EXECUTING)** When a ComPrimitive is removed from the CoP Queue for execution, the status of the ComPrimitive is set to PDU_COPST_EXECUTING.

— If the CoP is of type PDU_COPT_UPDATEPARAM, copy the queued active buffer to the ComLogicalLinks active buffer and immediately set the state to PDU_COPST_FINISHED.

NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time.

NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.

— If the CoP is of type PDU_COPT_RESTORE_PARAM, copy the active buffer to the working buffer and immediately set the state to PDU_COPST_FINISHED.

— If the protocol cannot handle the length of a ComPrimitive, an error event, PDU_ERR_EVT_PROT_ERR, is generated and the ComPrimitive is put into the FINISHED state. A protocol handler may be defined by ComParams which are used to validate a ComPrimitive size and therefore could reject a ComPrimitive based on the length of the PDU (e.g. see CP_HeaderFormatKW).

b) **Use Case: CoP State Change (EXECUTING -> WAITING)** A periodic send ComPrimitive will transition to PDU_COPST_WAITING after it has finished each of its periodic cycles.

c) **Use Case: CoP State Change (WAITING -> EXECUTING)** A periodic send ComPrimitive will transition to PDU_COPST_EXECUTING when it is time to begin its next transmission cycle.

d) **Use Case: CoP State Change (EXECUTING -> FINISHED)** A ComPrimitive will transition to PDU_COPST_FINISHED after it has completed execution. A periodic send ComPrimitive will transition to FINISHED after its last send cycle (NumSendCycles > 1 but not infinite (-1)). A ComPrimitive will transition to FINISHED whether it has completed successfully (e.g. all expected responses received) or unsuccessfully (e.g. receive timeout with no expected responses received).

e) **Use Case: CoP State Change (any state -> CANCELLED)** A ComPrimitive will transition to PDU_COPST_CANCELLED on the following conditions:

— A PDUDisconnect was issued for the ComLogicalLink.

— A PDUDestroyComLogicalLink was issued for the ComLogicalLink.

— A PDUCancelComPrimitive was issued for the ComPrimitive.

— A ComPrimitive of type PDU_COPT_STOPCOMM has completed and there were ComPrimitives currently executing or in the CoP queue.

— Communications were lost to the MVCI protocol module.

9.4.17.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUStartComPrimitive(**UNUM32** hMod, **UNUM32** hCLL, **T_PDU_COPT** CoPType, **UNUM32** CoPDataSize, **UNUM8** *pCoPData, **PDU_COP_CTRL_DATA** *pCopCtrlData, **void** *pCoPTag, **UNUM32** *phCoP)

9.4.17.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of the ComLogicalLink for which the ComPrimitive shall be started.
CoPType	Type of the ComPrimitive to be started. See ComPrimitive type values for a list of ComPrimitive types.
CoPDataSize	Size of data for the ComPrimitive; if 0, no data is supplied.
pCoPData	Reference of the buffer holding the data; NULL if no data is supplied.
pCoPCtrlData	Pointer to the control data structure for the ComPrimitive; NULL if no control data is supplied. Data structure described in 11.1.4.17. NOTE The PDU_COP_CTRL_DATA structure is not used for the ComPrimitives of type PDU_COPT_UPDATEPARAM and PDU_COPT_RESTORE_PARAM
pCoPTag	Application-specific tag value providing additional information concerning the event source (e.g. pointer into application-specific structure for ComLogicalLink). The PDU API does not interpret this value, it is tied to the ComPrimitive and made available to the application when event items are taken from the event queue. For more information, see Annex E.
phCoP	Call-by-reference place for storage of ComPrimitive handle. This unique handle is assigned by the D-PDU API for this new ComPrimitive.

9.4.17.5 Return values

Table 26 — PDUStartComPrimitive return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_CLL_NOT_CONNECTED	ComLogicalLink is not connected.
PDU_ERR_TX_QUEUE_FULL	The ComLogicalLink's transmit queue is full; the ComPrimitive could not be queued.
PDU_ERR_RSC_LOCKED_BY_OTHER_CLL	The ComLogicalLink's resource is currently locked by another ComLogicalLink.
PDU_ERR_INVALID_PARAMETERS	Invalid NULL pointer for phCoP or pCopData or pCopCtrlData or the expected response structure for a ComPrimitive with the NumReceiveCycles != 0 is NULL or has 0 entries.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_TEMPPARAM_NOT_ALLOWED	Physical ComParams cannot be changed as a temporary ComParam.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_CLL_NOT_STARTED	Communications are not started on the ComLogicalLink yet. A Send ComPrimitive cannot be accepted in this state.

9.4.18 PDUCancelComPrimitive

9.4.18.1 Purpose

Cancel the current running operation for the given ComPrimitive.

9.4.18.2 Behaviour

a) Validate input parameters.

b) Remove ComPrimitive from the CoP Queue.

c) Set status of ComPrimitive to PDU_COPST_CANCELLED.

d) If the ComPrimitive is already in the PDU_COPST_FINISHED status, this call will return success.

9.4.18.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUCancelComPrimitive(**UNUM32** hMod**, UNUM32** hCLL**, UNUM32** hCoP)

9.4.18.4 Parameters

hMod	Handle of MVCI protocol module.
hCLL	Handle of ComLogicalLink.
hCoP	Handle of the ComPrimitive which is to be cancelled.

9.4.18.5 Return values

Table 27 — PDUCancelComPrimitive return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle or ComPrimitive handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_CLL_NOT_CONNECTED	ComLogicalLink is not connected.

9.4.19 PDUGetEventItem

9.4.19.1 Purpose

Retrieve event item data (PDU_EVENT_ITEM) for given event source. PDUEventItem expects a reference of an MVCI protocol module or ComLogicalLink as input parameter to identify the event source. After retrieving the event item, the application can evaluate the type of item and then access the item-specific data.

For definition of PDU_EVENT_ITEM and event types, see 11.1.4.11.

9.4.19.2 Behaviour

a) Validate all input parameters.

NOTE 1 Pointer parameters cannot be NULL.

b) Allocate memory for PDU_EVENT_ITEM.

c) Fill out the event item information for the specified handle (Module or CLL).

d) Remove the event item entry from the queue. Memory for the item remains allocated.

NOTE 2 The event item is allocated and managed by the D-PDU API. It is destroyed by the application after use by calling the API function PDUDestroyItem() (see 9.4.20).

9.4.19.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetEventItem(**UNUM32** hMod, **UNUM32** hCLL, **PDU_EVENT_ITEM** **pEventItem)

9.4.19.4 Parameters

hMod — Handle of the MVCI protocol module for which the event item is to be retrieved. PDU_HANDLE_UNDEF if an item is for a system event (e.g. PDU API system events like PDU_IT_INFO).

NOTE If hMod is set to PDU_HANDLE_UNDEF then the hCLL handle is ignored.

hCLL — Handle of the ComLogicalLink for which the event item is to be retrieved; PDU_HANDLE_UNDEF if an item for the given MVCI protocol module is to be retrieved (e.g. MVCI protocol module events).

pEventItem — Call-by-reference place for storing the pointer to the event item corresponding to the given event, hMod and hCLL. Returns NULL if no result item is available. Data structure is described in 11.1.4.11.

9.4.19.5 Return values

Table 28 — PDUGetEventItem return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_INVALID_PARAMETERS	Invalid NULL pointer for pEventItem.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_EVENT_QUEUE_EMPTY	No more event items are available.

9.4.20 PDUDestroyItem

9.4.20.1 Purpose

Destroy the given item (works with all created items; item data type has to be casted). See D-PDU API item type values for the different type of items for the D-PDU API.

9.4.20.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Validate item type to be destroyed (see 11.1.4.2 for the description of item types).

c) Free memory reserved by the D-PDU API.

9.4.20.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUDestroyItem(**PDU_ITEM** *pItem)

9.4.20.4 Parameters

pItem Pointer to the item to be destroyed. The data structure is described in 11.1.4.2.

9.4.20.5 Return values

Table 29 — PDUDestroyItem return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid item type or the pItem parameter is NULL. See 11.1.4.2 for the different type of items possible.

9.4.21 PDURegisterEventCallback

9.4.21.1 Purpose

Register or unregister a callback function for event notification. By default, event notification is deactivated.

9.4.21.2 Behaviour

a) Validate input parameter's handles.

NOTE All handles could be PDU_HANDLE_UNDEF, which means that it is an event registration for the System (i.e. D-PDU API).

b) Determine whether it is a register or un-register request.

c) Either add or remove the callback function pointer to the proper object (System, Module, ComLogicalLink).

d) Figure 24 — Sequence of event handling shows the internal handling of events in the D-PDU API.

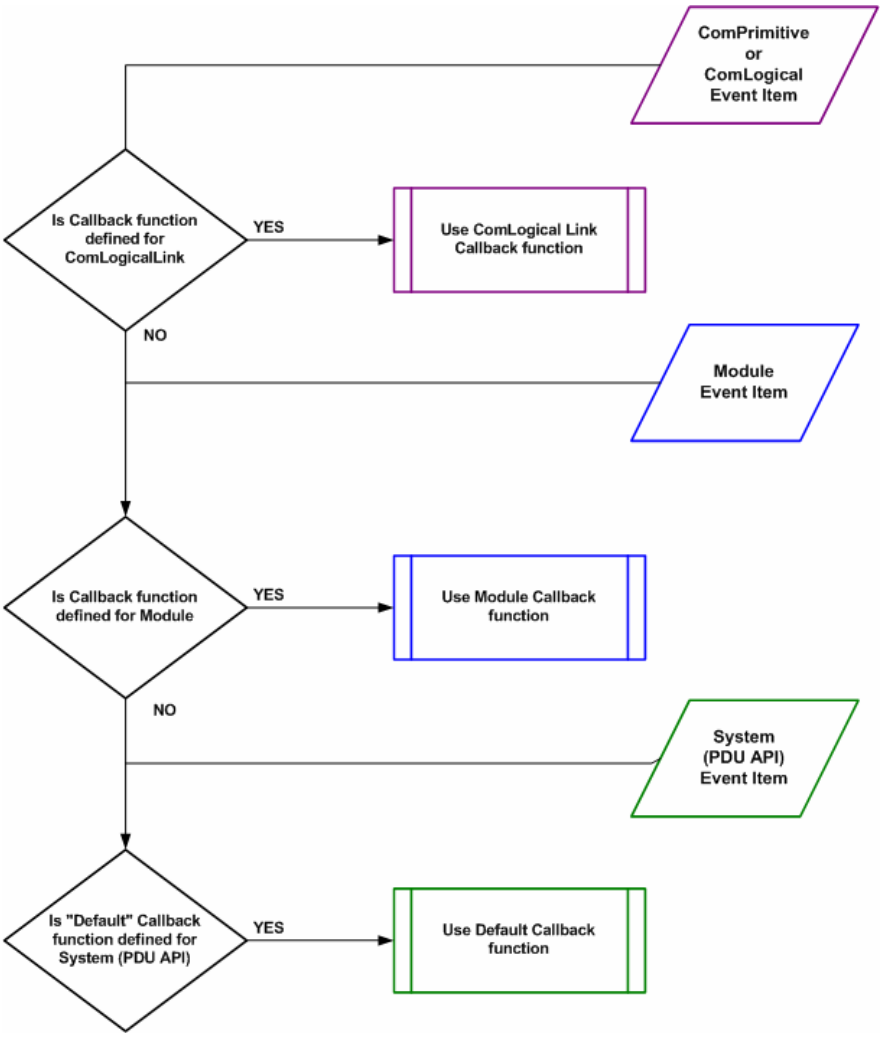


Figure 24 — Sequence of event handling

9.4.21.3 C/C++ Prototype

EXTERNC T_PDU_ERROR PDURegisterEventCallback(**UNUM32** hMod, **UNUM32** hCLL, **CALLBACKFNC** EventCallbackFunction)

9.4.21.4 Parameters

hMod	Handle of a Module if an event callback function shall be registered for the Module/System events. If hMod is PDU_HANDLE_UNDEF, the hCLL parameter is not used, and the callback function is used for System event callbacks (i.e. DLL/Shared Library error events.)
hCLL	Handle of ComLogicalLink if an event callback function shall be registered with respect to a ComLogicalLink or PDU_HANDLE_UNDEF for registration of Module/System callback functions. NOTE If a callback registration to a ComLogicalLink is requested after a ComLogicalLink has been connected (i.e. PDUConnect), an error will be returned.
EventCallbackFunction	Reference of callback function to be used for event notification. Or NULL to deactivate the callback mechanism. C/C++ qualifier described in 11.1.2.

9.4.21.5 Return values

Table 30 — PDURegisterEventCallback return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_CLL_CONNECTED	ComLogicalLink is not in the OFFLINE state and cannot accept the registration of a new callback.

9.4.22 EventCallback prototype

9.4.22.1 Purpose

The EventCallback prototype needs to be implemented and registered by the application. It is registered and known to the D-PDU API after a call of function PDURegisterEventCallback() with a reference to the application's callback function as a parameter. After registration, the application's callback function will be invoked by the D-PDU API whenever an event occurs. The callback function receives the event type, a handle of the resource (i.e. MVCI protocol module or ComLogicalLink) causing the event and an application-specific tag. The application can process the event immediately or pass it to an internal thread, which processes the events for the specific resource (i.e. MVCI protocol module or ComLogicalLink).

The runtime duration of the event callback function shall be as short as possible in order to avoid any unnecessary blocking of the D-PDU API software. The callback function will be called on the thread of the D-PDU API, therefore it is recommended that the application callback function post an event to wake another thread to do the reading of the event data. If the application shall make a D-PDU API function call in the callback routine, then PDUGetEventItem is the only permitted call.

NOTE 1 All events (status, error and results) generated by a ComLogicalLink or ComPrimitive will be placed in the ComLogicalLink's Event Queue. An event callback is either generated when there are events in the queue when the PDURegisterEventCallback function is called that registers a callback function or the ComLogicalLink's Event Queue transitions from empty to NOT empty. In other words, multiple events will not generate multiple callbacks even though each is a separate event item in the Event Queue. The application is responsible for reading ALL events from the ComLogicalLink's Event Queue before another call back will be generated.

The application shall be careful when registering the same callback function to multiple ComLogicalLinks. In this case, the callback function should be re-entrant just in case another ComLogicalLink (which may be running on a separate D-PDU API thread) makes a callback while a previous callback is currently executing.

NOTE 2 If there is NO ComLogicalLink callback registered for a specific ComLogicalLink, and a Module or System callback is registered the D-PDU API will default to using first the Module callback, and otherwise use the system callback when events are received for the ComLogicalLink. The application checks the handles of the EventCallback to determine whether it is from a module, system or ComLogical Link. This is also true if there is no module callback defined; any module events would use the system callback.

NOTE 3 In a Windows D-PDU API DLL, the callback function will have the same _stdcall calling convention as used for all other D-PDU API functions exported from the DLL (see 9.7.2).

9.4.22.2 C/C++ prototype

void EventCallback(**T_PDU_EVT_DATA** eventType, **UNUM32** hMod, **UNUM32** hCLL, **void** *pCllTag, **void** *pAPITag)

9.4.22.3 Parameters

eventType	Type of event which occurred (see D.1.8).
hMod	Handle of MVCI protocol module (PDU_HANDLE_UNDEF if not from a module (System event callback)).
hCLL	Handle of ComLogicalLink causing the event (PDU_HANDLE_UNDEF if not from a ComLogicalLink).
pCllTag	Tag value for a ComLogicalLink. This tag should be ignored if the hCLL parameter = PDU_HANDLE_UNDEF. This is an application-specific tag value providing additional information concerning the event source (e.g. pointer onto application specific structure for ComLogicalLink).
pAPITag	Tag value for the PDU API. This is an application-specific tag value providing additional information concerning the event source (e.g. pointer onto application specific structure for the PDU API Library).

9.4.22.4 Return values

No return values are defined for this function.

9.4.23 PDUGetObjectId

9.4.23.1 Purpose

Retrieve the item id for given item of a given type. PDUGetObjectId expects the item type and the name of the item as input parameters to identify the item. It then retrieves the id of the given item. The item id can also be obtained by parsing the MDF file.

9.4.23.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Determine the id of the requested object.

c) Fill out the response parameter pPduObjectId with the information.

9.4.23.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetObjectId(**T_PDU_OBJT** pduObjectType, **CHAR8*** pShortname, **UNUM32** *pPduObjectId)

9.4.23.4 Parameters

pduObjectType	Enumeration ID of object type. See Object type values.
pShortname	Pointer to the shortname of object, e.g. ComParam “CP_P2Max”.
pPduObjectId	Call-by-reference place for storing the PDU Object ID for “Shortname” of “pduObjectType ”. The id will be set to PDU_ID_UNDEF if the PDU API has no valid Object Id for the requested object type and shortname.

9.4.23.5 Return values

Table 31 — PDUGetObjectId return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.
PDU_ERR_MODULE_FW_OUT_OF_DATE	The D-PDU API library has a newer version than the MVCI protocol module firmware. The MVCI protocol module firmware should be updated to work with the D-PDU API Library.
PDU_ERR_API_SW_OUT_OF_DATE	The MVCI protocol module firmware has a newer version than the D-PDU API Library. The D-PDU API Library should be updated to work with the MVCI protocol module firmware.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (ObjectType, ShortName), or the pointer to the pPduObjectId is NULL.

9.4.24 PDUGetModuleIds

9.4.24.1 Purpose

Obtain module type Id, module handle information, vendor specific string information, and module status from the D-PDU API. All MVCI protocol modules detected by the D-PDU API are assigned a handle (hMod) by the D-PDU API. Each MVCI protocol module is of a certain module type (ModuleTypeId). The hMod information is used to access the individual modules in most D-PDU API function calls.

An information callback occurs (see PDU_INFO_MODULE_LIST_CHG: Information event values) when a change in the list of MVCI protocol modules is detected by the D-PDU API. The client application should call PDUGetModuleIds again to get the new list of available MVCI protocol modules. The module handles (hMod) for modules which have already been detected will not be changed. A module which has been connected to (See PDUModuleConnect) will maintain its handle (hMod) even after communication has been lost to the module. In this case, the module handle is destroyed only after a PDUModuleDisconnect or PDUDestruct.

Changes to a module connection are observed by a status change (see PDU_IT_STATUS: Structure for status data D.1.4 Status code values). Change of status occurs during PDUModuleConnect, PDUModuleDisconnect, and loss of communications with an MVCI protocol module. Change of status does not generate a PDU_INFO_MODULE_LIST_CHG event item.

9.4.24.2 Behaviour

a) Validate input parameter.

NOTE 1 Pointer parameter cannot be NULL.

b) Allocate PDU_MODULE_ITEM structure and fill the call-by-reference variable pModuleIdList. The D-PDU API structure (pModuleIdList) has to be freed by calling PDUDestroyItem from the application.

NOTE 2 In the case of no detection of any MVCI protocol modules, the call to PDUGetModuleIds will return a PDU_MODULE_ITEM with the number of entries set to zero (NumEntries = 0) and the pointer to PDU_MODULE_DATA set to NULL (pModuleData = NULL).

c) The D-PDU API shall generate a unique handle for each MVCI protocol module interface type supported.

EXAMPLE MVCI protocol module with three interface types. The strings are vendor specific.

Table 32 — Example of unique handles per interface type

	Ethernet Interface	Wireless Interface	USB Interface
hMod	0x00000001	0x00000002	0x00000003
ModuleTypeId	0x00000001	0x00000001	0x00000001
ModuleStatus	PDU_MODST_AVAIL	PDU_MODST_AVAIL	PDU_MODST_AVAIL
pVendorModuleName	“VCI 1”	“VCI 1”	“VCI 1”
pVendorAdditionalInfo	“Interface='Ethernet'”	“Interface='Wireless'”	“Interface='USB'”

d) If detection of a module or module interface type is lost and the handle was in the state PDU_MODST_AVAIL, the handle will no longer be valid and will be removed from the list of detected modules. If the module or module interface type is re-detected a new module handle will be generated by the D-PDU API for the module. Each time the list of module handles changes, an information event will be generated to indicate that a new list of MVCI protocol module handles is available (See PDU_INFO_MODULE_LIST_CHG event).

9.4.24.2.1 Behaviour — Use Cases

When an MVCI protocol module changes status, a status event item is generated (see Status code values). The following list describes each status change use case.

a) **Use Case: Module State = PDU_MODST_AVAIL** This is the initial state of a MVCI protocol module when it is initially detected by the D-PDU API. NO status event item is generated on this initial state. A module shall be in the state PDU_MODST_READY to allow any API function calls to the module (See PDUModuleConnect).

b) **Use Case: Module State Change = (PDU_MODST_AVAIL -> PDU_MODST_READY)** The module transitions to PDU_MODST_READY after a successful call to PDUModuleConnect. The module is now ready to begin an API session with the client application. NO status event item can be generated at this time because the function callback (PDURegisterEventCallback) can only be applied after the module is in the state PDU_MODST_READY.

c) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_NOT_READY)** The module transitions to PDU_MODST_NOT_READY when a condition occurs on the device which prohibits execution of any further API calls. This condition may only be momentary while the module recovers from the not ready state (e.g. PDU_IOCTL_RESET).

d) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_NOT_AVAIL) or (PDU_MODST_NOT_READY -> PDU_MODST_NOT_AVAIL)** The module transitions to PDU_MODST_NOT_AVAIL on a loss of communication to a module. All ComPrimitives currently executing (i.e. periodic) and all ComPrimitives in the CoP queue will be cancelled (PDU_COPST_CANCELLED). All active ComLogicalLinks will go into the offline state (PDU_CLLST_OFFLINE). The orders of events under the case of losing communications to a module are: PDU_ERR_EVT_LOST_COMM_TO_VCI, PDU_COPST_CANCELLED, PDU_CLLST_OFFLINE, and PDU_MODST_NOT_AVAIL.

e) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_AVAIL)** The module transitions to PDU_MODST_AVAIL after a successful call to PDUModuleDisconnect. All resources are freed for the module. NO status event item is generated since further event items will not be queued for the module.

9.4.24.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetModuleIds(**PDU_MODULE_ITEM** **pModuleIdList)

9.4.24.4 Parameters

pModuleIdList	Pointer for storing the pointer to Module Type Ids and the Module handles for all modules that are connected to the D-PDU API. The data structure is described in 11.1.4.6.

9.4.24.5 Return values

Table 33 — PDUGetModuleIds return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_INVALID_PARAMETERS	Invalid NULL pointer for pModuleList.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.

9.4.25 PDUGetResourceIds

9.4.25.1 Purpose

Obtain a list of resource ids from the D-PDU API for a given module that supports the resource data information. The resource data information is defined as a protocol, bus type and pin(s). The object Ids for the resource data information can be obtained by using the PDUGetObjectId function.

The caller supplies a reference to a memory object that is of the type PDU_RSC_DATA. This object contains resource data information (pResourceIdData) for a single set of resource data information. The D-PDU API shall generate a PDU_IT_RSC_ID object (pResourceIdList) that has a list of resource Id's that match the given resource data information. The application shall release the D-PDU API memory by calling PDUDestroyItem after it has used the resource Id list information.

9.4.25.2 Behaviour

a) Validate input parameters.

NOTE Pointer parameters cannot be NULL.

b) Function takes pResourceIdData structure as allocated by the application.

c) Allocate memory for the pResourceIdList result information.

d) Extracts required information from pResourceIdData structure and determines the correct list of resource Ids that match the resource data requested.

9.4.25.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetResourceIds(**UNUM32** hMod, **PDU_RSC_DATA** *pResourceIdData, **PDU_RSC_ID_ITEM** **pResourceIdList)

9.4.25.4 Parameters

hMod	Handle of MVCI protocol module. If set to PDU_HANDLE_UNDEF then all modules connected to the D-PDU API will return their resource Ids and the module handles which support the PDU_RSC_DATA elements.
pResourceIdData	Call-by-reference place for the resource Id data information for a particular module type. The data structure is described in 11.1.4.8.
pResourceIdList	Call-by-reference place for storing the Resource Id list for the selected resource data. This item shall be destroyed by the application by calling PDUDestroyItem. The data structure is described in 11.1.4.7.

9.4.25.5 Return values

Table 34 — PDUGetResourceIds return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_FW_OUT_OF_DATE	The D-PDU API library has a newer version than the MVCI protocol module firmware. The MVCI protocol module firmware should be updated to work with the D-PDU API Library.
PDU_ERR_API_SW_OUT_OF_DATE	The MVCI protocol module firmware has a newer version than the D-PDU API Library. The D-PDU API Library should be updated to work with the MVCI protocol module firmware.
PDU_ERR_INVALID_PARAMETERS	The reference pointer is invalid (NULL) for pResourceIdData or pResrouceIdList.

9.4.26 PDUGetConflictingResources

9.4.26.1 Purpose

Provide a list of resources that conflict with, and cannot therefore be selected at the same time, as a specified resource. The reason for the conflict may be that the resources utilise the same pin or utilise the same controller. The D-PDU API uses the MDF and CDF to extract the information from all modules and module types. It is possible to detect conflicting resources in a one-vendor D-PDU API system. When MVCI protocol modules of more than one vendor are connected by a Y-cable, the system-integrator has to take care of any conflicting resources. This information would only be addressed to multiple MVCI protocol modules if there is more than 1 MVCI protocol module connected to a vehicle. It is the responsibility of the application to determine which group of modules are connected to a single vehicle and to fill out the pInputModuleList correctly.

9.4.26.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Determine all resource conflicts of ResourceId between the modules listed in pInputModuleList.

c) Allocate memory for the PDU_RSC_CONFLICT_ITEM structure.

d) Fill the call-by-reference variable pOutputConflictList. The D-PDU API structure (pOutputConflictList) has to be freed by calling PDUDestroyItem from the application.

9.4.26.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetConflictingResources(**UNUM32** resourceId, **PDU_MODULE_ITEM** *pInputModuleList, **PDU_RSC_CONFLICT_ITEM** **pOutputConflictList)

9.4.26.4 Parameters

resourceId	The resource identifier to check for conflicts. The resource id is available from the MDF file and PDUGetResourceIds function.
pInputModuleList	List of modules to determine conflicts against. The data structure is described in 11.1.4.6. NOTE Both hMod and ModuleType need to be valid in this structure.
pOutputConflictList	Call-by-reference place for storing the information for each conflicted resource. The data structure is described in 11.1.4.9.

9.4.26.5 Return values

Table 35 — PDUGetConflictingResources return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.
PDU_ERR_MODULE_FW_OUT_OF_DATE	The D-PDU API library has a newer version than the MVCI protocol module firmware. The MVCI protocol module firmware should be updated to work with the D-PDU API Library.
PDU_ERR_API_SW_OUT_OF_DATE	The MVCI protocol module firmware has a newer version than the D-PDU API Library. The D-PDU API Library should be updated to work with the MVCI protocol module firmware.
PDU_ERR_INVALID_PARAMETERS	Invalid resource ID, or one of the reference pointers (pInputModuleList or pOutputConflictList) are invalid (NULL).

9.4.27 PDUGetUniqueRespIdTable

9.4.27.1 Purpose

Retrieve information of all unique response identifiers configured for the ComLogicalLink. Each unique response identifier is associated with a list of ComParams that are of type: PDU_PC_UNIQUE_ID.

When this function is called prior to a PDUSetUniqueRespIdTable, the structure returned will contain the ComParam information for only a single unique response and the UniqueRespIdentifier will be set to PDU_ID_UNDEF. The ComParam information can then be used to determine the correct set of ComParams used by the Protocol for unique ECU response identification.

Since the Unique Response ID Table is a structure holding ComParams, PDUGetUniqueRespIdTable uses the same mechanisms for handling ComParams in an internal working table as described for PDUGetComParams.

NOTE ComParams that are of type PDU_PC_UNIQUE_ID can only be used with the Unique Response ID Table. They cannot be used in the functions PDUGetComParam() or PDUSetComParam().

9.4.27.2 Behaviour

a) Validate all input parameters.

   NOTE Pointer parameters cannot be NULL.

b) Allocate PDU_UNIQUE_RESP_ID_TABLE_ITEM structure. If the table has not been previously set by PDUSetUniqueRespIdTable, then only 1 entry will be allocated and the UniqueRespIdentifier will be PDU_ID_UNDEF.

c) Fill in the table structure for the ComLogicalLink. The elements in the tables are based on the selected protocol for the ComLogicalLink. The number of ComParams in the list will be protocol dependent. The number of entries in the table can be 1 or more.

9.4.27.3 C/C++ prototype

EXTERNC **T_PDU_ERROR** PDUGetUniqueRespIdTable(**UNUM32** hMod, **UNUM32** hCLL, **PDU_UNIQUE_RESP_ID_TABLE_ITEM** **pUniqueRespIdTable)

9.4.27.4 Parameters

hMod	Handle of VCI Module.
hCLL	Handle of ComLogicalLink.
pUniqueRespIdTable	Call-by-reference place for storing the Unique Response ID Table for the CLL; the item is allocated by the D-PDU API and has to be released after use from the application by calling the function PDUDestroyItem(). The data structure is described in 11.1.4.10.

9.4.27.5 Return values

Table 36 — PDUGetUniqueRespIdTable return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_PARAMETERS	The pointer pUniqueRespIdTable is invalid (NULL).

9.4.28 PDUSetUniqueRespIdTable

9.4.28.1 Purpose

Set Unique Response Id Table information for a ComLogicalLink. This function is used to set up a table of unique response identifiers. Each unique response identifier contains a set of ComParams that uniquely define any response from a specific ECU (functional or physical responses). The application assigns the UniqueRespIdentifier. The valid range for Unique Response Identifier values is 0x0 - 0xFFFFFFFF.

The Unique Response Id Table is used for physical responses, as well as for functional responses and monitored messages. All addressing type modes (functional/physical) are contained in the list of ComParams so that any message from a specific ECU is tied to a unique ECU identifier. This allows the application to use the UniqueRespIdentifier to an ECU variant without having to interpret any protocol-specific information (e.g. CAN Id's and ECU Source Addresses).

Since the Unique Response ID Table is a structure holding ComParams, PDUSetUniqueRespIdTable uses the same mechanisms for handling ComParams in an internal working Buffer as described for PDUSetComParams. The new table will only become active upon a PDUStartComPrimitive of type PDU_COPT_UPDATEPARAM.

9.4.28.2 Behaviour

a) Validate all input parameters.

   NOTE Pointer parameters cannot be NULL.

b) Verify that all ComParam entries in the table are of the type PDU_PC_UNIQUE_ID.

c) Store the table for ECU Response Handling in a working buffer.

9.4.28.2.1 Behaviour — Use Cases

a) **Use Case: "ComLogicalLink, not connected"** The Unique Response Identifer working table will be moved to the active table after calling the function PDUConnect.

b) **Use Case: "ComLogicalLink, connected"** Initiating a PDUStartComPrimitive function of type PDU_COPT_UPDATEPARAM will queue the ComPrimitive in the ComLogicalLink's internal ComPrimitive Queue. A copy of the URID Table will be stored in a queued active table when the ComPrimitive is placed on the ComPrimitive Queue. The queued active table will be used for all subsequent ComPrimitives being placed on the ComPrimitive queue. The Unique Response Identifier queued active table will be moved to the ComLogicalLinks active table when the ComPrimitive changes status to EXECUTING (PDU_COPST_EXECUTING). This functionality is similar to the ComParam use case described in the Example for ComParam buffer attachment to a ComPrimitive.

9.4.28.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUSetUniqueRespIdTable (**UNUM32** hMod, **UNUM32** hCLL, **PDU_UNIQUE_RESP_ID_TABLE_ITEM** *pUniqueRespIdTable)

9.4.28.4 Parameters

hMod	Handle of VCI Module.
hCLL	Handle of ComLogicalLink.
pUniqueRespIdTable	Call-by-reference place which contains the Unique Response ID Table for the CLL. The item is allocated by the application. The data structure is described in 11.1.4.10.

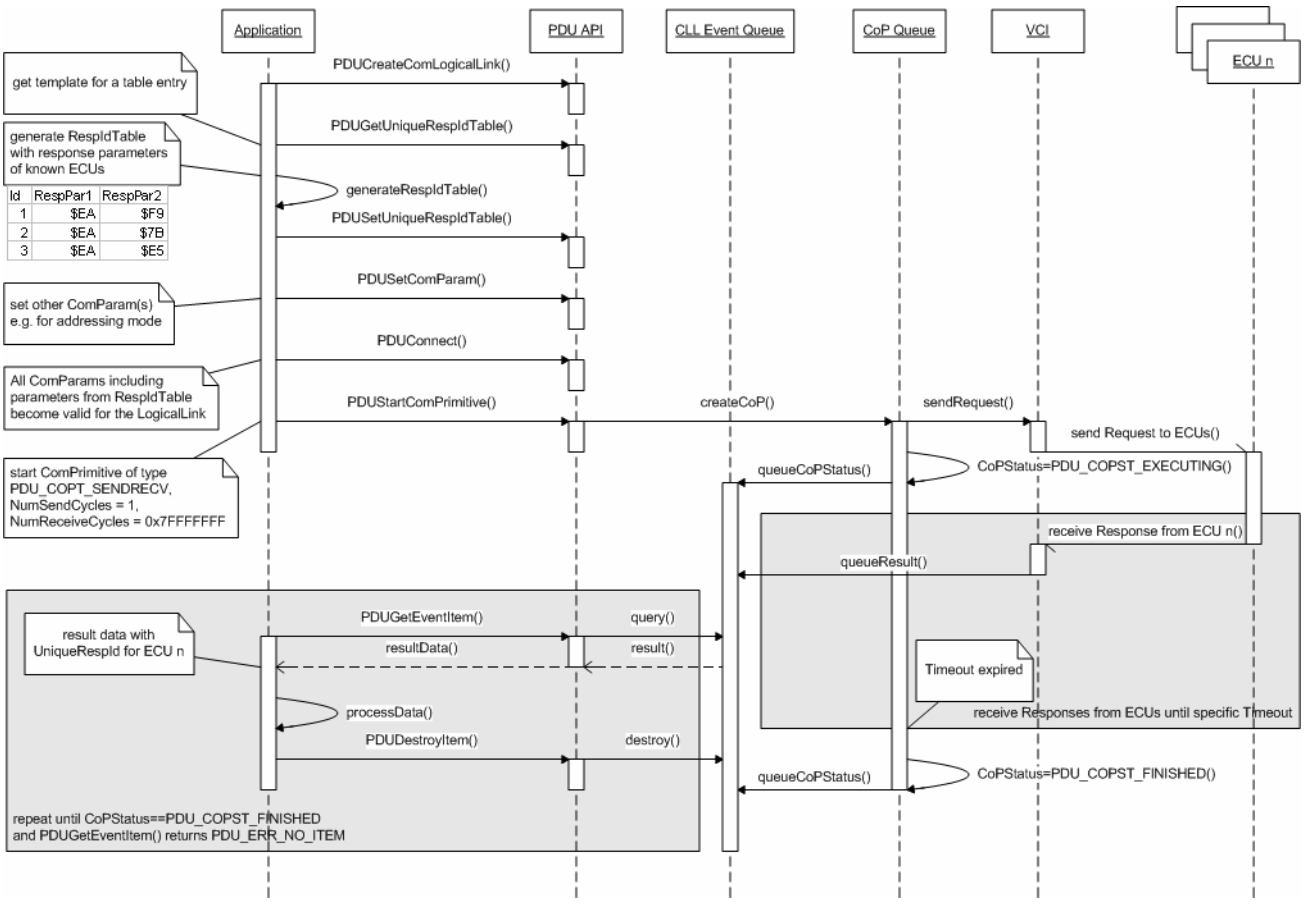
9.4.28.5 Return values

Table 37 — PDUSetUniqueRespIdTable return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	PDU API has not been constructed before.
PDU_ERR_COMPARAM_NOT_SUPPORTED	One of the ComParams in the list is not of the type PDU_PC_UNIQUE_ID.
PDU_ERR_INVALID_PARAMETERS	The pointer pUniqueRespIdTable is invalid (NULL).
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle or ComLogicalLink handle.

9.4.28.6 Using the Unique Response ID Table (URID Table) for physical and functional addressing

The sequence diagram demonstrates how to use the Unique Response ID Table for functional and physical addressing.



Id	RespPar1	RespPar2
1	$EA	$F9
2	$EA	$7B
3	$EA	$E5

Figure 25 — Sequence of Unique Response ID Table (URID Table) for physical and functional addressing

After creating a ComLogicalLink, the application generates the Unique Response ID Table, using the template from a table entry retrieved by calling PDUGetUniqueRespIdTable(). The application does the following steps to configure the Unique Response Id Table:

a) Add a table entry for each ECU in the functional group. If doing physical addressing, then only one entry is needed.

b) Each entry contains a list of ComParams which uniquely identify an ECU response. These ComParams are of type PDU_PC_UNIQUE_ID.

c) Assign a Unique Response ID value for each table entry (ID range is 0 to 0xFFFFFFFF).

d) With this generated table the application calls PDUSetUniqueRespIdTable().

e) The application also sets other ComParams (PDUSetComParam), e.g. to switch the addressing mode to functional addressing.

NOTE Some details are left out in the diagram, like necessary calls of PDUDestroyItem.

f) The application calls PDUConnect(), the Unique Response ID Table and other ComParams become valid for all future ComPrimitives on the ComLogicalLink.

When a ComPrimitive is configured with NumSendCycles set to 1 and NumReceiveCycles set to -2 (IS-MULTIPLE), the MVCI protocol module expects responses from one or more ECUs. Until a specific timeout expires, the MVCI protocol module receives responses and tries to match the Unique Response ID for each response (see the following subclauses for details). The Unique Response Id is saved and then returned in a result item when the payload data is matched to a ComPrimitive expected response. The application retrieves the result items from the ComLogicalLink's Event Queue (details of event notification are not shown in the diagram). When processing the result data, the application is able to assign the data to a certain ECU via the Unique Response ID.

The sequence for physical addressing with single request / single response is very similar. The main difference is that the Unique Response ID Table contains exactly one entry, and with NumReceiveCycles set to 1 the ComPrimitive reaches the status PDU_COPST_FINISHED immediately when the only response is received.

9.4.28.7 Handling of known and unknown responses from an ECU

9.4.28.7.1 Use cases

The following use cases concerning ECU response handling have to be regarded:

a) **Use case 1: Only known responses**

The application knows the response parameters of each ECU to respond to the functional/physical request. The application fills the Unique Response ID Table with an entry for each ECU. Then the D-PDU API uses the response parameters from the Unique Response ID Table entries to set up receive message acceptance filters. Thus only responses from known ECUs with a corresponding table entry will be received.

b) **Use case 2: Only unknown responses**

The application has no knowledge about the response parameters of any ECU to respond to the functional/physical request. The application uses a Unique Response ID Table with only one entry, with the UniqueRespIdentifier set to PDU_ID_UNDEF (response parameter values are “don't care” (i.e. NumParamItems = 0). Then the D-PDU API receives all possible diagnostic messages and filters them only with the expected response structure, as described below for handling of unknown ECU response Id's.

c) **Use case 3: Known and unknown responses**

The application knows the response parameters of some ECUs to respond to the functional request, but there may be additional unknown ECUs responding, and the application also wants to receive these responses to detect unknown ECUs. The application fills the Unique Response ID Table with an entry for each known ECU response, and an additional entry with the UniqueRespIdentifier set to PDU_ID_UNDEF (response parameter values are “don't care” (i.e. NumParamItems = 0)). Then the D-PDU API receives all possible diagnostic messages and filters them only with the expected response structure. Responses with known and unknown response Id's are treated as described below.

NOTE In all cases the receive message acceptance filters automatically configured by the D-PDU API using the Unique Response ID Table will be overridden by filters set by the application using a PDU_IOCTL_START_MSG_FILTER command.

9.4.28.7.2 Handling of known ECU response ids

When the D-PDU API receives a message from an ECU the following process steps are applied:

a) Determine if the message passes the acceptance filters (see PDU_IOCTL_START_MSG_FILTER).

b) Match the received message header information to an entry in the table of Unique Response ids. The matching algorithm is protocol specific (e.g. some protocols will use CAN ids, others will use Target Addresses, ECU Sources address, etc.).

c) Once a UniqueRespIdentifier is found, the payload data is attempted to be matched to the ExpectedResponseStructure (see Structure for expected response) of all active ComPrimitives (Starting with the active SENDRECV ComPrimitive).

d) When a match is found, the UniqueRespIdentifier is returned (along with the data and RxFlag information) to the application indicating which ECU the message was from (see Structure for result data).

9.4.28.7.3 Handling of unknown ECU response ids

If a known ECU match cannot be found in the Unique Response Id Table and the table has an entry for unknown handling (i.e. one entry has the UniqueRespIdentifier set to PDU_ID_UNDEF), the following steps will be followed:

a) Determine if the payload data can be matched to an ExpectedResponseStructure entry of an active ComPrimitive. (SendRecv or RecvOnly).

b) Set the UniqueRespIdentifier to PDU_ID_UNDEF in the PDU_RESULT_DATA for a PDU_EVENT_ITEM, indicating a valid message was received, but the ECU does not have a unique identifier in the URID table.

c) Additional message header information can be obtained by setting the ENABLE_EXTRA_INFO bit in the TxFlag for the ComPrimitive (see TxFlag definition).

NOTE 1 For certain protocols, an unknown ECU response can be incomplete and need additional flow control handling by the D-PDU API, which can be impossible without a corresponding entry in the Unique Response Id Table. Then the D-PDU API will drop this incomplete response.

NOTE 2 Depending on the protocol, it might not be possible to clearly distinguish if a response from an unknown ECU identifier or a non-diagnostic message has been received. Then the D-PDU API might not be able to deliver unexpected responses reliably.

9.4.28.7.4 ECU Response Handling Flow Chart

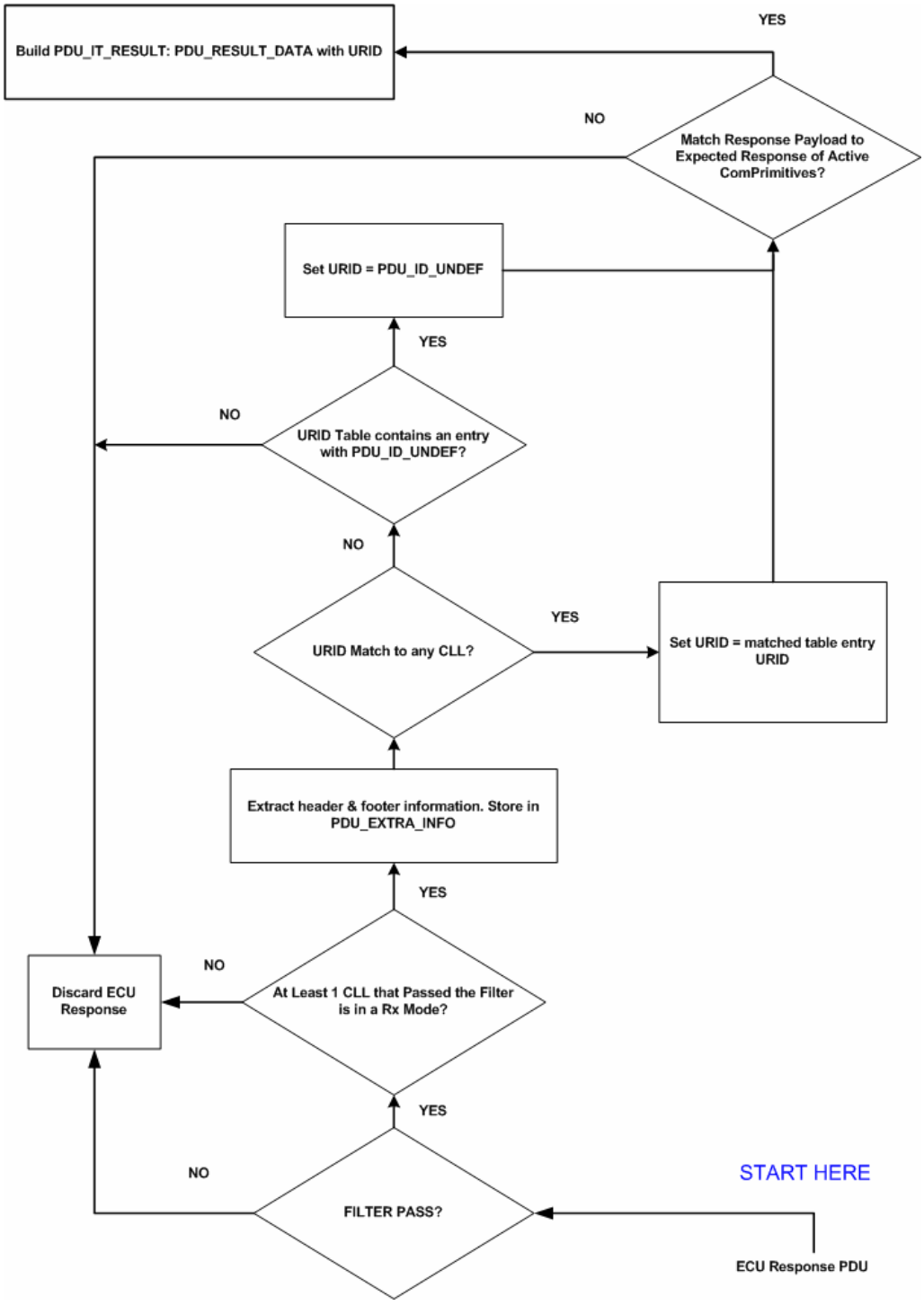


Figure 26 — Sequence of unique response identifiers and expected responses

9.4.29 PDUModuleConnect

9.4.29.1 Purpose

Establish connection to the specified MVCI protocol module and initialize its system-level drivers. Obtain available resources from the specified MVCI protocol module and create internal structures including a resource table. The communication state is offline, i.e. no allocation of resources and no communication over vehicle interface takes place.

9.4.29.2 Behaviour

a) Determine if connection is available to MVCI protocol module. Module shall be in the state PDU_MODST_AVAIL. If connection is not possible, return error PDU_ERR_FCT_FAILED.

b) Initialize communication with the specific MVCI protocol module.

c) Determine all resources status on the MVCI protocol module.

d) Set the Module Status to PDU_MODST_READY (No event callback is generated since a callback could not have been registered by the client until after connection).

NOTE 1 Most D-PDU API function calls which require a hMod parameter will return an error (PDU_ERR_MODULE_NOT_CONNECTED) if the module status is not in the state PDU_MODST_READY. The following list of D-PDU API functions are allowed to be used prior to a PDUModuleConnect:

— PDUGetResourceIds

— PDUGetObjectId

— PDUGetConflictingResources

— PDUGetStatus

NOTE 2 When the D-PDU API detects a loss of communications to an MVCI protocol module after it has been connected, the module status is set to PDU_MODST_NOT_AVAIL. It is advisable that a client application calls PDUModuleDisconnect when communications have been lost to the MVCI protocol module after all items have been retrieved from the module event queue. (See PDU_ERR_EVT_LOST_COMM_TO_VCI.)

e) Once a module has been connected, the handle (hMod) remains valid until a PDUModuleDisconnect even after a loss of communication with the module. This behaviour is required in order to maintain the event queues for the client application retrieval of event items.

9.4.29.2.1 Behaviour — Use Cases

When an MVCI protocol module changes status, a status event item is generated (see Status code values). The following list describes each status change use case.

a) **Use Case: Module State = PDU_MODST_AVAIL** This is the initial state of an MVCI protocol module when it is initially detected by the D-PDU API. NO status event item is generated on this initial state. A module shall be in the state PDU_MODST_READY to allow any API function calls to the module (See PDUModuleConnect).

b) **Use Case: Module State Change = (PDU_MODST_AVAIL -> PDU_MODST_READY)** The module transitions to PDU_MODST_READY after a successful call to PDUModuleConnect. The module is now ready to begin an API session with the client application. NO status event item can be generated at this time because the function callback (PDURegisterEventCallback) can only be applied after the module is in the state PDU_MODST_READY.

c) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_NOT_READY)** The module transitions to PDU_MODST_NOT_READY when a condition occurs on the device which prohibits execution of any further API calls. This condition may only be momentary while the module recovers from the not ready state (e.g. PDU_IOCTL_RESET).

d) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_NOT_AVAIL) or (PDU_MODST_NOT_READY -> PDU_MODST_NOT_AVAIL)** The module transitions to PDU_MODST_NOT_AVAIL on a loss of communication to a module. All ComPrimitives currently executing (i.e. periodic) and all ComPrimitives in the CoP queue will be cancelled (PDU_COPST_CANCELLED). All active ComLogicalLinks will go into the offline state (PDU_CLLST_OFFLINE). The orders of events under the case of losing communications to a module are: PDU_ERR_EVT_LOST_COMM_TO_VCI, PDU_COPST_CANCELLED, PDU_CLLST_OFFLINE, and PDU_MODST_NOT_AVAIL.

e) **Use Case: Module State Change = (PDU_MODST_READY -> PDU_MODST_AVAIL)** The module transitions to PDU_MODST_AVAIL after a successful call to PDUModuleDisconnect. All resources are freed for the module. NO status event item is generated since further event items will not be queued for the module.

9.4.29.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUModuleConnect (**UNUM32** hMod)

9.4.29.4 Parameters

hMod	Handle of the MVCI protocol module to be connected. If set to PDU_HANDLE_UNDEF then the D-PDU API will establish a connection to all detected MVCI protocol modules. It is up to the MVCI protocol module vendor to choose which interface type of connection will be made (e.g. a vendor may choose wireless over USB if applicable).

9.4.29.5 Return values

Table 38 — PDUModuleConnect return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.
PDU_ERR_MODULE_FW_OUT_OF_DATE	The D-PDU API library has a newer version than the MVCI protocol module firmware. The MVCI protocol module firmware should be updated to work with the D-PDU API Library.
PDU_ERR_API_SW_OUT_OF_DATE	The MVCI protocol module firmware has a newer version than the D-PDU API Library. The D-PDU API Library should be updated to work with the MVCI protocol module firmware.
PDU_ERR_FCT_FAILED	Command failed.

9.4.30 PDUModuleDisconnect

9.4.30.1 Purpose

Closes all open communication links and frees communication resources to the specified module. Internal memory segments shall be freed and system-level drivers disconnected. Execution of PDUModuleDisconnect does not initiate any communication on the vehicle interfaces. For a given module, after the execution of PDUModuleDisconnect, PDUModuleConnect may be called again.

9.4.30.2 Behaviour

a) Close any open communication links to the specified VCI module(s).

b) Deinitialize the specified MVCI protocol module(s).

c) Free all internal memory associated with the MVCI protocol module(s).

d) If communications have not been lost to the module, set the Module Status to PDU_MODST_AVAIL. (No event callback is generated since further event items are not allowed for the module.) The module handle (hMod) is still valid for further PDUModuleConnect calls.

e) If communications to the module have been lost, then the hMod handle is no longer valid.

NOTE It is advisable that a client application calls PDUModuleDisconnect when communications have been lost to the MVCI protocol module after all items have been retrieved from the module event queue. (See PDU_ERR_EVT_LOST_COMM_TO_VCI.)

9.4.30.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUModuleDisconnect(**UNUM32** hMod)

9.4.30.4 Parameters

hMod	Handle of the MVCI protocol module to be disconnected. If set to PDU_HANDLE_UNDEF then the D-PDU API will disconnect from all previously connected MVCI protocol modules.

9.4.30.5 Return values

Table 39 — PDUModuleDisconnect return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_FCT_FAILED	Command failed.

9.4.31 PDUGetTimestamp

9.4.31.1 Purpose

Function obtains the current time (hardware clock) from an MVCI protocol module. This time is usually derived directly from the hardware clock of the MVCI protocol module. This time is also used internally to generate the timestamps returned by PDUGetStatus and has the same unit and resolution.

9.4.31.2 Behaviour

a) Validate all input parameters.

NOTE Pointer parameters cannot be NULL.

b) Get the latest status information for the specified handle (Module) and store the information in the memory allocated by the client application.

9.4.31.3 C/C++ prototype

EXTERNC T_PDU_ERROR PDUGetTimestamp(**UNUM32** hMod, **UNUM32** *pTimestamp)

9.4.31.4 Parameters

hMod	Handle of MVCI protocol module for which the timestamp is to be requested.
pTimestamp	Call-by-reference place for storing timestamp in microseconds.

9.4.31.5 Return values

Table 40 — PDUGetTimestamp return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_FCT_FAILED	Function call failed.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API has not been constructed before.
PDU_ERR_INVALID_PARAMETERS	Invalid (NULL) pTimestamp.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.

9.5 I/O control section

9.5.1 IOCTL API command overview

Table 41 — Overview of PDUIOCTL function — IOCTL commands gives an overview of the standard IOCTL commands for MVCI protocol modules. The following subclauses describe the details for all Ioctl commands listed in the table. In the detailed description, the input and output data, as well as the specific possible return values are specified for each command.

— See 9.4.4 for the complete prototype of the API function.

— See 11.1.4.3 for a description of the PDU_DATA_ITEM structure.

— See Items for IOCTL data transfer (PDUIoctl), for a definition of the Data Item Types used for IOCTLs.

Table 41 — Overview of PDUIOCTL function — IOCTL commands

IOCTL short name (IoCtlCommandId from MDF)	Target	pInputData DataItemType	pOutputData DataItemType	Purpose
IOCTL short name:	**Short name of the specific IOCTL command from the MDF.**			
Target:	**M = command for MVCI protocol modules; L = command for ComLogicalLinks.**			
pInputData:	**Description of input data for the command.**			
pOutputData:	**Description of output data for the command.**			
Purpose:	**Description of the command.**			
PDU_IOCTL_RESET	M	—	—	Reset specific MVCI protocol module.
PDU_IOCTL_CLEAR_TX_QUEUE	L	—	—	Clear transmit queue of specific ComLogicalLink.
PDU_IOCTL_SUSPEND_TX_QUEUE	L	—	—	Suspend transmit queue of specific ComLogicalLink. The queue processing will be halted upon this command. This can be used to fill up a ComLogicalLink's queue with ComPrimitives to achieve a steady processing of ComPrimitives after resuming the queue (e.g. for fast flash programming operation).
PDU_IOCTL_RESUME_TX_QUEUE	L	—	—	Resume transmit queue of specific ComLogicalLink. The queue processing will be started upon this command.
PDU_IOCTL_CLEAR_RX_QUEUE	L	—	—	Clear event queue of specific ComLogicalLink.
PDU_IOCTL_READ_VBATT	M	—	PDU_IT_IO_UNUM32	Read voltage on pin 16 of MVCI protocol module.
PDU_IOCTL_SET_PROG_VOLTAGE	M	PDU_IT_IO_PROG_VOLTAGE	—	Set the programmable voltage on the specified Pin/Resource of the DLC connector. The voltage and pin information are specified in the PDU_DATA_ITEM, which is passed as InputData.
PDU_IOCTL_READ_PROG_VOLTAGE	M	—	PDU_IT_IO_UNUM32	Read the feedback of the programmable voltage.
PDU_IOCTL_GENERIC	M	PDU_IT_IO_BYTEARRAY	—	Allows the application to send a generic message to its drivers. The message in the Data buffer is sent down to the MVCI protocol module, intercepting or interpreting it.
PDU_IOCTL_SET_BUFFER_SIZE	L	PDU_IT_IO_UNUM32	—	Sets the buffer size limit of item Structure for result. See 11.1.4.11.4.
PDU_IOCTL_START_MSG_FILTER	L	PDU_IT_IO_FILTER	—	Starts filtering of incoming messages for the specified ComLogicalLink.
PDU_IOCTL_STOP_MSG_FILTER	L	PDU_IT_IO_UNUM32	—	Stops the specified filter, based on filter number.
PDU_IOCTL_CLEAR_MSG_FILTER	L	—	—	Clears all message filters for the ComLogicalLink.

Table 41 (*continued*)

IOCTL short name (IoCtlCommandId from MDF)	Target	pInputData DataItemType	pOutputData DataItemType	Purpose
IOCTL short name:	**Short name of the specific IOCTL command from the MDF.**			
Target:	**M = command for MVCI protocol modules; L = command for ComLogicalLinks.**			
pInputData:	**Description of input data for the command.**			
pOutputData:	**Description of output data for the command.**			
Purpose:	**Description of the command.**			
PDU_IOCTL_SET_EVENT_QUEUE_PROPERTIES	L	PDU_IT_IO_EVENT_QUEUE_PROPERTY	—	Sets the maximum size of the ComLogicalLink event queue and the queue mode.
PDU_IOCTL_GET_CABLE_ID	M	—	PDU_IT_IO_UNUM32	Get the Cable Id of the Cable currently connected to the MVCI protocol module.
PDU_IOCTL_SEND_BREAK	L	—	—	Sends a UART Break Signal on the ComLogicalLink.
PDU_IOCTL_READ_IGNITION_SENSE_STATE	M	PDU_IT_IO_UNUM32	PDU_IT_IO_UNUM32	Read the ignition sense state from the specified vehicle connector pin.

For manufacturer specific purposes the IOCTL list can be expanded by further commands. These commands are to be listed in the MDF by their short name, following those that are described above.

9.5.2 PDU_IOCTL_RESET

The Ioctl command PDU_IOCTL_RESET is used to reset the MVCI protocol module with the handle, which is passed as a parameter to the PDUIoctl() function. The command is executed synchronously (i.e. returns after completion of the reset procedure).

InputData: NULL

OutputData: NULL

NOTE 1 The reset command will cancel all activities currently being executed by the MVCI protocol module (without proper termination). All existing ComLogicalLinks will be suspended, and receive and transmit queues will be cleared. Therefore, all associated ComPrimitives and received data items will be destroyed. All existing ComLogicalLinks will be destroyed too. All hardware properties of the MVCI protocol module (e.g. programming voltage) will be reset to the default settings. After the completion of the reset command, the application will need to use the MVCI protocol module as if it were a new MVCI protocol module.

NOTE 2 The resource table (set up after the start up of the module) won't change because of a PDU_IOCTL_RESET. Therefore, it is not necessary to call function PDUConstruct again after the reset.

NOTE 3 The timestamp base is reset to zero.

Table 42 — PDU_IOCTL_RESET return values specifies specific return values.

Table 42 — PDU_IOCTL_RESET return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Reset command failed.

9.5.3 PDU_IOCTL_CLEAR_TX_QUEUE

The Ioctl command PDU_IOCTL_CLEAR_TX_QUEUE is used to clear the transmit queue of the ComLogicalLink with the handle, which is passed as parameter to the PDUIoctl() function. All ComPrimitive items are destroyed in the D-PDU API internally. Further function calls of the application, which refer to destroyed ComPrimitive items, will report an error.

InputData: NULL

OutputData: NULL

NOTE To avoid overlapped operation of queue processing and queue clearing it is recommended to execute the command PDU_IOCTL_SUSPEND_TX_QUEUE before executing PDU_IOCTL_CLEAR_TX_QUEUE.

Table 43 — PDU_IOCTL_CLEAR_TX_QUEUE return values specifies specific return values.

Table 43 — PDU_IOCTL_CLEAR_TX_QUEUE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.

9.5.4 PDU_IOCTL_SUSPEND_TX_QUEUE

The Ioctl command PDU_IOCTL_SUSPEND_TX_QUEUE is used to suspend transmit queue's processing for the ComLogicalLink with the handle being passed as parameter to the PDUIoctl() function.

InputData: NULL

OutputData: NULL

NOTE This command can be used to fill up a ComLogicalLink's queue with ComPrimitives before executing a PDU_IOCTL_RESUME_TX_QUEUE command. Thus, a steady processing of ComPrimitives can be achieved (e.g. for fast flash programming operation).

Table 44 — PDU_IOCTL_SUSPEND_TX_QUEUE return values specifies specific return values.

Table 44 — PDU_IOCTL_SUSPEND_TX_QUEUE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.

9.5.5 PDU_IOCTL_RESUME_TX_QUEUE

The Ioctl command PDU_IOCTL_RESUME_TX_QUEUE is used to resume the transmit queue's processing for the ComLogicalLink with the handle being passed as parameter to the PDUIoctl() function.

InputData: NULL

OutputData: NULL

Table 45 — PDU_IOCTL_RESUME_TX_QUEUE return values specifies specific return values.

Table 45 — PDU_IOCTL_RESUME_TX_QUEUE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.

9.5.6 PDU_IOCTL_CLEAR_RX_QUEUE

The Ioctl command, PDU_IOCTL_CLEAR_RX_QUEUE, is used to clear the event queue for the appropriate ComLogicalLink (a handle is passed as an input parameter to the PDUIoctl() function). All event items (i.e. result data, information about errors or status changes) in the event queue of the ComLogicalLink will be cleared and automatically destroyed (i.e. the D-PDU API internally performs a PDUDestroyItem call for each item in the event queue).

InputData: NULL

OutputData: NULL

Table 46 — PDU_IOCTL_CLEAR_RX_QUEUE return values specifies specific return values.

Table 46 — PDU_IOCTL_CLEAR_RX_QUEUE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.

9.5.7 PDU_IOCTL_READ_VBATT

The Ioctl command PDU_IOCTL_READ_VBATT is used to read the voltage on pin 16 of the MVCI protocol module's connector. The MVCI protocol module handle is passed as a parameter to the PDUIoctl() function. The voltage will be written to the UNUM32 value (4 data bytes) of the PDU_DATA_ITEM structure being passed as OutputData by reference. For a description of PDU_DATA_ITEM, see 11.1.4.3.

InputData: NULL

OutputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_UNUM32

pData UNUM32 Vbat_mv; /* vehicle battery in mV */

Table 47 — PDU_IOCTL_READ_VBATT return values specifies specific return values.

Table 47 — PDU_IOCTL_READ_VBATT return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	Command failed.

9.5.8 PDU_IOCTL_SET_PROG_VOLTAGE

The Ioctl command PDU_IOCTL_SET_PROG_VOLTAGE is used to set the programmable voltage on the specified Pin of the DLC connector. The MVCI protocol module handle is passed as parameter to the PDUIoctl() function. The voltage and pin information are specified in the PDU_DATA_ITEM, which is passed as InputData. For a description of PDU_DATA_ITEM, see 11.1.4.3. Valid values are: 5 000 mV to 20 000 mV (limited to 100 mA with a resolution of ±100 mV). See also Table 48 — PDU IOCTL programming voltage description.

InputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_PROG_VOLTAGE

pData pointer PDU_IO_PROG_VOLTAGE_DATA structure (see 11.1.4.3.2)

OutputData: NULL

Table 48 — PDU IOCTL programming voltage description

Coded value of voltage	Meaning
0x00001388 – 0x00004E20	5 000 mV – 20 000 mV
0xFFFFFFFE	SHORT_TO_GROUND (zero impedance)
0xFFFFFFFF	VOLTAGE_OFF (high impedance)

Table 49 — PDU_IOCTL_SET_PROG_VOLTAGE return values specifies specific return values.

Table 49 — PDU_IOCTL_SET_PROG_VOLTAGE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_RESOURCE_BUSY	Resource is busy; the application has to execute the command again.
PDU_ERR_FCT_FAILED	Command failed.
PDU_ERR_VOLTAGE_NOT_SUPPORTED	The voltage is not supported by the MVCI protocol module.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_MUX_RSC_NOT_SUPPORTED	The specified pin/Resource are not supported by the MVCI protocol module.

9.5.9 PDU_IOCTL_READ_PROG_VOLTAGE

The Ioctl command PDU_IOCTL_READ_PROG_VOLTAGE is used to read the feedback of the programmable voltage from the voltage source, which is set by the command PDU_IOCTL_SET_PROG_VOLTAGE. The MVCI protocol module handle is passed as parameter to the PDUIoctl() function. The voltage will be written to the UNUM32 value (4 data bytes) of the PDU_DATA_ITEM structure being passed as OutputData by reference. For a description of PDU_DATA_ITEM, see 11.1.4.3. See also Table 48 — PDU IOCTL programming voltage description.

InputData:

OutputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_UNUM32

pData UNUM32 ProgVoltage_mv; /* programming voltage in mV */

Table 50 — PDU_IOCTL_READ_PROG_VOLTAGE return values specifies specific return values.

Table 50 — PDU_IOCTL_READ_PROG_VOLTAGE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid MVCI protocol module or ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	Command failed.

9.5.10 PDU_IOCTL_GENERIC

This command was added due to compatibility reasons for RP1210a. It allows the application to send a generic message to its drivers. The D-PDU API simply passes the message in the Data buffer down to MVCI protocol module, if any, associated with the device hardware without intercepting or interpreting it. The generic command will be written to the element “Data” of the PDU_DATA_ITEM structure as a free form buffer of bytes. The PDU_DATA_ITEM structure is passed as InputData by reference. For a description of PDU_DATA_ITEM, see 11.1.4.3.

InputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_BYTEARRAY

pData pointer PDU_IO_BYTEARRAY_DATA structure (see 11.1.4.3.3)

OutputData: NULL

Table 51 — PDU_IOCTL_GENERIC return values specifies specific return values.

Table 51 — PDU_IOCTL_GENERIC return values

Definition	Description
PDU_ERR_FCT_FAILED	Command failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.

9.5.11 PDU_IOCTL_SET_BUFFER_SIZE

This IOCtl command sets the maximum buffer size of the received PDU on a ComLogicalLink. (See PDU_RESULT_DATA: 11.1.4.11.4 Structure for result data) The buffer size is contained in the UNUM32 value (4 data bytes) of the PDU_DATA_ITEM structure being passed as InputData by reference. For a description of PDU_DATA_ITEM, see 11.1.4.3.

InputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_ IO_UNUM32

pData UNUM32 MaxRxBufferSize; /* maximum size of a received PDU for the ComLogicalLink */

OutputData: NULL

Table 52 — PDU_IOCTL_SET_BUFFER_SIZE return values specifies specific return values.

Table 52 — PDU_IOCTL_SET_BUFFER_SIZE return values

Definition	Description
PDU_ERR_FCT_FAILED	Command failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.

9.5.12 PDU_IOCTL_GET_CABLE_ID

To let the application know which cable is currently connected to an MVCI protocol module, the following PDU_IOCTL command can be used:

InputData: NULL

OutputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_ IO_UNUM32

pData UNUM32 CableId; /* Cable Id from CDF */

With the cable ID, the application can retrieve information about the cable from the CDF, like short name, description and DLCType (connector type).

Table 53 — PDU_IOCTL_GET_CABLE_ID return values specifies specific return values.

Table 53 — PDU_IOCTL_GET_CABLE_ID return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_CABLE_UNKNOWN	Cable is unknown.
PDU_ERR_NO_CABLE_DETECTED	No cable is detected.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	The MVCI protocol module doesn't support cable detection.

9.5.13 PDU_IOCTL_START_MSG_FILTER

This Ioctl command starts filtering incoming messages for the specified ComLogicalLink. A minimum of 64 filters can be supported per ComLogicalLink. A PDUDestroyComLogicalLink shall delete all its defined message filters. Filtering will only become active when the ComLogicalLink is in the PDU_CLLST_ONLINE state (see PDUConnect). If the application does not configure any filters, the D-PDU API will automatically determine a set of filters by using the PDU_PC_UNIQUE_ID ComParams configured for the ComLogicalLink. (See PDUSetUniqueRespIdTable.) Any filters set by the application using the IOCTL filter commands will override any filters internally configured by the D-PDU API.

All Protocols:

— Pass filters and block filters will be applied to all received messages. They shall not be applied to indications or loopback messages.

— Messages that match a pass filter can still be blocked by a block filter (see Figure 27 — MSG_FILTER block diagram).

For the ISO 15765 protocol:

— Pass filters and block filters are applied to CAN ID filtering. They shall not be applied to indications or loopbacks of CAN IDs.

NOTE The UniqueRespIdTable (see 11.1.4.10) is used for USDT/UUDT frame handling plus flow control and extended address handling.

InputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_FILTER

pData pointer PDU_IO_FILTER_LIST structure (see 11.1.4.3.4)

OutputData: NULL

Table 54 — PDU_IOCTL_START_MSG_FILTER return values specifies specific return values.

Table 54 — PDU_IOCTL_START_MSG_FILTER return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	Command failed.

9.5.13.1 MSG_FILTER block diagram

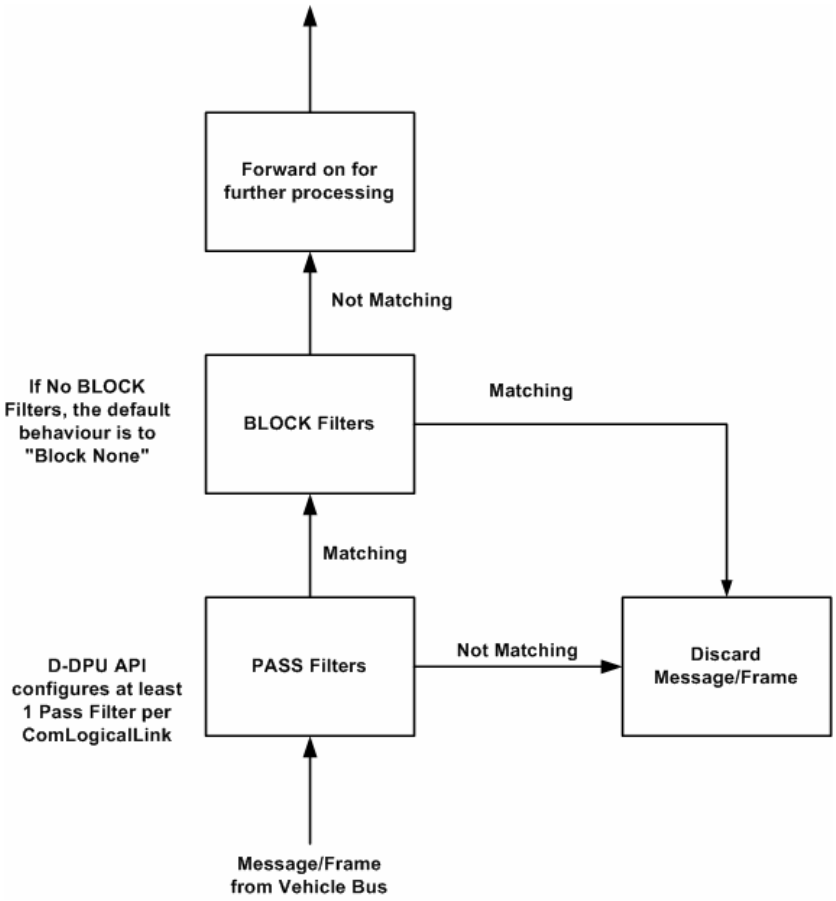


Figure 27 — MSG_FILTER block diagram

9.5.14 PDU_IOCTL_STOP_MSG_FILTER

The Ioctl command PDU_IOCTL_STOP_MSG_FILTER removes the specified filter from the ComLogicalLink.

InputData: Value settings for PDU_DATA_ITEM

ItemType	PDU_IT_IO_UNUM32		
pData	UNUM32	FilterNumber;	/* Filter Number to stop */

OutputData: NULL

Table 55 — PDU_IOCTL_STOP_MSG_FILTER return values specifies specific return values.

Table 55 — PDU_IOCTL_STOP_MSG_FILTER return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData) or the Filter Number is invalid.
PDU_ERR_FCT_FAILED	Command failed.

9.5.15 PDU_IOCTL_CLEAR_MSG_FILTER

The Ioctl command PDU_IOCTL_CLEAR_MSG_FILTER removes all message filters from the ComLogicalLink.

InputData: NULL

OutputData: NULL

Table 56 — PDU_IOCTL_CLEAR_MSG_FILTER return values specifies specific return values.

Table 56 — PDU_IOCTL_CLEAR_MSG_FILTER return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.

9.5.16 PDU_IOCTL_SET_EVENT_QUEUE_PROPERTIES

The Ioctl command PDU_IOCTL_SET_EVENT_QUEUE_PROPERTIES sets the properties of the ComLogicalLink event queue. There are two properties associated with an event queue: the event queue size, and the queuing mechanism to be used. The PDU_IOCTL_SET_EVENT_QUEUE_PROPERTIES can only be used prior to calling the PDUConnect function. If the ComLogicalLink is already connected, the function will return the PDU_ERR_CLL_CONNECTED error.

The queue mode sets the behaviour of the queuing mechanism in case the ComLogicalLink reaches the maximum size of the event queue.

Table 57 — Queue modes defines three types of queue modes.

Table 57 — Queue modes

Queue Mode Type	Description
Unlimited Mode	An attempt is made to allocate memory for every item being placed on the event queue. In Unlimited Mode, the QueueSize is ignored. (Default Mode for ComLogicalLink)
Limited Mode	When the ComLogicalLink's event queue is full (i.e. maximum size has been reached), no new items are placed on the event queue. The event items are discarded in this case.
Circular Mode	When the ComLogicalLink's event queue is full (i.e. maximum size has been reached), then the oldest event item in the queue is deleted so that the new event item can then be placed in the event queue.

When a ComLogicalLink reaches a queue full state, the special PDU_EVT_DATA_LOST event is generated. No result items will be created (i.e. no PDU_IT_ERROR items will be attempted to be placed on the event queue). See Event callback data values for event types.

InputData: Value settings for PDU_DATA_ITEM

ItemType PDU_IT_IO_EVENT_QUEUE_PROPERTY

pData pointer PDU_IO_EVENT_QUEUE_PROPERTY_DATA structure (see 11.1.4.3.6)

OutputData: NULL

Table 58 — PDU__IOCTL_SET_EVENT_QUEUE_PROPERTIES return values specifies specific return values.

Table 58 — PDU__IOCTL_SET_EVENT_QUEUE_PROPERTIES return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_CLL_CONNECTED	CLL is already in the “online” state.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	Command failed.

9.5.17 PDU_IOCTL_SEND_BREAK

The Ioctl command PDU_IOCTL_SEND_BREAK is used to send a break signal on the ComLogicalLink. A break signal can only be sent on certain physical layers (e.g. SAE J1850 VPW physical links and UART physical links). If the link does not support the break feature a PDU_ERR_FCT_FAILED will be returned.

UART Break signals are caused by sending continuous (0) values (no Start or Stop bits). The Break signal shall be of a duration longer than the time it takes to send a complete byte plus Start, Stop and Parity bits. Most UARTs can distinguish between a Framing Error and a Break, but if the UART cannot do this, the Framing Error detection can be used to identify Breaks.

SAE J1850 Break signals are determined by observing the timing of the active to passive transition. If the transition does not occur until after 240 µs, the current signal will be considered a valid Break signal. A Break signal should be followed by a SOF signal beginning with the next message to be transmitted onto the

SAE J1850 bus. All nodes on a SAE J1850 bus shall return to normal operating conditions after detecting a Break signal. Many SAE J1850 hardware components support the Break signal feature (transmit and receive). There is no specification on the maximum length of a SAE J1850 break signal, but it shall not be excessively long. Therefore, the maximum length shall be greater than the minimum length of 240 µs.

The ComLogicalLink's handle is passed as a parameter to the PDUIoctl() function.

InputData: NULL

OutputData: NULL

Table 59 — PDU_IOCTL_SEND_BREAK return values specifies specific return values.

Table 59 — PDU_IOCTL_SEND_BREAK return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_INVALID_HANDLE	Invalid ComLogicalLink handle.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_FCT_FAILED	Command failed.
PDU_ERR_CLL_NOT_STARTED	Communications are not started on the ComLogicalLink yet. A Send ComPrimitive cannot be accepted in this state.
PDU_ERR_MODULE_NOT_CONNECTED	MVCI protocol module has not been connected. See PDUModuleConnect function.
PDU_ERR_CLL_NOT_CONNECTED	ComLogicalLink is not connected.
PDU_ERR_RSC_LOCKED_BY_OTHER_CLL	The ComLogicalLink's resource is currently locked by another ComLogicalLink.

9.5.18 PDU_IOCTL_READ_IGNITION_SENSE_STATE

The Ioctl command PDU_IOCTL_READ_IGNITION_SENSE_STATE is used to read the Switched Vehicle Battery Voltage (Ignition on/off) pin. In accordance with ISO 22900-1, this information is available on pin 24 of the MVCI module chassis connector. There is no corresponding pin on the legislated ISO 15031-3/SAE J1962 compatible vehicle connectors.

This IOCTL allows for reading of a specified vehicle connector pin to determine the state of the ignition switch. Since a MVCI protocol module vendor may support a cable type which routes the ignition sense to pin 24 of the module, a DLC pin number of 0 will indicate that the Switched Vehicle Battery Voltage is to be read from the MVCI protocol module pin 24 and not from a DLC pin.

The D-PDU API will determine the sense of the ignition by first reading the permanent positive battery voltage from the vehicle (UBATvehicle (pin 16 on the DLC)) and then reading the specified switched vehicle battery voltage pin. Ignition ON will be +/- 2 volts of the permanent vehicle battery voltage.

InputData: Value settings for PDU_DATA_ITEM

ItemType	PDU_IT_IO_UNUM32		
pData	UNUM32	DLCPinNumber;	/* Pin number of the vehicles data link connector which contains the vehicle switched battery voltage. If DLCPinNumber = 0, then the ignition sense is routed to pin 24 of the MVCI protocol module*/

OutputData: Value settings for PDU_DATA_ITEM

ItemType	PDU_IT_IO_UNUM32		
pData	UNUM32	IgnitionState;	/* Evaluated state of switched vehicle battery voltage. 0 = Ignition OFF 1 = Ignition ON*/

Table 60 — PDU_IOCTL_READ_IGNITION_SENSE_STATE return values specifies specific return values.

Table 60 — PDU_IOCTL_READ_IGNITION_SENSE_STATE return values

Definition	Description
PDU_STATUS_NOERROR	Function call successful.
PDU_ERR_PDUAPI_NOT_CONSTRUCTED	D-PDU API construct has not been called before.
PDU_ERR_COMM_PC_TO_VCI_FAILED	Communication between host and MVCI protocol module failed.
PDU_ERR_INVALID_PARAMETERS	At least one of the parameters is invalid (pInputData and/or pOutputData).
PDU_ERR_FCT_FAILED	Command failed.
PDU_ERR_PIN_NOT_CONNECTED	The requested Pin is not routed by supported cable.

9.6 API functions — error handling

9.6.1 Synchronous error handling

Errors which occur during the execution of a function (i.e. synchronously), will be reported by the function's return value. The specific return values are documented for each API function in 9.4.

In Clause D.3, reserved return values of the API functions are documented. These reserved values are supposed to provide a standard mechanism for handling errors between different D-PDU API implementations.

9.6.2 Asynchronous error handling

Asynchronous Errors are reported by event items (i.e. items PDU_EVENT_ITEM with type PDU_IT_ERROR). They are queued by the D-PDU API using the regular internal queuing mechanisms. The application will get error items using the same functions as for result items (i.e. PDUGetEventItem). Asynchronous errors can be related to a MVCI protocol module (e.g. hardware errors), to a ComLogicalLink (e.g. CAN bus error) or to a specific ComPrimitive (e.g. ECU timeout). This relationship will be expressed by the specific handle, which is used in the function PDUGetEventItem to get the error item. The error item contains a D-PDU API defined error code (see Clause D.4), which identifies the error that occurred along with a vendor-specific extra error code. A text translation of the vendor-specific extra error codes is available in the MDF XML file.

In Clause D.4, reserved error codes for error items are documented. These reserved codes provide a standard mechanism for handling most asynchronous error events between different D-PDU API implementations.

9.7 Installation

9.7.1 Generic description

The D-PDU API root description file (RDF) is the central entry point for all applications accessing MVCI protocol modules in either Windows or Linux. See Clause F.1 D-PDU API root description file for the UML description of the root description file.

During installation, an MVCI protocol module Tool Integrator (see 9.3.2) adds the vendor-specific information to the root description file. If the root file has not been previously created, then the installation process shall create the root description file (and the registry information for Windows) in the specified location (see subclauses below).

The MVCI protocol module vendor shall ensure that the information to be added to the root description file does not conflict with another entry. The Tool Integrator will have to ensure uniqueness. The <MVCI_PDU_API> element contains the following sub-elements to help ensure unique entries:

— SHORT_NAME

— DESCRIPTION

— SUPPLIER_NAME

The following subclauses describe the location of the root description file and the loading process of the associated libraries.

9.7.2 Windows installation process

9.7.2.1 Locating the Windows D-PDU API DLL

The application will be able to locate all of the D-PDU API implementations installed on the machine by accessing the D-PDU API root file. The location of the root file is to be identified as follows:

a) The application shall navigate to the registry key HKEY_LOCAL_MACHINE\SOFTWARE \D-PDU API.

b) Under this key, the value-name “Root File” (String) contains the full path to the root file.

EXAMPLE [HKEY_LOCAL_MACHINE\SOFTWARE\D-PDU API]

“Root File”=“C:\Program Files\D-PDU API\pdu_api_root.xml”

NOTE The complete file path to the D-PDU API Root File is stored at the defined location in the registry.

c) Only one Key (D-PDU API) and one Value (Root File) shall be created. The pdu_api_root.xml file contains all the installed MVCI protocol modules' DLL information from each vendor. The uninstall program shall remove its information from the pdu_api_root.xml file, but shall not affect the other entries.

9.7.2.2 Loading the Windows D-PDU API DLL

To load the D-PDU API DLL, the application will use native Win32 API functions such as:

— LoadLibrary

— GetProcAddress: When using GetProcAddress, the application shall supply the name of the function whose address is being requested. To support this method with un-mangled names (when using certain compilers), the MVCI protocol module vendor shall compile the DLL with an export library definition file.

— FreeLibrary

NOTE 1 See the Win32 API SDK reference for the details of these functions.

NOTE 2 All D-PDU API functions exported from the DLL will have the __stdcall calling convention.

9.7.3 Linux installation process

9.7.3.1 Locating the Linux D-PDU API shared library

The application may locate all the D-PDU API implementations installed on the machine by accessing the D-PDU API root file. The location of the root file is to be identified as follows:

a) The root file is stored as the file “pdu_api_root.xml” in the directory “/etc”.

b) The pdu_api_root.xml file contains all the installed MVCI protocol modules' Shared Library information from each vendor. The uninstall program shall remove its information from the pdu_api_root.xml file, but shall not affect the other entries.

9.7.3.2 Loading the Linux D-PDU API shared library

To load the D-PDU API shared library, the application will use functions like:

— dlopen,

— dlsym: When using the function dlsym, the application shall supply the name of the function whose address is being requested,

— dlclose.

NOTE See the Linux documentation for the details of these functions.

9.7.4 Selecting MVCI protocol modules

The client application should use the pdu_api_root.xml file to determine the list of available D-PDU API implementations. Once the application has selected one or more implementations, the pdu_api_root.xml file is used to retrieve all the information regarding the implementation so that the appropriate DLLs or Shared Libraries can be loaded for use.

9.8 Application notes

9.8.1 Interaction with the MDF

Both the D-PDU API and the application may read the MDF file to retrieve information.

9.8.2 Accessing additional hardware features for MVCI protocol modules

Additional hardware features (e.g. analogue channels, digital I/O, etc.), which are not covered directly by the standard D-PDU API functions can be also implemented using standard D-PDU API function calls. The following points shall serve as a guideline for manufacturer specific implementations of additional hardware features. However, the manufacturer is free to choose between several implementation approaches, which are outlined in the following sentences:

— The manufacturer defines a specific “HARDWARE” protocol in the MDF. This is defined the same way as for diagnostic protocols like ISO 15765.

— The “HARDWARE” protocol has a set of ComParams. These are also described in the MDF.

— To use the additional hardware features a ComLogicalLink with the specific “HARDWARE” protocol is created by the application. Thereafter, the hardware features can be accessed either by getting and setting ComParams, or by starting ComPrimitives.

— To control simple hardware features (like setting/reading digital I/O) the ComParam method (PDUSetComParam) might be sufficient. In this case, the ComParam value will carry the specific information (e.g. value of digital I/O port).

— To control advanced hardware features, the method using ComPrimitives might be a good approach. In this case, all standard features of ComPrimitives like periodic send or receive operation can be used (e.g. periodic reading analogue values). Also, more information can be exchanged between the MVCI protocol module and the application using the ComPrimitive data and its result data items.

9.8.3 Documentation and information provided by MVCI protocol module vendors

Each MVCI protocol module vendor will provide a different name implementation of the files supplied with the installation: module description file(s), D-PDU API library, and cable description file(s). Since a number of D-PDU API implementations could simultaneously reside on the same PC, a MVCI protocol module vendor shall not name any of its files “PDU_API.dll” nor “PDU_API.so”. The following rules shall be followed for naming each of the files delivered:

— MDF_<VendorName>[<XXX>].xml

— CDF_<VendorName>[<XXX>].xml

— PDUAPI_<VendorName>[<XXX>].dll

— PDUAPI_<VendorName>[<XXX>].so

where

<VendorName> is the name of the vendor;

<XXX> is an optional string (vendor specific).

EXAMPLE

— MDF_DoctorWho_V_1_0_1.xml

— CDF_Automan_1_0.xml

— PDUAPI_Bob_Ver_2_1_0.dll

The protocol documentation listed below will be provided.

a) A tool manufacturer shall document the protocol behaviour and the ComParams for each protocol supported by the tool manufacturer.

b) The documentation shall describe the behaviour of the protocol with regard to the specified ComPrimitive types and status values.

c) All protocol ComParams shall be documented.

d) The tool manufacturer shall provide the protocol-specific entries in the MDF.

The vendor will also supply the OptionStr for PDUConstruct. The string provides a list of attributes and their values, which are specific to a D-PDU API implementation (see 9.4.2.4 for more information).

9.8.4 Performance Testing

The mechanism for retrieving performance test results and the measurement process shall be MVCI protocol module vendor specific. See ComParam (CP_EnablePerformanceTest).

10 Using the D-PDU API with existing applications

10.1 SAE J2534-1 and RP1210a existing standards

The standards SAE J2534-1 and RP1210a were defined prior to the D-PDU API, and applications have already been introduced to the after-sales market. In order to preserve the applications based on SAE J2534-1 and RP1210a an MVCI-compliant device (i.e. MVCI protocol module) shall be convertible to SAE J2534-1 or RP1210a with a compatibility layer or wrapper. This library configuration shall enable SAE J2534-1 and RP1210a applications to run on a MVCI compliant device.

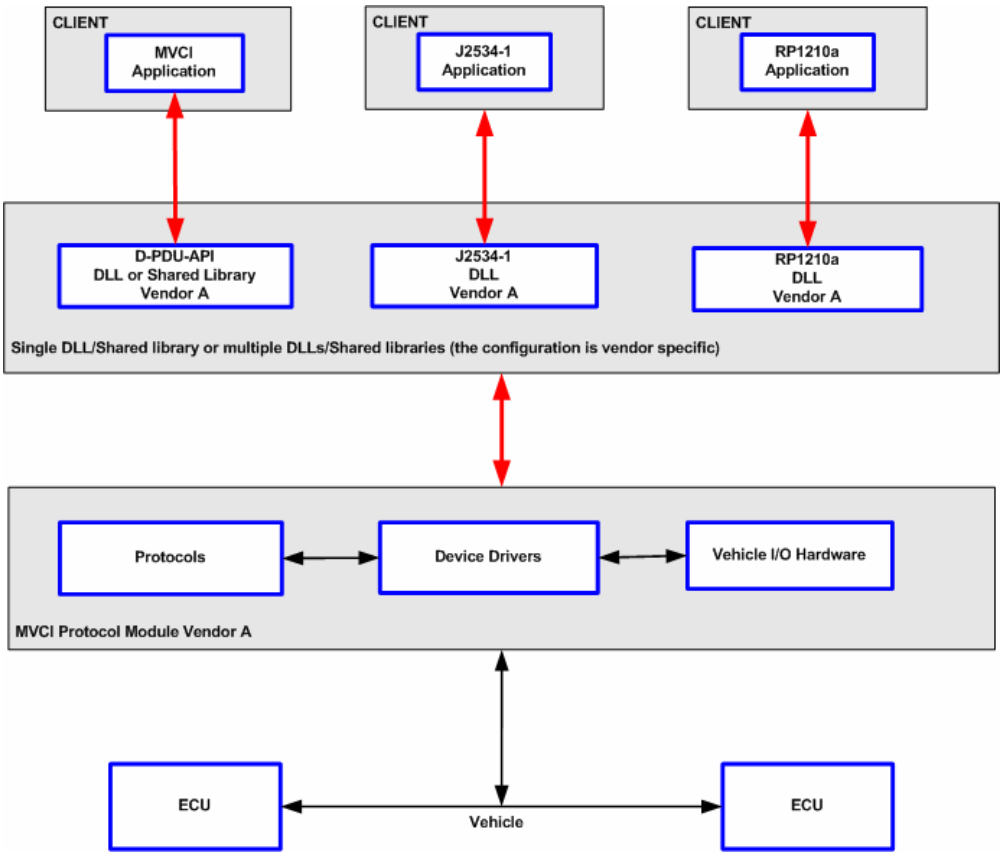


Figure 28 — Adapting MVCI device to SAE J2534-1 and RP1210a API

11 Data structures

11.1 API functions — data structure definitions

11.1.1 Abstract basic data types

For all input/output parameters, the following subset of abstract basic data types shall be used.

Table 61 — Abstract data types

Data type	Description
UNUM8	Unsigned numeric 8 bits.
SNUM8	Signed numeric 8 bits.
UNUM16	Unsigned numeric 16 bits.
SNUM16	Signed numeric 16 bits.
UNUM32	Unsigned numeric 32 bits.
SNUM32	Signed numeric 32 bits.

In addition to these data types, the following abstract data types shall be used for string handling.

Table 62 — Abstract data types - string handling

Data type	Description
CHAR8	ASCII-coded 8-bit character value (ISO 8859-1 (Latin 1)).

All strings shall be handled as zero-terminated character field of the appropriate character data type. Length information is calculated without the zero termination character value.

11.1.2 Definitions

The following definitions are used for D-PDU API functions:

Table 63 — Definitions for D-PDU API functions

Definition	Description
EXTERNC	Extern “C” declaration, required for C++ code.
CALLBACKFNC	Callback function type.

These definitions shall be defined according to the requirements of the specific C/C++ compiler.

NOTE In a Windows D-PDU API DLL, all D-PDU API functions will have the _stdcall calling convention in accordance with 9.7.2.

11.1.3 Bit encoding for UNUM32

Table 64 — Definition of byte and bit position for UNUM32 describes how to set or read a parameter field which contains a bit encoded field. This table has been added to help with Endian problems between different hardware platforms.

Table 64 — Definition of byte and bit position for UNUM32

BYTE 3 (MSB)								BYTE 2								BYTE 1								BYTE 0 (LSB)							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

11.1.4 API data structures

11.1.4.1 General information

The following data structures are required for data transfer of D-PDU API functions. Byte packing of one byte is adopted from SAE J2534-1. This has to be defined according to the requirements of the specific C/C++ compiler.

11.1.4.2 Generic Item for type evaluation and casting

This is a generic item used for casting to item specific structures. PDU_ITEM is used in the function PDUDestroyItem.

```
typedef struct {

    T_PDU_IT    ItemType; /* Clause D.1.1 D-PDU API item type values */

} PDU_ITEM;
```

Table 65 — Item types structures for typecasting lists the different type of Item types and their respective structures.

Table 65 — Item types structures for typecasting

Item types	Item type specific structure
PDU_IT_IO_UNUM32	PDU_DATA_ITEM, void *pData contains a single UNUM32 value.
PDU_IT_IO_PROG_VOLTAGE	PDU_DATA_ITEM, void *pData contains a pointer to the PDU_IO_PROG_VOLTAGE_DATA structure.
PDU_IT_IO_BYTEARRAY	PDU_DATA_ITEM, void *pData contains a pointer to the PDU_IO_BYTEARRAY_DATA structure.
PDU_IT_IO_FILTER	PDU_DATA_ITEM, void *pData contains a pointer to the PDU_IO_FILTER_LIST structure.
PDU_IT_IO_EVENT_QUEUE_PROPERTY	PDU_DATA_ITEM, void *pData contains a pointer to the PDU_IO_EVENT_QUEUE_PROPERTY_DATA structure.
PDU_IT_RSC_STATUS	PDU_RSC_STATUS_ITEM
PDU_IT_PARAM	PDU_PARAM_ITEM
PDU_IT_RESULT	PDU_RESULT_DATA
PDU_IT_STATUS	PDU_STATUS_DATA
PDU_IT_INFO	PDU_INFO_DATA
PDU_IT_ERROR	PDU_ERROR_DATA
PDU_IT_RSC_ID	PDU_RSC_ID_ITEM
PDU_IT_RSC_CONFLICT	PDU_RSC_CONFLICT_ITEM
PDU_IT_MODULE_ID	PDU_MODULE_ITEM
PDU_IT_UNIQUE_RESP_ID_TABLE	PDU_UNIQUE_RESP_ID_TABLE_ITEM

11.1.4.3 Items for IOCTL data transfer (PDUIoctl)

11.1.4.3.1 Item for Generic IOCTL data item

This is a generic IOTCL data item used for casting to specific IOCTL type structures. PDU_DATA_ITEM is used in the function PDUIoctl.

```
typedef struct {
    T_PDU_IT ItemType;          /* value= one of the IOCTL constants from D.1.1 */
    void *pData;                /* pointer to the specific IOCTL data structure */
} PDU_DATA_ITEM;
```

11.1.4.3.2 IOCTL programming voltage structure (PDU_IT_IO_PROG_VOLTAGE)

```
typedef struct {
    UNUM32 ProgVoltage_mv;      /* programming voltage in mV */
    UNUM32 PinOnDLC;            /* pin number on Data Link Connector */
} PDU_IO_PROG_VOLTAGE_DATA;
```

11.1.4.3.3 IOCTL byte array structure (PDU_IT_IO_BYTEARRAY)

```
typedef struct {
    UNUM32   DataSize;          /* number of bytes in the data array */
    UNUM8    *pData;            /* pointer to the data array */
} PDU_IO_BYTEARRAY_DATA;
```

11.1.4.3.4 IOCTL filter list structure (PDU_IT_IO_FILTER)

```
typedef struct {
    UNUM32 NumFilterEntries;        /* number of Filter entries in the filter list array */
    PDU_IO_FILTER_DATA *pFilterData;/* pointer to an array of filter data */
} PDU_IO_FILTER_LIST;
```

11.1.4.3.5 IOCTL filter data structure

```
typedef struct {
    T_PDU_FILTER    FilterType;         /* type of filter being configured. D.1.10 IOCTL filter types values*/
    UNUM32          FilterNumber;       /* Filter Number. Used to replace filters and stop filters. Range
                                           depends on implementation (see 9.5.13
                                           PDU_IOCTL_START_MSG_FILTER)*/
    UNUM32          FilterCompareSize;  /* Number of bytes used out of each of the filter messages arrays
                                           Range 1-12. */
    UNUM8           FilterMaskMessage[12]; /* (Mask message to be ANDed to each incoming message.)
                                           When using the CAN protocol, setting the first 4 bytes of
                                           FilterMaskMessage to 0xFF makes the filter specific to one CAN
                                           ID. Using other values allows for the reception or blocking of
                                           multiple CAN identifiers.*/
```

```
    UNUM8           FilterPatternMessage[12]; /* (Pattern message to be compared to the incoming message
                                                 after the FilterMaskMessage has been applied). If the result
                                                 matches this pattern message and the FilterType is a pass filter,
                                                 then the incoming message will be processed for further reception
                                                 (otherwise it will be discarded). If the result matches this pattern
                                                 message and the FilterType is a block filter, then the incoming
                                                 message will be discarded (otherwise it will be processed for
                                                 further reception). Message bytes in the received message that
                                                 are beyond the FilterCompareSize of the pattern message will
                                                 be treated as “don't care”.*/
} PDU_IO_FILTER_DATA;
```

11.1.4.3.6 IOCTL event queue property structure (PDU_IT_IO_EVENT_QUEUE_PROPERTY)

```
typedef struct {
    UNUM32              QueueSize;      /* maximum size of event queue */
    T_PDU_QUEUE_MODE    QueueMode;      /* Queue mode. D.1.11 IOCTL event queue mode type values */
} PDU_IO_EVENT_QUEUE_PROPERTY_DATA;
```

11.1.4.4 Item for resource status information (used by PDUGetResourceStatus)

```
typedef struct {
    T_PDU_IT        ItemType;               /* value= PDU_IT_RSC_STATUS (IN parameter)*/
    UNUM32          NumEntries;             /* (IN Parameter) = number of entries in pResourceStatusData
    array. */
    PDU_RSC_STATUS_DATA   *pResourceStatusData;  /* array to contain resource status (IN Parameter)*/
} PDU_RSC_STATUS_ITEM;

typedef struct {
    UNUM32          hMod;                   /* Handle of a MVCI protocol module (IN parameter) */
    UNUM32          ResourceId              /* Resource ID (IN parameter) */
    UNUM32          ResourceStatus;         /* Resource Information Status (OUT Parameter):
                                               (see D.1.6 for specific values.)*/
} PDU_RSC_STATUS_DATA;
```

11.1.4.5 Item for ComParam data (used by PDUGetComParam, PDUSetComParam)

```
typedef struct {
    T_PDU_IT        ItemType;           /* value= PDU_IT_PARAM */
    UNUM32          ComParamId;         /* ComParam Id. Value from MDF of MVCI protocol module */
    T_PDU_PT        ComParamDataType;   /* Defines the data type of the ComParam B.3.3 ComParam data type */
    T_PDU_PC        ComParamClass;      /*ComParam Class type. The class type is used by the D-PDU API for
                                          special ComParam handling cases. (BusType (physical ComParams)
                                          and Unique ID ComParams)). B.3.2 */
    void            *pComParamData;     /* pointer to ComParam data of type ComParamDataType */
} PDU_PARAM_ITEM;
```

11.1.4.6 Item for module identification (used by PDUGetModuleIds)

```
typedef struct {
    T_PDU_IT            ItemType;       /* value= PDU_IT_MODULE_ID */
    UNUM32              NumEntries;     /* number of entries written to the pModuleData array */
    PDU_MODULE_DATA     *pModuleData;   /* pointer to array containing module types and module handles */
} PDU_MODULE_ITEM;

typedef struct {
    UNUM32          ModuleTypeId;           /* MVCI protocol moduleTypeId */
    UNUM32          hMod;                   /* handle of MVCI protocol module assigned by D-PDU API */
    CHAR8           *pVendorModuleName;     /* Vendor specific information string for the unique module
                                               identification, e.g. Module serial number or user friendly name */
    CHAR8           *pVendorAdditionalInfo; /* Vendor specific additional information string */
    T_PDU_STATUS    ModuleStatus;           /* Status of MVCI protocol module detected by D-PDU API session.
                                               D.1.4 Status code values*/
} PDU_MODULE_DATA;
```

pVendorModuleName and pVendorAdditionalInfo String Description:

The pVendorModuleName and pVendorAdditionalInfo strings contain a list of attributes and their values. An attribute and its corresponding value are to be separated by a >=< sign. The value needs to be put inside two >'< signs. Between pairs of attribute and value shall be at least one space character. Attributes and values are specific to a D-PDU API vendor implementation.

When no string information is available, the pVendorxxx strings will be set to NULL.

EXAMPLE String

pVendorModuleName = “VendorName='MVCI Company' MVCI Friendly Name = 'Hugo' ”

pVendorAdditionalInfo = “Connection Type Wireless='xx.xx.xx.xx' ”

The additional information can contain the IP addresses and connection types available:

a) Ethernet

b) Bluetooth

c) Infrared

d) 802.11g/802.11b

e) 802.3

f) RS232

g) USB

h) PCMCIA

i) PCI Express

j) WAN (GPRS, UMTS, …)

11.1.4.7 Items for resource identification (used by PDUGetResourceIds)

```
typedef struct {
    T_PDU_IT                ItemType;               /* value = PDU_IT_RSC_ID (IN parameter)*/
    UNUM32                  NumModules;             /* number of entries in pResourceIdDataArray. */
    PDU_RSC_ID_ITEM_DATA    *pResourceIdDataArray;  /* pointer to an array of resource Id Item Data */
} PDU_RSC_ID_ITEM;
typedef struct {
    UNUM32                  hMod;                   /* MVCI protocol module Handle */
    UNUM32                  NumIds;                 /* number of resources that match PDU_RSC_DATA */
    UNUM32                  *pResourceIdArray;      /* pointer to a list of resource ids */
} PDU_RSC_ID_ITEM_DATA;
```

11.1.4.8 Structure for resource data (used by PDUGetResourceIds and PDUCreateComLogicalLink)

```
typedef struct {
UNUM32                  BusTypeId;              /* Bus Type Id (IN parameter) */
UNUM32                  ProtocolId;             /* Protocol Id (IN parameter) */
UNUM32                  NumPinData;             /* Number of items in the following array */
PDU_PIN_DATA            *pDLCPinData;           /* Pointer to array of PDU_PIN_DATA structures*/
} PDU_RSC_DATA;
```

PDU_PIN_DATA is defined as:

```
typedef struct {
    UNUM32                  DLCPinNumber;           /* Pin number on DLC */
    UNUM32                  DLCPinTypeId;           /* Pin ID */
} PDU_PIN_DATA;
```

11.1.4.9 Item for conflicting resources (used by PDUGetConflictingResources)

```
typedef struct {
    T_PDU_IT                ItemType;               /* value= PDU_IT_RSC_CONFLICT */
    UNUM32                  NumEntries;             /* number of entries written to pRscConflictData*/
    PDU_RSC_CONFLICT_DATA   *pRscConflictData;      /* pointer to array of PDU_RSC_CONFLICT_DATA*/
} PDU_RSC_CONFLICT_ITEM;

typedef struct {
    UNUM32                  hMod;                   /* Handle of the MVCI protocol module with conflict*/
    UNUM32                  ResourceId;             /* Conflicting Resource ID */
} PDU_RSC_CONFLICT_DATA;
```

11.1.4.10 Item for unique response identification (used by PDUGetUniqueRespIdTable and PDUSetUniqueRespIdTable)

```
typedef struct {
    T_PDU_IT                    ItemType;       /* value= PDU_IT_UNIQUE_RESP_ID_TABLE */
    UNUM32                      NumEntries;     /* number of entries in the table */
    PDU_ECU_UNIQUE_RESP_DATA    *pUniqueData;   /* pointer to array of table entries for each ECU response */
} PDU_UNIQUE_RESP_ID_TABLE_ITEM;

typedef struct {
    UNUM32          UniqueRespIdentifier;   /* filled out by application */
    UNUM32          NumParamItems;          /* number of ComParams for the Unique Identifier */
    PDU_PARAM_ITEM  *pParams;               /* pointer to array of ComParam items to uniquely define a
                                               ECU response. The list is protocol specific */
} PDU_ECU_UNIQUE_RESP_DATA;
```

EXAMPLE Table 66 — Example set of ComParams for an ISO 15765 protocol response address ComParam list and Table 67 — Example set of ComParams for a SAE J2190 (non-CAN) response structure per ECU are examples for URID table configurations.

Table 66 — Example set of ComParams for an ISO 15765 protocol response address ComParam list

ComParam	Description
CP_CanPhysReqFormat	CAN Id format for a physical request. Used for Flow Control Can transmission as well. First entry in the Unique Response Identifer table is the default entry for a physical request.
CP_CanPhysReqId	CAN Id for physical request. Used for flow Control Can transmission as well. First entry in the Unique Response Identifer table is the default entry for a physical request.
CP_CanPhysReqExtAddr	Can extended address for physical request. Used for Flow Control Can transmission as well. First entry in the Unique Response Identifer table is the default entry for a physical request.
CP_CanRespUSDTFormat	CAN Id format for a USDT response. Used for response handling.
CP_CanRespUSDTId	CAN Id for a USDT response. Used for response handling. Value set to 0xFFFFFFFF is not used.
CP_CanRespUSDTExtAddr	CAN extended address for a USDT response. Used for response handling.
CP_CanRespUUDTFormat	CAN Id format for a UUDT response. Used for response handling.
CP_CanRespUUDTExtAddr	CAN Id extended address for a UUDT response. Used for response handling.
CP_CanRespUUDTId	CAN Id for a UUDT response. Used for response handling. Value set to 0xFFFFFFFF is not used.

Table 67 — Example set of ComParams for a SAE J2190 (non-CAN) response structure per ECU

ComParam	Description
CP_FuncRespFormatPriorityType	First byte of received message is the format/priority byte. This is the expected first byte on a functional response.
CP_FuncRespTargetAddr	Second byte of received message for a functional addressed response. The protocol handler will use either the Tester Source address or this FuncRespTargetAddr. (e.g. OBD using 0x6B as the Target address instead of the Tester Address).
CP_PhysRespFormatPriorityType	First byte of received message is the format/priority byte. This is the expected first byte on a physical response.
CP_EcuRespSourceAddress	Expected ECU Source Address. This is typically the 3rd byte of the message.

11.1.4.11 Item for event notification

```
typedef struct {
    T_PDU_IT    ItemType;       /* value= PDU_IT_RESULT or PDU_IT_STATUS or
                                   PDU_IT_ERROR or PDU_IT_INFO */
    UNUM32      hCop;           /* If item is from a ComPrimitive then the hCop contains the valid
                                   ComPrimitive handle, else it contains PDU_HANDLE_UNDEF */
    void *      pCoPTag;        /* ComPrimitive Tag. Should be ignored if hCop =
                                   PDU_HANDLE_UNDEF */
    UNUM32      Timestamp;      /* Timestamp in microseconds */
    void        *pData;         /* points to the data for the specified Item Type. 11.1.4.11.1 to
                                   11.1.4.11.4 */
} PDU_EVENT_ITEM;
```

Note that a successful call to PDUGetEventItem will automatically remove the item from the top of the event queue in the D-PDU API. The application shall call PDUDestroyItem to release the memory back to the D-PDU API.

11.1.4.11.1 Structure for status data

Asynchronous status change notification for PDU_IT_STATUS Item.

```
T_PDU_STATUS PDU_STATUS_DATA;       /* Status code information. D.1.4 Status code values */
```

11.1.4.11.2 Asynchronous event information notification for PDU_IT_INFO Item.

```
typedef struct {
    T_PDU_INFO      InfoCode;       /* Information code. D.1.5 Information event values */
    UNUM32          ExtraInfoData;  /* Optional additional information */
} PDU_INFO_DATA;
```

11.1.4.11.3 Asynchronous error notification structure for the PDU_IT_ERROR Item

```
typedef struct {
    T_PDU_ERR_EVT    ErrorCodeId;        /* error code, binary information. */
    UNUM32           ExtraErrorInfoId;   /* Optional additional error information, text translation via MDF file. Binary Information, 0 indicates no additional error information. Clause D.4 Event error codes */
} PDU_ERROR_DATA;
```

11.1.4.11.4 Structure for result data

Asynchronous result notification structure (received data) for the PDU_IT_RESULT Item.

```
typedef struct {
    PDU_FLAG_DATA    RxFlag;             /* Receive message status. Clause D.2.2 RxFlag definition.*/
    UNUM32           UniqueRespIdentifier; /* ECU response unique identifier */
    UNUM32           AcceptanceId;       /* Acceptance Id value from ComPrimitive Expected Response Structure. If multiple expected response entries match the response payload data, then the first matching expected response id found in the array of expected responses is used. (I.e. acceptance filtering is carried out in the sequence of the expected responses as they appear in the array of expected responses. Thus, an expected response with the lowest array index has the highest priority.)*/
    PDU_FLAG_DATA    TimestampFlags;     /* Bitoriented Timestamp Indicator flag (See Structure for flag data and TimestampFlag definition). If the flag data is 0, then the following timestamp information is not valid.*/
    UNUM32           TxMsgDoneTimestamp; /* Transmit Message done Timestamp in microseconds */
    UNUM32           StartMsgTimestamp;  /* Start Message Timestamp in microseconds */
    PDU_EXTRA_INFO   *pExtraInfo;        /* If NULL, no extra information is attached to the response structure. This feature is enabled by setting the ENABLE_EXTRA_INFO bit in the TxFlag for the ComPrimitive (See TxFlag definition)*/
    UNUM32           NumDataBytes;       /* Data size in bytes, if RawMode then the data includes header bytes, checksum, message data bytes (pDataBytes), and extra data, if any.*/
    UNUM8            *pDataBytes;        /* Reference pointer to D-PDU API memory that contains PDU Payload data. In non-Raw mode this data contains no header bytes, CAN Ids, or checksum information. In RawMode, this data will contain the exact data received from the ECU. For ISO 15765, ISO 11898 and SAE J1939, the first 4 bytes are the CAN ID (11 bit or 29 bit) followed by a possible extended address byte (Table D.4 — TxFlag) */
} PDU_RESULT_DATA;
```

11.1.4.12 Structure for extra result data information

```
typedef struct {
    UNUM32           NumHeaderBytes;     /* Number of header bytes contained in pHeaderBytes array. */
    UNUM32           NumFooterBytes;     /* Number of footer bytes contained in pFooterBytes array. (SAE J1850 PWM) Start position of extra data in received message (for example, IFR or ISO 14230 checksum.) When no extra data bytes are present in the message, NumFooterBytes shall be set to zero. */
```

```
    UNUM8       *pHeaderBytes;      /* Reference pointer to Response PDU Header bytes, NULL if
                                       NumHeaderBytes = 0 */
    UNUM8       *pFooterBytes;      /* Reference pointer to Response PDU Footer bytes, NULL if
                                       NumFooterBytes = 0 */
} PDU_EXTRA_INFO;
```

11.1.4.13 Structure for flag data

```
typedef struct {
    UNUM32      NumFlagBytes;       /* number of bytes in pFlagData array*/
    UNUM8       *pFlagData;         /* Pointer to flag bytes used for TxFlag, RxFlag, and CllCreateFlag.
                                       Clause D.2 Flag definitions) */
} PDU_FLAG_DATA;
```

11.1.4.14 Structure for version information (used by PDUGetVersion)

```
typedef struct {
    UNUM32  MVCI_Part1StandardVersion;  /* Release version of supported MVCI Part 1 standard (see Coding of
                                           version numbers)*/
    UNUM32  MVCI_Part2StandardVersion;  /* Release version of supported MVCI Part 2 standard (see Coding of
                                           version numbers)*/
    UNUM32  HwSerialNumber;             /* Unique Serial number of MVCI HW module from a vendor */
    CHAR8   HwName[64];                 /* Name of MVCI HW module; zero terminated */
    UNUM32  HwVersion;                  /* Version number of MVCI HW module (see Coding of version
                                           numbers)*/
    UNUM32  HwDate;                     /* Manufacturing date of MVCI HW module (see Coding of dates)*/
    UNUM32  HwInterface;                /* Type of MVCI HW module; zero terminated */
    CHAR8   FwName[64];                 /* Name of the firmware available in the MVCI HW module */
    UNUM32  FwVersion;                  /* Version number of the firmware in the MVCI HW module (see Coding
                                           of version numbers)*/
    UNUM32  FwDate;                     /* Manufacturing date of the firmware in the MVCI HW module (see
                                           Coding of dates)*/
    CHAR8   VendorName[64];             /* Name of vendor; zero terminated */
    CHAR8   PDUApiSwName[64];           /* Name of the D-PDU API software; zero terminated */
    UNUM32  PDUApiSwVersion;            /* Version number of D-PDU API software (see Coding of version
                                           numbers)*/
    UNUM32  PDUApiSwDate;               /* Manufacturing date of the D-PDU API software (see Coding of
                                           dates)*/
} PDU_VERSION_DATA;
```

11.1.4.15 Coding of version numbers

Version numbers from PDU_VERSION_DATA are coded as shown below.

Table 68 — Coding of version numbers: UNUM32

MSB			LSB
Major (0..255)	Minor (0..255)	Revision (0..255)	0

11.1.4.16 Coding of dates

Date numbers from PDU_VERSION_DATA are coded as shown below.

Table 69 — Coding of dates: UNUM32

MSB			LSB
Year since 1970 (0..255)	Month (1..12)	Day (1..31)	Week (1..52, 0 if not used)

11.1.4.17 Structure to control a ComPrimitive's operation (used by PDUStartComPrimitive)

PDU_COP_CTRL_DATA is not applicable to ComPrimitives types: PDU_COPT_UPDATEPARAM and PDU_COPT_RESTORE_PARAM.

```
typedef struct {
    UNUM32          Time;                   /* Cycle time in ms for cyclic send operation or delay time for
                                               PDU_COPT_DELAY ComPrimitive. If cyclic time is set to 0, then the
                                               ComPrimitive is put on the transmit queue after each completion cycle,
                                               but is at a lower priority than other ComPrimitives and Tester Present
                                               Messages. */
    SNUM32          NumSendCycles;          /* # of send cycles to be performed; -1 for infinite cyclic send operation */
    SNUM32          NumReceiveCycles;       /* # of receive cycles to be performed; -1 (IS-CYCLIC) for infinite receive
                                               operation, -2 (IS-MULTIPLE) for multiple expected responses from 1 or
                                               more ECUs */
    UNUM32          TempParamUpdate;        /* Temporary ComParam settings for the ComPrimitive:

                                               0 = Do not use temporary ComParams for this ComPrimitive. The
                                               ComPrimitive shall attach the “Active” ComParam buffer to the
                                               ComPrimitive. This buffer shall be in effect for the ComPrimitive until it is
                                               finished. The ComParams for the ComPrimitive will not change even if
                                               the “Active” buffer is modified by a subsequent ComPrimitive type of
                                               PDU_COPT_UPDATEPARAM.

                                               1 = Use temporary ComParams for this ComPrimitive; The
                                               ComPrimitive shall attach the ComParam “Working” buffer to the
                                               ComPrimitive. This buffer shall be in effect for the ComPrimitive until it is
                                               finished. The ComParams for the ComPrimitive will not change even if
                                               the “Active” or “Working” buffers are modified by any subsequent calls to
                                               PDUSetComParam.

                                               NOTE 1 If TempParamUpdate is set to 1, the ComParam Working
                                               Buffer is restored to the Active Buffer when this PDUStartComPrimitive
                                               function call returns.

                                               NOTE 2 Physical ComParams cannot be changed using the
                                               TempParamUpdate flag */
    PDU_FLAG_DATA   TxFlag;                 /* Transmit Flag used to indicate protocol specific
                                               elements for the ComPrimitive's execution. (D.2.1
                                               TxFlag definition.)*/
    UNUM32          NumPossibleExpectedResponses;   /* number of entries in pExpectedResponseArray
                                                       */
    PDU_EXP_RESP_DATA   *pExpectedResponseArray;    /* pointer to an array of expected responses
                                                       (11.1.4.18 Structure for expected response) */
} PDU_COP_CTRL_DATA;
```

11.1.4.18 Structure for expected response

```
typedef struct {
    UNUM32      ResponseType;           /* 0 = positive response; 1 = negative response */
    UNUM32      AcceptanceId;           /* ID assigned by application to be returned in PDU_RESULT_DATA,
                                           which indicates which expected response matched */
    UNUM32      NumMaskPatternBytes;    /* number of bytes in the Mask Data and Pattern Data*/
    UNUM8       *pMaskData;             /* Pointer to Mask Data. Bits set to a '1' are care bits, '0' are don't care
                                           bits. */
    UNUM8       *pPatternData;          /* Pointer to Pattern Data.  Bytes to compare after the mask is applied */
    UNUM32      NumUniqueRespIds;       /* number of items in the following array of unique response identifiers. If
                                           the number is set to 0, then responses with any unique response
                                           identifier are considered, when trying to match them to this expected
                                           response. */
    UNUM32      *pUniqueRespIds;        /* Array containing unique response identifiers. Only responses with a
                                           unique response identifier found in this array are considered, when
                                           trying to match them to this expected response. */
} PDU_EXP_RESP_DATA;
```

11.1.4.18.1 Expected response type

a) **Positive Response Type (ResponseType = 0)** The D-PDU API uses a matched positive response entry to indicate no further processing needs to be done on the complete received message (i.e. negative response handling is not checked). A complete received message from an ECU contains all frames (for protocols that use a transport/network layer (e.g. ISO 15765)) or all messages (for protocols that have CP_EnableConcatenation on). The received message will be sent to the client application with the associated "Acceptance Id".

NOTE 1 The positive receive message can be discarded for ISO 14229-1 if the SuppressPositiveResponse bit is set and a positive response has been sent after a negative response.

b) **Negative Response Type (ResponseType = 1)** The D-PDU API uses a matched negative response entry to indicate that the received message may need negative response processing (see ComParams CP_RCxxHandling). If negative response handling is not enabled for the 0x7F response code, then the message will be sent to the client application with the associated "Acceptance Id". In this case, it is the responsibility of the client application to handle the negative response message.

NOTE 2 For ISO 15765 protocols, only USDT single frames can be matched to a negative response entry, negative responses are never transmitted in UUDT frames.

c) **"Generic" negative response handling** The D-PDU API uses a special case for negative response handling if no match is found in the expected response structure. If negative response handling is enabled (CP_RCxxHandling is not 0), the D-PDU API follows these steps:

1) Does the ComLogicalLink have an active SendRecv ComPrimitive? If not discard the message.

2) If the protocol is of the type ISO 15765, is the CAN ID USDT? If not discard the frame.

3) Is the first byte of the message = 0x7F? If not discard the message.

4) Is the second byte of the message = to the Service Id (SID) of the active ComPrimitive? If not discard the message.

5) Retrieve the negative response code from the message (See CP_RCByteOffset). Does it match one of the types enabled (See CP_RCxxHandling)? If not, discard the message.

6) Process negative response message as if there were a match in the expected response structure.

11.1.4.18.2 Array of unique response ids (pUniqueRespIds)

The array of unique response identifiers may be used, if an expected response only appears for specific unique response identifiers. This situation may occur in the case of functional addressing, where the possible responses are not common to all ECUs.

The number of unique response identifiers may be 0. In this case the array pUniqueRespIds is not used and all responses with any unique response identifier are considered when trying to match actual response data to the expected response data.

11.1.4.18.3 Expected response matching rules

If multiple expected response entries match the response payload data, then the first matching expected response id found in the array of expected responses is used. (I.e. acceptance filtering is carried out in the sequence of the expected responses as they appear in the array of expected responses. Thus, an expected response with the lowest array index has the highest priority.)

For acceptance filtering, the D-PDU API tries to match the data bytes of a received response to the pattern bytes of an expected response (always regarding the mask bytes.) The number of data bytes in the received response may differ from the number of mask and pattern bytes (NumMaskPatternbytes) in the expected response. Acceptance filtering uses the following rules:

a) If the number of received data bytes is less than NumMaskPatternBytes, the response does not match the expected response.

b) If the number of received data bytes equals NumMaskPatternBytes, all data bytes are compared to the pattern data bytes.

c) If the number of received data bytes exceeds NumMaskPatternBytes, only the initial data bytes of the received response are compared to all pattern data bytes of the expected response. Any following data bytes in the received response are “don't care”.

This expected response structure can be used to mask for ranges of expected responses. For example, a single request to an ECU could generate a 0x7F response, a positive response, an On-Event response, a repetitive response, etc.

The NumberOfPossibleExpectedResponses could contain two entries if 0x7F responses are possible for the requested service.

11.1.4.18.4 Expected response example

Example array of expected responses:

[0] Acceptance ID: 0 MaskData: 0xFF 0xFF PatternData: 0x5A 0x90

[1] Acceptance ID: 1 MaskData: 0xFF PatternData: 0x5A

[2] Acceptance ID: 2 MaskData: 0xFF 0xFF PatternData: 0x7F 0x1A

Example response matching:

Received response (a): 0x5A 0x90 ---> AcceptanceId = 0

Received response (b): 0x5A 0x90 0x31 ---> AcceptanceId = 0

Received response (c): 0x5A ---> AcceptanceId = 1

Received response (d): 0x5A 0x91 ---> AcceptanceId = 1

Received response (e): 0x5B ---> AcceptanceId = unexpected response (discarded)

Received response (f): 0x7F 0x1A ---> AcceptanceId = 2

Received response (g): 0x7F 0x5A ---> AcceptanceId = unexpected response (discarded)

11.1.4.18.5 Expected response structure (RawMode/NonRawMode)

In NonRawMode, no header bytes are returned to the application. Therefore, the expected response structure contains expected message payload data only.

In RawMode, the expected response shall include the header bytes of the expected message. For ISO 15765, ISO_11898_RAW and SAE J1939, the first 4 bytes will always contain the CAN ID. If extended addressing is expected from the responding ECU, then the first byte after the CAN ID contains the extended address. After any header bytes or CAN IDs, the expected message payload data can be masked for.

The following table describes how the PDU_EXP_RESP_DATA is handled in RawMode per protocol.

Table 70 — Raw Mode expected response format per protocol

Protocol	RawMode — Expected Response Handling Description
ISO 15765	The first 4 bytes of the expected data is reserved for the Can ID (11 or 29 bit). If extended addressing, then the 5th byte of the expected data contains the expected extended address.
SAE J1850_VPW, SAE J1850_PWM, ISO 9141	Expected data contains header bytes (1-3) followed by the payload data bytes.
ISO 14230	The number of ECU response header bytes can vary from 1 to 4 followed by the payload data bytes. It is up to the application to determine the expected number of header bytes.
ISO 11898, SAE J1939	The first 4 bytes of the expected data is reserved for the Can ID (11 or 29 bit).
SAE J2610	Expected message data from the vehicle serial bus. Expected response data does not include any echoed bytes when the protocol is in half-duplex mode.
SAE J1708	Expected data contains MID (byte 1) followed by any number of expected payload data bytes.

Annex A
(normative)

D-PDU API compatibility mappings

A.1 Overview of D-PDU API, SAE J2534-1, and RP1210a function mapping

A.1.1 Mapping of D-PDU, SAE J2534-1 and RP1210a API functions

Table A.1 — Mapping of D-PDU, SAE J2534-1 and RP1210a API functions shows how functions could be mapped between the D-PDU API, SAE J2534-1 API and RP1210a API. The table is split into functional groups.

Table A.1 — Mapping of D-PDU, SAE J2534-1 and RP1210a API functions

Functional group	SAE J2534-1 functions	RP1210a functions	D-PDU API
Startup	PassThruOpen	RP1210_ClientConnect	PDUConstruct
Connection	PassThruConnect	RP1210_ClientConnect	PDUCreateComLogicalLink PDUConnect
Disconnect	PassThruDisconnect	RP1210_ClientDisconnect	PDUDisconnect PDUDestroyComLogicalLink
Shutdown	PassThruClose	RP1210_ClientDisconnect	PDUDestruct
Control Services	PassThruIoctl	RP1210_SendCommand	PDUIoctl
Send/Receive (single)	PassThruReadMsgs	RP1210_ReadMessage	PDUGetStatus (optional) PDUGetEventItem
	PassThruWriteMsgs	RP1210_SendMessage	PDUStartComPrimitive
Send/Receive (cyclic)	PassThruStartPeriodicMsg		PDUStartComPrimitive
	PassThruStopPeriodicMsg		PDUCancelComPrimitive
Protocol ComParam Configuration	PassThruIoctl (Set_Config/Get_Config)		PDUGetComParam PDUSetComParam Update ComParam via ComPrimitive
Filtering	PassThruStartMsgFilter PassThruStopMsgFIlter		PDUIoctl PDUIoCtl
HW control	PassThruSetProgramming-Voltage		PDUIoctl
Information	PassThruReadVersion	RP1210_ReadVersion	PDUGetVersion
		RP1210_GetHardwareStatus	PDUGetStatus
ErrorHandling	PassThruGetLastError	RP1210_GetErrorMsg	PDUGetLastError

Besides normal API functions, SAE J2534-1 and RP1210a define I/O controls. The I/O controls basically represent sub-functions or ComParam settings. In order to map easily these existing standards onto the D-PDU API, all of these I/O controls shall have an equivalent within the D-PDU API or at least be handled by a D-PDU API function other than PDUIoCtl. Table A.2 — Comparison of device control functions lists all I/O controls of SAE J2534-1 and RP1210a and maps them onto the corresponding I/O control or API function within the D-PDU API.

Table A.2 — Comparison of device control functions

Functional group	SAE J2534-1 function Ioctl	RP1210a function RP1210_SendCommand	D-PDU API IoctlCommandId (alternative: separate function if available in brackets)
Reset			
Reset		Reset Device	PDU_IOCTL_RESET
Start Filter			
Start Filter	(PassThruStartMsgFilter)	Set All Filter States to Pass	PDU_IOCTL_START_MSG_FILTER
		Set Message Filtering for SAE J1939	PDU_IOCTL_START_MSG_FILTER
		Set Message Filtering for CAN	PDU_IOCTL_START_MSG_FILTER
		Set Message Filtering for SAE J1708	PDU_IOCTL_START_MSG_FILTER
Stop Filter			
StopFilter	(PassThruStopMsgFilter)		PDU_IOCTL_STOP_MSG_FILTER
Clear Filters			
ClearFilters	CLEAR_MSG_FILTERS	Set All Filter States to Discard	PDU_IOCTL_CLEAR_MSG_FILTER
General			
General		Generic Driver Command: Pass the raw command data to the driver	PDU_IOCTL_GENERIC
	SET_CONFIG (loopback)	Set Echo Transmitted Messages: Echo on/off	(implicit via SendTimestamp information of each ComPrimitive; explicit loopback mode via PDUSetComParam for each ComLogicalLink)
		Set Message Receive: Enable/disable receive from the specified client	(PDUConnect) (PDUDisconnect)
	GET_CONFIG		(PDUGetComParam)
	SET_CONFIG		(PDUSetComParam)
	CLEAR_TX_BUFFER		PDU_IOCTL_CLEAR_TX_QUEUE
	CLEAR_RX_BUFFER		PDU_IOCTL_CLEAR_RX_QUEUE
	CLEAR_PERIODIC_MSGS		(PDUCancelComPrimitive)

Table A.2 (*continued*)

Functional group	SAE J2534-1 function Ioctl	RP1210a function RP1210_SendCommand	D-PDU API IoctlCommandId (alternative: separate function if available in brackets)
Protocol			
Protocol		Set SAE J1708 Mode: Enable/disable raw mode for SAE J1708	(PDUSetComParam)
		Protect SAE J1939 address	(PDUSetComParam)
	FIVE_BAUD_INIT		(PDUSetComParam) (PDUStartComPrimitive:PDU_COPT_STARTCOMM)
	FAST_INIT		(PDUSetComParam) (PDUStartComPrimitive:PDU_COPT_STARTCOMM)
	CLEAR_FUNCT_MSG_LOOKUP_TABLE		(PDUSetComParam)
	DELETE_FROM_FUNCT_MSG_LOOKUP_TABLE		(PDUSetComParam)
	ADD_TO_FUNCT_MSG_LOOKUP_TABLE		(PDUSetComParam)
Hardware			
HW	READ_VBATT		PDU_IOCTL_READ_VBATT
	READ_PROG_VOLTAGE		PDU_IOCTL_READ_PROG_VOLTAGE

Additional notes concerning SAE J2534-1 and RP1210a compatibility:

— The elements *RxStatus* and *TxFlags* of the PASSTHRU_MSG structure in SAE J2534-1 are mapped to appropriate elements in ComParams and the RxFlag and TxFlag structures.

— SAE J2534-1 I/O control functions, which are related to diagnostic protocol or bustype settings are mapped to protocol and bustype ComParams. In the table above this is indicated by *(PDUSetComParam)* and *(PDUGetComParam)* in the table's “D-PDU API IoCtlCommandId” column. All protocol and bustype ComParams are defined within the MVCI module description file (see MVCI module description file).

— ComParams, which are get or set via the IoCtl function GET_CONFIG and SET_CONFIG in SAE J2534-1, are also mapped to protocol or bustype ComParams. All protocol and bustype ComParams are defined within the MVCI module description file (see MVCI module description file).

— The information returned by the RP1210a function RP1210_GetHardwareStatus() will be assembled by the RP1210a compatibility layer, because it consists of status information available for the MVCI protocol module and the several ComLogicalLinks being used with that MVCI protocol module.

A.1.2 Mapping of D-PDU API ComParams with SAE J2534-1 ComParams

Table A.3 — Mapping of D-PDU API ComParams to SAE J2534-1

D-PDU API COMPARAM	SAE J2534 IOCTL Get/Set ComParams	SAE J2534 Connect Flags	SAE J2534 IOCTL commands	Comments
CP_Loopback	LOOPBACK			
CP_P3Min	P3_MIN			
CP_5BaudMode	FIVE_BAUD_MOD			
CP_BlockSize	ISO15765_BS			
CP_BlockSizeOverride	BS_TX			
CP_CanMaxNumWait-Frames	ISO15765_WFT_MAX			
CP_FuncRespTargetAddr			CLEAR_FUNC_MSG_LOOKUP_TABLE ADD_TO_FUNC_MSG_LOOKUP_TABLE DELETE_FROM_FUNC_MSG_LOOKUP_TABLE	This response COMPARAM is used for a table of possible ECU response. This table is also used to help configure the SAE J1850_PWM hardware to support functional addressing responses ECU on the bus.
CP_InitializationSettings			FIVE_BAUD_INIT and FAST_INIT	
CP_P1Max	P1_MAX			
CP_P4Min	P4_MIN			
CP_TesterSourceAddress	NODE_ADDRESS			
CP_Stmin	ISO15765_STMIN			
CP_StMinOverride	STMIN_TX			
CP_T1Max	T1_MAX			
CP_T2Max	T2_MAX			
CP_T3Max	T3_MAX			
CP_T4Max	T4_MAX			
CP_T5Max	T5_MAX			
CP_TIdle	W0 and TIDLE and W5			Combined into a single ComParam. Idle time used before either starting a fast init or transmitting the 5 baud address byte.
CP_TInil	TINIL			
CP_TWup	TWUP			
CP_W1Max	W1			

Table A.3 (*continued*)

D-PDU API COMPARAM	SAE J2534 IOCTL Get/Set ComParams	SAE J2534 Connect Flags	SAE J2534 IOCTL commands	Comments
CP_W2Max	W2			
CP_W3Max	W3			
CP_W4Min	W4			
CP_Baudrate	DATARATE			
CP_BitSamplePoint	BIT_SAMPLE_POINT			
CP_NetworkLine	NETWORK_LINE			
CP_ChangeSpeedRate	SWCAN_HS_DATA_ RATE			
CP_ChangeSpeedCtrl	SWCAN_SPEEDCHAN GE_ENABLE			
CP_ChangeSpeedResCtrl	SWCAN_RES_SWITCH			
CP_SyncJumpWidth	SYNC_JUMP_WIDTH			
CP_UARTConfig	PARITY and DATA_BITS			Configure the parity, data bit size and stop bits of a Uart protocol.
CP_K_L_LineInit		ISO9141_K_LINE_ ONLY		

A.1.3 Mapping of D-PDU API ComParams with RP1210a ComParams

Table A.4 — Mapping of D-PDU API ComParams to RP1210a

D-PDU API COMPARAM	RP1210a Get/Set ComParams	RP1210a Connect Flags	RP1210a commands	Comments
CP_BlockSize CP_Stmin			RP1210_Set_ISO15765_ Flow_Control	This function sets these ComParams in addition to setting up a FLOW_CONTROL filter.
CP_Cs			RP1210_Set_J1939_ Interpacket_Time	This is the time between bytes for BAM and RTS/CTS messages sent by the VCI.
CP_Baudrate			RP1210_Set_J1708_ Baud	
CP_J1939PreferredAddress			RP1210_Protect_J1939_ Address	To fully implement this function, a Com Primitive would also have to be called.
CP_Loopback			RP1210_Echo_ Transmitted_Messages	

A.1.4 Mapping of D-PDU API function error codes with SAE J2534-1 error codes

Table A.5 — Mapping of D-PDU API error codes with SAE J2534-1 error codes

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruOpen			
PassThruOpen	STATUS_NOERROR	PDUConstruct	PDU_STATUS_NOERROR
PassThruOpen	ERR_DEVICE_NOT_ CONNECTED	PDUGetModuleIds	If PDU_STATUS_NOERROR and NumEntries = 0 in the returned PDU_MODULE_ITEM structure
PassThruOpen	ERR_DEVICE_IN_USE	PDUConstruct	PDU_ERR_SHARING_ VIOLATION
PassThruOpen	ERR_NULL_PARAMETER	PDUConstruct	PDU_ERR_INVALID_ PARAMETERS
PassThruOpen	ERR_FAILED	PDUConstruct	PDU_ERR_PARAMETER_NOT_ SUPPORTED
PassThruOpen	ERR_FAILED	PDUConstruct	PDU_ERR_VALUE_NOT_ SUPPORTED:
PassThruOpen	ERR_FAILED	PDUConstruct	PDU_ERR_FCT_FAIILED
PassThruClose			
PassThruClose	STATUS_NOERROR	PDUDestruct	PDU_STATUS_NOERROR
PassThruClose	ERR_DEVICE_NOT_ CONNECTED	PDUDestruct	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruClose	ERR_INVALID_DEVICE_ID	N/R	
PassThruClose	ERR_FAILED	PDUDestruct	PDU_ERR_FCT_FAILED
PassThruConnect			
PassThruConnect	STATUS_NOERROR	PDUGetResourceIds	PDU_STATUS_NOERROR
PassThruConnect	STATUS_NOERROR	PDUCreateComLogical-Link	PDU_STATUS_NOERROR
PassThruConnect	STATUS_NOERROR	PDUConnect	PDU_STATUS_NOERROR
PassThruConnect	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruConnect	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUGetResourceIds	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUCreateComLogical-Link	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUCreateComLogical-Link	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUConnect	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUConnect	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_ CONNECTED
PassThruConnect	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruConnect	ERR_NOT_SUPPORTED	N/A	
PassThruConnect	ERR_INVALID_DEVICE_ID	PDUCreateComLogical-Link	PDU_ERR_INVALID_HANDLE
PassThruConnect	ERR_INVALID_DEVICE_ID	PDUConnect	PDU_ERR_INVALID_HANDLE
PassThruConnect	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruConnect	ERR_INVALID_PROTOCOL_ ID	PDUGetResourceIds	PDU_ERR_INVALID_ PARAMETERS
PassThruConnect	ERR_NULL_PARAMETER	PDUCreateComLogical-Link	PDU_ERR_INVALID_ PARAMETERS
PassThruConnect	ERR_NULL_PARAMETER	PDUDestroyItem	PDU_ERR_INVALID_ PARAMETERS
PassThruConnect	ERR_INVALID_FLAGS	PDUCreateComLogical-Link	PDU_ERR_INVALID_ PARAMETERS
PassThruConnect	ERR_INVALID_BAUDRATE	PDUSetComParam	PDU_ERR_INVALID_ PARAMETERS
PassThruConnect	ERR_FAILED	PDUConnect	PDU_ERR_FCT_FAILED
PassThruConnect	ERR_CHANNEL_IN_USE	PDUCreateComLogical-Link	PDU_ERR_RESOURCE_BUSY
PassThruConnect	ERR_CHANNEL_IN_USE	PDUConnect	PDU_ERR_CLL_CONNECTED
PassThruConnect	No Error Is Returned	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruDisconnect			
PassThruDisconnect	STATUS_NOERROR	PDUDisconnect	PDU_STATUS_NOERROR
PassThruDisconnect	STATUS_NOERROR	PDUDestroyComLogical-Link	PDU_STATUS_NOERROR
PassThruDisconnect	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruDisconnect	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyComLogical-Link	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_CLL_NOT_ CONNECTED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyComLogical-Link	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_ CONNECTED

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruDisconnect	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruDisconnect	ERR_INVALID_DEVICE_ID	PDUDestroyComLogical Link	PDU_ERR_INVALID_HANDLE
PassThruDisconnect	ERR_INVALID_DEVICE_ID	PDUDisconnect	PDU_ERR_INVALID_HANDLE
PassThruDisconnect	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruDisconnect	ERR_FAILED	PDUDestroyItem	PDU_ERR_INVALID_ PARAMETERS
PassThruDisconnect	ERR_INVALID_CHANNEL_ID	PDUDestroyComLogical-Link	PDU_ERR_INVALID_HANDLE
PassThruDisconnect	ERR_INVALID_CHANNEL_ID	PDUDisconnect	PDU_ERR_INVALID_HANDLE
PassThruDisconnect	No Error Is Returned	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruReadMsgs			
PassThruReadMsgs	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruReadMsgs	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruReadMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruReadMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_ CONNECTED
PassThruReadMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruReadMsgs	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruReadMsgs	ERR_INVALID_CHANNEL_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruReadMsgs	ERR_NULL_PARAMETER	PDUDestroyItem	PDU_ERR_INVALID_ PARAMETERS
PassThruReadMsgs	ERR_TIMEOUT	N/R	
PassThruReadMsgs	ERR_BUFFER_EMPTY	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruReadMsgs	ERR_NO_FLOW_CONTROL	N/R	
PassThruReadMsgs	ERR_FAILED	N/R	
PassThruReadMsgs	ERR_BUFFER_OVERFLOW	N/R	
PassThruWriteMsgs			
PassThruWriteMsgs	STATUS_NOERROR	PDUStartComPrimitive	PDU_STATUS_NOERROR
PassThruWriteMsgs	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruWriteMsgs	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_CLL_NOT_ CONNECTED

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_ CONNECTED
PassThruWriteMsgs	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruWriteMsgs	ERR_INVALID_DEVICE_ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruWriteMsgs	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruWriteMsgs	ERR_NOT_SUPPORTED	N/R	
PassThruWriteMsgs	ERR_INVALID_CHANNEL_ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruWriteMsgs	ERR_INVALID_CHANNEL_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruWriteMsgs	ERR_INVALID_MSG	N/R	
PassThruWriteMsgs	ERR_NULL_PARAMETER	PDUDestroyItem	PDU_ERR_INVALID_ PARAMETERS
PassThruWriteMsgs	ERR_NULL_PARAMETER	PDUStartComPrimitive	PDU_ERR_INVALID_ PARAMETERS
PassThruWriteMsgs	ERR_FAILED	N/R	
PassThruWriteMsgs	ERR_TIMEOUT	N/R	
PassThruWriteMsgs	ERR_MSG_PROTOCOL_ID	N/R	
PassThruWriteMsgs	ERR_NO_FLOW_CONTROL	N/R	
PassThruWriteMsgs	ERR_BUFFER_FULL	PDUStartComPrimitive	PDU_ERR_TX_QUEUE_FULL
PassThruWriteMsgs	Wait for not empty	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruStartPeriodicMsg			
PassThruStartPeriodic Msg	STATUS_NOERROR	PDUStartComPrimitive	PDU_STATUS_NOERROR
PassThruStartPeriodic Msg	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruStartPeriodic Msg	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_CLL_NOT_ CONNECTED
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_ CONNECTED
PassThruStartPeriodic Msg	ERR_DEVICE_NOT_ CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruStartPeriodic Msg	ERR_INVALID_DEVICE_ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruStartPeriodic Msg	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruStartPeriodicMsg	ERR_NOT_SUPPORTED	N/R	
PassThruStartPeriodicMsg	ERR_INVALID_CHANNEL_ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruStartPeriodicMsg	ERR_INVALID_CHANNEL_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruStartPeriodicMsg	ERR_INVALID_MSG	N/R	
PassThruStartPeriodicMsg	ERR_NULL_PARAMETER	PDUStartComPrimitive	PDU_ERR_INVALID_PARAMETERS
PassThruStartPeriodicMsg	ERR_NULL_PARAMETER	PDUDestroyItem	PDU_ERR_INVALID_PARAMETERS
PassThruStartPeriodicMsg	ERR_INVALID_TIME_INTERVAL	N/R	
PassThruStartPeriodicMsg	ERR_FAILED	N/R	
PassThruStartPeriodicMsg	ERR_MSG_PROTOCOL_ID	N/R	
PassThruStartPeriodicMsg	ERR_EXCEEDED_LIMIT	PDUStartComPrimitive	PDU_ERR_TX_QUEUE_FULL
PassThruStartPeriodicMsg	Wait for not empty	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruStopPeriodicMsg			
PassThruStopPeriodicMsg	STATUS_NOERROR	PDUCancelComPrimitive	PDU_STATUS_NOERROR
PassThruStopPeriodicMsg	STATUS_NOERROR	PDUGetEventItem	PDU_STATUS_NOERROR
PassThruStopPeriodicMsg	STATUS_NOERROR	PDUDestroyItem	PDU_STATUS_NOERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDUCancelComPrimitive	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDUCancelComPrimitive	PDU_ERR_CLL_NOT_CONNECTED
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDUGetEventItem	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDUGetEventItem	PDU_ERR_CLL_NOT_CONNECTED
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDUDestroyItem	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
PassThruStopPeriodicMsg	ERR_INVALID_DEVICE_ID	PDUCancelComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruStopPeriodicMsg	ERR_INVALID_DEVICE_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruStopPeriodicMsg	ERR_INVALID_CHANNEL_ID	PDUCancelComPrimitive	PDU_ERR_INVALID_HANDLE

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruStopPeriodicMsg	ERR_INVALID_CHANNEL_ID	PDUGetEventItem	PDU_ERR_INVALID_HANDLE
PassThruStopPeriodicMsg	ERR_FAILED	PDUCancelComPrimitive	PDU_ERR_FCT_FAILED
PassThruStopPeriodicMsg	ERR_FAILED	PDUDestroyItem	PDU_ERR_INVALID_PARAMETERS
PassThruStopPeriodicMsg	ERR_INVALID_MSG_ID	N/R	
PassThruStopPeriodicMsg	Wait for not empty	PDUGetEventItem	PDU_ERR_QUEUE_EMPTY
PassThruStartMsgFilter			
PassThruStartMsgFilter	STATUS_NOERROR	PDUIoCtl	PDU_STATUS_NOERROR
PassThruStartMsgFilter	ERR_DEVICE_NOT_CONNECTED	PDUIoCtl	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
PassThruStartMsgFilter	ERR_DEVICE_NOT_CONNECTED	PDUIoCtl	PDU_ERR_COMM_PC_TO_VCI_FAILED
PassThruStartMsgFilter	ERR_INVALID_FILTER_ID	PDUIoCtl	PDU_ERR_ID_NOT_SUPPORTED
PassThruStartMsgFilter	ERR_INVALID_DEVICE_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruStartMsgFilter	ERR_INVALID_CHANNEL_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruStartMsgFilter	ERR_FAILED	PDUIoCtl	PDU_ERR_FCT_FAILED
PassThruStartMsgFilter	ERR_INVALID_MSG	N/R	
PassThruStartMsgFilter	ERR_NULL_PARAMETER	N/R	
PassThruStartMsgFilter	ERR_NOT_UNIQUE	N/R	
PassThruStartMsgFilter	ERR_EXCEEDED_LIMIT	N/R	
PassThruStartMsgFilter	ERR_MSG_PROTOCOL_ID	N/R	
PassThruStopMsgFilter			
PassThruStopMsgFilter	STATUS_NOERROR	PDUIoCtl	PDU_STATUS_NOERROR
PassThruStopMsgFilter	ERR_DEVICE_NOT_CONNECTED	PDUIoCtl	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
PassThruStopMsgFilter	ERR_DEVICE_NOT_CONNECTED	PDUIoCtl	PDU_ERR_COMM_PC_TO_VCI_FAILED
PassThruStopMsgFilter	ERR_INVALID_FILTER_ID	PDUIoCtl	PDU_ERR_ID_NOT_SUPPORTED
PassThruStopMsgFilter	ERR_INVALID_DEVICE_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruStopMsgFilter	ERR_INVALID_CHANNEL_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruStopMsgFilter	ERR_FAILED	PDUIoCtl	PDU_ERR_FCT_FAILED

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruSetProgrammingVoltage			
PassThruSetProgram-mingVoltage	STATUS_NOERROR	PDUIoCtl	PDU_STATUS_NOERROR
PassThruSetProgram-mingVoltage	ERR_DEVICE_NOT_ CONNECTED	PDUIoCtl	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruSetProgram-mingVoltage	ERR_DEVICE_NOT_ CONNECTED	PDUIoCtl	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruSetProgram-mingVoltage	ERR_NOT_SUPPORTED	PDUIoCtl	PDU_ERR_ID_NOT_ SUPPORTED
PassThruSetProgram-mingVoltage	ERR_INVALID_DEVICE_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruSetProgram-mingVoltage	ERR_FAILED	PDUIoCtl	PDU_ERR_FCT_FAILED
PassThruSetProgram-mingVoltage	ERR_PIN_INVALID	N/R	
PassThruReadVersion			
PassThruReadVersion	STATUS_NOERROR	PDUGetVersion	PDU_STATUS_NOERROR
PassThruReadVersion	ERR_DEVICE_NOT_ CONNECTED	PDUGetVersion	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruReadVersion	ERR_DEVICE_NOT_ CONNECTED	PDUGetVersion	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruReadVersion	ERR_FAILED	N/R	
PassThruReadVersion	ERR_INVALID_DEVICE_ID	PDUGetVersion	PDU_ERR_INVALID_HANDLE
PassThruReadVersion	ERR_NULL_PARAMETER	PDUGetVersion	PDU_ERR_INVALID_ PARAMETERS
PassThruGetLastError			
PassThruGetLastError	STATUS_NOERROR	PDUGetLastError	PDU_STATUS_NOERROR
PassThruGetLastError	STATUS_NOERROR	PDUGetLastError	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruGetLastError	STATUS_NOERROR	PDUGetLastError	PDU_ERR_INVALID_HANDLE
PassThruGetLastError	STATUS_NOERROR	PDUGetLastError	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruGetLastError	ERR_NULL_PARAMETER	PDUGetLastError	PDU_ERR_INVALID_ PARAMETERS
PassThruIoctl			
PassThruIoctl	STATUS_NOERROR	PDUIoCtl	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUSetComParam	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUGetComParam	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUStartComPrimitive	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUConnect	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUDisconnect	PDU_STATUS_NOERROR
PassThruIoctl	STATUS_NOERROR	PDUCancelComPrimitive	PDU_STATUS_NOERROR

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUIoCtl	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUIoCtl	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUSetComParam	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUGetComParam	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_CLL_NOT_ CONNECTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUStartComPrimitive	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUConnect	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUConnect	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_CLL_NOT_ CONNECTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUDisconnect	PDU_ERR_COMM_PC_TO_ VCI_FAILED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUCancelComPrimitive	PDU_ERR_PDUAPI_NOT_ CONSTRUCTED
PassThruIoctl	ERR_DEVICE_NOT_ CONNECTED	PDUCancelComPrimitive	PDU_ERR_CLL_NOT_ CONNECTED
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUSetComParam	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUGetComParam	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUDisconnect	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_CHANNEL_ ID	PDUCancelComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_IOCTL_ID	PDUIoCtl	PDU_ERR_ID_NOT_ SUPPORTED
PassThruIoctl	ERR_NULL_PARAMETER	PDUStartComPrimitive	PDU_ERR_INVALID_PARAMETE RS
PassThruIoctl	ERR_NOT_SUPPORTED	PDUSetComParam	PDU_ERR_COMPARAM_NOT_ SUPPORTED

Table A.5 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Call	D-PDU API Return Value
PassThruIoctl	ERR_NOT_SUPPORTED	PDUGetComParam	PDU_ERR_COMPARAM_NOT_SUPPORTED
PassThruIoctl	ERR_FAILED	PDUIoCtl	PDU_ERR_FCT_FAILED
PassThruIoctl	ERR_FAILED	PDUSetComParam	PDU_ERR_FCT_FAILED
PassThruIoctl	ERR_FAILED	PDUSetComParam	PDU_ERR_COMPARAM_FIXED
PassThruIoctl	ERR_FAILED	PDUSetComParam	PDU_ERR_COMPARAM_NOT_SUPPORTED
PassThruIoctl	ERR_FAILED	PDUConnect	PDU_ERR_CLL_CONNECTED
PassThruIoctl	ERR_FAILED	PDUCancelComPrimitive	PDU_ERR_FCT_FAILED
PassThruIoctl	ERR_INVALID_MSG	N/R	
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUIoCtl	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUSetComParam	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUGetComParam	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUStartComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUConnect	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUDisconnect	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_DEVICE_ID	PDUCancelComPrimitive	PDU_ERR_INVALID_HANDLE
PassThruIoctl	ERR_INVALID_IOCTL_VALUE	PDUSetComParam	PDU_ERR_INVALID_PARAMETERS
PassThruIoctl	ERR_INVALID_IOCTL_VALUE	PDUGetComParam	PDU_ERR_INVALID_PARAMETERS
PassThruIoctl	ERR_EXCEEDED_LIMIT	N/R	

A.1.5 Mapping of D-PDU API event error codes with SAE J2534-1 error codes

Table A.6 — Mapping of D-PDU API event error codes with SAE J2534-1 error codes

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Standard Error Codes
PassThruConnect		
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_INIT_ERROR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_FRAME_STRUCT
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_TX_ERROR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_TESTER_PRESENT_ERROR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_RX_TIMEOUT
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_RX_ERROR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_PROT_ERR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_LOST_COMM_TO_VCI
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_VCI_HARDWARE_FAULT
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_INIT_ERROR
PassThruConnect	PDU_ERR_COMM_PC_TO_VCI_FAILED	PDU_ERR_EVT_RX_TIMEOUT

Table A.6 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Standard Error Codes
PassThruDisconnect		
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_FRAME_STRUCT
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TX_ERROR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TESTER_PRESENT_ERROR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_ERROR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_PROT_ERR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_LOST_COMM_TO_VCI
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_VCI_HARDWARE_FAULT
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruDisconnect	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT
PassThruReadMsgs		
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_FRAME_STRUCT
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TX_ERROR
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TESTER_PRESENT_ERROR
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_ERROR
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_PROT_ERR
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_LOST_COMM_TO_VCI
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_VCI_HARDWARE_FAULT
PassThruReadMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruReadMsgs	ERR_TIMEOUT	PDU_ERR_EVT_RX_TIMEOUT
PassThruWriteMsgs		
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_FRAME_STRUCT
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TX_ERROR
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TESTER_PRESENT_ERROR
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_ERROR
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_PROT_ERR
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_LOST_COMM_TO_VCI
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_VCI_HARDWARE_FAULT
PassThruWriteMsgs	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruWriteMsgs	ERR_TIMEOUT	PDU_ERR_EVT_RX_TIMEOUT

Table A.6 (*continued*)

SAE J2534 API Call	SAE J2534 API Return Value	D-PDU API Standard Error Codes
PassThruWriteMsgs		
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_FRAME_STRUCT
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TX_ERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_TESTER_PRESENT_ERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_ERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_PROT_ERR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_LOST_COMM_TO_VCI
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_VCI_HARDWARE_FAULT
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_INIT_ERROR
PassThruStopPeriodicMsg	ERR_DEVICE_NOT_CONNECTED	PDU_ERR_EVT_RX_TIMEOUT

A.1.6 Mapping of D-PDU API event error codes with RP1210a error codes

Table A.7 — Mapping of D-PDU API event error codes with RP1210a error codes

RP1210A Error	D-PDU API Error
ERR_DLL_NOT_INITIALIZED	PDU_ERR_PDUAPI_NOT_CONSTRUCTED
ERR_CLIENT_ALREADY_CONNECTED	PDU_ERR_CLL_CONNECTED
ERR_CLIENT_AREA_FULL	PDU_ERR_RESOURCE_ERROR
ERR_NOT_ENOUGH_MEMORY	PDU_ERR_RESOURCE_ERROR
ERR_INVALID_DEVICE	PDU_ERR_INVALID_HANDLE
ERR_DEVICE_IN_USE	PDU_ERR_RESOURCE_BUSY
ERR_INVALID_PROTOCOL	PDU_ERR_INVALID_PARAMETERS
ERR_CONNECT_NOT_ALLOWED	PDU_ERR_SHARING_VIOLATION
ERR_INVALID_CLIENT_ID	PDU_ERR_INVALID_HANDLE
ERR_FREE_MEMORY	PDU_ERR_RESOURCE_ERROR
ERR_TX_QUEUE_FULL	PDU_ERR_TX_QUEUE_FULL
ERR_TX_QUEUE_CORRUPT	PDU_ERR_EVT_VCI_HARDWARE_FAULT

Table A.7 (*continued*)

RP1210A Error	D-PDU API Error
ERR_MESSAGE_TOO_LONG	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_MESSAGE_TOO_LONG
ERR_HARDWARE_NOT_RESPONDING	PDU_ERR_COMM_PC_TO_VCI_FAILED
ERR_CLIENT_DISCONNECTED	PDU_ERR_CLL_NOT_CONNECTED
ERR_ADDRESS_LOST	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_CLAIM_ADDRESS_LOST
ERR_BLOCK_NOT_ALLOWED	(Provided by RP1210A wrapper functions)
ERR_ADDRESS_NEVER_CLAIMED	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_ADDRESS_NEVER_CLAIMED
ERR_WINDOW_HANDLE_REQUIRED	(Provided by RP1210A wrapper functions)
ERR_MESSAGE_NOT_SENT	PDU_ERR_EVT_TX_ERROR
ERR_MAX_NOTIFY_EXCEEDED	(Provided by RP1210A wrapper functions)
ERR_RX_QUEUE_FULL	PDU_EVT_DATA_LOST
ERR_RX_QUEUE_CORRUPT	PDU_ERR_EVT_VCI_HARDWARE_FAULT
ERR_MULTIPLE_CLIENTS_CONNECTED	PDU_ERR_FCT_FAILED This error code is used for multiple failures. Wrapper functions will have to translate this from the response from the PDU_IOCTL_RESET or generate the RP1210 error based on the RP1210 definition.
ERR_CHANGE_MODE_FAILED	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_CHANGE_MODE_FAILED
ERR_INVALID_COMMAND	PDU_ERR_INVALID_PARAMETERS
ERR_COMMAND_NOT_SUPPORTED	PDU_ERR_ID_NOT_SUPPORTED
ERR_BUS_OFF	PDU_ERR_EVT_RX_ERROR
ERR_COULD_NOT_TX_ADDRESS_CLAIMED	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_COULD_NOT_TX_ADDRESS_CLAIMED
ERR_ADDRESS_CLAIM_FAILED	PDU_ERR_EVT_PROT_ERROR Recommended additional error: PDU_XTRA_ERR_ADDRESS_CLAIM_FAILED
ERR_CODE_NOT_FOUND	PDU_ERR_FCT_FAILED

A.2 Mapping of D-PDU API and D-Server API

Table A.8 — Mapping of D-PDU API send/receive cycles and D-Server API

Runtime Mode	Repetition Mode	NumSendCycles	NumReceiveCycles
eNONCYCLIC	eSINGLE	1	1
eNONCYCLIC	eREPEATED	1	1
eCYCLIC	eSINGLE	1	-1

A.3 Mapping of D-PDU API and ODX

Table A.9 — Mapping of D-PDU API send/receive cycles and ODX

ODX	NumSendCycles	NumReceiveCycles
IS-CYCLIC	1	-1
IS-MULTIPLE	1	-2

Annex B
(normative)

D-PDU API standard ComParams and protocols

B.1 Standardized protocols - support and naming conventions

B.1.1 General overview

The D-PDU API is not restricted to specific diagnostic protocols. Since the supported protocols and its ComParams are described in the MDF, the protocol support of an MVCI protocol module using the D-PDU API can be extended easily. The only important requirement is that the designation of the protocols (e.g. protocol names) is unique. To assure this requirement, see B.1.4.

B.1.2 SAE J2534 and RP1210a standard protocol names

Table B.1 — SAE J2534-1 and RP1210a Standard protocol names

Protocol name	Description
ISO_11898_RAW	Raw CAN protocol (layer 2); behaviour identical to protocol ID CAN in SAE J2534-1 or protocol string CAN in RP1210a.
ISO_15765_2	ISO 15765 protocol with ISO 15765-2 flow control enabled; behaviour identical to protocol ID ISO 15765 in SAE J2534-1.
ISO_15765_3	ISO 15765 protocol with automatic flow control handling, Tester Present handling and enhanced support of the ComLogicalLink concept. All address information (CAN identifiers) for physical and functional addressing is defined as ComParams for the ComLogicalLink. The application only needs to care for the ServiceID and data during communication.
SAE_J1850_VPW	GM/DaimlerChrysler CLASS2; behaviour identical to protocol ID SAE J1850_VPW in SAE J2534-1 or protocol string SAE J1850 in RP1210a (using a SAE J1850_VPW MVCI protocol module).
SAE_J1850_PWM	Ford SCP; behaviour identical to protocol ID SAE J1850_PWM in SAE J2534-1 or protocol string SAE J1850 in RP1210a (using a SAE J1850_PWM MVCI protocol module).
SAE_J1939_21	SAE J1939 network protocol; behaviour identical to protocol string SAE J1939 in RP1210a.
SAE_J1708	SAE J1708 network protocol; behaviour identical to protocol string SAE J1708 in RP1210a.
SAE_J2610_SCI	SAE J2610 protocol (DaimlerChrysler SCI); four configurations are defined in protocol: configuration A for engine, (ID: SCI_A_ENGINE) configuration A for transmission (ID: SCI_A_TRANS), configuration B for engine (ID: SCI_B_ENGINE), configuration B for transmission (ID: SCI_B_TRANS).
ISO_14230_4	ISO 14230-4 (Keyword protocol 2000); behaviour identical to protocol ID ISO 14230 in SAE J2534-1.
ISO_9141_2	Raw ISO 9141 or ISO 9141-2 protocol; behaviour identical to protocol ID ISO 9141 in SAE J2534-1.

NOTE A specific MVCI protocol module is **not** required to support a minimum set of protocols. The protocols supported by the specific MVCI protocol module can be evaluated by the application using the MDF and the function call PDUGetResourceStatus().

B.1.3 Protocol names – combination list

Some protocols consist of several protocol layers which may be combined. All combinations shall be treated as a protocol definition itself, as it is not transparent to the application that is implemented in the D-PDU API. Table B.2 — Standard protocol combination list indicates the necessary layering of some standard protocols.

Table B.2 — Standard protocol combination list

Protocol Full Name	Application Layer	Transport Layer (CAN), DataLink Layer (K-Line)	Physical Layer(s)
KWP2000 on K Line	ISO_14230_3	ISO_14230_2	ISO_14230_1_UART
KWP2000 on CAN	ISO_14230_3	ISO_15765_2	ISO_11898_2_DWCAN, ISO_11898_3_DWFTCAN, SAE_J2411_SWCAN
ISO UDS on CAN	ISO_15765_3 (ISO_14229_1)	ISO_15765_2	ISO_11898_2_DWCAN, ISO_11898_3_DWFTCAN, SAE_J2411_SWCAN
Enhanced Diagnostics on ISO 14230 K-Line	SAE_J2190	ISO_14230_2	ISO_14230_1_UART
Enhanced Diagnostics on ISO 9141 K-Line	SAE_J2190	ISO_9141_2	ISO_9141_2_UART
Enhanced Diagnostics on CAN	SAE_J2190	ISO_15765_2	ISO_11898_2_DWCAN, ISO_11898_3_DWFTCAN, SAE_J2411_SWCAN
Enhanced Diagnostics on SAE J1850_VPW	SAE_J2190	SAE_J1850_VPW	SAE_J1850_VPW
Enhanced Diagnostics on SAE J1850_PWM	SAE_J2190	SAE_J1850_PWM	SAE_J1850_PWM
ISO OBD on K-Line	ISO_15031_5	ISO_9141_2 ISO_14230_4	ISO_9141_2_UART ISO_14230_1_UART
ISO OBD on SAE J1850	ISO_15031_5	SAE_J1850_VPW SAE_J1850_PWM	SAE_J1850_VPW SAE_J1850_PWM
ISO OBD on CAN	ISO_15031_5	ISO_15765_4	ISO_11898_2_DWCAN
ISO RAW CAN	ISO_11898_RAW	N/A	ISO_11898_2_DWCAN, ISO_11898_3_DWFTCAN, SAE_J2411_SWCAN
Truck and Bus on CAN	SAE_J1939_73	SAE_J1939_21	SAE_J1939_11_DWCAN
Truck and Bus on UART	SAE_J1587	SAE_J1708	SAE_J1708_UART
Chrysler SCI	SAE_J2610	SAE_J2610_SCI	SAE_J2610_UART

B.1.4 Standard protocol naming guidelines

The following naming guidelines apply:

— If the protocol is specified as a standard, the designation of the standard shall be used and the standardization organization shall be included in the name as a prefix (e.g. ISO_99999, SAE_J8888). If the protocol is specified as part of a standard, the part number shall be included in the name as postfix (e.g. ISO_15765_2).

— The standard protocol short names which are used in the MDF file for the PROTOCOL element are a concatenation of the application Layer specification name, plus the transport layer specification layer name, connected by the additional string "_on_", as shown in Table B.3 — Standard protocol short names in ODX and Table B.4 — OBD protocol shortnames.

— The physical layer name as shown in Table B.2 — Standard protocol combination list is used in the MDF file as short name for the BUSTYPE element.

B.1.5 Standard protocol short names

Table B.3 — Standard protocol short names in ODX

Short name	Protocol Description
ISO_14230_3_on_ISO_14230_2	KWP2000 on K-Line
ISO_14230_3_on_ISO_15765_2	KWP2000 on CAN
ISO_15765_3_on_ISO_15765_2	ISO UDS on CAN
SAE_J2190_on_ISO_14230_2	Enhanced Diagnostics on KWP2000 K-Line
SAE_J2190_on_ISO_9141_2	Enhanced Diagnostics on 9141 K-Line
SAE_J2190_on_ISO_15765_2	Enhanced Diagnostics on CAN
SAE_J2190_on_SAE_J1850_VPW	Enhanced Diagnostics on SAE J1850_VPW
SAE_J2190_on_SAE_J1850_PWM	Enhanced Diagnostics on SAE J1850_PWM
ISO_15031_5_on_ISO_9141_2	ISO OBD on 9141-2 K-Line
ISO_15031_5_on_SAE_J1850_VPW	ISO OBD on SAE J1850 VPW
ISO_15031_5_on_ISO_15765_4	ISO OBD on CAN
ISO_15031_5_on_SAE_J1850_PWM	ISO OBD on SAE J1850 PWM
ISO_15031_5_on_ISO_14230_4	ISO OBD on KWP2000 K-Line
ISO_15031_5_on_SAE_J1939_73	ISO OBD on Truck and Bus CAN
SAE_J1939_73_on_SAE_J1939_21	Truck and Bus on CAN
SAE_J1587_on_SAE_J1708	Truck and Bus on UART
SAE_J2610_on_SAE_J2610_SCI	Chrysler SCI
ISO_11898_RAW	ISO RAW CAN

B.1.6 D-PDU API optional OBD protocol short names

These OBD protocols will allow an OBD application to perform a quick OBD Initialization. Many features of an OBD initialization are supported internally by the D-PDU API when the below protocols are supported. See Annex J OBD Initialization for more information regarding OBD Initialization supported by the D-PDU API.

Table B.4 — OBD protocol shortnames

Short name	Protocol Description
ISO_OBD_on_K_Line	ISO OBD on 9141-2 K-Line and KWP2000 K-Line
ISO_OBD_on_SAE_J1850	ISO OBD on SAE J1850 VPW and SAE J1850 PWM
ISO_OBD_on_ISO_15765_4	ISO OBD on CAN
ISO_OBD_on_SAE_J1939_73	ISO OBD on Truck and Bus CAN

B.2 Standard protocol pin types and short names

The MVCI protocol module communicates to a vehicle serial bus using one or more vehicle connector pins. These pins types can be referenced by their ODX compliant short-names in Table B.5 — Pin type short names.

Table B.5 — Pin type short names

Short name	Pin Type Description (example protocol usage)
HI	Differential Line - High (e.g. DW_CAN High)
LOW	Differential Line - Low (e.g. DW_CAN Low)
K	UART K-Line (e.g. KWP2000)
L	UART L-Line (e.g. ISO 9141-2)
TX	UART uni-directional transmit (e.g. SAE J2190)
RX	UART uni-directional receive (e.g. SAE J2190)
PLUS	SAE J1850 Plus (e.g. SAE J1850 VPW and SAE J1850 PWM)
MINUS	SAE J1850 Minus (e.g. SAE J1850 PWM)
SINGLE	Single wire [e.g. SW_CAN, and UART bi-directional transmit/receive (e.g. SAE J2740)]
PROGV	Pin to set the programmable voltage on DLC
IGNITION-CLAMP	Pin to read the ignition sense state from DLC

B.3 Standard protocol communication parameters (ComParams)

B.3.1 Protocol ComParam description method

ISO 22901-1 (ODX specification) already defines mechanisms for the description of ComParams for a protocol. The D-PDU API can be used in combination with ODX data files. Therefore, the description mechanisms from the ODX specification are used to define ComParams in the MDF (for details see the ODX specification).

For each protocol that the MVCI protocol module supports, the MDF shall assign the reference between the ComParams and the unique protocol id. For each protocol, the MDF includes the following elements:

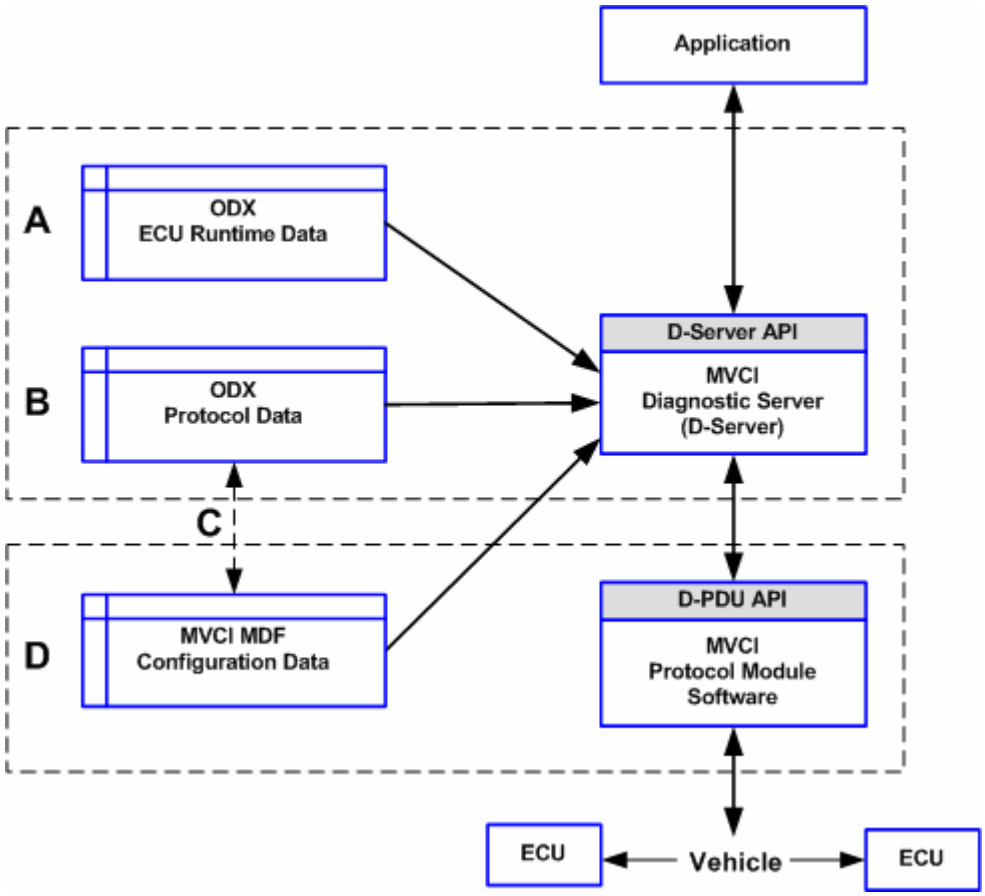
— ProtocolName

— Short name and unique ID for each protocol ComParam

The format for each standard protocol ComParam short name shall be CP_yyyy, where yyyy is the parameter name. An example of a standard protocol ComParam short name would be CP_Baudrate.

NOTE For protocol ComParams, only parameter data types supported by the D-PDU API are used.

Figure B.1 — Example for ComParam configuration illustrates the relationship between the various definition files.



Key

A ShortName=*CP_Baudrate*, LongName=Baudrate for CAN bus, DataType=PDU_PT_UNUM32, Min=500000, Max=500000, Default=500000.

B File: ISO15765.ODX, describes ISO 15765 protocol capabilities.

C ComParams, protocol and bus type must match between B and D.

D Protocol=ISO15765, ShortName=*CP_Baudrate*, ID=0x1234.

Figure B.1 — Example for ComParam configuration

The application (in this case the MVCI D-Server) uses the ECU ODX file for a specific ECU, which uses protocol ISO 15765. This file contains the protocol ComParams, which are required for the specific ECU. For example, the CAN bus baud rate for the specific ECU is specified by the short name *Cp_Baudrate.* The MDF contains entries for all protocol ComParams of each protocol supported by the MVCI protocol module. Therefore, it contains the entry *Cp_Baudrate* for protocol ISO 15765 together with the assigned ID value of 0x1234. The ID value has been assigned by the MVCI protocol module supplier and it is documented in the MDF. The ID value can now be used in D-PDU API function calls.

The MDF contains the following information about a ComParam:

— Short name

— Long name

— ComParam Class

— Layer Info

— ComParam data type

— Minimum value

— Maximum value

— Default value (per protocol)

To avoid the usage of different short names for the same ComParams with MVCI protocol modules from different suppliers, see Table B.1 — SAE J2534-1 and RP1210a Standard protocol names and Table B.3 — Standard protocol short names in ODX. In most cases, the ComParam names are similar or even identical to those used in SAE J2534-1 and RP1210a specifications (see these specifications for details). For different protocols, it is recommended to use the same designations for protocol ComParams in the corresponding protocol specifications. It is not required that a MVCI protocol module support all listed protocol ComParams. *However, if a MVCI protocol module supports a protocol ComParam listed below, it is mandatory that the listed protocol ComParam short name is used in the MDF.*

The ID value for each protocol ComParam can be freely assigned by the MVCI supplier, because the ID value is used only within the supplier-specific PDU API.

B.3.2 ComParam class

Each ComParam belongs to an ODX PARAM-CLASS. Table B.6 includes a list of the relevant ODX PARAM-CLASS.

```
typedef enum E_PDU_PC
{
    PDU_PC_TIMING              = 1,
    PDU_PC_INIT                = 2,
    PDU_PC_COM                 = 3,
    PDU_PC_ERRHDL              = 4,
    PDU_PC_BUSTYPE             = 5,
    PDU_PC_UNIQUE_ID           = 6,
    PDU_PC_TESTER_PRESENT      = 7,
} T_PDU_PC;
```

Table B.6 — Definition of the ODX ComParam classes

D-PDU API ComParam Class	ODX PARAM-CLASS	Class Description
PDU_PC_TIMING	TIMING	Message flow timing ComParams, e.g. inter-byte time or time between request and response.
PDU_PC_INIT	INIT	ComParams for initiation of communication e.g. trigger address or wakeup pattern.
PDU_PC_COM	COM	General communication ComParam.
PDU_PC_ERRHDL	ERRHDL	ComParam defining the behaviour of the runtime system in case an error occurred, e.g. runtime system could either continue communication after a timeout was detected, or stop and reactivate.
PDU_PC_BUSTYPE	BUSTYPE	This is used to define a bustype specific ComParam (e.g. baud rate). Most of these ComParams affect the physical hardware. These ComParams can only be modified by the first Com Logical Link that acquired the physical resource (PDUCreateComLogicalLink()). When a second Com Logical Link is created for the same resource, these ComParams that were previously set by the initial Com Logical Link will be active for the new Com Logical Link.
PDU_PC_UNIQUE_ID	UNIQUE_ID	This type of ComParam is used to indicate to both the ComLogicalLink and the application that the information is used for protocol response handling from a physical or functional group of ECUs to uniquely define an ECU response.
PDU_PC_TESTER_PRESENT	TESTER_PRESENT	This type of ComParam is used for tester present type of ComParams (CP_TesterPresentxxx). Tester Present ComParams cannot be changed temporarily using the TempParamUpdate flag like other ComParams. Using this type of ComParam class enables an application and database to properly configure and use Tester Present ComParams.

B.3.3 ComParam data type

Each ComParam has a data type which describes the possible data types for ComParams

```
typedef enum E_PDU_PT
{
    PDU_PT_UNUM8          = 0x00000101,  /* Unsigned byte */
    PDU_PT_SNUM8          = 0x00000102,  /* Signed byte */
    PDU_PT_UNUM16         = 0x00000103,  /* Unsigned two bytes */
    PDU_PT_SNUM16         = 0x00000104,  /* Signed two bytes */
    PDU_PT_UNUM32         = 0x00000105,  /* Unsigned four bytes */
    PDU_PT_SNUM32         = 0x00000106,  /* Signed four bytes */
    PDU_PT_BYTEFIELD      = 0x00000107,  /* Structure contains an array of UNUM8 bytes with a maximum length
                                            and actual length fields. See ComParam BYTEFIELD data type for
                                            the definition. */
    PDU_PT_STRUCTFIELD    = 0x00000108,  /* Structure contains a void * pointer to an array of structures. The
                                            ComParamStructType item determines the type of structure to be
                                            typecasted onto the void * pointer. This structure contains a field for
                                            maximum number of struct entries and the actual number of struct
                                            entries. See ComParam STRUCTFIELD data type for the definition.
                                            */
    PDU_PT_LONGFIELD      = 0x00000109,  /* Structure contains an array of UNUM32 entries with a maximum
                                            length and actual length fields. See ComParam LONGFIELD Data
                                            Type for the definition. */
} T_PDU_PT;
```

B.3.3.1 ComParam BYTEFIELD data type

```
typedef struct {
    UNUM32    ParamMaxLen;    /* Contains the maximum number of UNUM8 bytes the ComParam can contain in
                                 pDataArray. This is also the amount of memory the D-PDU API allocates prior to
                                 a call of PDUGetComParam. The value of ParamMaxLen is given in the MDF file
                                 as part of the DEFAULT_VALUE entry of the corresponding COMPARAM_REF
                                 or COMPARAM (F.2.2 ComParam String Format). */

                              NOTE 1 A MAX_VALUE entry does not appear at the corresponding
                              COMPARAM_REF or COMPARAM for this type of ComParam.

    UNUM32    ParamActLen;    /* Contains the actual number of UNUM8 bytes in pDataArray. The value of
                                 ParamActLen is given in the MDF file as part of the DEFAULT_VALUE entry of
                                 the corresponding COMPARAM_REF or COMPARAM (F.2.2 ComParam String
                                 Format). */

                              NOTE 2 A MIN_VALUE entry does not appear at the corresponding
                              COMPARAM_REF or COMPARAM for this type of ComParam.

    UNUM8     *pDataArray;    /* Pointer to an array of UNUM8 values */
} PDU_PARAM_BYTEFIELD_DATA;
```

NOTE 3 In the MDF (see MVCI module description file (MDF)) the elements MIN_VALUE, MAX_VALUE and DEFAULT_VALUE are optional at the COMPARAM_REF and COMPARAM, except that only DEFAULT_VALUE is mandatory at COMPARAM. This is to ensure that ParamMaxlen is always retrievable from the MDF.

B.3.3.2 ComParam STRUCTFIELD data type

```
typedef struct {
    T_PDU_CPST      ComParamStructType;     /* type of ComParam Structure being used. See
                                               ComParamStructType typedef*/
    UNUM32          ParamMaxEntries;        /* Contains the maximum number of struct entries the
                                               ComParam can contain in pStructArray. The D-PDU API
                                               allocates this amount of memory based on the size of the
                                               structure type prior to a call of PDUGetComParam. The value
                                               of ParamMaxLen is given in the MDF file as part of the
                                               DEFAULT_VALUE entry of the corresponding
                                               COMPARAM_REF or COMPARAM (F.2.2 ComParam String
                                               Format). */
                                            NOTE 1  A MAX_VALUE entry does not appear at the
                                               corresponding COMPARAM_REF or COMPARAM for this
                                               type of ComParam.
    UNUM32          ParamActEntries;        /* Contains the actual number of struct entries in pStructArray.
                                               The value of ParamActLen is given in the MDF file as part of
                                               the DEFAULT_VALUE entry of the corresponding
                                               COMPARAM_REF or COMPARAM (F.2.2 ComParam String
                                               Format). */
                                            NOTE 2  A MIN_VALUE entry does not appear at the
                                               corresponding COMPARAM_REF or COMPARAM for this
                                               type of ComParam.
    void            *pStructArray;          /* Pointer to an array of structs (typecasted to the
                                               ComParamStructType) */
} PDU_PARAM_STRUCTFIELD_DATA;
```

NOTE 3 STRUCTFIELD type structures (i.e. structures pointed to by pStructArray) are on even byte boundaries.

NOTE 4 In the MDF (see MVCI module description file (MDF)) the elements MIN_VALUE, MAX_VALUE and DEFAULT_VALUE are optional at the COMPARAM_REF and COMPARAM, except that only DEFAULT_VALUE is mandatory at COMPARAM. This is to ensure that ParamMaxlen is always retrievable from the MDF.

B.3.3.2.1 ComParamStructType typedef

Each ComParam of type PDU_PT_STRUCTFIELD has a type (ComParamStructType) which describes the structure expected in the ComParam. The typedef T_PDU_CPST is used in this structure.

```
typedef enum E_PDU_CPST
{
    PDU_CPST_SESSION_TIMING     = 0x00000001, /* See ComParam struct type
                                                 PDU_PARAM_STRUCT_SESS_TIMING */
    PDU_CPST_ACCESS_TIMING      = 0x00000002, /* See ComParam struct type
                                                 PDU_PARAM_STRUCT_ACCESS_TIMING */
} T_PDU_CPST;
```

B.3.3.2.2 ComParam STRUCTFIELD = Session timing

Structure used for a STRUCTFIELD ComParam of ComParamStructType = PDU_CPST_SESSION_TIMING

```
typedef struct {
    UNUM16 session;             /* Session Number, for the diagnostic session of ISO 15765-3 */
```

```
    UNUM8 P2Max_high;       /* 1 ms resolution, Default P2Can_Server_max timing supported by the server for the
                               activated diagnostic session. Used for ComParam CP_P2Max. */
    UNUM8 P2Max_low;        /* 1 ms resolution. Used for ComParam CP_P2Min. */
    UNUM8 P2Star_high;      /* 10 ms resolution. Enhanced (NRC 78 hex) P2Can_Server_max supported by the
                               server for the activated diagnostic session. Used for ComParam CP_P2Star */
    UNUM8 P2Star_low;       /* 10 ms resolution. Used for internal ECU use only. */
} PDU_PARAM_STRUCT_SESS_TIMING;
```

B.3.3.2.3 ComParam STRUCTFIELD = Access timing

Structure used for a STRUCTFIELD ComParam of ComParamStructType = PDU_CPST_ACCESS_TIMING. This structure is used for both ECU ComParams and Tester ComParams (See CP_AccessTiming_Ecu and CP_AccessTimingOverride)

```
typedef struct {
    UNUM8 P2Min;            /* 0,5 ms resolution. Minimum time between tester request and ECU response(s). Used
                               for ComParam CP_P2Min */
    UNUM8 P2Max;            /* Resolution see ISO 14230-2, Table 5. Maximum time between tester request and
                               ECU response(s). Used for ComParam CP_P2Max. */
    UNUM8 P3Min;            /* 0,5 ms resolution. Minimum time between end of ECU responses and start of new
                               tester request. Used for ComParam CP_P3Min. */
    UNUM8 P3Max;            /* 250 ms resolution. Maximum time between ECU responses and start of new tester
                               request Used for ComParam CP_P3Max_Ecu or CP_P2Star for the Tester*/
    UNUM8 P4Min;            /* 0,5 ms resolution. Minimum inter byte time for tester request. Used for ComParam
                               CP_P4Min. */
    UNUM8 TimingSet;        /* Set number allowing multiple sets of timing parameters
                               1 = default timing set used by ECU on a TPI 1 request from the Tester. (Values also
                               returned by the ECU on a TPI 2.)
                               2 = override timing values received by ECU (Tester does not use values returned by
                               ECU, but instead uses values in this structure. (Used during a positive TPI 2 response))
                               3 = override timing values set by Tester (ECU does not use values set by Tester, but
                               instead uses values in this structure. (Used during a request of TPI 3.))
                               4 = normal timing values used by the ECU after initialization.
                               0xFF = extended timing (values in this structure are used after a keyword initialization
                               (if extended timing is supported by the KeyBytes). Timing is used by both tester and
                               ECU)) */
} PDU_PARAM_STRUCT_ACCESS_TIMING;
```

B.3.3.3 ComParam LONGFIELD Data Type

```
typedef struct {
    UNUM32  ParamMaxLen;    /* Contains the maximum number of UNUM32 entries the ComParam can contain in
                               pDataArray. The D-PDU API allocates this amount of UNUM32 memory prior to a call
                               of PDUGetComParam. The value of ParamMaxLen is given in the MDF file as part of
                               the DEFAULT_VALUE entry of the corresponding COMPARAM_REF or COMPARAM
                               (F.2.2 ComParam String Format). */
                               NOTE 1 A MAX_VALUE entry does not appear at the corresponding
                               COMPARAM_REF or COMPARAM for this type of ComParam.
```

```
    UNUM32  ParamActLen;    /* Contains the actual number of UNUM32 entries in pDataArray. The value of
                               ParamActLen is given in the MDF file as part of the DEFAULT_VALUE entry of the
                               corresponding COMPARAM_REF or COMPARAM (F.2.2 ComParam String Format). */
                            NOTE 2 A MIN_VALUE entry does not appear at the corresponding
                            COMPARAM_REF or COMPARAM for this type of ComParam.
    UNUM32  *pDataArray;    /* Pointer to an array of UNUM32 values */
} PDU_PARAM_LONGFIELD_DATA;
```

NOTE 3 In the MDF (see MVCI module description file (MDF)) the elements MIN_VALUE, MAX_VALUE and DEFAULT_VALUE are optional at the COMPARAM_REF and COMPARAM, except that only DEFAULT_VALUE is mandatory at COMPARAM. This is to ensure that ParamMaxlen is always retrievable from the MDF.

B.3.4 ComParam support

Each ComParam may or may not be supported by a MVCI protocol module. If a MVCI protocol module supports a protocol, then only the ComParams that are considered “standard” shall be supported by the MVCI protocol module. OEM-specific ComParams may be defined but will not be part of the standard.

ECU specific ComParams will not be interpreted by the D-PDU API. In case an ECU specific ComParam is passed to the D-PDU API, the API will return an error code.

Table B.7 — Definition of the ODX ComParam support types

ComParam Support	Acronym	Type Description
PDU_PS_STANDARD	S	The ComParam belonging to a standardized protocol has to be supported by the D-PDU API system to be compliant with this standard for every protocol supported by the D-PDU API. These ComParams apply to both the tester and the ECU unless CPUSAGE (see B.3.5) is specified.
PDU_PS_OPTIONAL	O	This ComParam does not have to be supported by the D-PDU API.

B.3.5 ComParam usage

In the PDU API ComParam tables the optional ComParam usage acronyms “T” and “E” are used to indicate whether a ComParam is relevant only for a Tester/MVCI protocol module (“T”) or whether it is only relevant for ECU software generation or configuration (“E”). If a ComParam is relevant for both tester and ECU, none of the acronyms “T” or “E” are used.

In ODX for each COMPARAM the attribute CPUSAGE shall be set to one of the possible values: “TESTER”, “ECU-SOFTWARE”, “ECU-COMM” or “APPLICATION”. The relation between the CPUSAGE attribute used in ODX and the optional ComParam usage acronyms “T” and “E” used in the PDU API ComParam tables is shown in Table B.8 — Definition of the ODX ComParam usage.

Table B.8 — Definition of the ODX ComParam usage

ODX CPUSAGE attribute	ComParam usage acronym used in PDU API ComParam tables	Description
TESTER	T	The ComParam is specific to the tester (VCI) and is neither supported nor implemented by the ECU.
ECU-SOFTWARE	E	The ComParam is specific to the ECU and is neither supported nor implemented by the tester (VCI).
ECU-COMM	—	The ComParam is needed for communication between tester and ECU and shall be supported by both tester and ECU (e.g. addresses).
APPLICATION	N/A	The ComParam is only evaluated by the application. It is never passed down to the D-PDU API by an MCD 3D/MVCI Diagnostic Server. The ComParam is not specified within the D-PDU API standard.

B.3.6 ComParam OSI layer reference

Each ComParam is applicable to a specific OSI Layer.

Table B.9 — Definition of the O.S.I. layer

Layer Info	Acronym	Layer Description
PDU_PL_APPLICATION	APP	ComParams in this layer apply to timing and error handling elements that are referenced in the application layer specifications.
PDU_PL_TRANSPORT	TRANS	ComParams in this layer apply to timing and configuration elements that are referenced in the Transport/Network layer specifications. These ComParams are used to configure header bytes, develop CAN ids, framing information, checksums, etc.
PDU_PL_PHYSICAL	PHYS	ComParams in this layer apply to elements that are referenced in the datalink/physical layer specifications. These ComParams affect the physical characteristics of bus configuration.

B.4 ComParam summary tables

B.4.1 Application layer

Table B.10 — Application layer ComParam summary table lists the ComParams applicable to the application Layer. If a ComParam is used by a particular protocol, the appropriate acronyms for the ODX ComParameter type (S, O), and the ODX ComParameter usage (T, E) are included.

Table B.10 — Application layer ComParam summary table

Parameter Short Name	ISO 15031_5												
	ISO_15765_4	ISO_14230_4	ISO_9141_2	SAE_J1850_VPW	SAE_J1850_PWM	ISO_14230_3	ISO_15765_3	ISO_11898_RAW	SAE_J1939_73	SAE_J1587	SAE_J2190	SAE_J2610	PARAM-CLASS
CP_CanTransmissionTime	O,T						O,T						TIMING
CP_ChangeSpeedCtrl	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_ChangeSpeedMessage	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_ChangeSpeedRate	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_ChangeSpeedResCtrl	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_ChangeSpeedTxDelay	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	TIMING
CP_CyclicRespTimeout	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	TIMING
CP_EnablePerformanceTest	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_Loopback	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM
CP_MessageIndicationRate									S,T				TIMING
CP_ModifyTiming		O,T				O,T	O,T						TIMING
CP_P2Max	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T	S,T		TIMING
CP_P2Max_Ecu	S,E	S,E	S,E			S,E	S,E						TIMING
CP_P2Min	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T			O,T		TIMING
CP_P2Star	S,T	S,T		S,T	S,T	S,T	S,T				S,T		TIMING
CP_P2Star_Ecu	S,E						S,E						TIMING
CP_P3Func	S,T						S,T	O,T					TIMING
CP_P3Max_Ecu		S,E	S,E			S,E							TIMING
CP_P3Min		S	S			S							TIMING
CP_P3Phys	S,T						S,T	O,T					TIMING
CP_RC21CompletionTimeout	S,T	S,T		S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RC21Handling	S,T	S,T		S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RC21RequestTime	S,T	S,T		S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RC23CompletionTimeout	O,T			S,T	S,T	S,T	O,T				S,T		ERRHDL
CP_RC23Handling	O,T			S,T	S,T	S,T	O,T				S,T		ERRHDL
CP_RC23RequestTime	O,T			S,T	S,T	S,T	O,T				S,T		ERRHDL
CP_RC78CompletionTimeout	S,T	S,T		S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RC78Handling	S,T	S,T		S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RCByteOffset	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		ERRHDL
CP_RepeatReqCountApp	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	ERRHDL
CP_SessionTiming_Ecu							S,E						TIMING

Table B.10 (*continued*)

Parameter Short Name	ISO 15031_5					ISO_14230_3	ISO_15765_3	ISO_11898_RAW	SAE_J1939_73	SAE_J1587	SAE_J2190	SAE_J2610	PARAM-CLASS
	ISO_15765_4	ISO_14230_4	ISO_9141_2	SAE_J1850_VPW	SAE_J1850_PWM								
CP_SessionTimingOverride							O,T						TIMING
CP_StartMsgIndEnable	S,T	S,T	S,T			S,T	S,T		S,T	S,T			COM
CP_SuspendQueueOnError	O,T	O,T	O,T	O,T	O,T	O,T	O,T		O,T		O,T		ERRHDL
CP_SwCan_HighVoltage	S,T					S,T	S,T	S,T					COM
CP_TesterPresentAddrMode	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentExpPos Resp	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentExpNeg Resp	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentHandling	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentMessage	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentReqRsp	S,T	S,T	S,T	S,T	S,T	S,T	S,T				S,T		TESTER_ PRESENT
CP_TesterPresentSendType	S,T	S,T	S,T	S,T	S,T	S,T	S,T						TESTER_ PRESENT
CP_TesterPresentTime	S,T	S,T	S,T	S,T	S,T	S,T	S,T						TESTER_ PRESENT
CP_TesterPresentTime_Ecu	S,E	S,E		S,E	S,E	S,E	S,E				S,E		TESTER_ PRESENT
CP_TransmitIndEnable	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	COM

B.4.2 Transport layer

Table B.11 — Transport layer ComParam summary table lists the ComParams applicable to the transport layer. If a ComParam is used by a particular protocol, the appropriate acronyms for the ODX ComParameter type (S, O), and the ODX ComParameter usage (T, E) are included.

Table B.11 — Transport layer ComParam summary table

Parameter Short Name	ISO_15765_4	ISO_14230_4	ISO_9141_2	ISO_15765_2	ISO_14230_2	SAE_J1939_21	SAE_J1708	SAE_J1850_VPW	SAE_J1850_PWM	SAE_2610_SCI	ISO_11898_RAW	PARAM-CLASS
CP_5BaudAddressFunc		S	S		S							COM
CP_5BaudAddressPhys			S		S							COM
CP_5BaudMode			S,T		S,T							INIT
CP_AccessTiming_Ecu		S,E			S,E							TIMING
CP_AccessTimingOverride		O,T			O,T							TIMING
CP_Ar	S,T			S,T								TIMING
CP_Ar_Ecu	S,E			S,E								TIMING
CP_As	S,T			S,T								TIMING
CP_As_Ecu	S,E			S,E								TIMING
CP_BlockSize	S,T			S,T		S,T	S,T					COM
CP_BlockSize_Ecu	S,E			S,E		S,E	S,E					COM
CP_BlockSizeOverride	O,T			O,T		O,T	O,T					COM
CP_Br	O,T			O,T		S	S					TIMING
CP_Br_Ecu	S,E			S,E		S,E	S,E					TIMING
CP_Bs	S,T			S,T		S	S					TIMING
CP_Bs_Ecu	S,E			S,E		S,E	S,E					TIMING
CP_CanDataSizeOffset	O,T			O,T								COM
CP_CanFillerByte	S			S		S					S	COM
CP_CanFillerByteHandling	S			S		S					S	COM
CP_CanFirstConsecutive-FrameValue	O,T			O,T								COM
CP_CanFuncReqExtAddr	S			S								COM
CP_CanFuncReqFormat	S			S								COM
CP_CanFuncReqId	S			S								COM
CP_CanMaxNumWaitFrames	S			S		S						COM
CP_CanPhysReqExtAddr	S			S							S	UNIQUE_ID
CP_CanPhysReqFormat	S			S							S	UNIQUE_ID
CP_CanPhysReqId	S			S							S	UNIQUE_ID
CP_CanRespUSDTExtAddr	S			S								UNIQUE_ID
CP_CanRespUSDTFormat	S			S								UNIQUE_ID
CP_CanRespUSDTId	S			S								UNIQUE_ID

Table B.11 (*continued*)

Parameter Short Name	ISO_15765_4	ISO_14230_4	ISO_9141_2	ISO_15765_2	ISO_14230_2	SAE_J1939_21	SAE_J1708	SAE_J1850_VPW	SAE_J1850_PWM	SAE_2610_SCI	ISO_11898_RAW	PARAM-CLASS
CP_CanRespUUDTExtAddr	S			S							S	UNIQUE_ID
CP_CanRespUUDTFormat	S			S							S	UNIQUE_ID
CP_CanRespUUDTId	S			S							S	UNIQUE_ID
CP_Cr	S,T			S,T		S	S					TIMING
CP_Cr_Ecu	S,E			S,E		S,E	S,E					TIMING
CP_Cs	O,T			O,T		S	S					TIMING
CP_Cs_Ecu	S,E			S,E		S,E	S,E					TIMING
CP_EcuRespSourceAddress		S	S		S			S	S			UNIQUE_ID
CP_EnableConcatenation		S,T	S,T		S,T			S,T	S,T			COM
CP_ExtendedTiming		S			S							TIMING
CP_FillerByte		S	S		S			S	S			COM
CP_FillerByteHandling		S	S		S			S	S			COM
CP_FillerByteLength		S	S		S			S	S			COM
CP_FuncReqFormatPriority-Type		S,T	S,T		S,T			S,T	S,T			COM
CP_FuncReqTargetAddr		S,T	S,T		S,T			S,T	S,T			COM
CP_FuncRespFormatPriority-Type		S	S		S			S	S			UNIQUE_ID
CP_FuncRespTargetAddr		S	S		S			S	S			UNIQUE_ID
CP_HeaderFormatJ1850								S,T	S,T			COM
CP_HeaderFormatKW		S,T			S,T							COM
CP_InitializationSettings		S	S		S							INIT
CP_J1939AddrClaimTimeout						S						TIMING
CP_J1939AddressNegotiation Rule						S						COM
CP_J1939DataPage						S						COM
CP_J1939MaxPacketTx						S						COM
CP_J1939Name						S,T						INIT
CP_J1939Name_Ecu						S,E						INIT
CP_J1939PDUFormat						S						COM
CP_J1939PDUSpecific						S						COM
CP_J1939PreferredAddress						S,T						INIT
CP_J1939PreferredAddress_ Ecu						S,E						INIT

Table B.11 (*continued*)

Parameter Short Name	ISO_15765_4	ISO_14230_4	ISO_9141_2	ISO_15765_2	ISO_14230_2	SAE_J1939_21	SAE_J1708	SAE_J1850_VPW	SAE_J1850_PWM	SAE_2610_SCI	ISO_11898_RAW	PARAM-CLASS
CP_J1939SourceAddress						S,T						UNIQUE_ID
CP_J1939SourceName						S,T						UNIQUE_ID
CP_J1939TargetAddress						S						COM
CP_J1939TargetName						S						COM
CP_MessagePriority						S	S					COM
CP_MidReqId							S					COM
CP_MidRespId							S					UNIQUE_ID
CP_P1Max		S	S		S							TIMING
CP_P1Min		O	O		O							TIMING
CP_P4Max		O	O		O							TIMING
CP_P4Min		S	S		S							TIMING
CP_PhysReqFormatPriority-Type		S,T	S,T		S,T			S,T	S,T			COM
CP_PhysReqTargetAddr		S	S		S			S	S			COM
CP_PhysRespFormatPriority-Type		S	S		S			S	S			UNIQUE_ID
CP_RepeatReqCountTrans	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T	O,T		ERRHDL
CP_RequestAddrMode	S,T	S,T	S,T	S,T	S,T			S,T	S,T			COM
CP_SCITransmitMode										S		INIT
CP_SendRemoteFrame	S			S		S					S	COM
CP_StMin	S,T			S,T								TIMING
CP_StMin_Ecu	S,E			S,E								TIMING
CP_StMinOverride	O,T			O,T								TIMING
CP_T1Max										S		TIMING
CP_T2Max										S		TIMING
CP_T3Max						S				S		TIMING
CP_T4Max						S				S		TIMING
CP_T5Max						S				S		TIMING
CP_TesterSourceAddress		S,T	S,T		S,T			S,T	S,T			COM
CP_TIdle		S	S		S							INIT
CP_TInil		S	S		S							INIT
CP_TPConnection-Management							S,T					COM

Table B.11 (*continued*)

Parameter Short Name	ISO_15765_4	ISO_14230_4	ISO_9141_2	ISO_15765_2	ISO_14230_2	SAE_J1939_21	SAE_J1708	SAE_J1850_VPW	SAE_J1850_PWM	SAE_2610_SCI	ISO_11898_RAW	PARAM-CLASS
CP_TWup		S	S		S							INIT
CP_W1Max		S	S		S							INIT
CP_W1Min		O	O		O							INIT
CP_W2Max		S	S		S							INIT
CP_W2Min		O	O		O							INIT
CP_W3Max		S	S		S							INIT
CP_W3Min		O	O		O							INIT
CP_W4Max		S	S		S							INIT
CP_W4Min		S	S		S							INIT

B.4.3 Physical layer

Table B.12 — Physical layer ComParam summary table lists the ComParams applicable to the Physical Layer. If a ComParam is used by a particular protocol, the appropriate acronyms for the ODX ComParameter type (S, O), and the ODX ComParameter usage (T, E) are included.

Table B.12 — Physical layer ComParam summary table

Parameter Short Name	ISO_11898_2_DWCAN	ISO_11898_3_DWFTCAN	ISO_11992_1_DWCAN	ISO_9141_2_UART	ISO_14230_1_UART	SAE_J2610_UART	SAE_J1708_UART	SAE_J1939_11_DWCAN	SAE_J1850_VPW	SAE_J1850_PWM	SAE_J2411_SWCAN	PARAM-CLASS
CP_Baudrate	S	S	S	S	S	S	S	S	S	S	S	BUSTYPE
CP_BitSamplePoint	S,T	S,T	S,T					S,T			S,T	BUSTYPE
CP_BitSamplePoint_Ecu	S,E	S,E	S,E					S,E			S,E	BUSTYPE
CP_CanBaudrateRecord	O,T	O,T	O,T					O,T				BUSTYPE
CP_K_L_LineInit				O	O							BUSTYPE
CP_K_LinePullup				O	O							BUSTYPE
CP_ListenOnly	O	O	O					O			O	BUSTYPE
CP_NetworkLine										S		BUSTYPE

Table B.12 (*continued*)

Parameter Short Name	ISO_11898_2_DWCAN	ISO_11898_3_DWFTCAN	ISO_11992_1_DWCAN	ISO_9141_2_UART	ISO_14230_1_UART	SAE_J2610_UART	SAE_J1708_UART	SAE_J1939_11_DWCAN	SAE_J1850_VPW	SAE_J1850_PWM	SAE_J2411_SWCAN	PARAM-CLASS
CP_SamplesPerBit	S,T	S,T	S,T					S,T			S,T	BUSTYPE
CP_SamplesPerBit_Ecu	S,E	S,E	S,E					S,E			S,E	BUSTYPE
CP_SyncJumpWidth	S,T	S,T	S,T					S,T			S,T	BUSTYPE
CP_SyncJumpWidth_Ecu	S,E	S,E	S,E					S,E			S,E	BUSTYPE
CP_TerminationType	O,T							O,T			O,T	BUSTYPE
CP_TerminationType_Ecu											O,E	BUSTYPE
CP_UartConfig				S	S	S	S					BUSTYPE

B.4.4 CAN identifier format for ISO 15765 and ISO 11898 protocols

The protocols transport layer uses the CAN identifier format information to properly format CAN frames, and to construct the correct CAN ID. For received frames, the information is used to handle expected CAN frames, and to help in receive format processing.

Table B.13 — CAN ID format (UNUM32) for ISO_15765 and ISO_11898

Bit Position	Name	Description
5,4	Padding Overwrite	00 = Use CP_CanFillerByteHandling for padding control 01 = Reserved 10 = Padding explicitly disabled for this CAN Id (overwrite CP_CanFillerByteHandling) 11 = Padding explicitly enabled for this CAN Id (overwrite CP_CanFillerByteHandling) NOTE These bits only apply to the CAN Ids transmitted by the MVCI, meaning that it only applies to the ComParams CP_CanPhysReqFormat and CP_CanFuncReqFormat.
3	Addressing Scheme	0 = Normal addressing 1 = Extended addressing (Byte 1 of CAN Frame will contain N_AE/N_TA)
2	Data Transfer Handling	0 = UUDT Message (No PCI Bytes) 1 = USDT Message (Segmented frames)
1	CAN Id Size	0 = 11-bit 1 = 29-bit
0	Flow Control	0 = Flow Control frames are disabled 1 = Flow Control frames are enabled

Table B.14 — Coded values for CAN ID format provides a summary of all possible coded values for the CAN ID format ComParams.

Table B.14 — Coded values for CAN ID format

Coded Value	Bit 5,4: Padding Overwrite	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description
0x00	normal	normal	unsegmented	11-bit	w/o FC	normal unsegmented 11-bit CP_CanFillerByteHandling for padding control
0x01	normal	normal	unsegmented	11-bit	with FC	n/a
0x02	normal	normal	unsegmented	29-bit	w/o FC	normal unsegmented 29-bit CP_CanFillerByteHandling for padding control
0x03	normal	normal	unsegmented	29-bit	with FC	n/a
0x04	normal	normal	segmented	11-bit	w/o FC	normal segmented 11-bit w/o FC CP_CanFillerByteHandling for padding control
0x05	normal	normal	segmented	11-bit	with FC	normal segmented 11-bit with FC CP_CanFillerByteHandling for padding control
0x06	normal	normal	segmented	29-bit	w/o FC	normal segmented 29-bit w/o FC CP_CanFillerByteHandling for padding control
0x07	normal	normal	segmented	29-bit	with FC	normal segmented 29-bit with FC CP_CanFillerByteHandling for padding control
0x08	normal	extended	unsegmented	11-bit	w/o FC	extended unsegmented 11-bit CP_CanFillerByteHandling for padding control
0x09	normal	extended	unsegmented	11-bit	with FC	n/a
0x0A	normal	extended	unsegmented	29-bit	w/o FC	extended unsegmented 29-bit CP_CanFillerByteHandling for padding control
0x0B	normal	extended	unsegmented	29-bit	with FC	n/a
0x0C	normal	extended	segmented	11-bit	w/o FC	extended segmented 11-bit w/o FC CP_CanFillerByteHandling for padding control
0x0D	normal	extended	segmented	11-bit	with FC	extended segmented 11-bit with FC CP_CanFillerByteHandling for padding control
0x0E	normal	extended	segmented	29-bit	w/o FC	extended segmented 29-bit w/o FC CP_CanFillerByteHandling for padding control

Table B.14 (*continued*)

Coded Value	Bit 5,4: Padding Overwrite	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description
0x0F	normal	extended	segmented	29-bit	with FC	extended segmented 29-bit with FC CP_CanFillerByteHandling for padding control
0x10-0x1F						Reserved
0x20	Disable padding	normal	unsegmented	11-bit	w/o FC	normal unsegmented 11-bit Do not use CP_CanFillerByteHandling for padding control
0x21	Disable padding	normal	unsegmented	11-bit	with FC	n/a
0x22	Disable padding	normal	unsegmented	29-bit	w/o FC	normal unsegmented 29-bit Do not use CP_CanFillerByteHandling for padding control
0x23	Disable padding	normal	unsegmented	29-bit	with FC	n/a
0x24	Disable padding	normal	segmented	11-bit	w/o FC	normal segmented 11-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x25	Disable padding	normal	segmented	11-bit	with FC	normal segmented 11-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x26	Disable padding	normal	segmented	29-bit	w/o FC	normal segmented 29-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x27	Disable padding	normal	segmented	29-bit	with FC	normal segmented 29-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x28	Disable padding	extended	unsegmented	11-bit	w/o FC	extended unsegmented 11-bit Do not use CP_CanFillerByteHandling for padding control
0x29	Disable padding	extended	unsegmented	11-bit	with FC	n/a
0x2A	Disable padding	extended	unsegmented	29-bit	w/o FC	extended unsegmented 29-bit Do not use CP_CanFillerByteHandling for padding control
0x2B	Disable padding	extended	unsegmented	29-bit	with FC	n/a

Table B.14 (*continued*)

Coded Value	Bit 5,4: Padding Overwrite	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description
0x2C	Disable padding	extended	segmented	11-bit	w/o FC	extended segmented 11-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x2D	Disable padding	extended	segmented	11-bit	with FC	extended segmented 11-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x2E	Disable padding	extended	segmented	29-bit	w/o FC	extended segmented 29-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x2F	Disable padding	extended	segmented	29-bit	with FC	extended segmented 29-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x30	Enable padding	normal	unsegmented	11-bit	w/o FC	normal unsegmented 11-bit Do not use CP_CanFillerByteHandling for padding control
0x31	Enable padding	normal	unsegmented	11-bit	with FC	n/a
0x32	Enable padding	normal	unsegmented	29-bit	w/o FC	normal unsegmented 29-bit Do not use CP_CanFillerByteHandling for padding control
0x33	Enable padding	normal	unsegmented	29-bit	with FC	n/a
0x34	Enable padding	normal	segmented	11-bit	w/o FC	normal segmented 11-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x35	Enable padding	normal	segmented	11-bit	with FC	normal segmented 11-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x36	Enable padding	normal	segmented	29-bit	w/o FC	normal segmented 29-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x37	Enable padding	normal	segmented	29-bit	with FC	normal segmented 29-bit with FC Do not use CP_CanFillerByteHandling for padding control

Table B.14 (*continued*)

Coded Value	Bit 5,4: Padding Overwrite	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description
0x38	Enable padding	extended	unsegmented	11-bit	w/o FC	extended unsegmented 11-bit Do not use CP_CanFillerByteHandling for padding control
0x39	Enable padding	extended	unsegmented	11-bit	with FC	n/a
0x3A	Enable padding	extended	unsegmented	29-bit	w/o FC	extended unsegmented 29-bit Do not use CP_CanFillerByteHandling for padding control
0x3B	Enable padding	extended	unsegmented	29-bit	with FC	n/a
0x3C	Enable padding	extended	segmented	11-bit	w/o FC	extended segmented 11-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x3D	Enable padding	extended	segmented	11-bit	with FC	extended segmented 11-bit with FC Do not use CP_CanFillerByteHandling for padding control
0x3E	Enable padding	extended	segmented	29-bit	w/o FC	extended segmented 29-bit w/o FC Do not use CP_CanFillerByteHandling for padding control
0x3F	Enable padding	extended	segmented	29-bit	with FC	extended segmented 29-bit with FC Do not use CP_CanFillerByteHandling for padding control

Table B.15 — Coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat provides a list of the coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat CAN ID format ComParams. This list includes the applicable subset of coded values defined in Table B.14 — Coded values for CAN ID format.

Table B.15 — Coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat

Coded Value	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description for CP_CanPhysReqFormat and CP_CanFuncReqFormat
0x00	normal	unsegmented	11-bit	w/o FC	Normal addressing for Source (Tester), UUDT Message Transmit (No PCI Bytes), 11-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x01	normal	unsegmented	11-bit	with FC	n/a
0x02	normal	unsegmented	29-bit	w/o FC	Normal addressing for Source (Tester), UUDT Message Transmit (No PCI Bytes), 29-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x03	normal	unsegmented	29-bit	with FC	n/a

Table B.15 (*continued*)

Coded Value	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description for CP_CanPhysReqFormat and CP_CanFuncReqFormat
0x04	normal	segmented	11-bit	w/o FC	Normal addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 11-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x05	normal	segmented	11-bit	with FC	Normal addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 11-bit CAN ID Size, Flow Control frames are expected from Target (ECU)
0x06	normal	segmented	29-bit	w/o FC	Normal addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 29-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x07	normal	segmented	29-bit	with FC	Normal addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 29-bit CAN ID Size, Flow Control frames are expected from Target (ECU)
0x08	extended	unsegmented	11-bit	w/o FC	Extended addressing for Source (Tester), UUDT Message Transmit (No PCI Bytes), 11-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x09	extended	unsegmented	11-bit	with FC	n/a
0x0A	extended	unsegmented	29-bit	w/o FC	Extended addressing for Source (Tester), UUDT Message Transmit (No PCI Bytes), 29-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x0B	extended	unsegmented	29-bit	with FC	n/a
0x0C	extended	segmented	11-bit	w/o FC	Extended addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 11-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x0D	extended	segmented	11-bit	with FC	Extended addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 11-bit CAN ID Size, Flow Control frames are expected from Target (ECU)
0x0E	extended	segmented	29-bit	w/o FC	Extended addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 29-bit CAN ID Size, No Flow Control frames are expected from Target (ECU)
0x0F	extended	segmented	29-bit	with FC	Extended addressing for Source (Tester), USDT Message Transmit (Segmented transmits), 29-bit CAN ID Size, Flow Control frames are expected from Target (ECU)

NOTE Table B.15 — Coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat does not explicitly consider the PaddingOverwrite bits (bits 4 and 5), but can be enhanced accordingly.

Table B.16 — Coded values for CP_CanRespUSDTFormat provides a list of the coded values for CP_CanRespUSDTFormat CAN ID format ComParam. This list includes the applicable subset of coded values defined in Table B.14 — Coded values for CAN ID format.

Table B.16 — Coded values for CP_CanRespUSDTFormat

Coded Value	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description for CP_CanRespUSDTFormat
0x0	normal	unsegmented	11-bit	w/o FC	n/a
0x1	normal	unsegmented	11-bit	with FC	n/a
0x2	normal	unsegmented	29-bit	w/o FC	n/a
0x3	normal	unsegmented	29-bit	with FC	n/a
0x4	normal	segmented	11-bit	w/o FC	Normal addressing for Target (ECU), USDT Message Receive (Segmented receives), 11-bit CAN ID Size, No Flow Control is sent when a First Frame is received
0x5	normal	segmented	11-bit	with FC	Normal addressing for Target (ECU), USDT Message Receive (Segmented receives), 11-bit CAN ID Size, Flow Control is sent when a First Frame is received
0x6	normal	segmented	29-bit	w/o FC	Normal addressing for Target (ECU), USDT Message Receive (Segmented receives), 29-bit CAN ID Size, No Flow Control is sent when a First Frame is received
0x7	normal	segmented	29-bit	with FC	Normal addressing for Target (ECU), USDT Message Receive (Segmented receives), 29-bit CAN ID Size, Flow Control is sent when a First Frame is received
0x8	extended	unsegmented	11-bit	w/o FC	n/a
0x9	extended	unsegmented	11-bit	with FC	n/a
0xA	extended	unsegmented	29-bit	w/o FC	n/a
0xB	extended	unsegmented	29-bit	with FC	n/a
0xC	extended	segmented	11-bit	w/o FC	Extended addressing for Target (ECU), USDT Message Receive (Segmented receives), 11-bit CAN ID Size, No Flow Control is sent when a First Frame is received
0xD	extended	segmented	11-bit	with FC	Extended addressing for Target (ECU), USDT Message Receive (Segmented receives), 11-bit CAN ID Size, Flow Control is sent when a First Frame is received
0xE	extended	segmented	29-bit	w/o FC	Extended addressing for Target (ECU), USDT Message Receive (Segmented receives), 29-bit CAN ID Size, No Flow Control is sent when a First Frame is received
0xF	extended	segmented	29-bit	with FC	Extended addressing for Target (ECU), USDT Message Receive (Segmented receives), 29-bit CAN ID Size, Flow Control is sent when a First Frame is received

NOTE The PaddingOverwrite bits (bits 4 and 5) do not apply to the ComParam CP_CanRespUSDTFormat.

Table B.17 — Coded values for CP_CanRespUUDTFormat provides a list of the coded values for CP_CanRespUUDTFormat CAN ID format ComParam. This list includes the applicable subset of coded values defined in Table B.14 — Coded values for CAN ID format.

Table B.17 — Coded values for CP_CanRespUUDTFormat

Coded Value	Bit 3: Addressing Scheme	Bit 2: Data Transfer Handling	Bit 1: CAN ID Size	Bit 0: Flow Control	Description for CP_CanRespUUDTFormat
0x0	normal	unsegmented	11-bit	w/o FC	Normal addressing for Target (ECU), UUDT Message Receive (No PCI Bytes), 11-bit CAN ID Size, UUDT Message Receive (No Flow Control)
0x1	normal	unsegmented	11-bit	with FC	n/a
0x2	normal	unsegmented	29-bit	w/o FC	Normal addressing for Target (ECU), UUDT Message Receive (No PCI Bytes), 29-bit CAN ID Size, UUDT Message Receive (No Flow Control)
0x3	normal	unsegmented	29-bit	with FC	n/a
0x4	normal	segmented	11-bit	w/o FC	n/a
0x5	normal	segmented	11-bit	with FC	n/a
0x6	normal	segmented	29-bit	w/o FC	n/a
0x7	normal	segmented	29-bit	with FC	n/a
0x8	extended	unsegmented	11-bit	w/o FC	Extended addressing for Target (ECU), UUDT Message Receive (No PCI Bytes), 11-bit CAN ID Size, UUDT Message Receive (No Flow Control)
0x9	extended	unsegmented	11-bit	with FC	n/a
0xA	extended	unsegmented	29-bit	w/o FC	Extended addressing for Target (ECU), UUDT Message Receive (No PCI Bytes), 29-bit CAN ID Size, UUDT Message Receive (No Flow Control)
0xB	extended	unsegmented	29-bit	with FC	n/a
0xC	extended	segmented	11-bit	w/o FC	n/a
0xD	extended	segmented	11-bit	with FC	n/a
0xE	extended	segmented	29-bit	w/o FC	n/a
0xF	extended	segmented	29-bit	with FC	n/a

NOTE The PaddingOverwrite bits (bits 4 and 5) do not apply to the ComParam CP_CanRespUUDTFormat.

B.4.4.1 CAN identifier format example

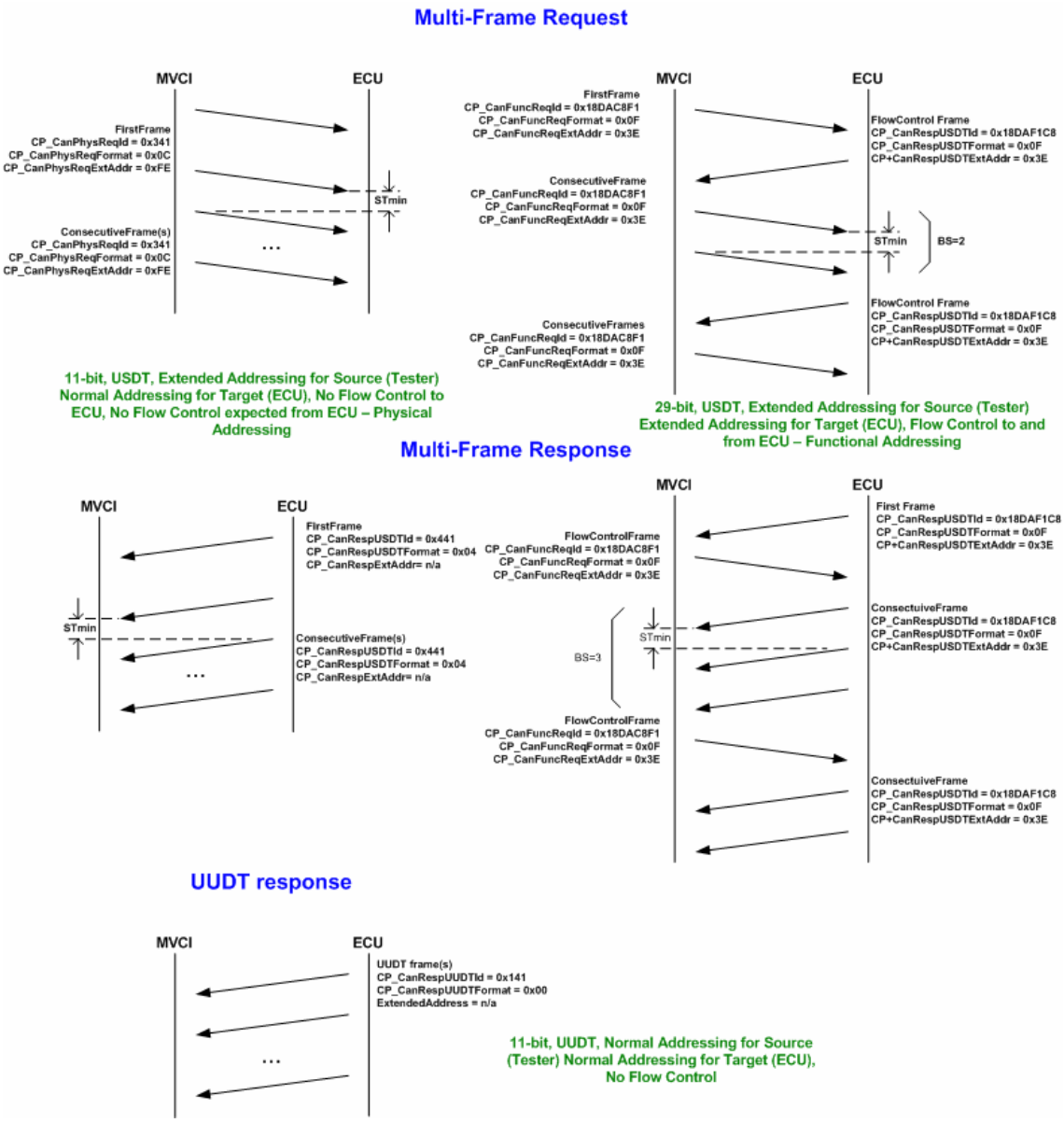


Figure B.2 — Example #1 CAN Id format configurations

B.4.4.2 CAN frame example

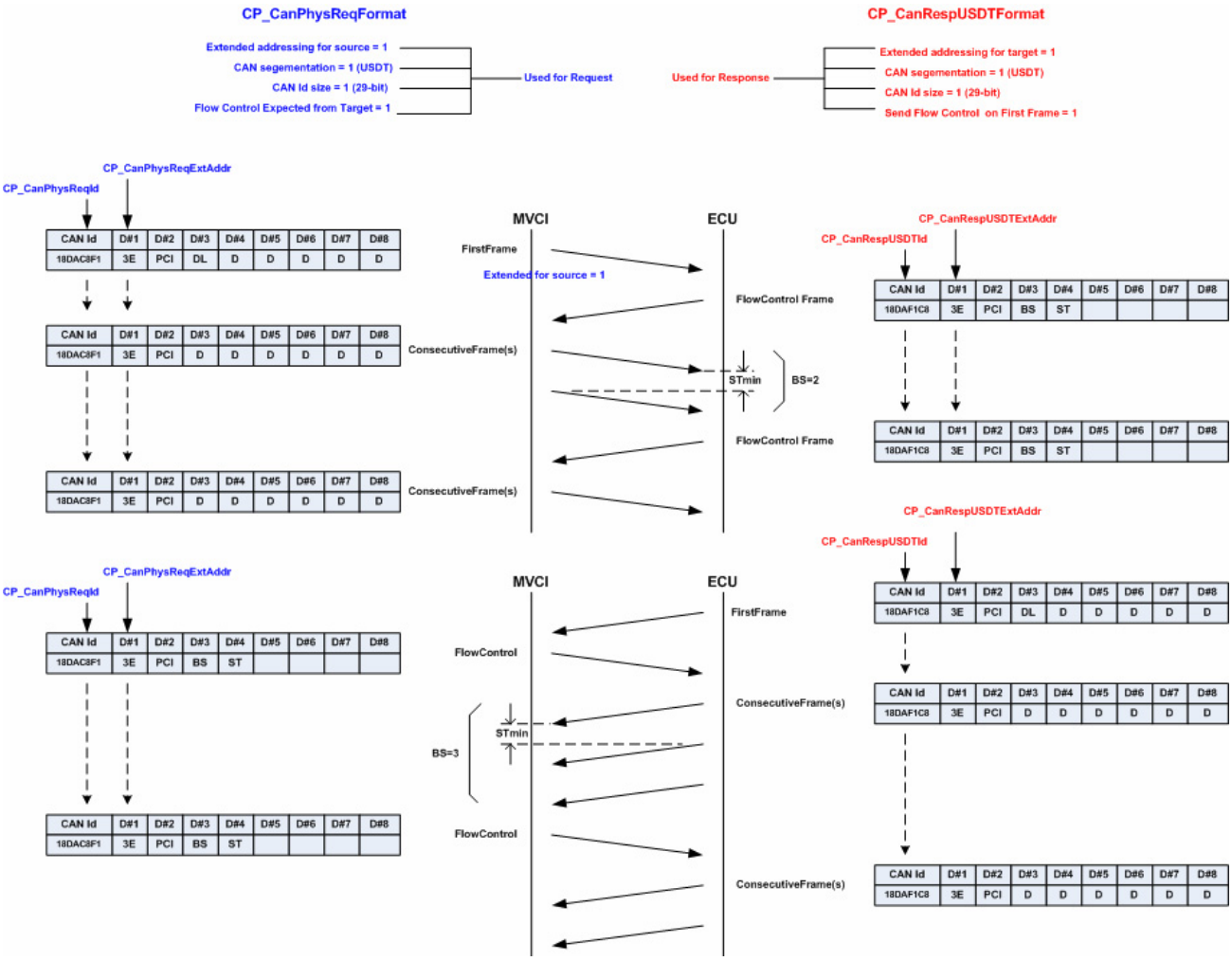


Figure B.3 — Example #2 CAN Id format configurations

B.4.5 Non-CAN ComParam examples

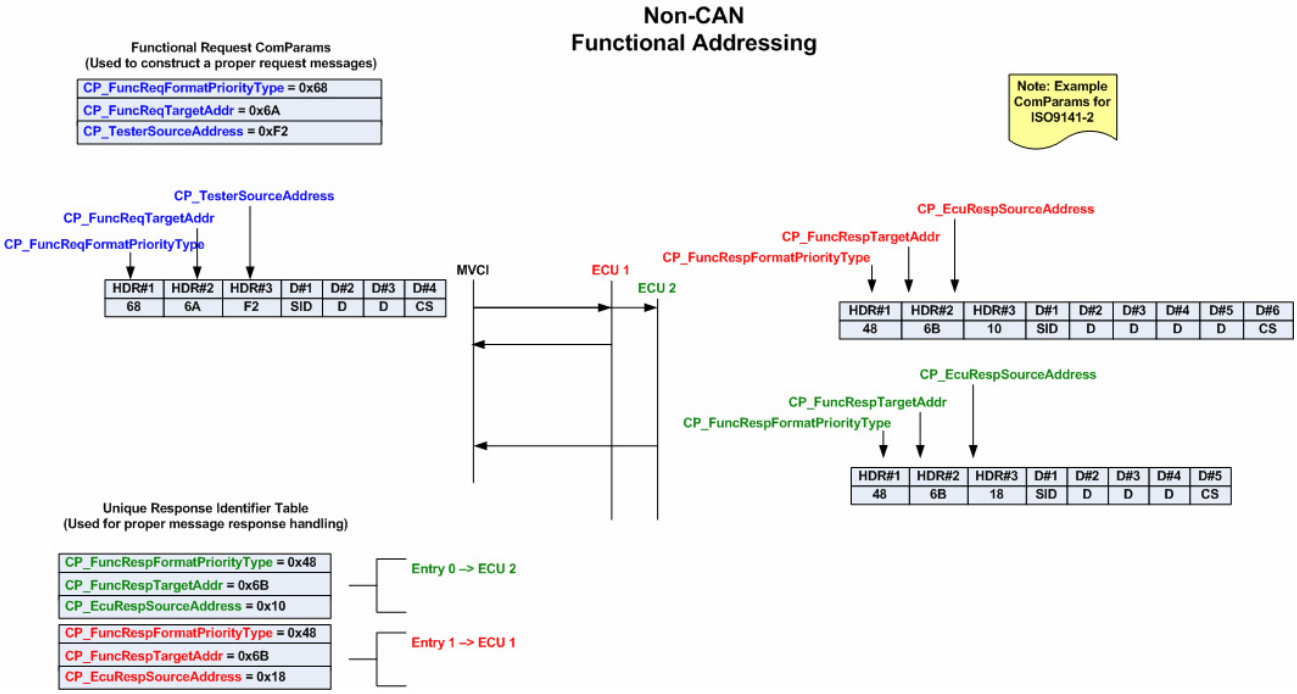


Figure B.4 — Example #1 Non-CAN functional addressing

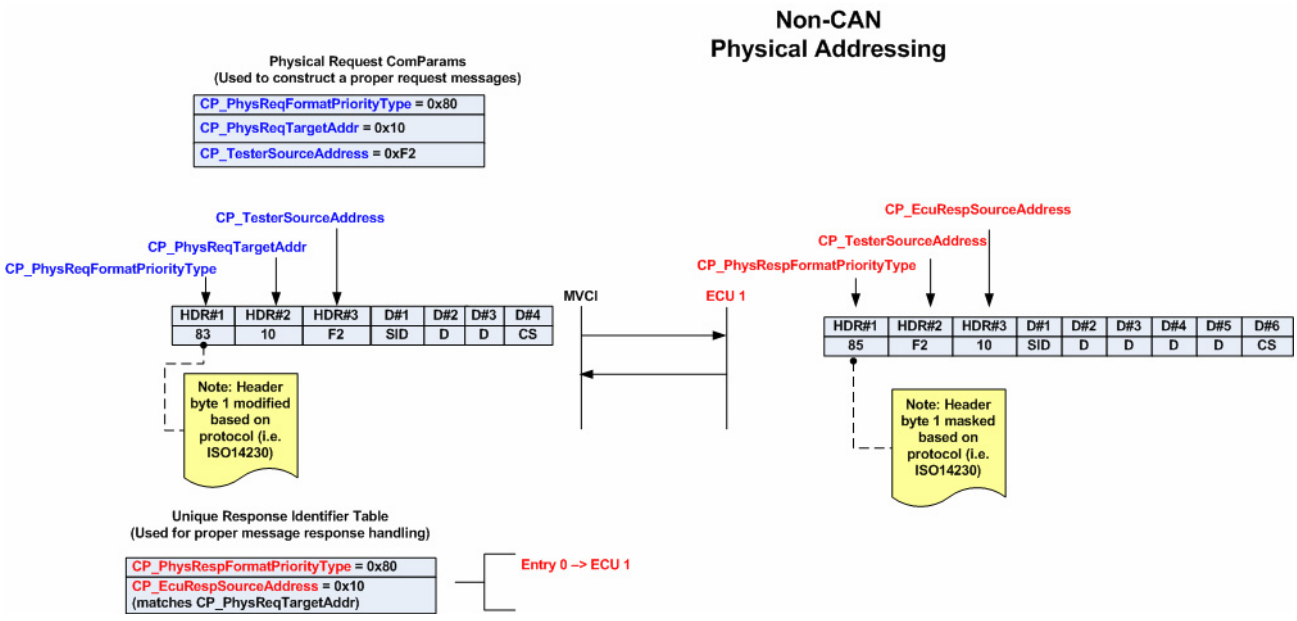


Figure B.5 — Example #2 Non-CAN physical addressing

B.4.6 29-bit CAN Identifier data page bits

The Extended Data Page and Data Page bits determine which format of the 29 bit CAN identifier shall be used for the SAE J1939 and ISO 15765-3 protocols.

Table B.18 — Definition of Extended Data Page and Data Page field

Extended Data Page Bit 25	Data Page Bit 24	Description
0	0	Page 0 PGNs SAE J1939 defined or manufacturer-defined “Normal Communication Message” strategy if SAE J1939 is not implemented
0	1	Page 1 PGNs SAE J1939 defined or manufacturer-defined “Normal Communication Message” strategy if SAE J1939 is not implemented
1	0	Reserved SAE J1939-reserved or manufacturer-defined “Normal Communication Message” strategy if SAE J1939 is not implemented
1	1	ISO 15765-3-defined

B.5 ComParam detailed descriptions

B.5.1 ComParam definitions for application layer

Table B.19 — Application layer ComParam definition table

Short Name	Detailed Description	Default (By Protocol)
CP_CanTransmissionTime	Description: If the timeout values are used which have been received by the ECU via session control response (0x50), the Can transmission time has to be added to the timeout values. P2 = received P2 + CanTransmissionTime (contains delay for both transmission directions).	ISO_15765_4 = 100000 ISO_15765_3 = 100000
	Type: PDU_PT_UNUM32 Range: 0x0000-0xFFFFFFFF Resolution: 1 µs	
CP_ChangeSpeedCtrl	Description Control the behaviour of the MVCI protocol module in processing speed change messages. When this ComParam is enabled, the speed rate change will be activated on a successful Send or SendRecv ComPrimitive when the transmitted or received message matches the CP_ChangeSpeedMessage (baud rate as specified in CP_ChangeSpeedRate and termination resistor as specified in CP_ChangeSpeedResCtrl). In the case of monitoring mode, when a receive PDU is bound to a Receive Only ComPrimitive, and this ComParam is enabled, the speed rate change will also be activated and the corresponding ComParams will be interpreted accordingly See use case example Table I.1 — Example vehicle bus baud rate changing scenario.	All = 0 (disabled)

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = NO_SPDCHANGE – No speed change 1 = ENABLE_SPDCHANGE – Change Speed rate is enabled	
CP_ChangeSpeedMessage	Description: Switch Speed Message. The message is monitored for transmit and receive. When this message is detected on the vehicle bus, the CP_ChangeSpeedRate and CP_ChangeSpeedResCtrl ComParams are processed. NOTE CP_ChangeSpeedCtrl is enabled for this ComParam to be active.	All Protocols: ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 12 ParamActLen = 0 to 12 pDataArray=ChangeSpdMessage[12] Range: Each byte = [0; 0xFF]	
CP_ChangeSpeedRate	Description: The data rate to be used when switching speed rates. When changed, this value is copied to CP_Baudrate ComParam.	All = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFFFFFFFF] Resolution: 1 bps	
CP_ChangeSpeedResCtrl	Description: This ComParam is used in conjunction with CP_ChangeSpeedCtrl. This ComParam is used to control automatic loading or unloading of the physical resource resistor when a change speed message has been transmitted or received.	All = 0 (DISABLE_AUTO_ RESISTOR)
	Type: PDU_PT_UNUM32 Value: [0; 0xFF] 0=Not used (DISABLE_AUTO_RESISTOR) 1=AC load resistor (AUTO_LOAD_AC_RESISTOR) 2=60 Ohm load resistor (AUTO_LOAD_60OHM_RESISTOR) 3=120 Ohm load resistor (AUTO_LOAD_120OHM_RESISTOR) 4=SWCAN load resistor (AUTO_LOAD_SWCAN_RESISTOR) 0x80=Unload resistor (AUTO_UNLOAD_RESISTOR). NOTE For AUTO_UNLOAD_RESISTOR, it is intended that CP_TerminationType be set to the initial value configured at the time of a PDUConnect.	

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_ChangeSpeedTxDelay	Description: Minimum amount of time to wait before allowing the next transmit message on the Vehicle Bus after the successful transmission of a baud rate change message.	All = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFFFFFFFF] Resolution: 1 µs	
CP_CyclicRespTimeout	Description: This ComParam is used for ComPrimitives that have a NumRecvCycles set to IS-CYCLIC (-1, infinite). The timer is enabled after the first positive response is received from an ECU. If CP_CyclicRespTimeout = 0, there is no receive timing enabled for the infinite receive ComPrimitive.	All protocols = 0
	Type: PDU_PT_UNUM32 Range: 0x0000-0xFFFFFFFF Resolution: 1 µs	
CP_EnablePerformanceTest	Description: This ComParam (when enabled) will place the tester into a performance measurement mode. Measurements will be collected during a normal ComPrimitive communications session. ComParams such as P1Min, P2Min, Br, Cs will be tested in this mode. Once the testing is disabled, results of the testing will be returned to the client application.	All protocols = 0
	Type: PDU_PT_UNUM32 Value [0;1] 0 = Disabled 1 = Enabled	
CP_Loopback	Description: Echo Transmitted messages in the receive queue, including periodic messages. Loopback messages shall only be sent after successful transmission of a message. Loopback frames are not subject to message filtering.	All Protocols=0
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = OFF 1 = ON	
CP_MessageIndicationRate	Description: The maximum rate for which the D-PDU API will generate PDU_EVENT_ITEM of PDU_IT_RESULT type for a receive only ComPrimitive. The D-PDU API will generate PDU_IT_RESULT events at time intervals greater than or equal to the value defined by this ComParam even if the ECU is sending the data at a faster rate. The function of this parameter is to prevent a broadcast PGN from an ECU that is sent at a high frequency from flooding the client with data.	SAE_J1939_73=0
	Type: PDU_PT_UNUM32 Range: 0x00000000 disabled 0x00000001 - 0xFFFFFFFF Resolution: 1 µs	

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_ModifyTiming	Description: This parameter signals the D-PDU API to automatically modify timing parameters based on a response from the ECU. For ISO 14230-2 this would apply to service 0x83/0xC3 with TPI of 1, 2 or 3. For ISO 15765-3 this would apply to service 0x10/0x50. For functional addressing mode, the worst case timing parameter returned by the responding ECUs shall be used. Based on the protocol, the following parameters are modified when a positive ECU response is received: — CP_P2Max — CP_P2Min — CP_P2Star — CP_P3Min — CP_P4Min NOTE The values returned by an ECU are in a different time resolution than the ComParams to be automatically modified. The values will be reinterpreted from the protocol specified time resolution to the 1us resolution specified in the D-PDU API. Type: PDU_PT_UNUM32 Value: [0;1] 0 = Disabled 1 = Enabled	ISO15765_3 = 0 ISO14230_4 = 0 ISO14230_3 = 0
CP_P2Max	Description: Timeout in receiving an expected frame after a successful transmit complete. Also used for multiple ECU responses. Type: PDU_PT_UNUM32 Range: [0; 125000000] Resolution: 1 µs	ISO_15765_4=140000 ISO_14230_4=50000 ISO_9141_2 =50000 SAE_J1850_VPW=100000 SAE_J1850_PWM=100000 ISO_14230_3=50000 ISO_15765_3=150000 ISO_11898_RAW = 50000 SAE_J1587= 60000000 SAE_J1939_73 = 200000 SAE_J2190=50000
CP_P2Max_Ecu	Description: Performance requirement for the server to start with the response message after the reception of a request message (indicated via N_USData.ind). This is a performance requirement ComParam. (CP_P2Max_ECU < CP_P2Max - CP_CanTransmissionTime) NOTE CP_P2Max_Ecu < CP_P2Max - CP_CanTransmissionTime Type: PDU_PT_UNUM32 Range: [0; 100000000] Resolution: 1 µs	ISO_15765_4 = 40000 ISO_14230_4 = 50000 ISO_9141_2 = 50000 ISO_14230_3 = 50000 ISO_15765_3 = 50000

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_P2Min	Description: This sets the minimum time between tester request and ECU responses, or two ECU responses. After the request, the interface shall be capable of handling an immediate response (P2_min=0). For subsequent responses, a byte received after P1_MAX shall be considered as the start of the subsequent response. This is a performance requirement ComParam. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_15765_4=0 ISO_14230_4=25000 ISO_9141_2 =25000 SAE_J1850_VPW = 0 SAE_J1850_PWM = 0 ISO_14230_3 = 25000 ISO_15765_3 = 0 ISO_11898 = 0 SAE_J2190 = 0
CP_P2Star	Description: Timeout for the client to expect the start of the response message after the reception of a negative response message (indicated via N_USData.ind) with response code 0x78 (enhanced response timing). See CP_RC78Handling for details describing 0x78 0x7F handling. This parameter is used for all protocols that support the negative response code 0x78. For some protocols it is used instead of the recommended P3Max parameter. Type: PDU_PT_UNUM32 Range: [0; 655350000] Resolution: 1 µs	ISO_15765_3=5050000 ISO_15765_4=5050000 (see ISO 15765-3 for delta P2) ISO_J1850_ VPW = 5000000 ISO_J1850_ PWM = 5000000 ISO_14230_3 = 5000000 ISO_14230_4 = 5000000 SAE_J2190=5000000
CP_P2Star_Ecu	Description: Performance requirement for the server to start with the response message after the transmission of a negative response message (indicated via N_USData.con) with response code 0x78 (enhanced response timing). This is a performance requirement ComParam. NOTE CP_P2Star_Ecu < CP_P2Star – 0.5 * CP_CanTransmissionTime Type: PDU_PT_UNUM32 Range: [0; 100000000] Resolution: 1 µs	ISO_15765_4=5000000 ISO_15765_3=5000000
CP_P3Func	Description: Minimum time for the client to wait after the successful transmission of a functionally addressed request message (indicated via N_USData.con), before it can transmit the next functionally addressed request message, in case no response is required, or the requested data is only supported by a subset of the functionally addressed servers. Type: PDU_PT_UNUM32 Range: [0; 125000000] Resolution: 1 µs	ISO_15765_4 = 50000 ISO_15765_3 = 50000 ISO_11898_RAW = 0

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_P3Max_Ecu	Description: Time between end of ECU responses and start of new tester request. Type: PDU_PT_UNUM32 Range: [0; 100000000] Resolution: 1 µs	ISO_14230_4=5000000 ISO_14230_3=5000000 ISO_9141_2 = 5000000
CP_P3Min	Description: Minimum time between end of non-negative ECU responses and start of new request. The interface will accept all responses up to CP_P3Min time. The interface will allow transmission of a request any time after CP_P3Min. (See CP_RC21RequestTime for minimum time between end of ECU negative responses and start of new requests.) Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2=55000 ISO_14230_4 = 55000 ISO_14230_3 = 55000
CP_P3Phys	Description: Minimum time for the client to wait after the successful transmission of a physically addressed request message (indicated via N_USData.con) with no response required before it can transmit the next physically-addressed request message. Type: PDU_PT_UNUM32 Range: [0; 125000000] Resolution: 1 µs	ISO_15765_4 = 50000 ISO_15765_3 = 50000 ISO_11898_RAW = 0
CP_RC21CompletionTimeout	Description: Time period the tester accepts repeated negative responses with response code 0x21 and repeats the same request. Timer is started after reception of first negative response. Type: PDU_PT_UNUM32 Range: [0; max] (max is protocol specific) Resolution: 1 µs	ISO_15765_4 = 1300000 ISO_14230_4=1300000 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=1300000 ISO_15765_3 = 1300000 SAE_J2190=0
CP_RC21Handling	Description: Repetition mode in case of response code 0x7F XX 0x21. Type: PDU_PT_UNUM32 Value: [0; 2] 0 = Disabled 1 = Continue handling negative responses until CP_RC21CompletionTimeout 2 = Continue handling unlimited (until disabled)	ISO_15765_4=2 ISO_14230_4=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=0 SAE_J2190=0

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_RC21RequestTime	Description: Time between negative response with response code 0x21 and the retransmission of the same request. If CP_P3Min is greater than CP_RC21RequestTime, the time delay prior to the retransmission of the same request will be CP_P3Min. Type: PDU_PT_UNUM32 Range: [0; 100000000] Resolution: 1 µs	ISO_15765_4= 200000 ISO_14230_4=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=10000 SAE_J2190 =0
CP_RC23CompletionTimeout	Description: Time period the tester accepts repeated negative responses with response code 0x23 and repeats the same request. Type: PDU_PT_UNUM32 Range: [0; max] (max is protocol specific) Resolution: 1 µs	ISO_15765_4=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=0 SAE_J2190=0
CP_RC23Handling	Description: Repetition mode in case of response code 0x7F XX 0x23. Type: PDU_PT_UNUM32 Value: [0; 2] 0 = Disabled 1 = Continue handling negative responses until CP_RC23CompletionTimeout 2 = Continue handling unlimited (until disabled)	ISO_15765_4=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=0 SAE_J2190=0
CP_RC23RequestTime	Description: The time the D-PDU API waits to re-request the message when receiving a negative response code 0x23. For some protocols (SAE_J1850_VPW) it is possible to get a positive response after receiving a negative response code 0x23, so the D-PDU API uses this ComParam as the time to receive a possible positive response before making the re-request. On a positive response within this time, the re-request is cancelled. The D-PDU API postpones the re-request until the timeout of CP_RC23RequestTime (or a CP_P3Min timeout, in case CP_P3Min is greater than CP_RC23RequestTime). For ISO 14230-3, there will be no positive response following a RC23 therefore the D-PDU API is expected to always make a re-request if enabled (CP_RC23Handling != 0). The cycle of receiving negative response code 0x23 and retransmitting the request continues until CP_RC23CompletionTimeout expires (applicable only if CP_RC23Handling is set to 1). Type: PDU_PT_UNUM32 Range: [0; 100000000] Resolution: 1 µs	ISO_15765_4=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=0 SAE_J2190=0

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_RC78CompletionTimeout	Description: Time period the tester accepts repeated negative responses with response code 0x78 and waits for a positive response further on. Type: PDU_PT_UNUM32 Range: [0; max] (max is protocol specific) Resolution: 1 µs	ISO_15765_4=30000000 ISO_14230_4=30000000 SAE_J1850_VPW= 25000000 SAE_J1850_PWM= 25000000 ISO_14230_3=25000000 ISO_15765_3=25000000 SAE_J2190=25000000
CP_RC78Handling	Description: Handling of 0x7F XX 0x78 ResponseTimeout and 0x78 Repetitions. The receive timeout value will be CP_P2Star. This timer will be reset on each consecutive reception of the 0x7F 0x78 response. Type: PDU_PT_UNUM32 Value: [0; 2] 0 = Disabled 1 = Continue handling negative responses until CP_RC78CompletionTimeout 2 = Continue handling unlimited (until disabled)	ISO_15765_4=2 ISO_14230_4=2 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=2 SAE_J2190=0
CP_RCByteOffset	Description: This parameter is used by the MVCI Protocol Handlers to offset into the received negative response message (0x7F) to retrieve the response code byte. Most protocols as a default place the response code as the last byte of the message. There are some protocols which place the response code after the Service Id (offset = 1). A range is provided to allow for different negative response configurations. Type: PDU_PT_UNUM32 Value: [1;0xFFFFFFFF]: 0 = invalid value 1 = first byte after the Service Id byte (0x7F) 0xFFFFFFFF = last byte in message (not including checksum bytes)	All protocols = 0xFFFFFFFF (last byte in message)
CP_RepeatReqCountApp	Description: This ComParam contains a counter to enable a re-transmission of the last request when either a transmit, receive error, or timeout with no response is detected. This only applies to the application layer. Type: PDU_PT_UNUM32 Range: [0; 127500] Resolution: 1 count	All protocols = 0

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_SessionTiming_Ecu	Description: Timing parameters to be used by different sessions for the ECU protocol application layer ISO15765_3 in response to a service 0x10 (Set Diagnostic Session). The ECU returns the session timing information on a positive response to the service. If CP_ModifyTiming is enabled, the MVCI protocol module will interpret the positive response from the ECU and set the appropriate timing ComParams.	ISO15765_3: ParamActEntries = 0 (not enabled)
	Type: PDU_PT_STRUCTFIELD STRUCTFIELD Format: ComParamStructType= PDU_CPST_SESSION_TIMING ParamMaxEntries = 255 ParamActEntries = 0 to 255 pStructArray=PDU_PARAM_STRUCT_SESS_ TIMING	
CP_SessionTimingOverride	Description: This parameter signals the D-PDU API to override the response from any ECUs to a Session Timing request (See CP_SessionTiming_Ecu and CP_ModifyTiming). The timing parameters are to be used for the ECU protocol application layer ISO15765_3 in response to a service 0x10 (Set Diagnostic Session). The ECU returns the session timing information on a positive response to the service. If CP_ModifyTiming is enabled and CP_SessionTimingOverride is not empty (ParamActEntries != 0), then the MVCI protocol module will use data in this ComParam instead of the data returned in a positive reponse from the ECUs.	ISO15765_3: ParamActEntries = 0 (not enabled)
	Type: PDU_PT_STRUCTFIELD STRUCTFIELD Format: ComParamStructType= PDU_CPST_SESSION_TIMING ParamMaxEntries = 255 ParamActEntries = 0 to 255 pStructArray=PDU_PARAM_STRUCT_SESS_ TIMING	
CP_StartMsgIndEnable	Description: Start Message Indication Enable. Upon receiving a first frame of a multi-frame message (ISO 15765), or upon receiving a first byte of a UART message, an indication will be set in the RX result item. No data bytes will accompany the result item.	ISO_15765_4=0 ISO_15765_3=0 ISO_14230_4=0 ISO_14230_3=0 ISO_9141_2=0 SAE_J1939=0 SAE_J1708=0
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Start Message Indication Disabled 1 = Start Message Indication Enabled	

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_SuspendQueueOnError	Description: This ComParam is used as a temporary ComParam for services that require a positive response before any further Com Primitives can be executed. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Do not suspend ComPrimitive Transmit Queue 1 = Suspend ComPrimitive Transmit Queue on a Timeout Error or on a non-handled 0x7F error (not an enabled protocol ComParam)	ISO_15765_4=0 ISO_14230_4=0 ISO_9141_2=0 ISO_14230_3=0 ISO_15765_3=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 SAE_J2190=0 SAE_J1939_73=0
CP_SwCan_HighVoltage	Description: Indicates that the Single Wire CAN message should be transmitted as a High-Voltage Message. Simultaneously transmitting in high voltage and high speed mode will result in undefined behaviour. This ComParam is only applicable when the Bus Type selected is SAE_J2411_SWCAN. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Normal Message 1 = High-Voltage Message	ISO_15765_4=0 ISO_15765_3=0 ISO_14230_3=0 ISO_11898_RAW=0
CP_TesterPresentAddrMode	Description: Addressing Mode to be used for periodic Tester Present messages. Uses the PhysReqxxx or FuncReqxxx ComParams. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Use Physical Addressing for the Tester Present message. 1 = Use Functional Addressing for the Tester Present message.	ISO_15765_4=0 ISO_14230_4=0 ISO_9141_2=0 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=0 ISO_15765_3=1

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_TesterPresentExpPosResp	Description: Define the expected ECU positive response to a Tester Present Message. This is only applicable if CP_TesterPresentReqRsp is set to 1 (ECU responses are expected on a Tester Present Message). No header bytes or checksum bytes are included. Only the ParamActLen bytes in the array will be compared to the received ECU data. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys. Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 12 ParamActLen = 0 to 12 pDataArray=TesterPresentExpPosResp[12] Range: Each byte = [0; 0xFF]	ISO_15765_4: ParamActLen = 0 (not enabled) ISO_14230_4: ParamActLen = 1, pDataArray = {0x7E} ISO_9141_2: ParamActLen = 2, pDataArray = {0x41, 0x00} SAE_J1850_VPW: ParamActLen = 0 (not enabled) SAE_J1850_PWM: ParamActLen = 0 (not enabled) ISO_14230_3: ParamActLen = 1, pDataArray = {0x7E} ISO_15765_3: ParamActLen = 0 (not enabled)
CP_TesterPresentExpNegResp	Description: Define the expected ECU negative response to a Tester Present Message. This is only applicable if CP_TesterPresentReqRsp is set to 1 (ECU responses are expected on a Tester Present Message). No header bytes or checksum bytes are included. When a negative response is received to a tester present message, which cannot be handled by the MVCI Protocol module (See RC 21, RC 23 and RC 78), the MVCI protocol module should report a Tester Present Error, but continue sending Tester Present Messages. (See PDU_ERR_EVT_TESTER_PRESENT_ERROR) NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys. Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 12 ParamActLen = 0 to 12 pDataArray=TesterPresentExpNegResp[12] Range: Each byte = [0; 0xFF]	ISO_15765_4: ParamActLen = 0 (not enabled) ISO_14230_4: ParamActLen = 2, pDataArray = {0x7F, 0x3E} ISO_9141_2: ParamActLen = 0 (not enabled) SAE_J1850_VPW: ParamActLen = 0 (not enabled) SAE_J1850_PWM: ParamActLen = 0 (not enabled) ISO_14230_3: ParamActLen = 2, pDataArray = {0x7F, 0x3E} ISO_15765_3: ParamActLen = 0 (not enabled)

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_TesterPresentHandling	Description: Define Tester Present message generation settings. The ComLogicaLink shall be in the state PDU_CLLST_COMM_STARTED to enable tester present message handling. (See PDU_COPT_STARTCOMM ComPrimitive.) NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.	ISO_15765_4=0 ISO_14230_4=1 ISO_9141_2=1 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=1 ISO_15765_3=1
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Do not generate Tester Present messages 1 = Generate Tester Present messages	
CP_TesterPresentMessage	Description: Define the Tester Present Message. This message data does not include any header bytes or checksum information. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.	ISO_15765_4: ParamActLen = 0 ISO_14230_4: ParamActLen = 1, pDataArray = {0x3E} ISO_9141_2: ParamActLen = 2, pDataArray = {0x01, 0x00} SAE_J1850_VPW: ParamActLen = 0 (not enabled) SAE_J1850_PWM: ParamActLen = 0 (not enabled) ISO_14230_3: ParamActLen = 1, pDataArray = {0x3E} ISO_15765_3: ParamActLen = 2, pDataArray = {0x3E, 0x80}
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 12 ParamActLen = 0 to 12 pDataArray=TesterPresentMessage[12] Range: Each byte = [0; 0xFF]	

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_TesterPresentReqRsp	Description: Define settings for handling Tester Present ECU responses. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.	ISO_15765_4=0 ISO_14230_4=1 ISO_9141_2=1 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=1 ISO_15765_3=0
	Type: PDU_PT_UNUM32 Value: [0; 1] 0=No response returned by an ECU on a Tester Present message. 1=An ECU response is expected from a Tester Present message. The response message will be discarded by the MVCI protocol module. See ComParams (CP_TesterPresentExpPosResp and CP_TesterPresentExpNegResp) for proper response handling.	
CP_TesterPresentSendType	Description: Define settings for the type of tester present transmits. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.	ISO_15765_4=0 ISO_14230_4=1 ISO_9141_2=1 SAE_J1850_VPW=0 SAE_J1850_PWM=0 ISO_14230_3=1 ISO_15765_3=0
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Send on periodic interval defined by CP_TesterPresentTime 1 = Send when bus has been idle for CP_TesterPresentTime	
CP_TesterPresentTime	Description: Time between Tester Present messages, or Time bus shall be idle before transmitting a Tester Present Message. NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time. NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.	ISO_15765_4=3000000 ISO_14230_4=3000000 SAE_J1850_ VPW=3000000 SAE_J1850_ PWM=3000000 ISO_14230_3=3000000 ISO_15765_3=2000000 SAE_J2190=3000000
	Type: PDU_PT_UNUM32 Range: [0; 30000000] Resolution: 1 µs	

Table B.19 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_TesterPresentTime_Ecu	Description: Time for the server to keep a diagnostic session (other than the default session) active while not receiving any diagnostic request message. Type: PDU_PT_UNUM32 Range: [0; 30000000] Resolution: 1 µs	ISO_15765_4=5000000 ISO_14230_4=5000000 SAE_J1850_ VPW=5000000 SAE_J1850_ PWM=5000000 ISO_14230_3=5000000 ISO_15765_3=5000000 SAE_J2190=5000000
CP_TransmitIndEnable	Description: Transmit Indication Enable. On completion of a transmit message by the protocol, an indication will be set in the RX_FLAG result item. No data bytes will accompany the result item. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Transmit Indication Disabled 1 = Transmit Indication Enabled	All Protocols = 0

B.5.2 ComParam definitions for transport layer

Table B.20 — Transport layer detailed ComParam table

Short Name	Detailed Description	Default (By Protocol)
CP_5BaudAddressFunc	Description: Value of 5Baud Address in case of functional-addressed communication. The correct baud rate address type (functional/physical) is selected during execution of a Start Communication Com Primitive based on the setting of the CP_RequestAddrMode ComParam. Type: PDU_PT_UNUM32 Value: [0; 0xFF]	ISO_9141_2=0x33 ISO_14230_2=0x33 ISO_14230_4=0x33 Ecu Variant Specific
CP_5BaudAddressPhys	Description: Value of 5Baud Address in case of physical-addressed communication. The correct baud rate address type (functional/physical) is selected during execution of a Start Communication Com Primitive based on the setting of the CP_RequestAddrMode ComParam. Type: PDU_PT_UNUM32 Value: [0; 0xFF]	ISO_9141_2=0x01 ISO_14230_2=0x01 Ecu Variant Specific

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_5BaudMode	Description: Type of 5 Baud initialization. This ComParam allows either ISO 9141 initialization sequence, ISO 9141-2/ISO 14230 initialization sequence, or hybrid versions, which include only one of the extra bytes defined for ISO 9141-2 and ISO 14230. (Initialization for ISO 9141-2 and ISO 14230 include the init sequence as defined in ISO 9141 plus inverted key byte 2 sent from the interface to the ECU and the inverted address sent from the ECU to the interface.)	ISO_9141_2=0 ISO_14230_2=0
	Type: PDU_PT_UNUM32 Value[0;3]: 0 = Init as defined in ISO 9141-2 and ISO 14230-4 1 = ISO 9141 init followed by interface sending inverted key byte 2, no inverted address 2 = ISO 9141 init followed by ECU sending inverted address, no inverted key byte 2 3 = Init as defined in ISO 9141, no inverted key byte 2 nor inverted address	
CP_AccessTiming_Ecu	Description: Timing parameters to be sent/used in response to a Service Id 0x83 (Access Timing Service) with TPI 1, 2 or 3. For a TPI of 1 (set default values), the ECU will set the timing parameters to the default values specified by ISO 14230-2. For a TPI of 2 (read active values), the ECU will return the active timing parameters in the response message. For a TPI of 3 (set parameters) the MVCI protocol module will set the timing parameters to the values to be used by the ECU. This ComParam allows the ECU to define sets of timing parameters to be used for normal and extended timing, as well as override timing values defined by a Tester.	ISO14230_2: ParamActEntries = 0 (not enabled) ISO14230_4: ParamActEntries = 0 (not enabled)
	Type: PDU_PT_STRUCTFIELD STRUCTFIELD Format: ComParamStructType= PDU_CPST_ACCESS_TIMING ParamMaxEntries = 8 ParamActEntries = 0 to 8 pStructArray=PDU_PARAM_STRUCT_ACCESS_ TIMING	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_AccessTimingOverride	Description: This ComParam along with CP_ModifyTiming ComParam signals the D-PDU API to override the response from any ECUs to an Access Timing request. The timing parameters are to be used in response to a Service Id 0x83 (Access Timing Service) with TPI 1, 2 or 3. For a TPI of 1 (set default values) The ECU will set the timing parameters to the default values specified by ISO 14230-2. For a TPI of 2 (read active values), the ECU will return the timing parameters in the response message. For a TPI of 3 (set parameters) the MVCI protocol module will set the timing parameters to the values to be used by the ECU. If CP_ModifyTiming is enabled and CP_AccessTimingOverride is not empty (ParamActEntries != 0), then the MVCI protocol module will use data in this ComParam instead of the data returned in a positive reponse from the ECU for TPI of 2.	ISO14230_2: ParamActEntries = 0 (not enabled) ISO14230_4: ParamActEntries = 0 (not enabled)
	Type: PDU_PT_STRUCTFIELD STRUCTFIELD Format: ComParamStructType= PDU_CPST_ACCESS_ TIMING ParamMaxEntries = 8 ParamActEntries = 0 to 8 pStructArray=PDU_PARAM_STRUCT_ACCESS_ TIMING	
CP_Ar	Description: Time for transmission of the CAN frame (any N_PDU) on the receiver side.	ISO_15765_2=1000000 ISO_15765_4=25000
	Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	
CP_Ar_Ecu	Description: Time for transmission of the CAN frame (any N_PDU) on the receiver side.	ISO_15765_2=1000000 ISO_15765_4=25000
	Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	
CP_As	Description: Time for transmission of the CAN frame (any N_PDU) on the sender side.	ISO_15765_2=1000000 ISO_15765_4=25000
	Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	
CP_As_Ecu	Description: Time for transmission of the CAN frame (any N_PDU) on the sender side.	ISO_15765_2=1000000 ISO_15765_4=25000
	Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_BlockSize	Description: This sets the block size that the interface should report to the vehicle for receiving segmented transfers in a Transmit Flow Control Message. Type: PDU_PT_UNUM32 Range: [0; 0xFF] Resolution: 1 Block	ISO_15765_2=0 ISO_15765_4=0 SAE_J1939_21=0xFF SAE_J1708=0xFF
CP_BlockSize_Ecu	Description: This sets the block size that the ECU should report to the tester for receiving segmented transfers in a Transmit Flow Control Message. Type: PDU_PT_UNUM32 Range: [0; 0xFF] Resolution: 1 Block	ISO_15765_2=0 ISO_15765_4=0 SAE_J1939_21=0xFF SAE_J1708=0xFF
CP_BlockSizeOverride	Description: This sets the block size that the interface should use to send segmented messages to the vehicle. The flow control value reported by the vehicle should be ignored. Type: PDU_PT_UNUM32 Value: [0; 0xFFFF] 0 – 0xFFFE = Block size 0xFFFF = Use the value reported by the vehicle Resolution: 1 Block	ISO_15765_2=0xFFFF ISO_15765_4=0xFFFF SAE_J1939_21=0xFFFF SAE_J1708=0xFFFF
CP_Br	Description: Time until transmission of the next FlowControl. This is equivalent to Th in J1939-21. For ISO 15765-2 and ISO 15765-4, this value is a performance requirement ComParam and should not be used as a timeout value by the tester. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=10000 ISO_15765_4=10000 SAE_J1939_21=500000 SAE_J1708=500000
CP_Br_Ecu	Description: Time until transmission of the next FlowControl. This is a performance requirement ComParam. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=10000 ISO_15765_4=10000 SAE_J1939_21=500000 SAE_J1708=500000
CP_Bs	Description: Timeout until reception of the next FlowControl. This is equivalent to T4 in J1939-21. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=1000000 ISO_15765_4=75000 SAE_J1939_21=1050000 SAE_J1708=60000000

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_Bs_Ecu	Description: Timeout until reception of the next FlowControl. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=1000000 ISO_15765_4=75000 SAEJ1939_21=1050000 SAE_J1708=60000000
CP_CanDataSizeOffset	Description: Offset subtracted from the total number of expected bytes received/transmitted in a first frame message. Type: PDU_PT_UNUM32 Range: [0; 8] Resolution: 1 Byte	ISO_15765_2=0 ISO_15765_4=0
CP_CanFillerByte	Description: Padding data byte to be used to pad all USDT type transmits frames (SF, FC, and last CF). Type: PDU_PT_UNUM32 Range: [0; 0xFF] NOTE The padding data byte value is typically 0x00, 0x55, or 0xAA.	ISO_15765_2=0x55 ISO_15765_4=0x00 ISO_J1939_21=0x00 ISO_11898_RAW=0x00
CP_CanFillerByteHandling	Description: Enable Padding, forcing the DLC of a CAN frame to always be 8. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Padding Disabled 1 = Padding Enabled	ISO_15765_2=1 ISO_15765_4=1 ISO_J1939_21=0 ISO_11898_RAW=0
CP_CanFirstConsecutiveFrameValue	Description: First consecutive frame number to be transmitted/received on a multi-segment transfer. Used to override the normal first consecutive frame value of 1. Type: PDU_PT_UNUM32 Range: [0; 0x0F]	ISO_15765_2=1 ISO_15765_4=1
CP_CanFuncReqExtAddr	Description: Address extension for enhanced diagnostics. The first byte of the requested CAN frame data contains the N_AE/N_TA byte followed by the correct number of PCI bytes. This ComParam is used for all transmitted CAN Frames that have the “Can Address Extension” bit set in the CanIdFormat. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_15765_2=0 ISO_15765_4=0
CP_CanFuncReqFormat	Description: CAN Format used for a functional address transmit. Type: PDU_PT_UNUM32 Range: [0; 0x3F] See Table B.15 — Coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat	ISO_15765_2=0x05 ISO_15765_4=0x05

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_CanFuncReqId	Description: CAN ID used for a functional address transmit. Type: PDU_PT_UNUM32 Range: [0; 0x1FFFFFFF]	ISO_15765_2=0x7DF ISO_15765_4=0x7DF
CP_CanMaxNumWaitFrames	Description: The maximum number of WAIT flow control frames allowed during a multi-segment transfer. For SAE J1939, this is the maximum number of allowed CTS frames. Type: PDU_PT_UNUM32 Range: [0; 1027]	ISO_15765_2=255 ISO_15765_4=0 SAE_J1939_21=255
CP_CanPhysReqExtAddr	Description: Address extension for enhanced diagnostics. The first byte of the requested CAN frame data contains the N_AE/N_TA byte followed by the correct number of PCI bytes. This ComParam is used for all transmitted CAN Frames that have the “Can Address Extension” bit set in the CanIdFormat. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_15765_2=0x00 ISO_15765_4=0x00
CP_CanPhysReqFormat	Description: CAN Format used for a physical address transmit. Type: PDU_PT_UNUM32 Range: [0; 0x3F] See Table B.15 — Coded values for CP_CanPhysReqFormat and CP_CanFuncReqFormat	ISO_15765_2=0x05 ISO_15765_4=0x05
CP_CanPhysReqId	Description: CAN ID used for a physical address transmit. Type: PDU_PT_UNUM32 Range: [0; 0x1FFFFFFF]	ISO_15765_2=0x7E0 ISO_15765_4 = 0x7E0
CP_CanRespUSDTExtAddr	Description: Extended Address used for a USDT response from an ECU if the CAN Format indicates address extension. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_15765_2=0 ISO_15765_4=0
CP_CanRespUSDTFormat	Description: CAN Format for the USDT CAN ID received from an ECU (Segment type Bit must = 1). Type: PDU_PT_UNUM32 Range: [0; 0xF] See Table B.16 — Coded values for CP_CanRespUSDTFormat	ISO_15765_2=0x05 ISO_15765_4=0x05
CP_CanRespUSDTId	Description: Received USDT CAN ID from an ECU. Type: PDU_PT_UNUM32 Range: [0; 0x1FFFFFFF, 0xFFFFFFFF] NOTE 0xFFFFFFFF indicates that the ComParam is not used. This ComParam is used in the Unique Response Identifier Table for CAN protocols.	ISO_15765_2=0x7E8 ISO_15765_4=0x7E8

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_CanRespUUDTExtAddr	Description: Extended Address used for UUDT response if the CAN Format indicates address extension. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_15765_2=0 ISO_15765_4=0 ISO_11898_RAW=0x00
CP_CanRespUUDTFormat	Description: Received CAN Format for CAN ID without segmentation (Segment Type Bit must = 0). Type: PDU_PT_UNUM32 Range: [0; 0xF] See Table B.17 — Coded values for CP_CanRespUUDTFormat	ISO_15765_2=0x00 ISO_15765_4=0x00 ISO_11898_RAW=0x00
CP_CanRespUUDTId	Description: Received UUDT CAN ID from an ECU. Type: PDU_PT_UNUM32 Range: [0; 0x1FFFFFFF, 0xFFFFFFFF] NOTE 0xFFFFFFFF indicates that the ComParam is not used. This ComParam is used in the Unique Response Identifier Table for CAN protocols.	ISO_15765_2=0x FFFFFFFF ISO_15765_4=0x FFFFFFFF ISO_11898_RAW=0x FFFFFFFF
CP_Cr	Description: Timeout for reception of the next ConsecutiveFrame. For SAE J1939-21, this is equivalent to T1. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=1000000 ISO_15765_4=150000 SAE_J1939_21=750000 SAE_J1708=1000000
CP_Cr_Ecu	Description: Timeout for reception of the next ConsecutiveFrame. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=1000000 ISO_15765_4=150000 SAE_J1939_21=750000 SAE_J1708=1000000
CP_Cs	Description: Time until transmission of the next Consecutive Frame. (This is used if FC is not enabled or if the STmin value in the FC=0 and STminOverride=0xFFFF.) See ISO 15765-2. For ISO 15765-2 and ISO 15765-4, this is a performance requirement ComParam and should not be used as a timeout value by the tester. For SAE J1939, this is equivalent to the time between sending packets in a multi-packet broadcast and a multi-packet destination-specific message. From text in SAE J1939-21:2006, 5.12.3. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=10000 ISO_15765_4=10000 SAE_J1939_21=50000 SAE_J1708=1000000

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_Cs_Ecu	Description: Time until transmission of the next Consecutive Frame. (This is used if FC is not enabled or if the STmin value in the FC=0 and STminOverride=0xFFFF.) See ISO 15765-2. This is a performance requirement ComParam. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	ISO_15765_2=10000 ISO_15765_4=10000 SAE_J1939_21=200000 SAE_J1708=1000000
CP_EcuRespSourceAddress	Description: ECU Source Address response of a non-CAN message. This ComParam is used for response handling only. It is a URID ComParam and is used whether addressing is functional or physical. The protocol handler extracts the ECU address from the response message and uses this information along with other URID ComParams to find a match in the URID table to retrieve the Unique Response Id for the ECU. For physical addressing it is possible that CP_EcuRespSourceAddress equals CP_PhysReqTargetAddr. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x10 ISO_14230_2=0x10 ISO_14230_4 = 0x10 SAE_J1850_VPW = 0x10 SAE_J1850_PWM = 0x10
CP_EnableConcatenation	Description: This ComParam instructs the application layer to automatically detect multiple responses from a single ECU and construct a single ECU response to the client application. Only the SID (1st byte of the message data) is used to indicate a segmented response to a service request is being sent by the ECU. The application layer will wait for a receive timeout before determining that all responses have been received. e.g. ECU response 1: SID 0x11 0x22 ECU response 2: SID 0x33 0x44 Response to Client application: SID 0x11 0x22 0x33 0x44 Type: PDU_PT_UNUM32 Value: [0;1] 0 = Disabled 1 = Enabled	ISO_14230_2 = 0 ISO_14230_4 = 0 ISO_9141_2 = 0 SAE_J1850_VPW = 0 SAE_J1850_PWM = 0

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_ExtendedTiming	Description: This ComParam is used to define extended timing values for K-Line protocols. The values are used after the key bytes are received from the ECU during the initialization sequence. If CP_ExtendedTiming is not empty (ParamActEntries != 0), then the MVCI protocol module will use data in this ComParam otherwise the MVCI protocol module will use the default extended values defined in ISO 14230-2. For normal timing the MVCI protocol module uses timing defined in the ComParams: CP_P2Max, CP_P3Min, etc.	ISO_14230_2: ParamActLen = 0 (not enabled) ISO_14230_4: ParamActLen = 0 (not enabled)
	Type: PDU_PT_STRUCTFIELD STRUCTFIELD Format: ComParamStructType= PDU_CPST_ACCESS_TIMING ParamMaxEntries = 1 ParamActEntries = 0 to 1 pStructArray=PDU_PARAM_STRUCT_ACCESS_TIMING	
CP_FillerByte	Description: Padding data byte to be used to pad all SAE J1850, ISO 9141-2 and ISO 14230-4 messages to the full length.	ISO_9141_2 = 0 ISO_14230_4 = 0 ISO_14230_2 = 0 SAE_J1850_VPW = 0 SAE_J1850_PWM = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFF] NOTE The padding data byte value is typically 0x00, 0x55, or 0xAA.	
CP_FillerByteHandling	Description: Enable Padding for SAE J1850, ISO 9141-2 and ISO 14230-4 messages (see CP_FillerByte).	ISO_9141_2 = 0 ISO_14230_4 = 0 ISO_14230_2 = 0 SAE_J1850_VPW=0 SAE_J1850_PWM=0
	Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Padding Disabled 1 = Padding Enabled	
CP_FillerByteLength	Description: Length to pad the data portion of the message for SAE J1850, ISO 9141-2 and ISO 14230-4 (See CP_FillerByteHandling and CP_FillerByte).	ISO_9141_2 = 0 ISO_14230_4 = 0 ISO_14230_2 = 0 SAE_J1850_VPW = 0 SAE_J1850_PWM = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFF] EXAMPLE If the data payload for the ComPrimitive is 0x21, 0x01 and CP_FillerLength is set to five and CP_FillerByte is set to 0xFF, the data portion of the message would be: 0x21 0x01 0xFF 0xFF 0xFF	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_FuncReqFormatPriority-Type	Description: First Header Byte of a non-CAN message for a functional address transmit. This ComParam is used for proper request message header construction in non-Raw mode. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x68 ISO_14230_2=0xC0+n, where n < 64 is generated by the protocol based on the addressing scheme. SAE_J1850_VPW = 0x68 SAE_J1850_PWM = 0x61 ISO_14230_4=0xC0+n, where n < 64 is generated by the protocol based on the addressing scheme.
CP_FuncReqTargetAddr	Description: Second Header Byte of a non-CAN message for a functional address transmit. This ComParam is used for proper request message header construction in non-Raw mode. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x6A ISO_14230_2 = 0x33 ISO_14230_4 = 0x33 SAE_J1850_VPW = 0x6A SAE_J1850_PWM= 0x6A
CP_FuncRespFormatPriority-Type	Description: First Header Byte of a non-CAN message received from the ECU for functional addressing. This ComParam is used for response handling only. It is a URID ComParam and is used for functional addressing only. The protocol handler extracts the format/priority byte from the response message and uses this information along with other URID ComParams to find a match in the URID table to retrieve the Unique Response Id for the ECU. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x48 ISO_14230_2 = 0xC0+n, where n < 64 is generated by the protocol based on the addressing scheme. SAE_J1850_VPW = 0x48 SAE_J1850_PWM = 0x41 ISO_14230_4=0xC0+n, where n < 64 is generated by the protocol based on the addressing scheme.
CP_FuncRespTargetAddr	Description: Second Header Byte of a non-CAN message received from the ECU for functional addressing. This ComParam is used for response handling only. It is a URID ComParam and is used for functional addressing only. The protocol handler extracts the Target address from the response message and uses this information along with other URID ComParams to find a match in the URID table to retrieve the Unique Response Id for the ECU. This information is also used to fill out the functional lookup table for SAE J1850_PWM. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x6B ISO_14230_2 = 0xF1 ISO_14230_4=0xF1 SAE_J1850_VPW = 0x6B SAE_J1850_PWM = 0x6B

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_HeaderFormatJ1850	Description: Header Byte configuration to be used for SAE J1850 communication. This setting is used to properly construct the message header bytes to complete the PDU. This ComParam is not used if the ComLogicalLink is in RawMode. Header bytes are constructed following the rules of the protocol specification.	SAE_J1850_VPW=3-byte-Header SAE_J1850_PWM=2-byte-Header
	Type: PDU_PT_UNUM32 Value: [0; 3] 0 = No Header Bytes 1 = 1 Byte Header 2 = 2 byte Header 3 = 3 byte Header	
CP_HeaderFormatKW	Description: Header Byte configuration for K-Line protocols (Keyword). This setting is used to properly construct the message header bytes to complete the PDU. This ComParam is not used if the ComLogicalLink is in RawMode. Header bytes are constructed following the rules of the protocol specification. This ComParam can be used to override any keybyte values received from the ECU during initialization. If the protocol cannot handle the length of a ComPrimitive based on the settings of this ComParam, then an error event, PDU_ERR_EVT_PROT_ERR, is generated and the ComPrimitive is FINISHED.	ISO_14230_2= 0 ISO_14230_4= 0

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
	Type: PDU_PT_UNUM32 Value: [0; 8] 0 = Use the header byte format specified by the ECU key bytes 1 = 1 Byte Only (max size = 0x3F) 2 = 2 Bytes (dependent on length) if 1st byte <= 0x3F 1st byte = size 2nd byte = not used else (1st byte > 0x3F) 1st byte does not contain size 2nd byte = size up to 0xFF endif 3 = 2 Bytes always 1st byte never contains size information 2nd byte = size up to 0xFF 4 =3 Bytes Only 1st byte = format with size up to 0x3F 2nd byte = target address 3rd byte = source address 5 = 4 Bytes (dependent on length) if 1st byte <= 0x3F 1st byte = size 2nd byte = target address 3rd byte = source address 4th byte not used. else (1st byte > 0x3F) 1st byte does not contain size 2nd byte = target address 3rd byte = source address 4th byte = size up to 0xFF endif 6 = 4 Bytes always 1st byte never contains size 2nd byte = target address 3rd byte = source address 4th byte = size up to 0xFF 7 = OEM-9141 Header Format (ms nibble of first byte = byte count) 8 = No header bytes	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_InitializationSettings	Description: Set Initialization method. Type: PDU_PT_UNUM32 Value: [1; 3] 1 = 5 Baud Init sequence 2 = Fast Init sequence 3 = No Init sequence	ISO_9141_2 = 1 ISO_14230_2= 2 ISO_14230_4 =2
CP_J1939AddrClaimTimeout	Description: Time after sending a Request for Address Claimed before the Tester should send its own Address Claimed message. While waiting for this timeout, (and at all times), the tester should be handling Address Claimed messages from all ECUs on the bus. Type: PDU_PT_UNUM32 Range: [0; 20000000] Resolution: 1 µs	SAE_J1939_21 = 1250000
CP_J1939AddressNegotiation-Rule	Description: This ComParam will specify whether the interface should issue a Request for Address Claim upon receiving a STARTCOMM ComPrimitive, and under what conditions the interface should send out its own Address Claim. Type: PDU_PT_UNUM32 Value: [0; 7] Bit Encoded: Bit 0: 0 = Issue Request for Address Claim upon receiving a STARTCOMM ComPrimitive from client app; 1 = Do not issue Request for Address Claim upon receiving a STARTCOMM ComPrimitive from client app; Bit 1: 0 = Make own Address Claim upon receiving a STARTCOMM ComPrimitive from client app. 1 = Do not make own Address Claim upon receiving a STARTCOMM ComPrimitive from client app. Bit 2: 0= Respond to a Request for Address Claim message or a challenging Address Claim message from the vehicle bus with own Address Claim. 1 = Do not respond to a Request for Address Claim message or a challenging Address Claim message from the vehicle bus with own Address Claim.	SAE_J1939 = 0

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_J1939DataPage	Description: The data page used to form the data page of a SAE J1939 CAN ID for request messages from the tester to the ECU. This ComParam is used to set bits 24 and 25 of the SAE J1939 CAN ID.	SAE_J1939_21 = 0
	Type: PDU_PT_UNUM32 Value: [1; 3] 0 = SAE J1939 Page 0 PGNs 1 = SAE J1939 Page 1 PGNs 2= reserved 3= ISO 15765-3 Addressing Format See Table B.18 — Definition of Extended Data Page and Data Page field	
CP_J1939MaxPacketTx	Description: Number of frames the tester should request to send at once when sending a RTS. Tester shall be capable of re-sending any block re-requested by the ECU.	SAE_J1939_21 = 0xFF
	Type: PDU_PT_UNUM32 Range: [0; 255]	
CP_J1939Name	Description: Name field from SAE J1939 document. This ComParam will contain the NAME of the Tester. The tester will require this to make an address claim (see SAE J1939-81:2003, 4.1.1 for further details). NOTE If CP_J1939AddressNegotiationRule has Bit 1 and/or Bit 2 set to 0, (protecting an address), a change to this parameter will not take effect until a StartComm CoP is received.	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 8 ParamActLen = 0 to 8 pDataArray = name[8] Range: Each byte = 0x00-0xFF	
CP_J1939Name_Ecu	Description: Name field from SAE J1939 document. This ComParam will contain an ECU NAME.	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 8 ParamActLen = 0 to 8 pDataArray = name[8] Range: Each byte = 0x00-0xFF	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_J1939PDUFormat	Description: This ComParam is used to set the PF field (bits 16 to 23) of the SAE J1939 CAN ID for request messages sent from the tester to the ECU.	SAE_J1939_21 = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFF]	
CP_J1939PDUSpecific	Description: This ComParam is used to set the PS field (bits 8 to 15) of the SAE J1939 CAN ID. This field is only used if CP_J1939PDUFormat is greater than or equal to 240 (PDU2 format messages). If CP_J1939PDUFormat is less than 240, then the PS field shall be filled with the source address of the ECU that the tester is sending the request to. (Use the source ECU address associated with CP_J1939TargetName.)	SAE_J1939_21 = 0
	Type: PDU_PT_UNUM32 Range: [0; 0xFF]	
CP_J1939PreferredAddress	Description: List of preferred addresses for the Tester. This ComParam is a list of source addresses for the MVCI protocol module. The first source address claimed by the MVCI Protocol Module remains claimed unless a higher-priority node on the bus requests the same address, at which time the tester will have to try to claim the next address in the list. An address remains claimed until the end of the ComLogicalLink communication. A PDU_COPT_STARTCOMM ComPrimitive will try to claim one of the source addresses in this byte field. Since the MVCI Protocol module might not be able to claim the first address requested, a list of tester addresses are supplied (see SAE J1939-81:2003, 4.1.1 for further details). NOTE If CP_J1939AddressNegotiationRule has Bit 1 and/or Bit 2 set to 0, (protecting an address), a change to this parameter will not take effect until a StartComm CoP is received.	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 8 ParamActLen = 0 to 8 pDataArray = address[8] Range: Each byte = 0x00-0xFF	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_J1939PreferredAddress_Ecu	Description: List of preferred addresses for the ECU. This ComParam is a list of source addresses that the ECU would like to acquire on the SAE J1939 bus (see SAE J1939-81:2003, 4.1.1 for further details).	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 2 ParamActLen = 0 to 2 pDataArray=preferredAddrList[2] Range: Each byte = [0; 0xFF]	
CP_J1939SourceAddress	Description: ECU Source Address from a J1939 response message. This ComParam is used for response handling only. It is a URID ComParam. The protocol handler extracts the ECU source address from the response message and uses this information to find a match in the URID table to retrieve the Unique Response Id for the ECU. NOTE: this UNIQUE_ID ComParam can also be used to assign a Unique Response Id for a standard, 11-bit Can Id appearing on the vehicle bus.	SAE_J1939 = 0x00
	Type: PDU_PT_UNUM32 Range: [0; 0xFFFF]	
CP_J1939SourceName	Description: Name field as described in the J1939 document. This ComParam is used for response handling only. It is the Name of an ECU. The protocol handler will extract the source address from a J1939 response message. By keeping a list of Names and Addresses of all ECUs on the bus (Network Management), the tester will find the Name of the ECU corresponding to the source address extracted from the message, and use the Name to find a match in the URID table to retrieve the Unique Response Id for the ECU.	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 8 ParamActLen = 0 to 8 pDataArray = name[8] Range: Each byte = 0x00-0xFE	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_J1939TargetAddress	Description: This ComParam is used instead of CP_J1939TargetName in the following 3 cases: 1) the ParmActLen for CP_J1939TargetName = 0, or 2) the NAME in CP_J1939TargetName is not found in the list of Names and Addresses of the ECUs that have sent out an Address Claim, or 3) the Address listed for the NAME is invalid (0xFE).	SAE_J1939_21=0xFFFF
	Type: PDU_PT_UNUM32 Range: [0; 0xFFFF] NOTE 1 If this Parameter = 0xFFFF, the interface will return a failure on the StartComPrimitive. This will serve to inform the client application in case the ECU named in CP_J1939TargetName has not claimed an address, or has lost its address to another claimant on the vehicle bus. NOTE 2 If this Parameter = 0xFF, and message length > 8, use BAM, else use RTS/CTS.	
CP_J1939TargetName	Description: Name field from SAE J1939 document. This is the name of the target ECU for a destination-specific outgoing message. Used when CP_J1939PDUFormat < 240; also used in transport protocol when CP_J1939PDUFormat >= 240 and message length > 8. By keeping a list of Names and Addresses of all ECUs on the bus (Network Management), the tester will find the ECU Address of the ECU with this name, and use it to form the CAN ID. If this ECU has not made an Address Claim on the bus, or if the ParamActLen for this ComParam = 0, the tester will use CP_J1939TargetAddress as the destination address (see SAE J1939-81:2003, 4.1.1 for further details).	SAE_J1939_21 = ParamActLen = 0 (not enabled)
	Type: PDU_PT_BYTEFIELD BYTEFIELD Format: ParamMaxLen = 8 ParamActLen = 0 to 8 pDataArray = name[8] Range: Each byte = 0x00-0xFF	
CP_MessagePriority	Description: Message Priority SAE J1939 protocol uses the 3 least significant bits that become part of the CAN ID. This is used only for request messages sent by the tester to the ECU. This parameter is used in bits 26 to 28 of the CAN ID for the SAE J1939 message. SAE J1708: The message priority goes into calculating the required idle bus time before transmitting the message.	SAE_J1939_21 = 6 SAE_J1708 = 8
	Type: PDU_PT_UNUM32 Range: [0; 0xFF]	

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_MidReqId	Description: Request Message Identifier used in building a transmit message to an ECU for a SAE J1708 protocol only. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	SAE_J1708 = 0
CP_MidRespId	Description: Response Message Identifier received from an ECU for a SAE J1708 protocol only. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	SAE_J1708 = 0
CP_P1Max	Description: Maximum inter-byte time for ECU Responses. Interface shall be capable of handling a P1_MIN time of 0 ms. After the request, the interface shall be capable of handling an immediate response (P2_MIN=0). For subsequent responses, a byte received after P1_MAX shall be considered as the start of the subsequent response. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 20000 ISO_14230_2 = 20000 ISO_14230_4 = 20000
CP_P1Min	Description: This sets the minimum inter-byte time for the ECU responses. Application shall not get or set this value. Interface shall be capable of handling P1_MIN=0. This is a performance requirement ComParam. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 0 ISO_14230_2 = 0 ISO_14230_4=0
CP_P4Max	Description: Maximum inter-byte time for a tester request. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 20000 ISO_14230_2 = 20000 ISO_14230_4=20000
CP_P4Min	Description: Minimum inter-byte time for tester transmits. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 5000 ISO_14230_2 = 5000 ISO_14230_4=5000

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_PhysReqFormatPriority-Type	Description: First Header Byte of a non-CAN message for physical address transmit. This ComParam is used for proper request message header construction in non-Raw mode. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0x6C ISO_14230_2=0x80+n, where n < 64 is generated by the protocol based on the addressing scheme. ISO_14230_4=0x80+n, where n < 64 is generated by the protocol based on the addressing scheme. SAE_J1850_VPW = 0x6C SAE_J1850_PWM = 0xC4
CP_PhysReqTargetAddr	Description: Physical Target Addressing Information used for correct Message Header Construction. This ComParam is used for proper request message header construction in non-Raw mode. It is possible that CP_PhysReqTargetAddr matches CP_EcuRespSourceAddress in one of the URID table entries. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2=0x10 ISO_14230_2=0x10 ISO_14230_4=0x10 SAE_J1850_VPW=0x10 SAE_J1850_PWM=0x10 (ECU Variant Specific)
CP_PhysRespFormatPriority-Type	Description: First Header Byte of a non-CAN message received from the ECU for physical addressing. This ComParam is used for response handling only. It is a URID ComParam and is used for physical addressing only. The protocol handler extracts the format/priority byte from the response message and uses this information along with other URID ComParams to find a match in the URID table to retrieve the Unique Response Id for the ECU. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2=0x6C ISO_14230_2=0x80+n, where n < 64 is generated by the protocol based on the addressing scheme. ISO_14230_4=0x80+n, where n < 64 is generated by the protocol based on the addressing scheme. SAE_J1850_VPW=0x2C SAE_J1850_PWM=0xC4
CP_RepeatReqCountTrans	Description: This ComParam contains a counter to enable a re-transmission of the last request when either a transmit, a receive error, or transport layer timeout is detected. This applies to the transport layer only. Type: PDU_PT_UNUM32 Range: [0; 255] Resolution: 1 count	All protocols = 0

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_RequestAddrMode	Description: Addressing Mode to be used for the Com Primitive. Type: PDU_PT_UNUM32 Value: [1; 2] 1 = Use Physical Addressing for the request 2 = Use Functional Addressing for the request	ISO_9141_2 = 2 ISO_15765_2 = 1 ISO_14230_2 = 1 SAE_J1850_VPW=2 SAE_J1850_PWM=2 ISO_15765_4 = 2 ISO_14230_4 = 2
CP_SCITransmitMode	Description: SCI transmit mode. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Transmit using SCI Full duplex mode 1 = Transmit using SCI Half duplex mode	SAE_J2610_SCI = 0
CP_SendRemoteFrame	Description: This ComParam is used for CAN remote frame handling. (No data bytes are transmitted. Just the CAN ID. The first byte of the PDU Data shall contain the Data Length Code.) Type: PDU_PT_UNUM32 Value: [0; 1] 0 = No Remote Frame Transmit 1 = Transmit a Remote Frame using the DLC in the PDU Data	ISO_15765_2 = 0 ISO_15765_4 = 0 SAE_J1939_21 = 0 ISO_11898 = 0
CP_StMin	Description: This sets the separation time the interface should report to the vehicle for receiving segmented transfers in a Transmit Flow Control Message. Type: PDU_PT_UNUM32 Range1: [0x0; 0x7F] Resolution1: 1 ms Range2: [0xF1; 0xF9] Resolution2: 100 µs	ISO_15765_2=0 ISO_15765_4=0
CP_StMin_Ecu	Description: The minimum time the sender shall wait between the transmissions of two ConsecutiveFrame N_PDUs. Type: PDU_PT_UNUM32 Range1: [0x0; 0x7F] Resolution1: 1 ms Range2: [0xF1; 0xF9] Resolution2: 100 µs	ISO_15765_2=0 ISO_15765_4=0

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_StMinOverride	Description: This sets the separation time the interface should use to transmit segmented messages to the vehicle. The flow control value reported by the vehicle should be ignored. Type: PDU_PT_UNUM32 Value: [0;0xFFFFFFFF] Resolution: 1 µs 0xFFFFFFFF: Use the value reported by the vehicle	ISO_15765_2= 0xFFFFFFFF ISO_15765_4= 0xFFFFFFFF
CP_T1Max	Description: This sets the maximum inter-frame response delay. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	SAE_2610_SCI=20000
CP_T2Max	Description: This sets the maximum inter-frame request delay. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	SAE_2610_SCI=100000
CP_T3Max	Description: This sets the maximum response delay from the ECU after processing a valid request message from the interface. For SAE J1939-21, this is equivalent to Tr. Type: PDU_PT_UNUM32 Range: [0; 2500000] Resolution: 1 µs	SAE_J2610_SCI=50000 SAE_J1939_21=200000
CP_T4Max	Description: This sets the maximum inter-message response delay. For SAE J1939, this is equivalent to T3, the maximum time allowed for the Originator to receive a CTS or an ACK after sending a packet. Type: PDU_PT_UNUM32 Range: [0; 2500000] Resolution: 1 µs	SAE_J2610_SCI=20000 SAE_J1939_21=1250000
CP_T5Max	Description: This sets the maximum inter-message request delay. For SAE J1939, this is equivalent to T2, the maximum time allowed for the Originator to send a packet after receiving a CTS from the Responder. Type: PDU_PT_UNUM32 Range: [0; 2500000] Resolution: 1 µs	SAE_J2610_SCI=100000 SAE_J1939_21=1250000

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_TesterSourceAddress	Description: Source address of transmitted message for non-CAN messages. This ComParam is used for proper request message header construction in non-Raw mode. This ComParam will also contain the claimed Tester Address for SAE J1939 (see ComParam CP_J1939PreferredAddress), which can be read by the client application after a successful address claim determined during a PDU_COPT_STARTCOMM ComPrimitive. Type: PDU_PT_UNUM32 Range: [0; 0xFF]	ISO_9141_2 = 0xF1 ISO_14230_2 = 0xF1 ISO_14230_4 = 0xF1 SAE_J1850_VPW = 0xF1 SAE_J1850_PWM = 0xF1
CP_TIdle	Description: Minimum bus idle time before tester starts the address byte sequence or the fast init sequence. (TIdle replaces W0 and W5.) Type: PDU_PT_UNUM32 Range: [0; 10000000] Resolution: 1 µs	ISO_9141_2 = 300000 ISO_14230_2 = 300000 ISO_14230_4 = 300000
CP_TInil	Description: Sets the duration for the low pulse in a fast initialization sequence. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 25000 ISO_14230_2 = 25000 ISO_14230_4 = 25000
CP_TPConnectionManagement	Description: When transmitting a message longer than 21 bytes, this tells whether to use a Broadcast message, or an RTS/CTS protocol. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = send the data bytes through broadcast (PID = 192) 1 = send the data bytes using connection mode data transfer (PIDs 197 and 198)	SAE_J1708=0
CP_TWup	Description: Sets total duration of the wakeup pulse (TWUP-TINIL)=high pulse before start communication message. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 50000 ISO_14230_2 = 50000 ISO_14230_4 = 50000
CP_W1Max	Description: Maximum time from the end of address byte to start of the synchronization pattern from the ECU. Type: PDU_PT_UNUM32 Range: [0; 1000000] Resolution: 1 µs	ISO_9141_2 = 300000 ISO_14230_2 = 300000 ISO_14230_4 = 300000

Table B.20 (*continued*)

Short Name	Detailed Description	Default (By Protocol)
CP_W1Min	Description: Minimum time from the end of address byte to start of the synchronization pattern from the ECU. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 60000 ISO_14230_2 = 60000 ISO_14230_4 = 60000
CP_W2Max	Description: Maximum time from the end of the synchronization pattern to the start of key byte 1. Type: PDU_PT_UNUM32 Range: [0; 1000000] Resolution: 1 µs	ISO_9141_2 = 20000 ISO_14230_2 = 20000 ISO_14230_4 = 20000
CP_W2Min	Description: Minimum time from the end of the synchronization pattern to the start of key byte 1. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 5000 ISO_14230_2 = 5000 ISO_14230_4 = 5000
CP_W3Max	Description: Maximum time between key byte 1 and key byte 2. Type: PDU_PT_UNUM32 Range: [0; 1000000] Resolution: 1 µs	ISO_9141_2 = 20000 ISO_14230_2 = 20000 ISO_14230_4 =20000
CP_W3Min	Description: Minimum time between key byte 1 and key byte 2. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 0 ISO_14230_2 = 0 ISO_14230_4 = 0
CP_W4Max	Description: Maximum time between receiving key byte 2 from the vehicle and the inversion being returned by the interface. Same is true for the inverted key byte 2 sent by the tester and the received inverted address from the vehicle. Type: PDU_PT_UNUM32 Range: [0; 1000000] Resolution: 1 µs	ISO_9141_2 = 50000 ISO_14230_2 = 50000 ISO_14230_4 = 50000
CP_W4Min	Description: Minimum time between receiving key byte 2 from the vehicle and the inversion being returned by the interface. Same is true for the inverted key byte 2 sent by the tester and the received inverted address from the vehicle. Type: PDU_PT_UNUM32 Range: [0; 250000] Resolution: 1 µs	ISO_9141_2 = 25000 ISO_14230_2 = 25000 ISO_14230_4 = 25000

B.5.3 ComParam definitions for physical layer

Table B.21 — Physical layer detailed ComParam table

Short Name	Description	Structure, resolution	Range (by Protocol)	Type	Default (By Protocol)
CP_Baudrate	Description: Represents the desired baud rate. If the desired baud rate cannot be achieved within the tolerance of the protocol, the interface will remain at the previous baud rate. Type: PDU_PT_UNUM32 Range: [0x0; 0xFFFFFFFF] Resolution: 1 bps				ISO_11898_2_DWCAN=500k ISO_11898_3_DWFTCAN=125k ISO_11992_1_DWCAN=125k ISO_9141_2_UART = 10400 ISO_14230_1_UART = 10400 SAE_J2610_UART = 7812 SAE_J1708_UART = 9600 SAE_J1939_11_DWCAN=250k SAE_J1850_VPW = 10400 SAE_J1850_PWM = 41600 SAE_J2411_SWCAN = 33333
CP_BitSamplePoint	Description: This sets the desired bit sample point as a percentage of the bit time. Type: PDU_PT_UNUM32 Range: [0; 100] Resolution: 1%				ISO_11898_2_DWCAN=80% ISO_11898_3_DWFTCAN=80% ISO_11992_1_DWCAN=80% SAE_J1939_11_DWCAN=80% SAE_J2411_SWCAN=87%
CP_BitSamplePoint_Ecu	Description: This sets the desired bit sample point as a percentage of the bit time. Type: PDU_PT_UNUM32 Range: [0; 100] Resolution: 1%				ISO_11898_2_DWCAN = 80% ISO_11898_3_DWFTCAN=80% ISO_11992_1_DWCAN=80% SAE_J1939_11_DWCAN=80% SAE_J2411_SWCAN=87%
CP_CanBaudrateRecord	Description: List of baud rates to use during an OBD CAN initialization sequence. Type: PDU_PT_LONGFIELD LONGFIELD Format: ParamMaxLen = 12 ParamActLen = 0 to 12 pDataArray=BaudrateList[12] Range: Each entry = [0x00000000; 0xFFFFFFFF]				ISO_11898_2_DWCAN: ParamActLen = 2, pDataArray = {500000, 250000} SAE_J1939_11_DWCAN: ParamActLen = 1, pDataArray = {250000}
CP_K_L_LineInit	Description: K and L line usage for ISO 9141 and ISO 14230 initialization address. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Use L-line and K-line for initialization address 1 = Use K-line only for initialization address				ISO_9141_2_UART = 0 ISO_14230_1_UART = 0

Table B.21 (*continued*)

Short Name	Description	Structure, resolution	Range (by Protocol)	Type	Default (By Protocol)
CP_K_LinePullup	Description: Control the K-Line voltage to either 12V or 24V. Type: PDU_PT_UNUM32 Value: [0; 2] 0 = No pull-up 1 = 12V 2 = 24V				ISO_9141_2_UART = 0 ISO_14230_1_UART = 0
CP_ListenOnly	Description: Enable a Listen Only mode on the Com Logical Link. This will cause the link to no longer acknowledge received frames on the CAN Network. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = Listen Only Mode Disabled 1 = Listen Only Mode Enabled				ISO_11898_2_DWCAN=0 ISO_11898_3_DWFTCAN=0 ISO_11992_1_DWCAN=0 SAE_J1939_11_DWCAN=0 SAE_J2411_SWCAN=0
CP_NetworkLine	Description: This sets the network line(s) that are active during communication (for cases where the physical layer allows this). Type: PDU_PT_UNUM32 Value: [0; 2] 0 = BUS_NORMAL 1 = BUS_PLUS 2 = BUS_MINUS				SAE_J1850_PWM = 0
CP_SamplesPerBit	Description: Number of samples per bit. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = 1sample per bit 1 = 3 samples per bit				ISO_11898_2_DWCAN=0 ISO_11898_3_DWFTCAN=0 ISO_11992_1_DWCAN=0 SAE_J1939_11_DWCAN=0 SAE_J2411_SWCAN=0
CP_SamplesPerBit_Ecu	Description: Number of samples per bit for the ECU. Type: PDU_PT_UNUM32 Value: [0; 1] 0 = 1sample per bit 1 = 3 samples per bit				ISO_11898_2_DWCAN=0 ISO_11898_3_DWFTCAN=0 ISO_11992_1_DWCAN=0 SAE_J1939_11_DWCAN=0 SAE_J2411_SWCAN = 0
CP_SyncJumpWidth	Description: This sets the desired synchronization jump width as a percentage of the bit time. Type: PDU_PT_UNUM32 Range: [0; 100] Resolution: 1%				ISO_11898_2_DWCAN=15% ISO_11898_3_DWFTCAN=15% ISO_11992_1_DWCAN=15% SAE_J1939_11_DWCAN=15% SAE_J2411_SWCAN=15%

Table B.21 (*continued*)

Short Name	Description	Structure, resolution	Range (by Protocol)	Type	Default (By Protocol)
CP_SyncJumpWidth_Ecu	Description: This sets the desired synchronization jump width as a percentage of the bit time. Type: PDU_PT_UNUM32 Range: [0; 100] Resolution: 1%				ISO_11898_2_DWCAN = 15% ISO_11898_3_DWFTCAN = 15% ISO_11992_1_DWCAN = 15% SAE_J1939_11_DWCAN = 15% SAE_J2411_SWCAN = 15%
CP_TerminationType	Description: CAN termination settings. This ComParam can be used to manually change the termination being used on the vehicle bus line. Type: PDU_PT_UNUM32 Value: [0; 4] 0 = No termination 1 = AC termination 2 = 60 Ohm termination 3 = 120 Ohm termination 4 = SWCAN termination				ISO_11898_2_DWCAN = 0 ISO_11898_3_DWFTCAN = 0 ISO_11992_1_DWCAN = 0 SAE_J1939_11_DWCAN = 0 SAE_J2411_SWCAN = 0
CP_TerminationType_Ecu	Description: CAN termination settings for SWCAN ECU emulation. Type: PDU_PT_UNUM32 Value: [0, 5; 6] 0 = No termination 5 = SWCAN Unit Load termination (See SAE J2411) 6 = SWCAN Primary Load termination				SAE_J2411_SWCAN = 0
CP_UartConfig	Description: Configure the parity, data bit size and stop bits of a Uart protocol. Type: PDU_PT_UNUM32 Value: [0; 17] 00 = 7N1 01 = 7O1 02 = 7E1 03 = 7N2 04 = 7O2 05 = 7E2 06 = 8N1 07 = 8O1 08 = 8E1 09 = 8N2 10 = 8O2 11 = 8E2 12 = 9N1 13 = 9O1 14 = 9E1 15 = 9N2 16 = 9O2 17 = 9E2				ISO_9141_2_UART = 06 ISO_14230_1_UART = 06 SAE_J2610_UART = 06 SAE_J1708_UART = 06

B.5.4 Access to standardized COMPARAM-SPEC files

Standardized ComParams and protocols are documented in the D-PDU API specification. The standardized protocol and ComParams are publicly available on the ISO Livelink public area.

Use the following Link to download the standardized COMPARAM-SPEC files for configuration of the MVCI and ODX based Diagnostic System.

http://isotc.iso.org/livelink/livelink.exe?func=ll&objId=962012&objAction=browse&sort=name

Select <Public Available Files> and then <Modular VCI and ODX ComParam Files>.

Annex C
(informative)

D-PDU API manufacturer specific ComParams and protocols

C.1 Manufacturer specific protocols - support and naming conventions

C.1.1 General overview

The D-PDU API is not restricted to specific diagnostic protocols. Since the supported protocols and its ComParams are described in the MDF, the protocol support of an MVCI protocol module using the D-PDU API can be extended easily. The only important requirement is that the designation of the protocols (e.g. protocol names) is unique. For standard ComParam and protocol naming guidelines, see Annex B.

C.1.2 Manufacturer protocol naming guidelines

The following naming guidelines apply:

— Customer or manufacturer-specific protocols shall be named with the prefix MSP_ (i.e. short name for manufacturer-specific protocol) followed by a protocol name, which can be freely defined by the manufacturer (e.g. MSP_KWP9999_on_ISO14230_1_UART).

— The protocol short names which are used in the MDF file for the PROTOCOL element, are a concatenation of the application Layer specification name, plus the transport layer specification layer name, connected by the additional string "_on_", as shown in Table B.3 — Standard protocol short names in ODX.

— The physical layer name as shown in Table B.2 — Standard protocol combination list is used in the MDF file as short name for the BUSTYPE element.

— When possible a customer or manufacturer-specific protocol should try and reuse a layer either from another customer specified protocol or from one of the standardized protocols.

C.1.3 Manufacturer protocol communication parameters (ComParams)

ISO 22901-1 (ODX specification) already defines mechanisms for the description of ComParams for a protocol. The D-PDU API can be used in combination with ODX data files. Therefore, the description mechanisms from the ODX specification are used to define ComParams in the MDF (for details see the ODX specification).

For each protocol that the MVCI protocol module supports, the MDF shall assign the reference between the ComParams and the unique protocol id. For each protocol, the MDF includes the following elements:

— ProtocolName

— Short name and unique ID for each protocol ComParam

The format for a manufacturer specific ComParam shall be CPM_xxxx_yyyy, where xxxx is the manufacturer's acronym, and yyyy is the parameter name.

NOTE For protocol ComParams, only parameter data types supported by the D-PDU API are used. See B.3.3 ComParam data type.

For manufacturer specific protocols, it is recommended to reuse any of the standard protocol ComParams as are applicable and only add new ComParams that are needed to support the unique features of the manufacturer specific protocol.

The ID value for each protocol ComParam can be freely assigned by the MVCI supplier, because the ID value is used only within the supplier-specific PDU API.

The MDF contains the following information about a ComParam:

— Short name

— Long name

— ComParam Class

— Layer Info

— ComParam data type

— Minimum value

— Maximum value

— Default value (per protocol)

C.1.4 Access to manufacturer specific COMPARAM-SPEC files

Manufacturer specific ComParams and protocols are not documented in the D-PDU API specification. It is recommended that any new protocol and ComParams be made publicly available on the ISO Livelink public area.

Use the following Link to download the manufacturer specific COMPARAM-SPEC files for configuration of the MVCI and ODX based Diagnostic System:

http://isotc.iso.org/livelink/livelink.exe?func=ll&objId=962012&objAction=browse&sort=name

Select <Public Available Files> and then <Modular VCI and ODX ComParam Files>.

Annex D
(normative)

D-PDU API constants

D.1 Constants

D.1.1 D-PDU API item type values

```
typedef enum E_PDU_IT
{
    PDU_IT_IO_UNUM32                    = 0x1000,   /* IOCTL UNUM32 item. */
    PDU_IT_IO_PROG_VOLTAGE              = 0x1001,   /* IOCTL Program Voltage item. */
    PDU_IT_IO_BYTEARRAY                 = 0x1002,   /* IOCTL Byte Array item. */
    PDU_IT_IO_FILTER                    = 0x1003,   /* IOCTL Filter item. */
    PDU_IT_IO_EVENT_QUEUE_PROPERTY      = 0x1004,   /* IOCTL Event Queue Property item. */
    PDU_IT_RSC_STATUS                   = 0x1100,   /* Resource Status item */
    PDU_IT_PARAM                        = 0x1200,   /* ComParam item */
    PDU_IT_RESULT                       = 0x1300,   /* Result item */
    PDU_IT_STATUS                       = 0x1301,   /* Status notification item */
    PDU_IT_ERROR                        = 0x1302,   /* Error notification item */
    PDU_IT_INFO                         = 0x1303,   /* Information notification item */
    PDU_IT_RSC_ID                       = 0x1400,   /* Resource ID item */
    PDU_IT_RSC_CONFLICT                 = 0x1500,   /* Resource Conflict Item */
    PDU_IT_MODULE_ID                    = 0x1600,   /* Module ID item */
    PDU_IT_UNIQUE_RESP_ID_TABLE         = 0x1700    /* Unique Response Id Table Item */
} T_PDU_IT;
```

D.1.2 ComPrimitive type values

```
typedef enum E_PDU_COPT
{
PDU_COPT_STARTCOMM      = 0x8001,   /* Start communication with ECU by sending an optional request. The
                                       detailed behaviour is protocol dependent. For certain protocols (.e.g.
                                       ISO 14230), this ComPrimitive is required as the first ComPrimitive. This
                                       ComPrimitive is also required to put the ComLogicalLink into the state
                                       PDU_CLLST_COMM_STARTED which allows for tester present
                                       messages to be enabled (see CP_TesterPresentHandling). Once tester
                                       present handling is enabled the message is sent immediately, prior to the
                                       initial tester present cyclic time (CP_TesterPresentTime)  */

PDU_COPT_STOPCOMM       = 0x8002,   /* Stop communication with ECU by sending an optional request. The
                                       detailed behaviour is protocol dependent. After successful completion of
                                       this ComPrimitive type, the ComLogicalLink is placed into
                                       PDU_CLLST_ONLINE state and no further tester presents will be sent. A
                                       PDU_COPT_STARTCOMM ComPrimitive might be required by some
                                       protocols (e.g. ISO 14230) to begin communications again.*/

PDU_COPT_UPDATEPARAM    = 0x8003,   /* Copies ComParams related to a ComLogicalLink from the working
                                       buffer to the active buffer. Prior to update, the values need to be passed to
                                       the D-PDU API by calling PDUSetComParam, which modifies the
                                       ComParams in the working buffer. If the physical ComParams are locked
                                       by another ComLogicalLink, then a PDU_COPT_UPDATEPARAM will
                                       generate an error event (PDU_ERR_EVT_RSC_LOCKED) if physical
                                       ComParams are to be modified.
```

NOTE 1 If the CLL is in the PDU_CLLST_COMM_STARTED state and tester present handling is enabled (see CP_TesterPresentHandling) any changes to one of the tester present ComParams will cause the tester present message to be sent immediately, prior to the initial tester present cyclic time.

NOTE 2 Protocol handler always waits the proper P3Min time before allowing any transmit. See CP_P3Min, CP_P3Func, CP_P3Phys.*/

```
PDU_COPT_SENDRECV       = 0x8004,  /* Send request data and/or receive corresponding response data (single
                                      or multiple responses). 11.1.4.17 for detailed settings of the
                                      PDU_COP_CTRL_DATA structure.*/

PDU_COPT_DELAY          = 0x8005,  /* Wait the given time span before executing the next ComPrimitive.*/

PDU_COPT_RESTORE_PARAM  = 0x8006,  /* Copies ComParams related to a ComLogicalLink from active buffer to
                                      working buffer. (Converse functionality of
                                      PDU_COPT_UPDATEPARAM.)*/
} T_PDU_COPT;
```

D.1.3 Object type values

See PDUGetObjectId function

```
typedef enum E_PDU_OBJT
{
    PDU_OBJT_PROTOCOL     = 0x8021,  /* Object type for object PROTOCOL of MDF.*/
    PDU_OBJT_BUSTYPE      = 0x8022,  /* Object type for object BUSTYPE of MDF.*/
    PDU_OBJT_IO_CTRL      = 0x8023,  /* Object type for object IO_CTRL of MDF.*/
    PDU_OBJT_COMPARAM     = 0x8024,  /* Object type for object COMPARAM of MDF.*/
    PDU_OBJT_PINTYPE      = 0x8025,  /* Object type for object PINTYPE of MDF.*/
    PDU_OBJT_RESOURCE     = 0x8026,  /* Object type for object RESOURCE of MDF. Note that the caller of
                                        this function with this object type would need to know the vendor
                                        specific short-name of the resource.*/
} T_PDU_OBJT;
```

D.1.4 Status code values

Status events are returned in an event item type PDU_IT_STATUS.

```
typedef enum E_PDU_STATUS
{
    /* ComPrimitive status */
    PDU_COPST_IDLE          = 0x8010,  /* ComPrimitive is in the CommLogicalLink's ComPrimitive Queue and
                                          has not been acted upon. */

    PDU_COPST_EXECUTING     = 0x8011,  /* ComPrimitive has been pulled from the CommLogicalLink's
                                          ComPrimitive Queue and is in an active running state. */

    PDU_COPST_FINISHED      = 0x8012,   /* ComPrimitive is finished. * No further event items will be generated
                                          for this ComPrimitive. */

    PDU_COPST_CANCELLED     = 0x8013,  /* ComPrimitive was cancelled by a PDUCancelComPrimitive request.
                                          No further event items will be generated for this ComPrimitive. */

    PDU_COPST_WAITING       = 0x8014,  /* A periodic send ComPrimitive (NumSendCycles > 1) has finished its
                                          periodic cycle and is waiting for its next cyclic time for transmission. */

    /* ComLogicalLink status */
    PDU_CLLST_OFFLINE       = 0x8050,  /* ComLogicalLink is in communication state “offline”. Refer to
                                          description of PDUConnect, PDUDisconnect. */
```

```
    PDU_CLLST_ONLINE            = 0x8051,  /* ComLogicalLink is in communication state “online”. A
                                              PDU_COPT_STARTCOMM ComPrimitive has not been commanded.
                                              Refer to description of PDUConnect, PDUDisconnect */

    PDU_CLLST_COMM_STARTED = 0x8052,  /* ComLogicalLink is in communication state “communication started”.
                                              A PDU_COPT_STARTCOMM ComPrimitive has been commanded.
                                              The ComLogicalLink is in a transmit/receive state.  */

    /* Module status */
    PDU_MODST_READY             = 0x8060,  /* The MVCI protocol module is ready for communication. The MVCI
                                              protocol module has been connected by this D-PDU API Session (see
                                              PDUModuleConnect)*/

    PDU_MODST_NOT_READY         = 0x8061,  /* The MVCI protocol module is not ready for communication.
                                              Additional information about the cause may be provided via an
                                              additional vendor specific status code returned in pExtraInfo. Refer to
                                              description of PDUGetStatus.
                                              EXAMPLE  After running a PDU_IOCTL_RESET command on the module,
                                              it may take some time for the module until it becomes ready. Module is
                                              connected by this D-PDU API Session, but it is not ready for communication.  */

    PDU_MODST_NOT_AVAIL         = 0x8062,  /* The MVCI protocol module is unavailable for connection.
                                              EXAMPLE  Communication was lost after previously being in a
                                              PDU_MODST_READY state.*/

    PDU_MODST_AVAIL             = 0x8063,  /* The MVCI protocol module is available for connection (i.e. not yet
                                              connected by a D-PDU API session). (See PDUModuleConnect and
                                              PDUModuleDisconnect.) */

} T_PDU_STATUS;
```

D.1.5 Information event values

Information events are returned in an event item type PDU_IT_INFO.

```
typedef enum E_PDU_INFO
{
    PDU_INFO_MODULE_LIST_CHG    = 0x8070,  /* New MVCI protocol module list is available. Client application
                                              should call PDUGetModuleIds to get a list of the new set of
                                              modules and status. This event item is not generated when the
                                              status of a module changes. Related to the System Callback. */

    PDU_INFO_RSC_LOCK_CHG       = 0x8071,  /* There has been a change in the lock status on a shared
                                              physical resource. Call PDUGetResourceStatus to get a
                                              description of the new lock status. Only applicable to a resource
                                              shared by multiple ComLogicalLinks. Related to the
                                              ComLogicalLink Callback.  */

    PDU_INFO_PHYS_COMPARAM_CHG = 0x8072  /* There has been a change to the physical ComParams by
                                              another ComLogicalLink sharing the resource. Related to the
                                              ComLogicalLink Callback.  */
} T_PDU_INFO;
```

D.1.6 Resource status values

Used for element “PDUResourceStatus” of structure PDU_RSC_STATUS_DATA (see 11.1.4.4). See Bit encoding for UNUM32 for interface definition.

Table D.1 — Resource status values (bit encoded)

Bit Position	Name	Description
0	Usage Status	0 = Resource not in use (default) 1 = Resource in use
1	Availability Status	0 = Resource available (default) 1 = Resource not available
2	Transmit Queue Lock Status	0 = Transmit Queue is not locked (default) 1 = Transmit Queue is locked by a CLL. No other CLL except the one which holds the lock is allowed to transmit on the physical resource.
3	Physical ComParam Lock Status	0 = Physical ComParams are not locked (default) 1 = Physical ComParams are locked by a CLL. No other CLL except the one which holds the lock is allowed to change the physical ComParams for the resource.

D.1.7 Resource lock values

Used for API functions “PDULockResource” and “PDUUnlockResource”. See Bit encoding for UNUM32 for interface definition.

Table D.2 — Resource lock/unlock values (bit encoded)

Bit Position	Name	Description
0	Lock Physical ComParams	A ComLogicalLink requests exclusive privilege to modify physical ComParams for a physical resource. No other ComLogicalLink that is sharing the physical resource may attempt to modify the physical ComParams.
1	Lock Physical Transmit Queue	A ComLogicalLink requests exclusive privilege to transmit on a physical resource. No other ComLogicalLink that is sharing the physical resource may transmit any ComPrimitives on the physical resource. Only monitoring of the vehicle bus may be done by other ComLogicalLinks (receive only ComPrimitives).

D.1.8 Event callback data values

See EventCallback prototype.

```
typedef enum E_PDU_EVT_DATA
{
    PDU_EVT_DATA_AVAILABLE    = 0x0801,  /* This event indicates that there is event data available to be read by
                                            the application. The data could be an error, status, or result item. The
                                            application must call PDUGetEventItem to retrieve the item. */

    PDU_EVT_DATA_LOST         = 0x0802   /* This event indicates that the Com Logical Link has lost data due to a
                                            buffer (queue) overrun. No event data is stored in the event queue.
                                            This is for information only. */
} T_PDU_EVT_DATA.
```

D.1.9 Reserved ID and handle values

Table D.3 — Reserved ID and handle values

Constant name	Constant value	Description
PDU_ID_UNDEF	0xFFFFFFFE	Undefined ID value. Used to indicate an ID value is undefined.
PDU_HANDLE_UNDEF	0xFFFFFFFF	Undefined handle value. Used to indicate a Handle value is undefined.

D.1.10 IOCTL filter types values

```
typedef enum E_PDU_FILTER
{
    PDU_FLT_PASS          = 0x00000001,  /* Allows matching messages into the receive event queue. For all
                                            protocols. */

    PDU_FLT_BLOCK         = 0x00000002,  /* Keeps matching messages out of the event queue. For all protocols.*/

    PDU_FLT_PASS_UUDT     = 0x00000011,  /* Allows matching messages into the receive event queue which are of
                                            a UUDT type only. For ISO 15765 only.*/

    PDU_FLT_BLOCK_UUDT    = 0x00000012   /* Keeps matching messages out of the event queue which are of a
                                            UUDT type only. For ISO 15765 only.*/
} T_PDU_FILTER;
```

D.1.11 IOCTL event queue mode type values

```
typedef enum E_PDU_QUEUE_MODE
{
    PDU_QUE_UNLIMITED     = 0x00000000,  /* An attempt is made to allocate memory for every item being placed
                                            on the event queue. In Unlimited Mode, the QueueSize is ignored
                                            (Default Mode for a ComLogicalLink).*/

    PDU_QUE_LIMITED       = 0x00000001,  /* When the ComLogicalLink's event queue is full (i.e. maximum size
                                            has been reached), no new items are placed on the event queue. The
                                            event items are discarded in this case. */

    PDU_QUE_CIRCULAR      = 0x00000002   /* When the ComLogicalLink's event queue is full (i.e. maximum size
                                            has been reached), then the oldest event item in the queue is deleted
                                            so that the new event item can then be placed in the event queue. */
} T_PDU_QUEUE_MODE;
```

D.2 Flag definitions

D.2.1 TxFlag definition

The TxFlag information is used in the PDU_COP_CTRL_DATA structure (see 11.1.4.17) as part of the function PDUStartComPrimitive function.

Default Number of Bytes: 4

Table D.4 — TxFlag

Byte Pos	Bit Pos	Definition	Description	Value
0	7	Unused		
0	6	SUPPRESS_POS_RESP	ISO 14229-1/ISO 15765-3 Suppress Positive Response	0 = Not Enabled 1 = Enabled
0	5	ENABLE_EXTRA_INFO	Enable adding header and footer information into the result data (See Structure for result data). Extra information can be used for ECU response debugging.	0 = Not Enabled 1 = Enabled
0	4-0	Unused		
1	7-0	Reserved		
2	7-3	Reserved		
2	2	Unused		
2	1	WAIT_P3_MIN_ONLY	RAW_MODE Only Modified message timing for ISO 14230. Used to decrease programming time if application knows only one response will be received. Does not affect timing on responses to functional requests.	0 = Interface message timing as specified in ISO 14230 1 = After a response is received for a physical request, the wait time shall be reduced to P3_MIN.
2	0	CAN_29BIT_ID	RAW_MODE Only CAN ID type for ISO 11898, SAE J1939, and ISO 15765. CAN ID is contained in the first 4 bytes of the PDU Data.	0 = 11-bit 1 = 29-bit
3	7	ISO15765_ADDR_TYPE	RAW_MODE Only ISO 15765-2 Addressing Method CAN Extended Address is contained in the byte following the CAN ID in the PDU Data.	0 = no extended address 1 = extended addressing is used
3	6	ISO15765_FRAME_PAD	RAW_MODE Only ISO 15765-2 Frame Padding	0 = no padding 1 = pad all messages to a full CAN frame using the value in the ComParam CP_CanFillerByte
3	5-0	Reserved		

D.2.2 RxFlag definition

The RxFlag information is used in the PDU_RESULT_DATA structure (see 11.1.4.11.4), which is used in a PDU_IT_RESULT event item.

Default Number of Bytes: 4

Table D.5 — RxFlag

Byte Pos	Bit Pos	Definition	Description	Value
0	7	REMOTE_FRAME	CAN remote frame detected. No data bytes are received. The first byte of the D-DPU will contain the data length code.	0 = No Remote Frame Received 1 = Received a Remote Frame
0	6-0	Unused		
1	7-3	Reserved		
1	2	SPD_CHG_EVENT	Indicates that the serial bus has transitioned to a new speed. All communication after this event will occur at the new speed. The message data in this message may contain the monitored Change Speed message received on the serial bus.	0 = No Event 1 = Transitioned to new speed rate
1	1	ECU_TIMING_CHANGE	The timing ComParams values have been modified for the Com Logical Link. The MVCI protocol module has received a positive timing change message by an ECU in response to a timing change request message (protocol specific). This flag will only be set if the CP_ModifyTiming ComParam is set to Enable.	0 = No Timing Change 1 = Timing ComParams have been modified
1	0	SW_CAN_HV_RX[3)]	Indicates that the Single Wire CAN message received was a High-Voltage Message.	0 = Normal Message 1 = High-Voltage Message
2	7-1	Reserved		
2	0	CAN_29BIT_ID	RAW_MODE ONLY CAN ID type for ISO 11898, SAE J1939, and ISO 15765 CAN ID is contained in the first 4 bytes of the PDU Data.	0 = 11-bit 1 = 29-bit
3	7	ISO15765_ADDR_TYPE	RAW_MODE ONLY ISO 15765-2 Addressing Method CAN Extended Address byte is contained in the bytes following the CAN ID in the PDU Data.	0 = no extended address 1 = extended addressing is used

3) A SW-CAN transceiver does not provide the capability to determine a high voltage reception during normal mode of operation and to tie this information to an ongoing reception. A SW-CAN transceiver only provides the capability to indicate a wake-up on the RxD pin during sleep mode operation without being able to receive the CAN frame that forced the wake-up, because only the voltage level over a period of time is used to determine a high voltage signal during this mode of operation. In order to determine a high voltage reception during normal mode of operation (when CAN messages are received) the voltage level of the bus pin has to be measured in parallel to the CAN message reception and this information has to be tied together according to the SAE J2411. Since the information of receiving a high voltage message is of secondary kind when the MVCI works as a tester device and a separate hardware is required to determine the voltage level, the handling of this flag is optional. In case an MVCI does not have the hardware to measure the SW-CAN bus pin voltage level this flag shall always be set to '0' = normal message.

Table D.5 (*continued*)

Byte Pos	Bit Pos	Definition	Description	Value
3	6	CAN_SEGMENTATION	RAW_MODE ONLY ISO 15765-2 Can Segmentation handling Received message was either handled as a segmented or unsegmented message. (If Segmented, then the segment information was removed from the PDU Data.)	0 = no segmentation 1 = segmented
3	5	Reserved		
3	4	ISO15765_ PADDING_ERROR	RAW_MODE ONLY For Protocol ISO 15765, a CAN frame was received with less than 8 data bytes.	0 = No Error 1 = Padding Error
3	3	TX_INDICATION	TxDone indication	0= No TxDone 1= TxDone
3	2	RX_BREAK	SAE J2610 and SAE J1850 VPW only Break indication received	0 = No break received 1 = Break received
3	1	START_OF_MESSAGE	Indicates the reception of the first byte of an ISO 9141 or ISO 14230 message, or first frame of an ISO 15765 multiframe message.	0 = Not a start of message indication 1 = First byte or frame received
3	0	TX_MSG_TYPE	Receive Indication/Transmit Loopback	0 = received (i.e. this message was transmitted on the bus by another node) 1 = transmitted (i.e. this is the echo of the message transmitted by the device)

D.2.3 CllCreateFlag definition

The CllCreateFlag information is used in the PDUCreateComLogicalLink function.

Default Number of Bytes: 4

Table D.6 — CllCreateFlag

Byte Pos	Bit Pos	Definition	Description	Value
0	7	RawMode	Enables the ability to pass through entire received messages, unchanged, through the datalink (transmitted and received). This feature is protocol specific. RawMode=OFF: When transmitting a message, RawMode OFF indicates that the D-PDU API will add the header bytes and checksums to the pCopData of the ComPrimitive before transmission. When receiving a message, RawMode OFF indicates that the D-PDU API will strip the header bytes and checksums before returning the Result Item (the TxFlag ENABLE_EXTRA_INFO can be used to obtain additional message header/footer information).	0 = OFF (If a protocol is configured to generate header byte information, header bytes will be appended before transmission and stripped after receipt.)
			RawMode=ON: When transmitting a message, RawMode ON indicates that the header bytes and checksums were in the pCopData when PDUStartComPrimitive( ) was called. When receiving a message, RawMode ON indicates that the header bytes and checksums will be left in the Result Item that is returned. The default value of the flag is RawMode=OFF (equal '0'), which means headers and checksums will not be appended to the message.	1 = ON (Interface will pass through the received PDU data. No header bytes will be generated or checked. Only the network layer, such as ISO 15765, will still be enabled.)
0	6	ChecksumMode	For protocols that use checksums, the D-PDU API can create and append the checksum to transmit messages based on this flag. ChecksumMode=OFF This flag is ignored for protocols that do not use Checksums. This flag is ignored if RawMode is set to OFF. The default value of the flag is ChecksumMode=OFF (equal '0'), which means a checksum will not be appended to the message. ChecksumMode=ON	0 = OFF The D-PDU API will not append a checksum to the transmitted PDU data nor will it validate and remove the received checksum. 1 = ON For the UART protocols using checksums, the D-PDU API will append a checksum to the transmitted PDU data and it will validate and remove the received checksum.

Table D.6 (*continued*)

Byte Pos	Bit Pos	Definition	Description	Value
0	5-0	Unused		
1	7-0	Unused		
2	7-0	Unused		
3	7-0	Unused		

D.2.4 TimestampFlag definition

The TimestampFlag information is used in the PDU_RESULT_DATA structure (see Structure for result data) as part of the data information returned in a PDU_IT_RESULT item.

Default Number of Bytes: 4

Table D.7 — TimestampFlag

Byte Pos	Bit Pos	Definition	Description	Value
0	7	TxMsgDoneTimestamp-Indicator	Transmit Done Timestamp Indicator. Indication that the Transmit Done Timestamp value in the PDU_RESULT_DATA structure is valid.	0 = Not Valid 1 = Valid
0	6	StartMsgTimestamp-Indicator	Start Message Timestamp Indicator. Indication. Indication that the Start Message Timestamp value in the PDU_RESULT_DATA structure is valid.	0 = Not Valid 1 = Valid
0	5-0	Unused		
1	7-0	Unused		
2	7-0	Unused		
3	7-0	Unused		

D.3 Function return values

The standard return values cover all return values described in 9.4. For each value, the symbolic definition is provided.

```
typedef enum E_PDU_ERROR
{
    PDU_STATUS_NOERROR                  = 0x00000000,   /* No error for the function call */

    PDU_ERR_FCT_FAILED                  = 0x00000001,   /* Function call failed (generic failure)*/

    PDU_ERR_RESERVED_1                  = 0x00000010,   /* Reserved by ISO 22900-2 */

    PDU_ERR_COMM_PC_TO_VCI_FAILED       = 0x00000011,   /* Communication between host and MVCI
                                                           protocol module failed */

    PDU_ERR_PDUAPI_NOT_CONSTRUCTED      = 0x00000020,   /*The D-PDU API has not yet been constructed */

    PDU_ERR_SHARING_VIOLATION           = 0x00000021,   /* A PDUDestruct was not called before another
                                                           PDUConstruct      */
```

```
PDU_ERR_RESOURCE_BUSY                = 0x00000030,  /* the requested resource is already in use.*/
PDU_ERR_RESOURCE_TABLE_CHANGED       = 0x00000031,  /* Not used by the D-PDU API */
PDU_ERR_RESOURCE_ERROR               = 0x00000032,  /* Not used by the D-PDU API */
PDU_ERR_CLL_NOT_CONNECTED            = 0x00000040,  /* The ComLogicalLink cannot be in the
                                                       PDU_CLLST_OFFLINE state to perform the
                                                       requested operation.*/
PDU_ERR_CLL_NOT_STARTED              = 0x00000041,  /* The ComLogicalLink must be in the
                                                       PDU_CLLST_COMM_STARTED state to perform
                                                       the requested operation. */
PDU_ERR_INVALID_PARAMETERS           = 0x00000050,  /* One or more of the parameters supplied in the
                                                       function are invalid. */
PDU_ERR_INVALID_HANDLE               = 0x00000060,  /* One or more of the handles supplied in the
                                                       function are invalid.  */
PDU_ERR_VALUE_NOT_SUPPORTED          = 0x00000061,  /* One of the option values in PDUConstruct is
                                                       invalid. */
PDU_ERR_ID_NOT_SUPPORTED             = 0x00000062,  /* IOCTL command id not supported by the
                                                       implementation of the D-PDU API*/
PDU_ERR_COMPARAM_NOT_SUPPORTED       = 0x00000063,  /* ComParam id not supported by the
                                                       implementation of the D-PDU API */
PDU_ERR_COMPARAM_LOCKED              = 0x00000064,  /* Physical ComParam cannot be changed
                                                       because it is locked by another ComLogicalLink.  */
PDU_ERR_TX_QUEUE_FULL                = 0x00000070,  /* The ComLogicalLink's transmit queue is full; the
                                                       ComPrimitive could not be queued. */
PDU_ERR_EVENT_QUEUE_EMPTY            = 0x00000071,  /* No more event items are available to be read
                                                       from the requested queue. */
PDU_ERR_VOLTAGE_NOT_SUPPORTED        = 0x00000080,  /* The voltage value supplied in the IOCTL call is
                                                       not supported by the MVCI protocol module. */
PDU_ERR_MUX_RSC_NOT_SUPPORTED        = 0x00000081,  /* The specified pin / resource are not supported
                                                       by the MVCI protocol module for the IOCTL call. */
PDU_ERR_CABLE_UNKNOWN                = 0x00000082,  /* The cable attached to the MVCI protocol module
                                                       is of an unknown type. */
PDU_ERR_NO_CABLE_DETECTED            = 0x00000083,  /* No cable is detected by the MVCI protocol
                                                       module */
PDU_ERR_CLL_CONNECTED                = 0x00000084,  /*The ComLogicalLink is already in the
                                                       PDU_CLLST_ONLINE state. */
PDU_ERR_TEMPPARAM_NOT_ALLOWED        = 0x00000090,  /* Physical ComParams cannot be changed as a
                                                       temporary ComParam. */
PDU_ERR_RSC_LOCKED                   = 0x000000A0,  /* The resource is already locked.*/
PDU_ERR_RSC_LOCKED_BY_OTHER_CLL      = 0x000000A1,  /* The ComLogicalLink's resource is currently
                                                       locked by another ComLogicalLink. */
PDU_ERR_RSC_NOT_LOCKED               = 0x000000A2,  /* The resource is already in the unlocked state. */
```

```
    PDU_ERR_MODULE_NOT_CONNECTED      = 0x000000A3,  /*The module is not in the PDU_MODST_READY
                                                      state. */

    PDU_ERR_API_SW_OUT_OF_DATE        = 0x000000A4,  /*The API software is older than the MVCI protocol
                                                      module Software*/

    PDU_ERR_MODULE_FW_OUT_OF_DATE     = 0x000000A5,  /* The MVCI protocol module software is older than
                                                      the API software. */
    PDU_ERR_PIN_NOT_CONNECTED         = 0x000000A6   /*The requested Pin is not routed by supported
                                                      cable*/

} T_PDU_ERROR;
```

D.4 Event error codes

D.4.1 Error event code returned in PDU_IT_ERROR

The standard error codes cover asynchronous error situations, which occur with typical MVCI protocol modules and protocols. Error event codes are returned in an event item type PDU_IT_ERROR.

```
typedef enum E_PDU_ERR_EVT
{
    PDU_ERR_EVT_NOERROR               = 0x00000000,  /* No Error. Event type only returned on a
                                                      PDUGetLastError if there were no previous
                                                      errors for the requested handle */

    PDU_ERR_EVT_FRAME_STRUCT          = 0x00000100,  /* CLL/CoP Error: The structure of the received
                                                      protocol frame is incorrect (e.g. wrong frame
                                                      number, missing FC …). */

    PDU_ERR_EVT_TX_ERROR              = 0x00000101,  /* CLL/CoP Error: Error encountered during
                                                      transmit of a ComPrimitive PDU. */

    PDU_ERR_EVT_TESTER_PRESENT_ERROR  = 0x00000102,  /* CLL/CoP Error: Error encountered in
                                                      transmitting a Tester Present message or in
                                                      receiving an expected response to a Tester
                                                      Present message. */

    PDU_ERR_EVT_RSC_LOCKED            = 0x00000109,  /* CLL Error: A physical ComParam was not set
                                                      because of a physical ComParam lock. */

    PDU_ERR_EVT_RX_TIMEOUT            = 0x00000103,  /* CLL/CoP Error: Receive timer (e.g. P2Max)
                                                      expired with no expected responses received
                                                      from the vehicle.*/

    PDU_ERR_EVT_RX_ERROR              = 0x00000104,  /* CLL/CoP Error: Error encountered in receiving
                                                      a message from the vehicle bus (e.g. checksum
                                                      error …). */

    PDU_ERR_EVT_PROT_ERR              = 0x00000105,  /* CLL/CoP Error: Protocol error encountered
                                                      during handling of a ComPrimitive (e.g. if the
                                                      protocol cannot handle the length of a
                                                      ComPrimitive).*/

    PDU_ERR_EVT_LOST_COMM_TO_VCI      = 0x00000106,  /* Module Error: Communication to a MVCI
                                                      protocol module has been lost.*/

    PDU_ERR_EVT_VCI_HARDWARE_FAULT    = 0x00000107,  /* Module Error: The MVCI protocol module has
                                                      detected a hardware error.*/

    PDU_ERR_EVT_INIT_ERROR            = 0x00000108,  /* CLL/CoP Error: A failure occurred during a
                                                      protocol initialization sequence. */

} T_PDU_ERR_EVT;
```

D.4.2 Additional error code returned in PDU_IT_ERROR

The D-PDU API allows for vendor defined additional error codes to be returned in an error event item. All additional error codes and their text translations shall be provided in the MDF.

Table D.8 — Event error and examples for additional error codes

Standard Event Error Codes	Examples for additional error codes for a MDF
PDU_ERR_EVT_FRAME_STRUCT	
PDU_ERR_EVT_FRAME_STRUCT	PDU_XTRA_ERR_ISO15765_PADDING
	PDU_XTRA_ERR_ISO15765_FRAME_NUM
	PDU_XTRA_ERR_1850_FRAME_STRUCT
PDU_ERR_EVT_TX_ERROR	
PDU_ERR_EVT_TX_ERROR	PDU_XTRA_ERR_TX_LOST_ARB
	PDU_XTRA_ERR_TX_NETWORK_FAULT
	PDU_XTRA_ERR_1850_CRC
	PDU_XTRA_ERR_1850_TX_ERR
	PDU_XTRA_ERR_1850_TX_LOST_ARB
	PDU_XTRA_ERR_MAX_WAIT_FRAME
PDU_ERR_EVT_TESTER_PRESENT_ERROR	
PDU_ERR_EVT_TESTER_PRESENT_ERROR	PDU_XTRA_ERR_TP_TX
	PDU_XTRA_ERR_TP_RX
PDU_ERR_EVT_RX_TIMEOUT	
PDU_ERR_EVT_RX_TIMEOUT	PDU_XTRA_ERR_ISO15765_CF_TIMEOUT
	PDU_XTRA_ERR_ISO15765_FC_TIMEOUT
	PDU_XTRA_ERR_RX_TIMEOUT_NO_RSP
PDU_ERR_EVT_RX_ERROR	
PDU_ERR_EVT_RX_ERROR	PDU_XTRA_ERR_CAN_BUS_OFF
	PDU_XTRA_ERR_CAN_BUS_ERROR_ACTIVE
	PDU_XTRA_ERR_CAN_BUS_ERROR_PASSIVE
	PDU_XTRA_ERR_RX_ERRORFRAME
	PDU_XTRA_ERR_CAN_NO_ACK
	PDU_XTRA_ERR_CAN_CRC
	PDU_XTRA_ERR_CAN_BIT_STUFF
	PDU_XTRA_ERR_CAN_BUS_FAULT
	PDU_XTRA_ERR_RX_CHECKSUM_BAD
	PDU_XTRA_ERR_RX_FRAMING
	PDU_XTRA_ERR_RX_NETWORK_FAULT
	PDU_XTRA_ERR_1850_CRC
	PDU_XTRA_ERR_1850_NO_IFR
	PDU_XTRA_ERR_1850_BIT_TIMING

Table D.8 (*continued*)

Standard Event Error Codes	Examples for additional error codes for a MDF
PDU_ERR_EVT_PROT_ERR	
PDU_ERR_EVT_PROT_ERR	PDU_XTRA_ERR_LOST_MASTER
	PDU_XTRA_ERR_NO_POLLING_MSG
	PDU_XTRA_ERR_UNEXP_RESPONSE
PDU_ERR_EVT_LOST_COMM_TO_VCI	
PDU_ERR_EVT_LOST_COMM_TO_VCI	PDU_XTRA_ERR_NO_RESP
	PDU_XTRA_ERR_WLAN_LOST
	PDU_XTRA_ERR_USB_DISCONNECT
PDU_ERR_EVT_VCI_HARDWARE_FAULT	
PDU_ERR_EVT_VCI_HARDWARE_FAULT	PDU_XTRA_ERR_RAM
	PDU_XTRA_ERR_FLASH
	PDU_XTRA_ERR_FILE_SYS
PDU_ERR_EVT_INIT_ERROR	
PDU_ERR_EVT_INIT_ERROR	PDU_XTRA_ERR_ISO_INVALID_KEYWORD
	PDU_XTRA_ERR_ISO_INIT_SEQ_ERROR

Annex E
(normative)

Application defined tags

In order to facilitate usage of callback routines and to provide best performance possible, the D-PDU API makes use of an application defined void * pointer (in the following called 'tag'). Even though the application is free to use the tag or not, and what to store with the tag, the tag's general intended function is as follows:

Usually, an application dealing with an API handle has to store additional data in conjunction with the handle. For example, the application could combine a ComPrimitive handle, retrieved from the D-PDU API, with a list of corresponding service qualifiers, into a single internal data structure. The application can now internally refer to the whole information set by using a single pointer to that structure. When the D-PDU API implementation executes the event callback function provided by the application, it returns a ComPrimitive handle. Unfortunately, if no additional information is provided, the application has to iterate through a list of structures, in order to find the internal data structure with the corresponding service qualifiers (because that qualifier is not being referenced within the ComPrimitive handle).

This shortcoming has been eliminated, as the D-PDU API allows for storing a void * pointer within a ComPrimitive, it returns the tag when executing the callback function. The application passes the pointer to the internal data structure as tag value to PDUStartComPrimitive. When the application's event callback function is executed, the application can now directly fetch the corresponding service qualifier without iterating through a list of structures.

The client application MAY use the tag pointer as received from the D-PDU API, always assuming that it can rely on the value returned by the PDU API in a callback function or a result item. If the client application does not trust the D-PDU API, it may instead use its own list of mapped pointers to avoid the possibility of the tag values being unexpectedly modified. Tag values are not necessary since the callback function and result item always contain the corresponding handles.

Reference document:

— Pattern-Oriented Software Architecture: Patterns for Concurrent and Networked Objects Douglas C. Schmidt, Michael Stal

— See also http://www.cs.wustl.edu/~schmidt/PDF/ACT.pdf

Tags are available for the following functionality:

— pAPITag: D-PDU API Library (default system level callback)

— pClITag: ComLogicalLink Tag (ComLogical link callback)

— pCoPTag: ComPrimitive Tag (returned in the PDU_RESULT_DATA for a ComLogicalLink callback)

Annex F
(normative)

Description files

F.1 D-PDU API root description file (RDF)

F.1.1 General overview

The D-PDU API root description file (RDF) is the central entry point for all applications accessing MVCI protocol modules. The location of this file, its structure, and the procedure to get access to it, is defined for Windows and Linux platforms (see 9.7). Taking this as a basis, applications can automatically determine the available resources without any prior knowledge about which MVCI protocol modules and D-PDU API implementations are installed. Due to a standardized XML Schema structure, the application may even offer a generic user dialog to configure and operate all MVCI protocol modules, their protocols and bus types.

F.1.2 UML diagram of RDF

Figure F.1 —UML class diagram of D-PDU API root description file shows the UML class diagram of the RDF. Every D-PDU API implementation shall add an “MVCI_PDU_API” element to the “MVCI_PDU_API_ROOT” element. As a minimum, the “MVCI_PDU_API” element contains a symbolic name identifying the implementation (“SHORT_NAME” element), a full file path onto its software library (“LIBRARY_FILE” element), its MVCI module description file (“MODULE_DESCRIPTION_PATH” element) and the cable description file (“CABLE_DESCRIPTION_FILE” element). Optionally, this element may also include a short description, and the supplier name related to the respective implementation.

NOTE Each DLL/library used at runtime belongs to one MVCI_PDU_API entry which exactly refers to one MDF and one CDF. The client application decides which MVCI_PDU_API entry or entries to use.

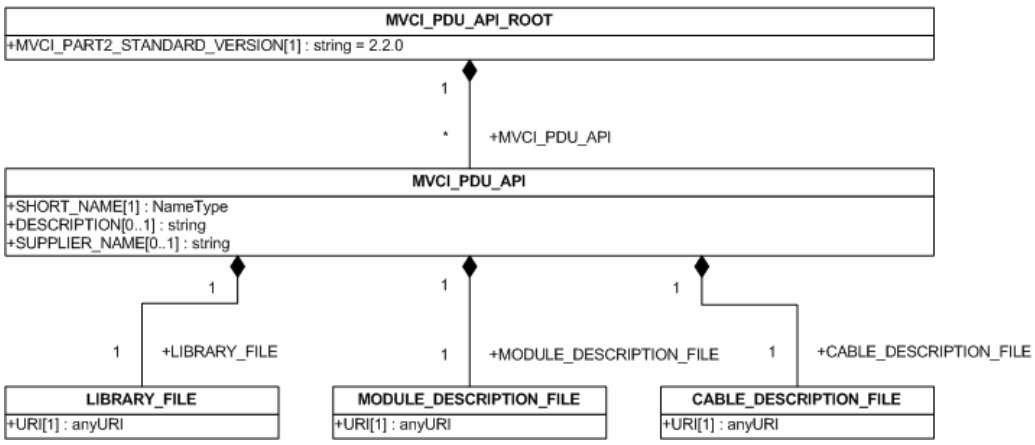


Figure F.1 —UML class diagram of D-PDU API root description file (RDF)

F.2 MVCI module description file (MDF)

F.2.1 General overview

The MVCI module description file (MDF) describes all ComParams, I/O controls, bus types, protocols and resources supported by a specific MVCI protocol module. In addition, if the D-PDU API implementation supports more than one type of MVCI protocol module, the MDF may list and describe all supported modules. All definitions of ComParams, bus types, protocols, etc., inside the configuration description files may be shared among the module definition in the same file.

Each element in the MDF contains a symbolic name, and its corresponding numeric ID. An application could provide a user interface showing the symbolic names, e.g. for a list of ComParams. When the application needs to get or set the ComParams at the API level, it would map the symbolic names onto the corresponding IDs.

The application may also operate the D-PDU API without extracting the symbolic names and IDs at runtime. If the use case excludes frequent changes to the MDFs, simple applications may also hard-code all necessary IDs, and operate the D-PDU API without parsing any MDF at runtime.

Optionally, each element in this type of the MDF may have a short description.

F.2.2 ComParam String Format

F.2.2.1 General

ComParam default values, min values and max values are stored as strings in the MDF file. The strings are written as a sequence of numbers separated by spaces. The numbers themselves are to be interpreted as follows.

If the first character is 0 and the second character is not 'x' or 'X', the number is interpreted as an octal integer; otherwise, it is interpreted as a decimal number. If the first character is '0' and the second character is 'x' or 'X', the number is interpreted as a hexadecimal integer. If the first character is '1' through '9', the number is interpreted as a decimal integer. Any number may be preceded by a + or – sign to indicate sign.

F.2.2.2 String format for numeric values (data type PDU_PT_UNUMx or PDU_PT_SNUMx)

Most ComParams values are in a simple single number format like PDU_PT_UNUM32. The default value, min value and max value in the MDF just contain a single number for these simple types.

EXAMPLE 1 Contents for baud rate: ComParam = CP_Baudrate: 10400.

```
<COMPARAM EID="ID1014">
  <ID>14</ID>
  <SHORT_NAME>CP_Baudrate</SHORT_NAME>
  <DESCRIPTION> Define the baud rate used for the physical vehicle bus</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10400 </DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
```

EXAMPLE 2 Same as EXAMPLE 1 with hexadecimal number.

```
<COMPARAM EID="ID1014">
  <ID>14</ID>
  <SHORT_NAME>CP_Baudrate</SHORT_NAME>
  <DESCRIPTION> Define the baud rate used for the physical vehicle bus</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0x28A0</DEFAULT_VALUE>
```

```
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
 </COMPARAM>
```

F.2.2.3 String format for bytefield values (data type PDU_PT_BYTEFIELD)

A bytefield structure essentially contains an array of bytes. The structure includes a maximum number of bytes, actual number of bytes, and the array of bytes (see ComParam BYTEFIELD data type).

EXAMPLE 1 Byte field contents for tester present message: ComParam = CP_TesterPresentMessage: max bytes = 12, actual bytes = 2, data = 0x3E, 0x01.

```
 <COMPARAM EID="ID1015">
  <ID>15</ID>
  <SHORT_NAME>CP_TesterPresentMessages</SHORT_NAME>
  <DESCRIPTION> Define the Tester Present Message used to keep a diagnostic session active on a vehicle serial bus.
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>0x0C 0x02 0x3E 0x01</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
```

EXAMPLE 2 Same as EXAMPLE 1 with a mixture of hexadecimal and decimal numbers.

```
 <COMPARAM EID="ID1015">
  <ID>15</ID>
  <SHORT_NAME>CP_TesterPresentMessages</SHORT_NAME>
  <DESCRIPTION> Define the Tester Present Message used to keep a diagnostic session active on a vehicle serial bus.
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>12 2 0x3E 1</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
```

F.2.2.4 String format for long field structures (data type PDU_PT_LONGFIELD)

A longfield structure essentially contains an array of longs. The structure includes a maximum number of longs, actual number of longs, and the array of longs (see ComParam LONGFIELD Data Type).

EXAMPLE 1 Longfield contents for Can Baudrate Record: ComParam = CP_CanBaudrateRecord: max longs = 12, actual longs = 3, data = 500000, 250000, 125000.

```
 <COMPARAM EID="ID1016">
  <ID>16</ID>
  <SHORT_NAME>CP_CanBaudrateRecord</SHORT_NAME>
  <DESCRIPTION> List of baud rates to use during an OBD CAN initialization sequence. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_LONGFIELD</DATA_TYPE>
  <DEFAULT_VALUE>12 3 500000 250000 125000</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
 </COMPARAM>
```

EXAMPLE 2 Same as EXAMPLE 1 with a mixture of hexadecimal and decimal numbers.

```
 <COMPARAM EID="ID1016">
  <ID>16</ID>
  <SHORT_NAME>CP_CanBaudrateRecord</SHORT_NAME>
```

```
  <DESCRIPTION> List of baud rates to use during an OBD CAN initialization sequence. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_LONGFIELD</DATA_TYPE>
  <DEFAULT_VALUE>0x0C 3 500000 250000 0x1e848</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
 </COMPARAM>
```

F.2.2.5 String format for complex structures (data type PDU_PT_STRUCTFIELD)

A structfield structure essentially contains an array of specific types of structures. Each structure in the array is separated by a space similar to PDU_PT_BYTEFIELD and PDU_PT_LONGFIELD ComParam types. The structure includes a structure type, maximum number of structures, actual number of structures, and the array of specific structures (see ComParam STRUCTFIELD data type).

EXAMPLE 1 Structfield contents for Can Session Timing override: ComParam = CP_SessionTimingOverride: Structure Type = PDU_CPST_SESSION_TIMING = 1, max num structures = 255, actual num structures = 2,

data = structure (1)

UNUM16 session = 1

UNUM8 P2Max_high = 60

UNUM8 P2Max_low = 25

UNUM8 P2Star_high = 250

UNUM8 P2Star_low = 50

data = structure (2)

UNUM16 session = 2

UNUM8 P2Max_high = 65

UNUM8 P2Max_low = 20

UNUM8 P2Star_high = 255

UNUM8 P2Star_low = 55

```
</COMPARAM>
 <COMPARAM EID="ID1017">
  <ID>17</ID>
  <SHORT_NAME>CP_SessionTimingOverride</SHORT_NAME>
  <DESCRIPTION> Override the ECU response to a set session timing command. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_STRUCTFIELD</DATA_TYPE>
  <DEFAULT_VALUE>1 255 2 1 60 25 250 50 2 65 20 255 55 </DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
```

EXAMPLE 2 Same as EXAMPLE 1 with a mixture of hexadecimal and decimal numbers.

```
</COMPARAM>
 <COMPARAM EID="ID1017">
  <ID>17</ID>
  <SHORT_NAME>CP_SessionTimingOverride</SHORT_NAME>
  <DESCRIPTION> Override the ECU response to a set session timing command. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_STRUCTFIELD</DATA_TYPE>
  <DEFAULT_VALUE>1 0xFF 2 1 60 25 250 50 0x02 65 20 0xFF 55 </DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
```

F.2.3 ComParam resolution tag

The MDF file contains an additional string value that specifies the resolution and unit of the ComParam. This is only used for informational purposes. The resolution means that the ComParams set via PDUSetComParam and received via PDUGetComParam will be in the defined resolution units.

EXAMPLE If the CP_P2Star has a resolution of 0,5 ms, then the client should send 4 000 to set the ComParam to 2 s.

F.2.4 UML diagram of MDF

Figure F.2 — UML class diagram of MVCI module description file shows the structure of the MVCI module description file. All elements attached to the “MVCI_MODULE_DESCRIPTION” element may exist multiple times, referring to different contents.

Within the configuration, bus types are clearly separated from protocols, because multiple protocols may run on the same bus type. The bus types are defined with the “BUSTYPE” element. Besides name, ID and description, this element has a list of ComParams. The referenced ComParams need to be defined in the same file.

Protocols are defined with the “PROTOCOL” element, and contain exactly the same sub-elements as the bus type element.

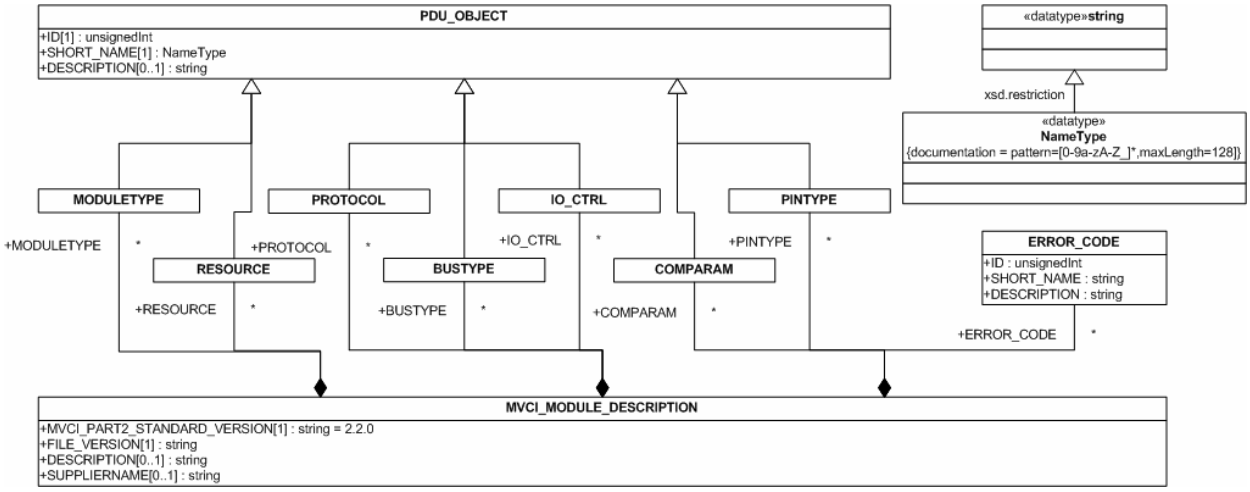


Figure F.2 — UML class diagram of MVCI module description file (MDF)

F.2.5 UML diagram of MDF elements COMPARAM

ComParams are defined with the “COMPARAM” element and contain mandatory entries for a symbolic name (“SHORT_NAME” element), an ID (“ID” element), and the ComParam type (“COMPARAM_TYPE” element) (see B.3.3).

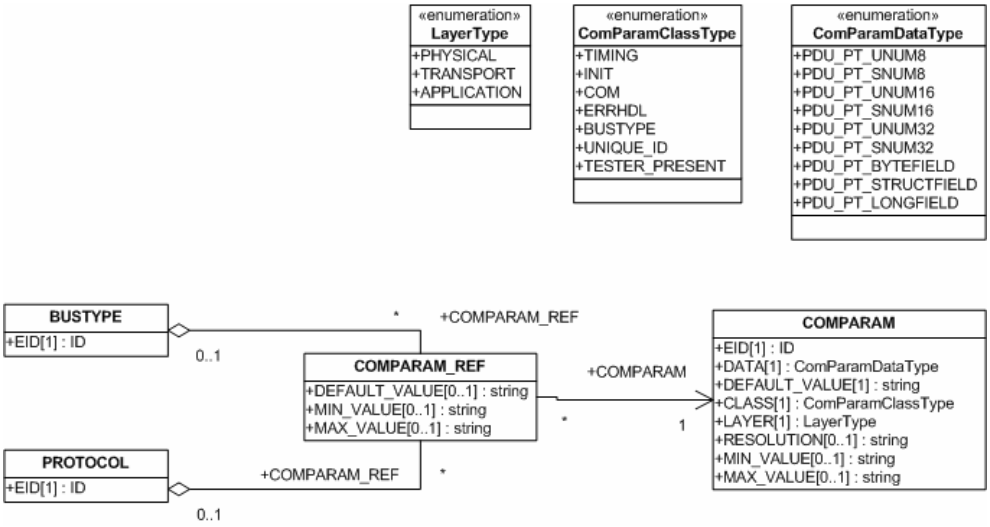


Figure F.3 — UML class diagram of element COMPARAM

F.2.6 UML diagram of MDF element RESOURCE

Resources consist of a bus type, and one protocol supported on that bus type, and are defined by the "RESOURCE" element. Besides name, ID and description, this element has a bus type, a protocol, and a list of pin numbers as sub-elements. Bus types and protocols are referenced by an ID/IDREF mechanism and shall be defined within the same file. The list of pin numbers contains all pins this resource occupies on the vehicles DLC interface. For example, for SAE J1850 VPW, the list would include one pin, whereas for CAN, it would include two pins, one for CAN High and one for CAN Low.

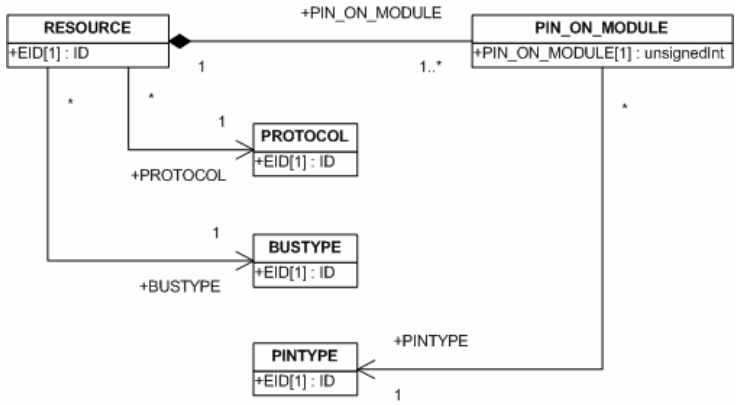


Figure F.4 — UML class diagram of element RESOURCE

F.2.7 UML diagram of MDF element MODULETYPE

As the last element in the logical chain, the modules are defined by the "MODULETYPE" element and have lists of I/O controls and resources, besides name, ID, and description. I/O controls are specified using the "IO_CTRL" element. The elements are defined by name, ID and description. A detailed view on I/O controls is depicted in I/O control section.

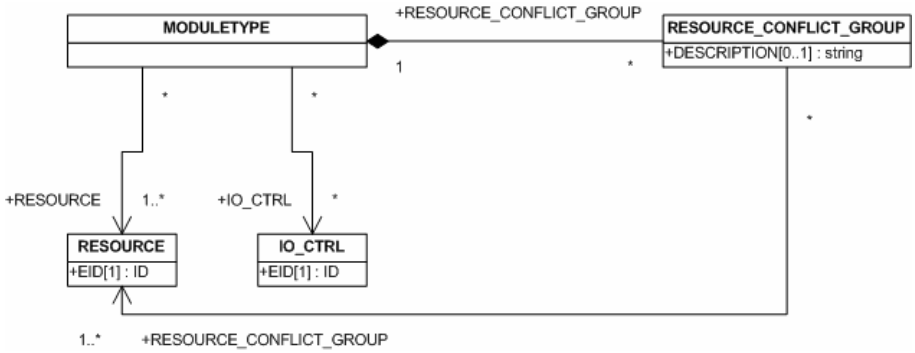


Figure F.5 — UML class diagram of element MODULETYPE, RESOURCE and IO_CTRL

F.3 Cable description file (CDF)

F.3.1 General overview

The cable description file (depicted in Figure F.6 — UML class diagram of cable description file (CDF)) closes the gap between the cable's pin assignment and the vendor-specific pin assignment on the MVCI protocol module's DLC interface.

F.3.2 UML diagram of CDF

Each cable has its own “CABLE” element and the mandatory sub-elements “SHORT_NAME”, “DLC_TYPE” and “ID”. The sub-element “DESCRIPTION” is again optional. Besides those sub-elements, there are two additional mandatory sub-elements: a “MAPPING” sub-element for each resource mapped, and one “CABLE_IDENTIFICATION” sub-element.

The “MAPPING” sub-element includes two mandatory sub-elements. The “PIN_ON_DLC” sub-element defines the pin number on the DLC, while the “PIN_ON_VCI” sub-element defines the corresponding pin number on the MVCI protocol module.

The “CABLE_IDENTIFICATION” sub-element contains the “CABLE_ID” sub-element, and optionally the “CABLE_ID_PIN” sub-element, which contains a resistance value and a pin number for automatic cable identification.

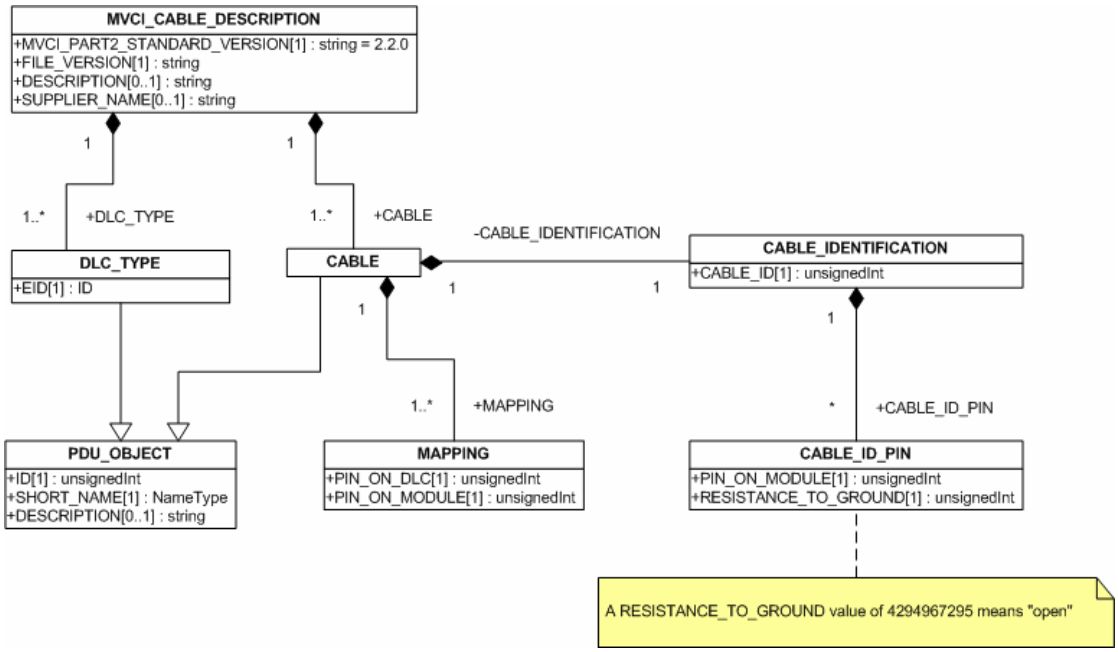


Figure F.6 — UML class diagram of cable description file (CDF)

F.4 XML schema

XML schema for the D-PDU API Description Files.

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
    <xsd:complexType name="BUSTYPE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="COMPARAM_REF" minOccurs="0" maxOccurs="unbounded"
type="COMPARAM_REF"/>
                </xsd:sequence>
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="CABLE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="CABLE_IDENTIFICATION" minOccurs="1" maxOccurs="1"
type="CABLE_IDENTIFICATION"/>
                    <xsd:element name="MAPPING" minOccurs="1" maxOccurs="unbounded" type="MAPPING"/>
                    <xsd:element name="DLCTYPE" minOccurs="1" maxOccurs="1">
                        <xsd:complexType>
                            <xsd:attribute name="IDREF" type="xsd:IDREF" />
                        </xsd:complexType>
                    </xsd:element>
                </xsd:sequence>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="CABLE_DESCRIPTION_FILE">
        <xsd:attribute name="URI" use="required" type="xsd:anyURI"/>
    </xsd:complexType>
    <xsd:complexType name="CABLE_ID_PIN">
        <xsd:sequence>
            <xsd:element name="PIN_ON_MODULE" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
            <xsd:element name="RESISTANCE_TO_GROUND" minOccurs="1" maxOccurs="1"
```

```
type="xsd:unsignedInt"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="CABLE_IDENTIFICATION">
        <xsd:sequence>
            <xsd:element name="CABLE_ID" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
            <xsd:element name="CABLE_ID_PIN" minOccurs="0" maxOccurs="unbounded"
type="CABLE_ID_PIN"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="COMPARAM">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="DATA_TYPE" minOccurs="1" maxOccurs="1"
type="ComParamDataType"/>
                    <xsd:element name="DEFAULT_VALUE" minOccurs="1" maxOccurs="1"
type="xsd:string"/>
                    <xsd:element name="CLASS" minOccurs="1" maxOccurs="1" type="ComParamClassType"/>
                    <xsd:element name="LAYER" minOccurs="1" maxOccurs="1" type="LayerType"/>
                    <xsd:element name="RESOLUTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
                    <xsd:element name="MIN_VALUE" minOccurs="0" maxOccurs="1" type="xsd:string"/>
                    <xsd:element name="MAX_VALUE" minOccurs="0" maxOccurs="1" type="xsd:string"/>
                </xsd:sequence>
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="COMPARAM_REF">
        <xsd:sequence>
            <xsd:element name="DEFAULT_VALUE" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="MIN_VALUE" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="MAX_VALUE" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="COMPARAM" minOccurs="1" maxOccurs="1">
                <xsd:complexType>
                    <xsd:attribute name="IDREF" type="xsd:IDREF" />
                </xsd:complexType>
            </xsd:element>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:simpleType name="ComParamClassType">
        <xsd:restriction base="xsd:string">
            <xsd:enumeration value="undefined"/>
            <xsd:enumeration value="TIMING"/>
            <xsd:enumeration value="INIT"/>
            <xsd:enumeration value="COM"/>
            <xsd:enumeration value="ERRHDL"/>
            <xsd:enumeration value="BUSTYPE"/>
            <xsd:enumeration value="UNIQUE_ID"/>
            <xsd:enumeration value="TESTER_PRESENT"/>
        </xsd:restriction>
    </xsd:simpleType>
    <xsd:simpleType name="ComParamDataType">
        <xsd:restriction base="xsd:string">
            <xsd:enumeration value="undefined"/>
            <xsd:enumeration value="PDU_PT_UNUM8"/>
            <xsd:enumeration value="PDU_PT_SNUM8"/>
            <xsd:enumeration value="PDU_PT_UNUM16"/>
            <xsd:enumeration value="PDU_PT_SNUM16"/>
            <xsd:enumeration value="PDU_PT_UNUM32"/>
            <xsd:enumeration value="PDU_PT_SNUM32"/>
            <xsd:enumeration value="PDU_PT_BYTEFIELD"/>
            <xsd:enumeration value="PDU_PT_STRUCTFIELD"/>
            <xsd:enumeration value="PDU_PT_LONGFIELD"/>
        </xsd:restriction>
    </xsd:simpleType>
    <xsd:complexType name="DLCTYPE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="ERROR_CODE">
        <xsd:sequence>
            <xsd:element name="ID" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
```

```
            <xsd:element name="SHORT_NAME" minOccurs="1" maxOccurs="1" type="NameType"/>
            <xsd:element name="DESCRIPTION" minOccurs="1" maxOccurs="1" type="xsd:string"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="IO_CTRL">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:simpleType name="LayerType">
        <xsd:restriction base="xsd:string">
            <xsd:enumeration value="undefined"/>
            <xsd:enumeration value="PHYSICAL"/>
            <xsd:enumeration value="TRANSPORT"/>
            <xsd:enumeration value="APPLICATION"/>
        </xsd:restriction>
    </xsd:simpleType>
    <xsd:complexType name="LIBRARY_FILE">
        <xsd:attribute name="URI" use="required" type="xsd:anyURI"/>
    </xsd:complexType>
    <xsd:complexType name="MAPPING">
        <xsd:sequence>
            <xsd:element name="PIN_ON_DLC" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
            <xsd:element name="PIN_ON_MODULE" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="MODULE_DESCRIPTION_FILE">
        <xsd:attribute name="URI" use="required" type="xsd:anyURI"/>
    </xsd:complexType>
    <xsd:complexType name="MODULETYPE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="RESOURCE_CONFLICT_GROUP" minOccurs="0" maxOccurs="unbounded"
type="RESOURCE_CONFLICT_GROUP"/>
                    <xsd:element name="IO_CTRL" minOccurs="0" maxOccurs="unbounded">
                        <xsd:complexType>
                            <xsd:attribute name="IDREF" type="xsd:IDREF" />
                        </xsd:complexType>
                    </xsd:element>
                    <xsd:element name="RESOURCE" minOccurs="1" maxOccurs="unbounded">
                        <xsd:complexType>
                            <xsd:attribute name="IDREF" type="xsd:IDREF" />
                        </xsd:complexType>
                    </xsd:element>
                </xsd:sequence>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="MVCI_CABLE_DESCRIPTION">
        <xsd:sequence>
            <xsd:element name="DESCRIPTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="SUPPLIER_NAME" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="DLCTYPE" minOccurs="1" maxOccurs="unbounded" type="DLCTYPE"/>
            <xsd:element name="CABLE" minOccurs="1" maxOccurs="unbounded" type="CABLE"/>
        </xsd:sequence>
        <xsd:attribute name="MVCI_PART2_STANDARD_VERSION" use="required" type="xsd:string"
fixed="2.2.0"/>
        <xsd:attribute name="FILE_VERSION" use="required" type="xsd:string"/>
    </xsd:complexType>
    <xsd:element name="MVCI_CABLE_DESCRIPTION" type="MVCI_CABLE_DESCRIPTION"/>
    <xsd:complexType name="MVCI_MODULE_DESCRIPTION">
        <xsd:sequence>
            <xsd:element name="DESCRIPTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="SUPPLIER_NAME" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="PINTYPE" minOccurs="0" maxOccurs="unbounded" type="PINTYPE"/>
            <xsd:element name="MODULETYPE" minOccurs="0" maxOccurs="unbounded" type="MODULETYPE"/>
            <xsd:element name="RESOURCE" minOccurs="0" maxOccurs="unbounded" type="RESOURCE"/>
            <xsd:element name="PROTOCOL" minOccurs="0" maxOccurs="unbounded" type="PROTOCOL"/>
            <xsd:element name="BUSTYPE" minOccurs="0" maxOccurs="unbounded" type="BUSTYPE"/>
            <xsd:element name="IO_CTRL" minOccurs="0" maxOccurs="unbounded" type="IO_CTRL"/>
            <xsd:element name="COMPARAM" minOccurs="0" maxOccurs="unbounded" type="COMPARAM"/>
            <xsd:element name="ERROR_CODE" minOccurs="0" maxOccurs="unbounded" type="ERROR_CODE"/>
        </xsd:sequence>
```

```
        <xsd:attribute name="MVCI_PART2_STANDARD_VERSION" use="required" type="xsd:string"
fixed="2.2.0"/>
        <xsd:attribute name="FILE_VERSION" use="required" type="xsd:string"/>
    </xsd:complexType>
    <xsd:element name="MVCI_MODULE_DESCRIPTION" type="MVCI_MODULE_DESCRIPTION"/>
    <xsd:complexType name="MVCI_PDU_API">
        <xsd:sequence>
            <xsd:element name="SHORT_NAME" minOccurs="1" maxOccurs="1" type="NameType"/>
            <xsd:element name="DESCRIPTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="SUPPLIER_NAME" minOccurs="0" maxOccurs="1" type="xsd:string"/>
            <xsd:element name="LIBRARY_FILE" minOccurs="1" maxOccurs="1" type="LIBRARY_FILE"/>
            <xsd:element name="MODULE_DESCRIPTION_FILE" minOccurs="1" maxOccurs="1"
type="MODULE_DESCRIPTION_FILE"/>
            <xsd:element name="CABLE_DESCRIPTION_FILE" minOccurs="1" maxOccurs="1"
type="CABLE_DESCRIPTION_FILE"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="MVCI_PDU_API_ROOT">
        <xsd:sequence>
            <xsd:element name="MVCI_PDU_API" minOccurs="0" maxOccurs="unbounded"
type="MVCI_PDU_API"/>
        </xsd:sequence>
        <xsd:attribute name="MVCI_PART2_STANDARD_VERSION" use="required" type="xsd:string"
fixed="2.2.0"/>
    </xsd:complexType>
    <xsd:element name="MVCI_PDU_API_ROOT" type="MVCI_PDU_API_ROOT"/>
    <xsd:simpleType name="NameType">
        <xsd:restriction base="xsd:string">
            <xsd:pattern value="[0-9a-zA-Z_]*"/>
            <xsd:maxLength value="128"/>
        </xsd:restriction>
    </xsd:simpleType>
    <xsd:complexType name="PDU_OBJECT">
        <xsd:sequence>
            <xsd:element name="ID" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
            <xsd:element name="SHORT_NAME" minOccurs="1" maxOccurs="1" type="NameType"/>
            <xsd:element name="DESCRIPTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="PIN_ON_MODULE">
        <xsd:sequence>
            <xsd:element name="PIN_ON_MODULE" minOccurs="1" maxOccurs="1" type="xsd:unsignedInt"/>
            <xsd:element name="PINTYPE" minOccurs="1" maxOccurs="1">
                <xsd:complexType>
                    <xsd:attribute name="IDREF" type="xsd:IDREF" />
                </xsd:complexType>
            </xsd:element>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:complexType name="PINTYPE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="PROTOCOL">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="COMPARAM_REF" minOccurs="0" maxOccurs="unbounded"
type="COMPARAM_REF"/>
                </xsd:sequence>
                <xsd:attribute name="EID" use="required" type="xsd:ID"/>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="RESOURCE">
        <xsd:complexContent>
            <xsd:extension base="PDU_OBJECT">
                <xsd:sequence>
                    <xsd:element name="PIN_ON_MODULE" minOccurs="1" maxOccurs="unbounded"
type="PIN_ON_MODULE"/>
                    <xsd:element name="BUSTYPE" minOccurs="1" maxOccurs="1">
                        <xsd:complexType>
                            <xsd:attribute name="IDREF" type="xsd:IDREF" />
```

```
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="PROTOCOL" minOccurs="1" maxOccurs="1">
                    <xsd:complexType>
                        <xsd:attribute name="IDREF" type="xsd:IDREF" />
                    </xsd:complexType>
                </xsd:element>
            </xsd:sequence>
            <xsd:attribute name="EID" use="required" type="xsd:ID"/>
        </xsd:extension>
    </xsd:complexContent>
</xsd:complexType>
<xsd:complexType name="RESOURCE_CONFLICT_GROUP">
    <xsd:sequence>
        <xsd:element name="DESCRIPTION" minOccurs="0" maxOccurs="1" type="xsd:string"/>
        <xsd:element name="RESOURCE" minOccurs="1" maxOccurs="unbounded">
            <xsd:complexType>
                <xsd:attribute name="IDREF" type="xsd:IDREF" />
            </xsd:complexType>
        </xsd:element>
    </xsd:sequence>
</xsd:complexType>
</xsd:schema>
```

F.5 Description file examples

F.5.1 Example MVCI protocol module

This subclause will demonstrate how a D-PDU API's and MVCI protocol module's capabilities have to be described according to the D-PDU API XML schema. The capabilities of an example MVCI protocol module are shown in Figure F.7 — Example MVCI protocol module. The example is considering different data link controllers, physical link transceivers, and diagnostic connectors. Also, multiplexing and shared pin resources are considered. All combinations of protocols, data link layers and physical link layers supported by this example are listed below the figure. The pin numbers listed, refer to the pin assignment on the cable, not on the example MVCI protocol module.

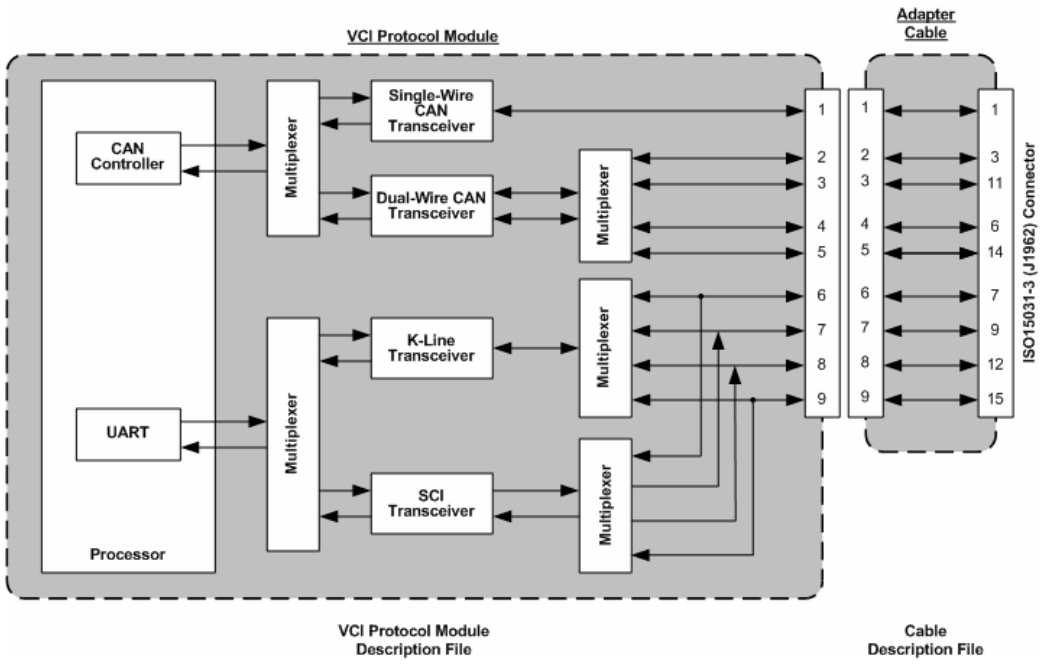


Figure F.7 — Example MVCI protocol module

The example in Figure 7 — Example: CLLs sharing physical bus with message serialization supports the following resources:

— Dual-Wire CAN on Pins 3 and 11 (Protocols: ISO 11898, ISO 15765, SAE J1939)

— Dual-Wire CAN on Pins 6 and 14 (Protocols: ISO 11898, ISO 15765, SAE J1939)

— Single-Wire CAN on Pin 1 (Protocols: ISO 11898, ISO 15765)

— ISO K-Line on Pin 7 (Protocol: KWP2000, ISO 9141-2)

— ISO K-Line on Pin 9 (Protocol: KWP2000, ISO 9141-2)

— ISO K-Line on Pin 12 (Protocol: KWP2000, ISO 9141-2)

— ISO K-Line on Pin 15 (Protocol: KWP2000, ISO 9141-2)

— SCI_B_ENGINE - Tx on Pin 12 and Rx on Pin 7 (Protocol: SAE J2610)

— SCI_B_TRANS - Tx on Pin 9 and Rx on Pin 15 (Protocol: SAE J2610)

F.5.2 Example root description file

According to the MVCI protocol module setup (see example root description file), there shall be at least two D-PDU API entries in the root description file. The XML entry MVCI_PDU_API “D_PDU_API_1” is the implementation supporting this example MVCI protocol module. Using XML entry LIBRARY_FILE (contains filename including full path), the application will find the D-PDU API implementation's dynamic library at “C:\tmp1\D-PDU API Example.dll”. Similarly, the application may locate the PDU API implementation's MDF and CDF file by reading the XML entry MODULE_DESCRIPTION_FILE and CABLE_DESCRIPTION_FILE (both contain filename including full path).

EXAMPLE Root description file (RDF file).

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- D-PDU-API root file -->
<MVCI_PDU_API_ROOT xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="C:\Data\Dev\eclipse\workspace\PduApi\pdu.xsd" MVCI_PART2_STANDARD_VERSION="2.2.0">
 <MVCI_PDU_API>
  <SHORT_NAME>D_PDU_API_1</SHORT_NAME>
  <DESCRIPTION>D-PDU-API Implementation used for MVCI of vendor #1</DESCRIPTION>
  <SUPPLIER_NAME>Vehicle Doctor Ltd.</SUPPLIER_NAME>
  <LIBRARY_FILE URI="file:/c:/tmp1/PDUAPI_VEHICLEDOCTOR_2.2.0.dll"/>
  <MODULE_DESCRIPTION_FILE URI="file:/c:/tmp1/MDF_VEHICLEDOCTOR_VCI1_2.2.0.xml"/>
  <CABLE_DESCRIPTION_FILE URI="file:/c:/tmp1/CDF_VEHICLEDOCTOR_VCI1_2.2.0.xml"/>
 </MVCI_PDU_API>
 <MVCI_PDU_API>
  <SHORT_NAME>D_PDU_API_2</SHORT_NAME>
  <DESCRIPTION>D-PDU-API Implementation used for MVCI of vendor #2</DESCRIPTION>
  <SUPPLIER_NAME>OBD Bob Ltd.</SUPPLIER_NAME>
  <LIBRARY_FILE URI="file:/c:/tmp2/PDUAPI_OBDBOB_2.2.0.dll"/>
  <MODULE_DESCRIPTION_FILE URI="file:/c:/tmp2/MDF_OBDBOB_ VCIx_2.2.0.xml"/>
  <CABLE_DESCRIPTION_FILE URI="file:/c:/tmp2/CDF_OBDBOB_ VCIx _2.2.0.xml"/>
 </MVCI_PDU_API>
</MVCI_PDU_API_ROOT>
```

F.5.3 Example module description file

The module description file (see example module description file) describes the example MVCI protocol module's capabilities in detail up to the pins seen on the MVCI protocol module itself. It does not include any mapping onto pins on a diagnostic link connector (DLC).

EXAMPLE Module Description file (MDF file). This is only an example and not a template based on the latest ComParam definitions.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- D-PDU-API module description file -->
<MVCI_MODULE_DESCRIPTION xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="C:\Data\Dev\eclipse\workspace\PduApi\pdu.xsd" FILE_VERSION="0.0.1"
MVCI_PART2_STANDARD_VERSION="2.2.0">
 <DESCRIPTION>This is an example for a module description file</DESCRIPTION>
 <SUPPLIER_NAME>Vehicle Doctor Ltd.</SUPPLIER_NAME>
 <PINTYPE EID="ID2297">
   <ID>2000</ID>
   <SHORT_NAME>HI</SHORT_NAME>
   <DESCRIPTION>High signal</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2298">
   <ID>2001</ID>
   <SHORT_NAME>LO</SHORT_NAME>
   <DESCRIPTION>Low signal</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2299">
   <ID>2002</ID>
   <SHORT_NAME>K</SHORT_NAME>
   <DESCRIPTION>K line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2300">
   <ID>2003</ID>
   <SHORT_NAME>L</SHORT_NAME>
   <DESCRIPTION>L line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2301">
   <ID>2004</ID>
   <SHORT_NAME>TX</SHORT_NAME>
   <DESCRIPTION>TX line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2302">
   <ID>2005</ID>
   <SHORT_NAME>RX</SHORT_NAME>
   <DESCRIPTION>RX line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2303">
   <ID>2006</ID>
   <SHORT_NAME>PLUS</SHORT_NAME>
   <DESCRIPTION>Plus line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2304">
   <ID>2007</ID>
   <SHORT_NAME>MINUS</SHORT_NAME>
   <DESCRIPTION>Minus line</DESCRIPTION>
 </PINTYPE>
 <PINTYPE EID="ID2305">
   <ID>2008</ID>
   <SHORT_NAME>SINGLE</SHORT_NAME>
   <DESCRIPTION>Single line</DESCRIPTION>
 </PINTYPE>
<PINTYPE EID="ID2306">
   <ID>2009</ID>
   <SHORT_NAME>IGN</SHORT_NAME>
   <DESCRIPTION>Pin for detection of Ignition Sense State</DESCRIPTION>
 </PINTYPE>
<PINTYPE EID="ID2307">
   <ID>2010</ID>
   <SHORT_NAME>PROGV</SHORT_NAME>
   <DESCRIPTION> Pin for Reading and Setting the Programable Voltage </DESCRIPTION>
 </PINTYPE>
<MODULETYPE>
```

```
  <ID>500</ID>
  <SHORT_NAME>Example_VCI_1</SHORT_NAME>
  <DESCRIPTION>Example MVCI #1 of vendor #1</DESCRIPTION>
  <RESOURCE-CONFLICT-GROUP>
   <DESCRIPTION>Conflicts with CAN controller</DESCRIPTION>
   <RESOURCE IDREF="ID11"/>
   <RESOURCE IDREF="ID12"/>
   <RESOURCE IDREF="ID13"/>
   <RESOURCE IDREF="ID14"/>
   <RESOURCE IDREF="ID15"/>
   <RESOURCE IDREF="ID16"/>
   <RESOURCE IDREF="ID17"/>
   <RESOURCE IDREF="ID18"/>
  </RESOURCE-CONFLICT-GROUP>
  <RESOURCE-CONFLICT-GROUP>
   <DESCRIPTION>Conflicts with UART</DESCRIPTION>
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   <RESOURCE IDREF="ID20"/>
   <RESOURCE IDREF="ID21"/>
   <RESOURCE IDREF="ID22"/>
   <RESOURCE IDREF="ID23"/>
   <RESOURCE IDREF="ID24"/>
  </RESOURCE-CONFLICT-GROUP>
  <IO_CTRL IDREF="ID2199"/>
  <IO_CTRL IDREF="ID2200"/>
  <RESOURCE IDREF="ID11"/>
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  <RESOURCE IDREF="ID22"/>
  <RESOURCE IDREF="ID23"/>
  <RESOURCE IDREF="ID24"/>
 </MODULETYPE>
 <MODULETYPE>
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  <SHORT_NAME>Example_VCI_2</SHORT_NAME>
  <DESCRIPTION>Example MVCI #2 of vendor #1</DESCRIPTION>
  <RESOURCE IDREF="ID23"/>
 </MODULETYPE>
 <RESOURCE EID="ID11">
  <ID>400</ID>
  <SHORT_NAME>DW_CAN_1</SHORT_NAME>
  <DESCRIPTION>Dual Wire CAN on pins 2 and 3 for protocol #1</DESCRIPTION>
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   <PINTYPE IDREF="ID2297"/>
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  <PIN_ON_MODULE>
   <PIN_ON_MODULE>3</PIN_ON_MODULE>
   <PINTYPE IDREF="ID2298"/>
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  <BUSTYPE IDREF="ID4"/>
  <PROTOCOL IDREF="ID52"/>
 </RESOURCE>
 <RESOURCE EID="ID12">
  <ID>401</ID>
  <SHORT_NAME>DW_CAN_2</SHORT_NAME>
  <DESCRIPTION>Dual Wire CAN on pins 2 and 3 for protocol #2</DESCRIPTION>
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   <PINTYPE IDREF="ID2297"/>
  </PIN_ON_MODULE>
  <PIN_ON_MODULE>
   <PIN_ON_MODULE>3</PIN_ON_MODULE>
   <PINTYPE IDREF="ID2298"/>
  </PIN_ON_MODULE>
  <BUSTYPE IDREF="ID4"/>
  <PROTOCOL IDREF="ID53"/>
```

```
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  <DESCRIPTION>Dual Wire CAN on pins 2 and 3 for protocol #3</DESCRIPTION>
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    <PINTYPE IDREF="ID2297"/>
  </PIN_ON_MODULE>
  <PIN_ON_MODULE>
    <PIN_ON_MODULE>3</PIN_ON_MODULE>
    <PINTYPE IDREF="ID2298"/>
  </PIN_ON_MODULE>
  <BUSTYPE IDREF="ID4"/>
  <PROTOCOL IDREF="ID54"/>
</RESOURCE>
<RESOURCE EID="ID14">
  <ID>403</ID>
  <SHORT_NAME>DW_CAN_4</SHORT_NAME>
  <DESCRIPTION>Dual Wire CAN on pins 4 and 5 for protocol #1</DESCRIPTION>
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    <PINTYPE IDREF="ID2297"/>
  </PIN_ON_MODULE>
  <PIN_ON_MODULE>
    <PIN_ON_MODULE>5</PIN_ON_MODULE>
    <PINTYPE IDREF="ID2298"/>
  </PIN_ON_MODULE>
  <BUSTYPE IDREF="ID4"/>
  <PROTOCOL IDREF="ID52"/>
</RESOURCE>
<RESOURCE EID="ID15">
  <ID>404</ID>
  <SHORT_NAME>DW_CAN_5</SHORT_NAME>
  <DESCRIPTION>Dual Wire CAN on pins 4 and 5 for protocol #2</DESCRIPTION>
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    <PINTYPE IDREF="ID2297"/>
  </PIN_ON_MODULE>
  <PIN_ON_MODULE>
    <PIN_ON_MODULE>5</PIN_ON_MODULE>
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  <BUSTYPE IDREF="ID4"/>
  <PROTOCOL IDREF="ID53"/>
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  <SHORT_NAME>DW_CAN_6</SHORT_NAME>
  <DESCRIPTION>Dual Wire CAN on pins 4 and 5 for protocol #3</DESCRIPTION>
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  <PIN_ON_MODULE>
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  <BUSTYPE IDREF="ID4"/>
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  <ID>406</ID>
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  <DESCRIPTION>Single Wire CAN on pin 2 for protocol #1</DESCRIPTION>
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  </PIN_ON_MODULE>
  <BUSTYPE IDREF="ID5"/>
  <PROTOCOL IDREF="ID52"/>
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```

```
  <DESCRIPTION>Single Wire CAN on pin 2 for protocol #2</DESCRIPTION>
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    <PINTYPE IDREF="ID2299"/>
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  <BUSTYPE IDREF="ID3"/>
  <PROTOCOL IDREF="ID50"/>
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  <ID>409</ID>
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  <DESCRIPTION>K-Line on pin 7</DESCRIPTION>
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  </PIN_ON_MODULE>
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  <DESCRIPTION>SCI on pins 6 and 8</DESCRIPTION>
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    <PINTYPE IDREF="ID2302"/>
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```

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  <ID>300</ID>
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  <DESCRIPTION>Keyword protocol 2000 on K-Line (ISO 14230)</DESCRIPTION>
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   <MAX_VALUE></MAX_VALUE>
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  <ID>302</ID>
  <SHORT_NAME>ISO_11898_RAW</SHORT_NAME>
  <DESCRIPTION>CAN raw</DESCRIPTION>
  <COMPARAM_REF>
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  <COMPARAM_REF>
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 </PROTOCOL>
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<PROTOCOL EID="ID54">
 <ID>304</ID>
 <SHORT_NAME>SAE_J1939_73_on_SAE_J1939_21</SHORT_NAME>
 <DESCRIPTION>SAE J1939 protocol</DESCRIPTION>
 <COMPARAM_REF>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <COMPARAM IDREF="ID1002"/>
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 <COMPARAM_REF>
  <COMPARAM IDREF="ID1003"/>
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  <MIN_VALUE></MIN_VALUE>
  <COMPARAM IDREF="ID1035"/>
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  <COMPARAM IDREF="ID1015"/>
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  <COMPARAM IDREF="ID1110"/>
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  <COMPARAM IDREF="ID1112"/>
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  <DEFAULT_VALUE>1500</DEFAULT_VALUE>
  <COMPARAM IDREF="ID1131"/>
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  <DEFAULT_VALUE>400</DEFAULT_VALUE>
  <COMPARAM IDREF="ID1133"/>
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  <COMPARAM IDREF="ID1121"/>
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  <MAX_VALUE></MAX_VALUE>
  <COMPARAM IDREF="ID1153"/>
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  <DEFAULT_VALUE>400</DEFAULT_VALUE>
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  <DEFAULT_VALUE>2500</DEFAULT_VALUE>
  <COMPARAM IDREF="ID1161"/>
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  <DEFAULT_VALUE>2500</DEFAULT_VALUE>
  <COMPARAM IDREF="ID1162"/>
 </COMPARAM_REF>
</PROTOCOL>
<PROTOCOL EID="ID51">
 <ID>301</ID>
 <SHORT_NAME>SAE_J2610_on_SAE_J2610_SCI</SHORT_NAME>
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  <DESCRIPTION>SCI Protocol (SAE J2610)</DESCRIPTION>
  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1002"/>
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  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1005"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1024"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1153"/>
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    <DEFAULT_VALUE>40</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1158"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>200</DEFAULT_VALUE>
    <MAX_VALUE></MAX_VALUE>
    <COMPARAM IDREF="ID1159"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>100</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1160"/>
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    <DEFAULT_VALUE>40</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1161"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>200</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1162"/>
  </COMPARAM_REF>
</PROTOCOL>
<BUSTYPE EID="ID3">
  <ID>200</ID>
  <SHORT_NAME>ISO_9141_2_UART</SHORT_NAME>
  <DESCRIPTION>K-Line interface as defined in ISO 9141</DESCRIPTION>
  <COMPARAM_REF>
    <DEFAULT_VALUE>10400</DEFAULT_VALUE>
    <MAX_VALUE></MAX_VALUE>
    <COMPARAM IDREF="ID1400"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1403"/>
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    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1404"/>
  </COMPARAM_REF>
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    <DEFAULT_VALUE>6</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1415"/>
  </COMPARAM_REF>
</BUSTYPE>
<BUSTYPE EID="ID4">
  <ID>201</ID>
  <SHORT_NAME>ISO_11898_2_DWCAN</SHORT_NAME>
  <DESCRIPTION>CAN according to ISO 11898</DESCRIPTION>
  <COMPARAM_REF>
    <DEFAULT_VALUE>500000</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1400"/>
  </COMPARAM_REF>
  <COMPARAM_REF>
    <DEFAULT_VALUE>80</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1401"/>
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  <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
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    <COMPARAM IDREF="ID1405"/>
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    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1407"/>
   </COMPARAM_REF>
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    <DEFAULT_VALUE>15</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1412"/>
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    <DEFAULT_VALUE>0</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1414"/>
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  <BUSTYPE EID="ID5">
   <ID>201</ID>
   <SHORT_NAME>SAE_J2411_SWCAN</SHORT_NAME>
   <DESCRIPTION>CAN according to ISO SAE J2411</DESCRIPTION>
   <COMPARAM_REF>
    <DEFAULT_VALUE>33333</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1400"/>
   </COMPARAM_REF>
   <COMPARAM_REF>
    <DEFAULT_VALUE>87</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1401"/>
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   <COMPARAM_REF>
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   <COMPARAM_REF>
    <DEFAULT_VALUE>0</DEFAULT_VALUE>
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  </BUSTYPE>
  <BUSTYPE EID="ID6">
   <ID>203</ID>
   <SHORT_NAME>SCI_J2610_UART</SHORT_NAME>
   <DESCRIPTION>SCI J2610 interface</DESCRIPTION>
   <COMPARAM_REF>
    <DEFAULT_VALUE>7812</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1400"/>
   </COMPARAM_REF>
   <COMPARAM_REF>
    <DEFAULT_VALUE>6</DEFAULT_VALUE>
    <COMPARAM IDREF="ID1415"/>
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  </BUSTYPE>
  <IO_CTRL EID="ID2199">
   <ID>800</ID>
   <SHORT_NAME>PDU_IOCTL_READ_PROG_VOLTAGE</SHORT_NAME>
```

```
  <DESCRIPTION>Read Programming Voltage</DESCRIPTION>
 </IO_CTRL>
 <IO_CTRL EID="ID2200">
  <ID>801</ID>
  <SHORT_NAME>PDU_IOCTL_SET_PROG_VOLTAGE</SHORT_NAME>
  <DESCRIPTION>Set Programming Voltage</DESCRIPTION>
 </IO_CTRL>
 <COMPARAM EID="ID1001">
  <ID>1</ID>
  <SHORT_NAME>CP_CanTransmissionTime</SHORT_NAME>
  <DESCRIPTION>If the timeout values are used which have been received by the ECU via session control response (0x50), the Can transmission
time has to be added to the timeout values: P2 = received P2 + CanTransmissionTime (contains delay for both transmission
directions)</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>200</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1002">
  <ID>2</ID>
  <SHORT_NAME>CP_EnablePerformanceTest</SHORT_NAME>
  <DESCRIPTION>This parameter will place the tester into a performance measurement mode.  Parameters such as P1Min, P2Min, Br, Cs will be
tested in this mode.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1003">
  <ID>3</ID>
  <SHORT_NAME>CP_J1939Name_Ecu</SHORT_NAME>
  <DESCRIPTION>Name field from J1939 document.  This parameter will contain the NAME of the ECU</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>SAE_J1939</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1004">
  <ID>4</ID>
  <SHORT_NAME>CP_J1939PreferredAddress_Ecu</SHORT_NAME>
  <DESCRIPTION>List of preferred addresses for the ECU</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>SAE J1939</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER> TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1005">
  <ID>5</ID>
  <SHORT_NAME>CP_Loopback</SHORT_NAME>
  <DESCRIPTION>Echo Transmitted messages in the receive queue. Including periodic messages. Loopback messages must only be sent after
successful transmission of a message. Loopback frames are not subject to message filtering.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1006">
  <ID>6</ID>
  <SHORT_NAME>CP_P2Max</SHORT_NAME>
  <DESCRIPTION>Timeout in receiving an expected frame after a successful transmit complete. Also used for multiple ECU responses.
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>200</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
  <RESOLUTION>0.5ms</RESOLUTION>
 </COMPARAM>
 <COMPARAM EID="ID1007">
  <ID>7</ID>
  <SHORT_NAME>CP_P2Max_Ecu</SHORT_NAME>
  <DESCRIPTION>Performance requirement for the server to start with the response message after the reception of a request message (indicated via
N_USData.ind).  This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>200</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
```

```
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1008">
  <ID>8</ID>
  <SHORT_NAME>CP_P2Min</SHORT_NAME>
  <DESCRIPTION>This sets the minimum time between tester request and ECU responses or two ECU responses. After the request, the interface shall be capable of handling an immediate response (P2_min=0). For subsequent responses, a byte received after P1_MAX shall be considered as the start of the subsequent response.  This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1009">
  <ID>9</ID>
  <SHORT_NAME>CP_P2Star</SHORT_NAME>
  <DESCRIPTION>Performance requirement for the client to expect the start of the response message after the reception of a negative response message (indicated via N_USData.ind) with response code 78 hex (enhanced response timing).</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>12000</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1010">
  <ID>10</ID>
  <SHORT_NAME>CP_P2Star_Ecu</SHORT_NAME>
  <DESCRIPTION>Performance requirement for the server to start with the response message after the transmission of a negative response message (indicated via N_USData.con) with response code 78 hex (enhanced response timing).  This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10000</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1011">
  <ID>11</ID>
  <SHORT_NAME>CP_P3Func</SHORT_NAME>
  <DESCRIPTION>Minimum time for the client to wait after the successful transmission of a functionally addressed request message (indicated via N_USData.con) before it can transmit the next functionally addressed request message in case no response is required or the requested data is only supported by a subset of the functionally addressed servers.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>100</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1012">
  <ID>12</ID>
  <SHORT_NAME>CP_P3Max_Ecu</SHORT_NAME>
  <DESCRIPTION>Time between end of ECU responses and start of new tester request</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10000</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1013">
  <ID>13</ID>
  <SHORT_NAME>CP_P3Min</SHORT_NAME>
  <DESCRIPTION>Minimum time between end of ECU responses and start of new request. The interface will accept all responses up to P3_MIN time. The interface will allow transmission of a request any time after P3_MIN.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>110</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1014">
  <ID>14</ID>
  <SHORT_NAME>CP_P3Phys</SHORT_NAME>
  <DESCRIPTION>Minimum time for the client to wait after the successful transmission of a physically addressed request message (indicated via N_USData.con) with no response required before it can transmit the next physically addressed request message</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>100</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1015">
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  <ID>15</ID>
  <SHORT_NAME>CP_J1939PreferredAddress</SHORT_NAME>
  <DESCRIPTION>Claim and protect a SAE J1939 address on the vehicle network. Reference RP1210a.  This will be used by the VCI to claim an
address on the J1939 bus</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>SAE_J1939</DEFAULT_VALUE>
  <CLASS> INIT</CLASS>
  <LAYER> TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1016">
  <ID>16</ID>
  <SHORT_NAME>CP_RC21CompletionTimeout</SHORT_NAME>
  <DESCRIPTION>Time period the tester accepts repeated negative responses with response code 0x21 and repeats the same request.
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>240</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1017">
  <ID>17</ID>
  <SHORT_NAME>CP_RC21Handling</SHORT_NAME>
  <DESCRIPTION>Repetition mode in case of response code 0x7F XX 0x21.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>3</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1018">
  <ID>18</ID>
  <SHORT_NAME>CP_RC21RequestTime</SHORT_NAME>
  <DESCRIPTION>Time between negative response with response code 0x21 and the retransmission of the same request.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>20</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1019">
  <ID>19</ID>
  <SHORT_NAME>CP_RC23CompletionTimeout</SHORT_NAME>
  <DESCRIPTION>Time period the tester accepts repeated negative responses with response code 0x23 and repeats the same request
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1020">
  <ID>20</ID>
  <SHORT_NAME>CP_RC23Handling</SHORT_NAME>
  <DESCRIPTION>Repetition mode in case of response code 0x7F XX 0x23. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>3</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1021">
  <ID>21</ID>
  <SHORT_NAME>CP_RC23RequestTime</SHORT_NAME>
  <DESCRIPTION>Time between negative response with response code 0x23 and the retransmission of the same request.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1022">
  <ID>22</ID>
  <SHORT_NAME>CP_RC78CompletionTimeout</SHORT_NAME>
  <DESCRIPTION>Time period the tester accepts repeated negative responses with response code 0x78 and waits for a positive response further on.
</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50000</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
```

```
<COMPARAM EID="ID1023">
  <ID>23</ID>
  <SHORT_NAME>CP_RC78Handling</SHORT_NAME>
  <DESCRIPTION>Handling of 0x7F XX 0x78ResponseTimeout and 0x78Repetitions</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1024">
  <ID>24</ID>
  <SHORT_NAME>CP_RepeatReqCountApp</SHORT_NAME>
  <DESCRIPTION>This parameter contains a counter to enable a re-transmission of the last request when either a transmit, receive error, or timeout
with no response is detected. This only applies to the application layer.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1025">
  <ID>25</ID>
  <SHORT_NAME>CP_StartMsgIndEnable</SHORT_NAME>
  <DESCRIPTION>Start Message Indication Enable.  Upon receiving a first frame of a multi-frame message (ISO15765) or upon receiving a first byte
of a UART message and indication will be set in the RX result item.  No data bytes will accompany the result item.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1026">
  <ID>26</ID>
  <SHORT_NAME>CP_SuspendQueueOnError</SHORT_NAME>
  <DESCRIPTION>This parameter is to be used as a temporary parameter for services that require a positive response before any further Com
Primitives can be executed.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1027">
  <ID>27</ID>
  <SHORT_NAME>CP_TesterPresentAddrMode</SHORT_NAME>
  <DESCRIPTION>Addressing Mode to be used for Tester Present. Uses the PhysicalReqxxx or FuncReqxxx information from the address parameter
table.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>1</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1028">
  <ID>28</ID>
  <SHORT_NAME>CP_TesterPresentHandling</SHORT_NAME>
  <DESCRIPTION>Define tester present message generation settings </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1031">
  <ID>31</ID>
  <SHORT_NAME>CP_TesterPresentSendType</SHORT_NAME>
  <DESCRIPTION>Define settings for the type of tester present transmits.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
</COMPARAM>
<COMPARAM EID="ID1033">
  <ID>33</ID>
  <SHORT_NAME>CP_TesterPresentTime_Ecu</SHORT_NAME>
  <DESCRIPTION>Time for the server to keep a diagnostic session other than the default session active while not receiving any diagnostic request
message</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10000</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
```

```
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1034">
  <ID>34</ID>
  <SHORT_NAME>CP_TransmitIndEnable</SHORT_NAME>
  <DESCRIPTION>Transmit Indication Enable.  On completion of a transmit message by the protocol an indication will be set in the RX_FLAG result item.  No data bytes will accompany the result item.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1035">
  <ID>35</ID>
  <SHORT_NAME>CP_J1939Name</SHORT_NAME>
  <DESCRIPTION>Name field from J1939 document.  This ComParam will contain the NAME of the Tester.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_BYTEFIELD</DATA_TYPE>
  <DEFAULT_VALUE>SAE_J1939</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>APPLICATION</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1100">
  <ID>100</ID>
  <SHORT_NAME>CP_5BaudAddressFunc</SHORT_NAME>
  <DESCRIPTION>Value of 5Baud Address in case of functional addressed communication. The correct baud rate address type (functional/physical) is selected during execution of a Start Communication Com Primitive based on the setting of  the CP_RequestAddrMode parameter</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>51</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1101">
  <ID>101</ID>
  <SHORT_NAME>CP_5BaudAddressPhys</SHORT_NAME>
  <DESCRIPTION>Value of 5Baud Address in case of physical addressed communication. The correct baud rate address type (functional/physical) is selected during execution of a Start Communication Com Primitive based on the setting of  the CP_RequestAddrMode parameter</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>01</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1102">
  <ID>102</ID>
  <SHORT_NAME>CP_5BaudMode</SHORT_NAME>
  <DESCRIPTION>Type of 5 Baud initialization.  This parameter allows either ISO9141 initialization sequence, ISO9141-2/ISO14230 initialization sequence, or hybrid versions which include only one of the extra bytes defined for ISO9141-2 and ISO14230 </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1103">
  <ID>103</ID>
  <SHORT_NAME>CP_Ar</SHORT_NAME>
  <DESCRIPTION>Time for transmission of the CAN frame (any N_PDU) on the receiver side</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1104">
  <ID>104</ID>
  <SHORT_NAME>CP_Ar_Ecu</SHORT_NAME>
  <DESCRIPTION>Time for transmission of the CAN frame (any N_PDU) on the receiver side</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1105">
  <ID>105</ID>
  <SHORT_NAME>CP_As</SHORT_NAME>
  <DESCRIPTION>Time for transmission of the CAN frame (any N_PDU) on the sender side</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
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  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1106">
  <ID>106</ID>
  <SHORT_NAME>CP_As_Ecu</SHORT_NAME>
  <DESCRIPTION>Time for transmission of the CAN frame (any N_PDU) on the sender side</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1107">
  <ID>107</ID>
  <SHORT_NAME>CP_BlockSize</SHORT_NAME>
  <DESCRIPTION>This sets the block size the interface should report to the vehicle for receiving segmented transfers in a Transmit Flow Control
Message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1108">
  <ID>108</ID>
  <SHORT_NAME>CP_BlockSize_Ecu</SHORT_NAME>
  <DESCRIPTION>This sets the block size the ECU should report to the tester for receiving segmented transfers in a Transmit Flow Control
Message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1109">
  <ID>109</ID>
  <SHORT_NAME>CP_BlockSizeOverride</SHORT_NAME>
  <DESCRIPTION>This sets the block size the interface should use to send segmented messages to the vehicle. The flow control value reported by the
vehicle should be ignored.  </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>65535</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1110">
  <ID>110</ID>
  <SHORT_NAME>CP_Br</SHORT_NAME>
  <DESCRIPTION>Time until transmission of the next FlowControl.  This is equivalent to Th in J1939-21. For ISO 15765-2 and 15765-4, this value is
a performance requirement parameter and should not be used as a timeout value by the tester.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>20</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1111">
  <ID>111</ID>
  <SHORT_NAME>CP_Br_Ecu</SHORT_NAME>
  <DESCRIPTION>Time until transmission of the next FlowControl.  This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>20</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1112">
  <ID>112</ID>
  <SHORT_NAME>CP_Bs</SHORT_NAME>
  <DESCRIPTION>Timeout until reception of the next FlowControl.  This is equivalent to T4 in J1939-21.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>150</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1113">
  <ID>113</ID>
  <SHORT_NAME>CP_Bs_Ecu</SHORT_NAME>
  <DESCRIPTION>Timeout until reception of the next FlowControl</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
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  <DEFAULT_VALUE>150</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1114">
  <ID>114</ID>
  <SHORT_NAME>CP_CanDataSizeOffset</SHORT_NAME>
  <DESCRIPTION>Offset subtracted from the total number of expected bytes received/transmitted in a first frame message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1115">
  <ID>115</ID>
  <SHORT_NAME>CP_CanFillerByte</SHORT_NAME>
  <DESCRIPTION>Padding data byte to be used to pad all USDT type transmits frames (SF, FC, and last CF).</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>00</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1116">
  <ID>116</ID>
  <SHORT_NAME>CP_CanFillerByteHandling</SHORT_NAME>
  <DESCRIPTION>Enable Padding forcing the DLC of a CAN frame to always be 8.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>1</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1117">
  <ID>117</ID>
  <SHORT_NAME>CP_CanFirstFrameValue</SHORT_NAME>
  <DESCRIPTION>First Frame number to be transmitted/received on a multi-segment transfer. Used to override the normal First Frame value of
1</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>1</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1118">
  <ID>118</ID>
  <SHORT_NAME>CP_CanFuncReqExtAddr</SHORT_NAME>
  <DESCRIPTION>Address extension for enhanced diagnostics.  The first byte of the requested CAN frame data contains the N_AE/N_TA byte
followed by the correct number of PCI bytes. This parameters is used for all transmitted CAN Frames that have the "Can Address Extension' Arial bit
set in the CanIdFormat</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1119">
  <ID>119</ID>
  <SHORT_NAME>CP_CanFuncReqFormat</SHORT_NAME>
  <DESCRIPTION>CAN Format used for a functional address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>05</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1120">
  <ID>120</ID>
  <SHORT_NAME>CP_CanFuncReqId</SHORT_NAME>
  <DESCRIPTION>CAN ID used for a functional address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>2015</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1121">
  <ID>121</ID>
  <SHORT_NAME>CP_CanMaxNumWaitFrames</SHORT_NAME>
  <DESCRIPTION>The maximum number of WAIT flow control frames allowed during a multi-segment transfer.  For J1939, this is the maximum
number of allowed CTS frames.</DESCRIPTION>
```

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  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>255</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1122">
  <ID>122</ID>
  <SHORT_NAME>CP_CanPhysReqExtAddr</SHORT_NAME>
  <DESCRIPTION>Address extension for enhanced diagnostics.  The first byte of the requested CAN frame data contains the N_AE/N_TA byte
followed by the correct number of PCI bytes. This parameters is used for all transmitted CAN Frames that have the "Can Address Extension' bit set in
the CanIdFormat</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>00</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1123">
  <ID>123</ID>
  <SHORT_NAME>CP_CanPhysReqFormat</SHORT_NAME>
  <DESCRIPTION>CAN Format used for a physical address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>05</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1124">
  <ID>124</ID>
  <SHORT_NAME>CP_CanPhysReqId</SHORT_NAME>
  <DESCRIPTION>CAN ID used for a physical address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>2016</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1125">
  <ID>125</ID>
  <SHORT_NAME>CP_CanRespUSDTExtAddr</SHORT_NAME>
  <DESCRIPTION>Extended Address used for a USDT response from an ECU if the CAN Format indicates address extension</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1126">
  <ID>126</ID>
  <SHORT_NAME>CP_CanRespUSDTFormat</SHORT_NAME>
  <DESCRIPTION>CAN Format for the USDT CAN ID received from an ECU (Segment type Bit must = 1)</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>05</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1127">
  <ID>127</ID>
  <SHORT_NAME>CP_CanRespUSDTId</SHORT_NAME>
  <DESCRIPTION>Received USDT CAN ID from an ECU</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>2024</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1128">
  <ID>128</ID>
  <SHORT_NAME>CP_CanRespUUDTFormat</SHORT_NAME>
  <DESCRIPTION>Received CAN Format for CAN ID without segmentation (Segment Type Bit must = 0)</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1129">
  <ID>129</ID>
  <SHORT_NAME>CP_CanRespUUDTExtAddr</SHORT_NAME>
  <DESCRIPTION>Extended Address used for UUDT response if the CAN Format indicates address extension</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
```

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  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1130">
  <ID>130</ID>
  <SHORT_NAME>CP_CanRespUUDTId</SHORT_NAME>
  <DESCRIPTION>Received UUDT CAN ID from an ECU</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>1512</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1131">
  <ID>131</ID>
  <SHORT_NAME>CP_Cr</SHORT_NAME>
  <DESCRIPTION>Timeout for reception  of the next ConsecutiveFrame.  For J1939-21, this is equivalent to T1.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>300</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1132">
  <ID>132</ID>
  <SHORT_NAME>CP_Cr_Ecu</SHORT_NAME>
  <DESCRIPTION>Timeout for reception  of the next ConsecutiveFrame</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>300</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1133">
  <ID>133</ID>
  <SHORT_NAME>CP_Cs</SHORT_NAME>
  <DESCRIPTION>Time until transmission of the next Consecutive Frame (This is used if FC is not enabled or if the STmin value in the FC=0 and
STminOverride=0xFFFF).  See ISO 15765-2.  For ISO 15765-2 and 15765-4, this is a performance requirement parameter and should not be used as a
timeout value by the tester. For J1939, this is equivalent to the maximum time between sending packets in a multi-packet broadcast and multi-packet
destination specific message.  From text in J1939-21 section 5.12.3.  </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>20</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1134">
  <ID>134</ID>
  <SHORT_NAME>CP_Cs_Ecu</SHORT_NAME>
  <DESCRIPTION>Time until transmission of the next Consecutive Frame (This is used if FC is not enabled or if the STmin value in the FC=0 and
STminOverride=0xFFFF).  See ISO 15765-2.  This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>20</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1135">
  <ID>135</ID>
  <SHORT_NAME>CP_EcuRespSourceAddress</SHORT_NAME>
  <DESCRIPTION>ECU Source Address response of a non-CAN message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>16</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1136">
  <ID>136</ID>
  <SHORT_NAME>CP_FuncReqFormatPriorityType</SHORT_NAME>
  <DESCRIPTION>First Header Byte of a non-CAN message for a functional address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>104</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1137">
  <ID>137</ID>
  <SHORT_NAME>CP_FuncRespFormatPriorityType</SHORT_NAME>
  <DESCRIPTION>First Header Byte of a non-CAN message received from the ECU for functional addressing</DESCRIPTION>
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  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>72</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1138">
  <ID>138</ID>
  <SHORT_NAME>CP_FuncReqTargetAddr</SHORT_NAME>
  <DESCRIPTION>Second Header Byte of a non-CAN message for a functional address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>106</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1139">
  <ID>139</ID>
  <SHORT_NAME>CP_FuncRespTargetAddr</SHORT_NAME>
  <DESCRIPTION>Second Header Byte of a non-CAN message received from the ECU for functional addressing.  This information is also used to fill out the functional lookup table for J1850_PWM.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>107</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1140">
  <ID>140</ID>
  <SHORT_NAME>CP_HeaderFormatJ1850</SHORT_NAME>
  <DESCRIPTION>Header Byte configuration to be used for J1850 communication. This setting is used to properly construct the message header bytes to complete the PDU. This parameter is not used if the protocol parameter RawMode is set. Header bytes are constructed following the rules of the protocol specification </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>3</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1141">
  <ID>141</ID>
  <SHORT_NAME>CP_HeaderFormatKW</SHORT_NAME>
  <DESCRIPTION>Header Byte configuration for K-Line protocol (Keyword). This setting is used to properly construct the message header bytes to complete the PDU. This parameter is not used if the protocol parameter RawMode is set. Header bytes are constructed following the rules of the protocol specification. This parameter overrides any keybyte values received from the ECU during initialization, which could be used for automatic header byte construction.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>4</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1142">
  <ID>142</ID>
  <SHORT_NAME>CP_InitializationSettings</SHORT_NAME>
  <DESCRIPTION>Set Initialization method. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>1</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1143">
  <ID>143</ID>
  <SHORT_NAME>CP_MessagePriority</SHORT_NAME>
  <DESCRIPTION>Message Priority. J1939 protocol uses the 3 least significant bits that become part of the CAN ID. J1708 uses 8 bits to define the first byte of the transmit message</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
 <COMPARAM EID="ID1144">
  <ID>144</ID>
  <SHORT_NAME>CP_MidReqId</SHORT_NAME>
  <DESCRIPTION>Request Message Identifier used in building a transmit message to an ECU for a J1708 protocol only</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
 </COMPARAM>
```

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<COMPARAM EID="ID1145">
  <ID>145</ID>
  <SHORT_NAME>CP_MidRespId</SHORT_NAME>
  <DESCRIPTION>Response Message Identifier received from an ECU for a J1708 protocol only.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1146">
  <ID>146</ID>
  <SHORT_NAME>CP_P1Max</SHORT_NAME>
  <DESCRIPTION>Maximum inter-byte time for ECU Responses. Interface must be capable of handling a P1_MIN time of 0 ms. After the request,
the interface shall be capable of handling an immediate response (P2_MIN=0). For subsequent responses, a byte received after P1_MAX shall be
considered as the start of the subsequent response.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1147">
  <ID>147</ID>
  <SHORT_NAME>CP_P1Min</SHORT_NAME>
  <DESCRIPTION>This sets the minimum inter-byte time for the ECU responses. Application shall not get or set this value. Interface must be
capable of handling P1_MIN=0. This is a performance requirement parameter.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1148">
  <ID>148</ID>
  <SHORT_NAME>CP_P4Max</SHORT_NAME>
  <DESCRIPTION>Maximum inter-byte time for a tester request.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1149">
  <ID>149</ID>
  <SHORT_NAME>CP_P4Min</SHORT_NAME>
  <DESCRIPTION>Minimum inter-byte time for tester transmits.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1150">
  <ID>145</ID>
  <SHORT_NAME>CP_PhysReqFormatPriorityType</SHORT_NAME>
  <DESCRIPTION>First Header Byte of a non-CAN message for physical address transmit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>108</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1151">
  <ID>151</ID>
  <SHORT_NAME>CP_PhysRespFormatPriorityType</SHORT_NAME>
  <DESCRIPTION>First Header Byte of a non-CAN message received from the ECU for physical addressing</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>104</DEFAULT_VALUE>
  <CLASS>UNIQUE_ID</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1152">
  <ID>152</ID>
  <SHORT_NAME>CP_PhysReqTargetAddr</SHORT_NAME>
  <DESCRIPTION>Physical Target Addressing Information used for correct Message Header Construction </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>16</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
```

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<COMPARAM EID="ID1153">
  <ID>153</ID>
  <SHORT_NAME>CP_RepeatReqCountTrans</SHORT_NAME>
  <DESCRIPTION>This parameter contains a counter to enable a re-transmission of the last request when either a transmit, a receive error, or transport layer timeout is detected.  This applies to the transport layer only.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>ERRHDL</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1154">
  <ID>154</ID>
  <SHORT_NAME>CP_RequestAddrMode</SHORT_NAME>
  <DESCRIPTION>Addressing Mode to be used for the Com Primitive</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>2</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1155">
  <ID>155</ID>
  <SHORT_NAME>CP_StMin</SHORT_NAME>
  <DESCRIPTION>This sets the separation time the interface should report to the vehicle for receiving segmented transfers in a Transmit Flow Control Message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1156">
  <ID>156</ID>
  <SHORT_NAME>CP_StMin_Ecu</SHORT_NAME>
  <DESCRIPTION>The minimum time the sender shall wait between the transmissions of two ConsecutiveFrame N_PDUs</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1157">
  <ID>157</ID>
  <SHORT_NAME>CP_StMinOverride</SHORT_NAME>
  <DESCRIPTION>This sets the separation time the interface should use to transmit segmented messages to the vehicle.  The flow control value reported by the vehicle should be ignored</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>65535</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1158">
  <ID>158</ID>
  <SHORT_NAME>CP_T1Max</SHORT_NAME>
  <DESCRIPTION>This sets the maximum inter-frame response delay.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1159">
  <ID>159</ID>
  <SHORT_NAME>CP_T2Max</SHORT_NAME>
  <DESCRIPTION>This sets the maximum inter-frame request delay.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>200</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1160">
  <ID>160</ID>
  <SHORT_NAME>CP_T3Max</SHORT_NAME>
  <DESCRIPTION>This sets the maximum response delay from the ECU after processing a valid request message from the interface.  For J1939-21, this is equivalent to Tr.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>100</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
```

```
</COMPARAM>
<COMPARAM EID="ID1161">
  <ID>161</ID>
  <SHORT_NAME>CP_T4Max</SHORT_NAME>
  <DESCRIPTION>This sets the maximum inter-message response delay. For J1939, this is equivalent to T3, the maximum time allowed for the
Originator to receive a CTS or an ACK after sending a packet. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1162">
  <ID>162</ID>
  <SHORT_NAME>CP_T5Max</SHORT_NAME>
  <DESCRIPTION>This sets the maximum inter-message request delay. For J1939, this is equivalent to T2, the maximum time allowed for the
Originator to send a packet after receiving a CTS from the Responder. </DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>200</DEFAULT_VALUE>
  <CLASS>TIMING</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1163">
  <ID>163</ID>
  <SHORT_NAME>CP_TesterSourceAddress</SHORT_NAME>
  <DESCRIPTION>Source address of transmitted message for non-CAN messages</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>241</DEFAULT_VALUE>
  <CLASS>COM</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1164">
  <ID>164</ID>
  <SHORT_NAME>CP_TIdle</SHORT_NAME>
  <DESCRIPTION>Minimum bus idle time before tester starts the address byte sequence or the fast init sequence. (TIDLE replaces W0 and
W5).</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>600</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1165">
  <ID>165</ID>
  <SHORT_NAME>CP_TInil</SHORT_NAME>
  <DESCRIPTION>Sets the duration for the low pulse in a fast initialization sequence.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1166">
  <ID>166</ID>
  <SHORT_NAME>CP_TWup</SHORT_NAME>
  <DESCRIPTION>Sets total duration of the wakeup pulse (TWUP-TINIL)=high pulse before start communication message.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>100</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1167">
  <ID>167</ID>
  <SHORT_NAME>CP_W1Max</SHORT_NAME>
  <DESCRIPTION>Maximum time from the end of address byte to start of the synchronization pattern from the ECU.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>600</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1168">
  <ID>168</ID>
  <SHORT_NAME>CP_W1Min</SHORT_NAME>
  <DESCRIPTION>Minimum time from the end of address byte to start of the synchronization pattern from the ECU.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>120</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
```

```
</COMPARAM>
<COMPARAM EID="ID1169">
  <ID>169</ID>
  <SHORT_NAME>CP_W2Max</SHORT_NAME>
  <DESCRIPTION>Maximum time from the end of the synchronization pattern to the start of key byte 1.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1170">
  <ID>170</ID>
  <SHORT_NAME>CP_W2Min</SHORT_NAME>
  <DESCRIPTION>Minimum time from the end of the synchronization pattern to the start of key byte 1.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>10</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1171">
  <ID>171</ID>
  <SHORT_NAME>CP_W3Max</SHORT_NAME>
  <DESCRIPTION>Maximum time between key byte 1 and key byte 2.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>40</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1172">
  <ID>172</ID>
  <SHORT_NAME>CP_W3Min</SHORT_NAME>
  <DESCRIPTION>Minimum time between key byte 1 and key byte 2.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1173">
  <ID>173</ID>
  <SHORT_NAME>CP_W4Max</SHORT_NAME>
  <DESCRIPTION>Maximum time between receiving key byte 2 from the vehicle and the inversion being returned by the
interface.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>100</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1174">
  <ID>174</ID>
  <SHORT_NAME>CP_W4Min</SHORT_NAME>
  <DESCRIPTION>Minimum time between receiving key byte 2 from the vehicle and the inversion being returned by the
interface.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>50</DEFAULT_VALUE>
  <CLASS>INIT</CLASS>
  <LAYER>TRANSPORT</LAYER>
</COMPARAM>
<COMPARAM EID="ID1400">
  <ID>400</ID>
  <SHORT_NAME>CP_Baudrate</SHORT_NAME>
  <DESCRIPTION>Represents the desired baud rate.  If the desired baud rate cannot be achieved within the tolerance of the protocol, the interface will
remain at the previous baud rate.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>500000</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1401">
  <ID>401</ID>
  <SHORT_NAME>CP_BitSamplePoint</SHORT_NAME>
  <DESCRIPTION>This sets the desired bit sample point as a percentage of the bit time.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>80</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
```

```
</COMPARAM>
<COMPARAM EID="ID1402">
  <ID>402</ID>
  <SHORT_NAME>CP_BitSamplePoint_Ecu</SHORT_NAME>
  <DESCRIPTION>This sets the desired bit sample point as a percentage of the bit time.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE> 80</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1403">
  <ID>403</ID>
  <SHORT_NAME>CP_K_L_LineInit</SHORT_NAME>
  <DESCRIPTION>K &amp;amp; L line usage for ISO9141 and ISO14230 initialization address</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1404">
  <ID>404</ID>
  <SHORT_NAME>CP_K_LinePullup</SHORT_NAME>
  <DESCRIPTION>Control the K-Line voltage to either 12V or 24V</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1405">
  <ID>405</ID>
  <SHORT_NAME>CP_ListenOnly</SHORT_NAME>
  <DESCRIPTION>Enable a Listen Only mode on the Com Logical Link.  This will cause the link to no longer acknowledge received frames on the
CAN Network</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1406">
  <ID>406</ID>
  <SHORT_NAME>CP_NetworkLine</SHORT_NAME>
  <DESCRIPTION>This sets the network line(s) that are active during communication (for cases where the physical layer allows
this)</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1407">
  <ID>407</ID>
  <SHORT_NAME>CP_SamplesPerBit</SHORT_NAME>
  <DESCRIPTION>Number of samples per bit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1408">
  <ID>408</ID>
  <SHORT_NAME>CP_SamplesPerBit_Ecu</SHORT_NAME>
  <DESCRIPTION>Number of samples per bit</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1412">
  <ID>412</ID>
  <SHORT_NAME>CP_SyncJumpWidth</SHORT_NAME>
  <DESCRIPTION>This sets the desired synchronization jump width as a percentage of the bit time.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>15</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
```

```
<COMPARAM EID="ID1413">
  <ID>413</ID>
  <SHORT_NAME>CP_SyncJumpWidth_Ecu</SHORT_NAME>
  <DESCRIPTION>This sets the desired synchronization jump width as a percentage of the bit time.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>15</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1414">
  <ID>414</ID>
  <SHORT_NAME>CP_TerminationType</SHORT_NAME>
  <DESCRIPTION>CAN termination settings.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>0</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<COMPARAM EID="ID1415">
  <ID>415</ID>
  <SHORT_NAME>CP_UartConfig</SHORT_NAME>
  <DESCRIPTION>Configure the parity, data bit size and stop bits of a Uart protocol.</DESCRIPTION>
  <DATA_TYPE>PDU_PT_UNUM32</DATA_TYPE>
  <DEFAULT_VALUE>06</DEFAULT_VALUE>
  <CLASS>BUSTYPE</CLASS>
  <LAYER>PHYSICAL</LAYER>
</COMPARAM>
<ERROR_CODE>
  <ID>3000</ID>
  <SHORT_NAME>AN_ERR_CODE</SHORT_NAME>
  <DESCRIPTION>This is an error code description</DESCRIPTION>
</ERROR_CODE>
</MVCI_MODULE_DESCRIPTION>
```

F.5.4 Example cable description file

Since the external connector on the MVCI protocol module may differ from the DLC on the vehicle or ECU setup, there is a need to describe how the cable maps the pins on the MVCI protocol module (PIN_ON_MODULE) onto the pins on the DLC (PIN_ON_DLC). The cable description file (see example Cable Description File) shows the mapping for two example cables that this MVCI protocol module is supposed to support. Also, if of interest for the application, the cable description file optionally defines which pins of the MVCI protocol module are used for cable identification, and what resistor values are expected for a specific cable (see also ISO 22900-1 about cable coding). However, the example only shows the first of both cables.

EXAMPLE Cable description file (CDF file).

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- D-PDU-API cable description file -->
<MVCI_CABLE_DESCRIPTION xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="C:\Data\Dev\eclipse\workspace\PduApi\pdu.xsd" FILE_VERSION="0.0.1"
MVCI_PART2_STANDARD_VERSION="2.2.0">
 <DESCRIPTION>This is an example for a cable description file (CDF)</DESCRIPTION>
 <SUPPLIER_NAME>Vehicle Doctor Ltd.</SUPPLIER_NAME>
 <DLCTYPE EID="ID1">
  <ID>1</ID>
  <SHORT_NAME>ISO_15031_3</SHORT_NAME>
  <DESCRIPTION>ISO 15031-3 OBD Connector</DESCRIPTION>
 </DLCTYPE>
 <CABLE>
  <ID>100</ID>
  <SHORT_NAME>SomeCableName</SHORT_NAME>
  <DESCRIPTION>Standard cable 5m</DESCRIPTION>
  <CABLE_IDENTIFICATION>
   <CABLE_ID>1002</CABLE_ID>
   <CABLE_ID_PIN>
    <PIN_ON_MODULE>17</PIN_ON_MODULE>
    <RESISTANCE_TO_GROUND>250</RESISTANCE_TO_GROUND>
   </CABLE_ID_PIN>
   <CABLE_ID_PIN>
    <PIN_ON_MODULE>18</PIN_ON_MODULE>
```

```
      <RESISTANCE_TO_GROUND>49999</RESISTANCE_TO_GROUND>
    </CABLE_ID_PIN>
  </CABLE_IDENTIFICATION>
  <MAPPING>
    <PIN_ON_DLC>13</PIN_ON_DLC>
    <PIN_ON_MODULE>5</PIN_ON_MODULE>
  </MAPPING>
  <MAPPING>
    <PIN_ON_DLC>16</PIN_ON_DLC>
    <PIN_ON_MODULE>6</PIN_ON_MODULE>
  </MAPPING>
  <MAPPING>
    <PIN_ON_DLC>15</PIN_ON_DLC>
    <PIN_ON_MODULE>8</PIN_ON_MODULE>
  </MAPPING>
  <DLCTYPE IDREF="ID1"/>
 </CABLE>
 <CABLE>
  <ID>101</ID>
  <SHORT_NAME>SomeOtherCableName</SHORT_NAME>
  <DESCRIPTION>Standard cable 5m</DESCRIPTION>
  <CABLE_IDENTIFICATION>
    <CABLE_ID>1002</CABLE_ID>
    <CABLE_ID_PIN>
      <PIN_ON_MODULE>17</PIN_ON_MODULE>
      <RESISTANCE_TO_GROUND>250</RESISTANCE_TO_GROUND>
    </CABLE_ID_PIN>
    <CABLE_ID_PIN>
      <PIN_ON_MODULE>18</PIN_ON_MODULE>
      <RESISTANCE_TO_GROUND>4294967295</RESISTANCE_TO_GROUND>
    </CABLE_ID_PIN>
  </CABLE_IDENTIFICATION>
  <MAPPING>
    <PIN_ON_DLC>13</PIN_ON_DLC>
    <PIN_ON_MODULE>5</PIN_ON_MODULE>
  </MAPPING>
  <MAPPING>
    <PIN_ON_DLC>16</PIN_ON_DLC>
    <PIN_ON_MODULE>6</PIN_ON_MODULE>
  </MAPPING>
  <MAPPING>
    <PIN_ON_DLC>15</PIN_ON_DLC>
    <PIN_ON_MODULE>9</PIN_ON_MODULE>
  </MAPPING>
  <DLCTYPE IDREF="ID1"/>
 </CABLE>
</MVCI_CABLE_DESCRIPTION>
```

Annex G
(informative)

Resource handling scenarios

G.1 Resource handling at the API level

G.1.1 Obtaining resource and object ids

G.1.1.1 General

A client application can use an XML parser to parse the CDF and MDF files to obtain object ids and resource ids. It is also possible to obtain the object ids by using the D-PDU API function PDUGetObjectIds using the standard short-names of the object. For a client application to retrieve a resource id using PDUGetObjectIds, the client application would need to know the vendor specific short-name of the resource.

Once a client application obtains the list of ids supported by the specific D-PDU API implementation, all D-PDU API functions can be used. Without the list of ids, many D-PDU API functions cannot be used.

EXAMPLE D-PDU API functions requiring object and or resource ids:

— PDUCreateComLogicalLink

— PDUSetComParam

— PDUGetResourceStatus

— PDUGetConflictingResources

— PDUSetUniqueRespIdTable

G.1.1.2 Using a XML Parser

Figure G.1 — Sequence for retrieving ids using an XML Parser illustrates via a sequence diagram how a client application can use a XML Parser for the MDF and CDF files to retrieve resource and object ids. D-PDU API functions still need to be called to retrieve the status of a resource and any conflicts on a resource.

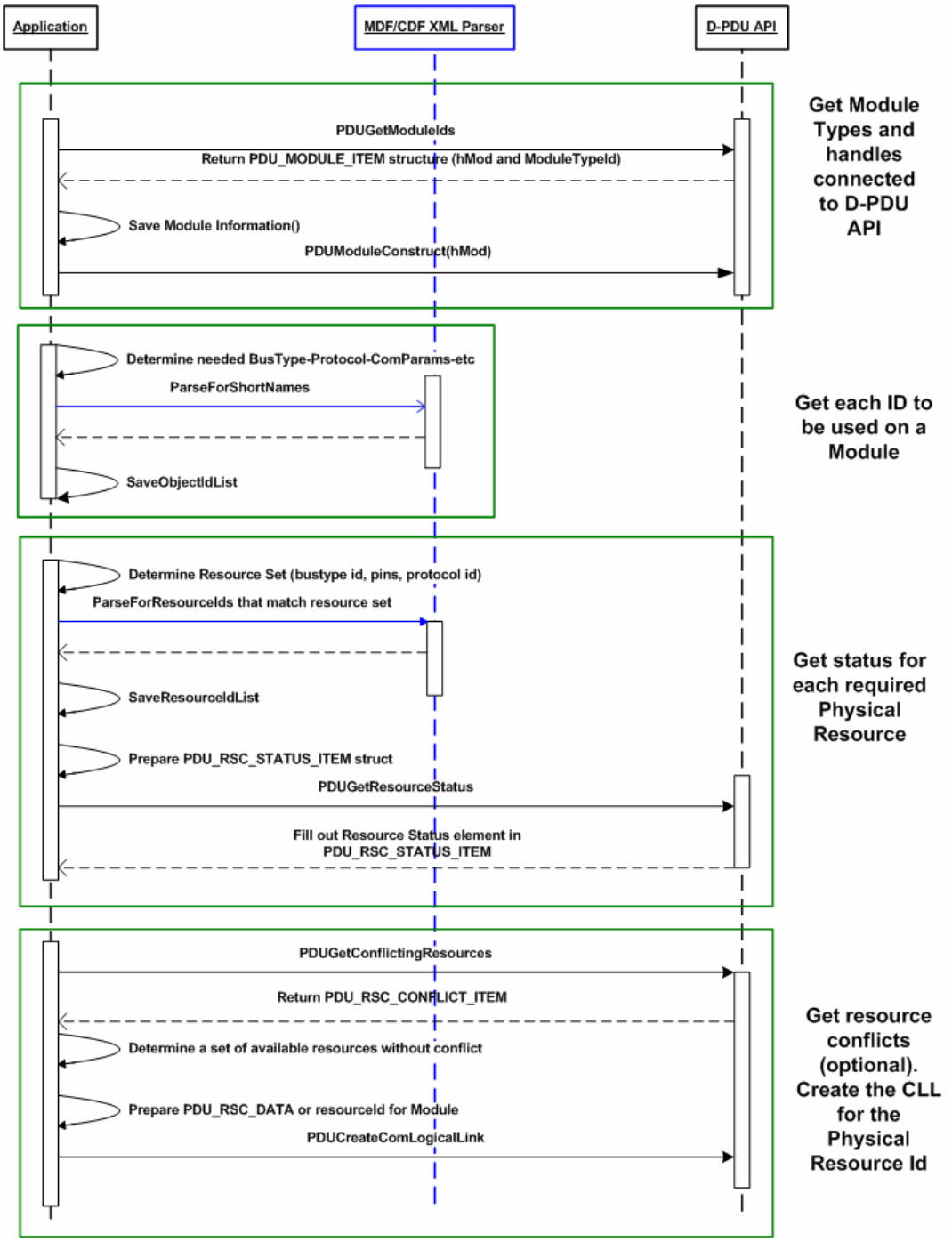


Figure G.1 — Sequence for retrieving ids using an XML Parser

G.1.1.3 Using D-PDU API Functions for resource information

Figure G.2 — Using D-PDU API functions to retrieve resource information and status illustrates how the D-PDU API functions are used to retrieve resource and object ids without parsing the XML MDF/CDF files. The functions (represented by circles) are expected to be called in the order indicated by the numbers in the circle.

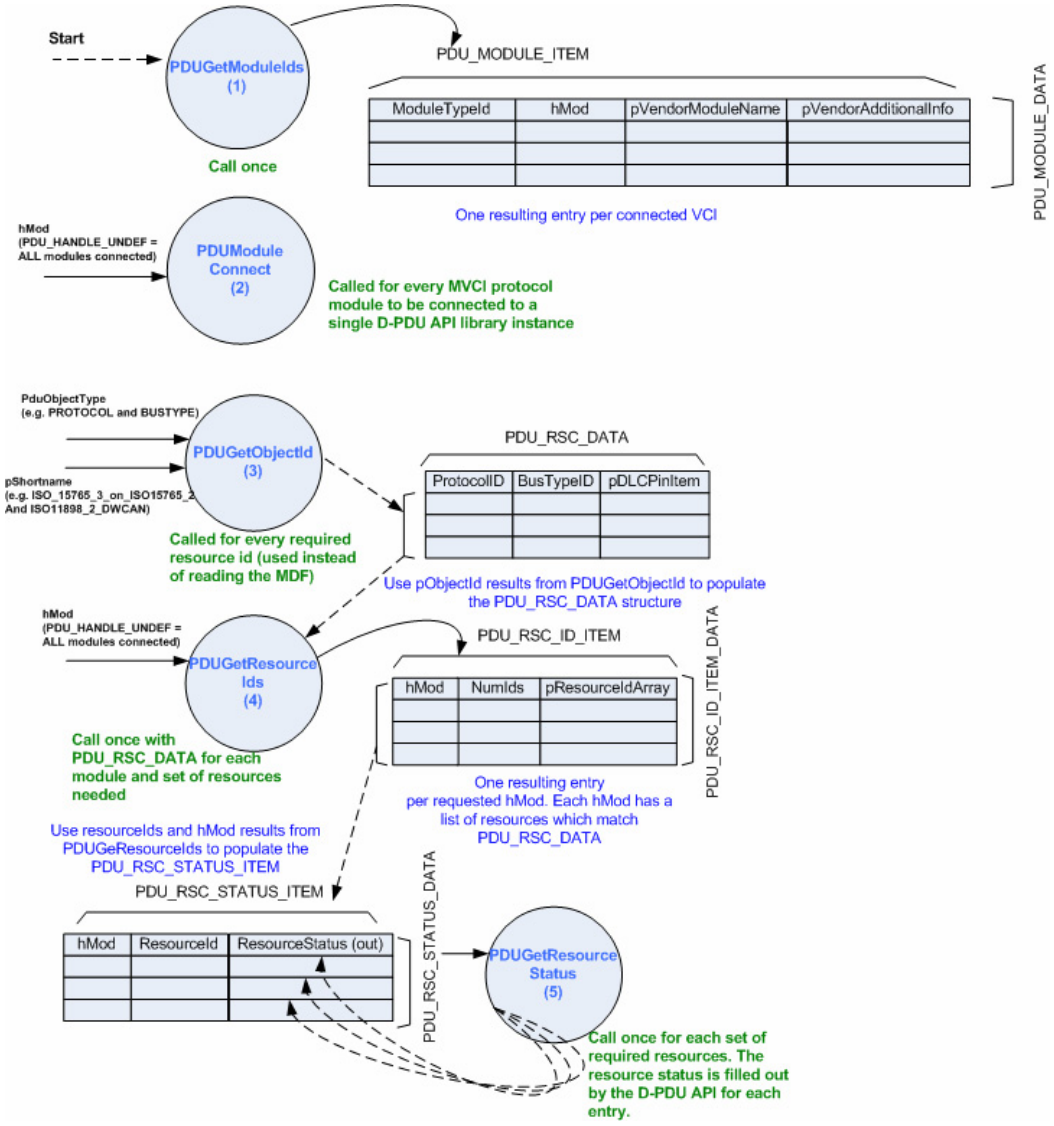


Figure G.2 — Using D-PDU API functions to retrieve resource information and status

G.1.1.4 Retrieving conflicting resources

Figure G.3 — Conflicting resources illustrates how the D-PDU API supports the client application in determining shared conflicts on a resource.

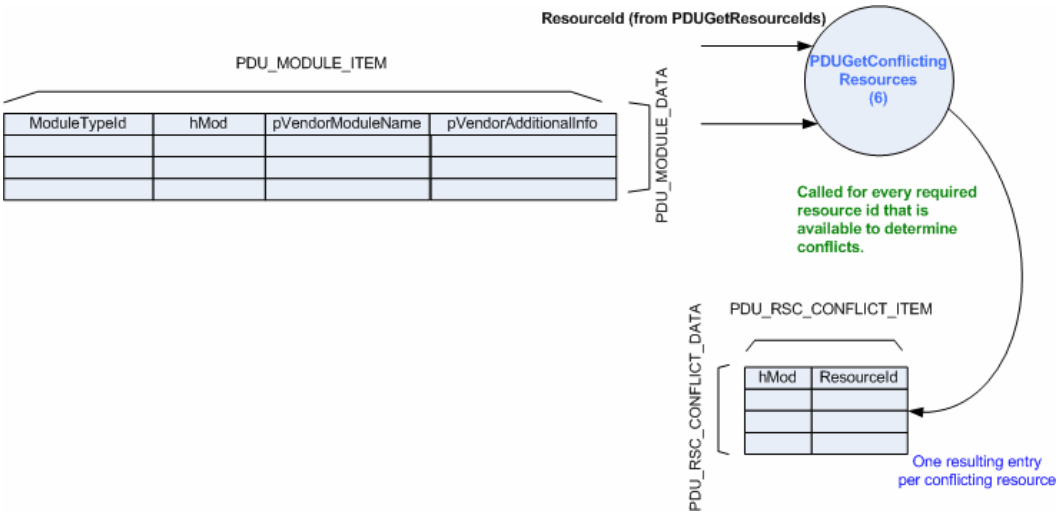


Figure G.3 — Conflicting resources

G.1.2 Example MVCI protocol module resource selection

Figure G.4 — Example MVCI protocol module and cable shows an example MVCI protocol module and cable for the purposes of demonstrating the logic employed by an application selecting resources.

In the example, the MVCI protocol module includes two general-purpose CAN controllers. The first may be used for either Single-wire or Dual-wire High Speed CAN. The second may be used for either Fault Tolerant or Dual Wire High Speed CAN. The resources functions allow an application to ensure that predictable results are always obtained each time it executes. For example, it's possible that an application could first request a Dual Wire High Speed CAN bus type and be allocated the first CAN controller, and then request a Single Wire CAN bus type. The second request could not be fulfilled due to pre-selection of the only CAN controller that could support Single Wire CAN. If the bus types had been requested in the reverse order, the required resources could have been satisfied.

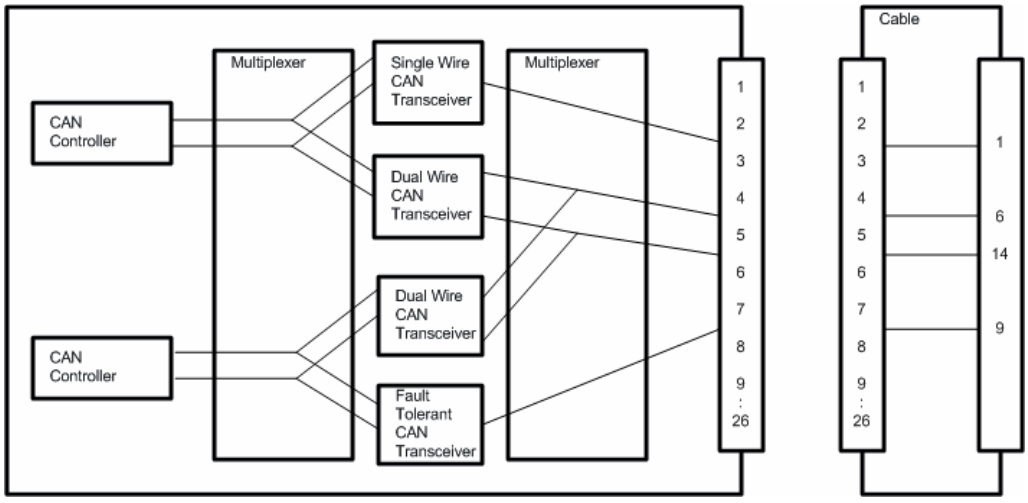


Figure G.4 — Example MVCI protocol module and cable

Figure G.5 — Available routes and selection logic shows the four possible combinations of resources supported by this combination of MVCI protocol module and cable. These combinations are known as Routes and are represented in the D-PDU API by ResourceIds. The application example requires two routes, one Single Wire and one Dual Wire. It uses the GetModuleIDs, GetObjectID, and GetResourceIDs to obtain ResourceIds (each representing a Route) that support the requirements of each connection. For this MVCI protocol module, there is one route that supports Single Wire CAN (Route 1), and two that support Dual Wire CAN (Route 2 and Route 3). After confirming that all three routes are available using GetResourceStatus, the application has to make a choice between the two possible routes supporting High Speed CAN. It makes this decision by checking for conflicts between the three routes.

GetConflictingResources is called once for each of the three routes.

For Route 1: Route 2 is indicated as conflicting (due to the common CAN Controller).

For Route 2: Routes 1 and Route 3 are indicated as conflicting (Route 1 due to the common CAN controller, Route 3 due to common pins).

For Route 3: Route 2 and Route 4 are conflicting (Route 2 due to common pins and Route 4 due to the common CAN controller).

Since there is only one route (Route 1) that supports Single Wire CAN, the application checks for the Dual Wire Route that does not conflict with Route 1. Hence, Route 2 is discounted due to the indicated conflict, and Route 3 is selected.

The application proceeds to call PDUCreateComLogicalLink once using the ResourceId provided for Route 1, and once using the ResourceId provided for Route 3.

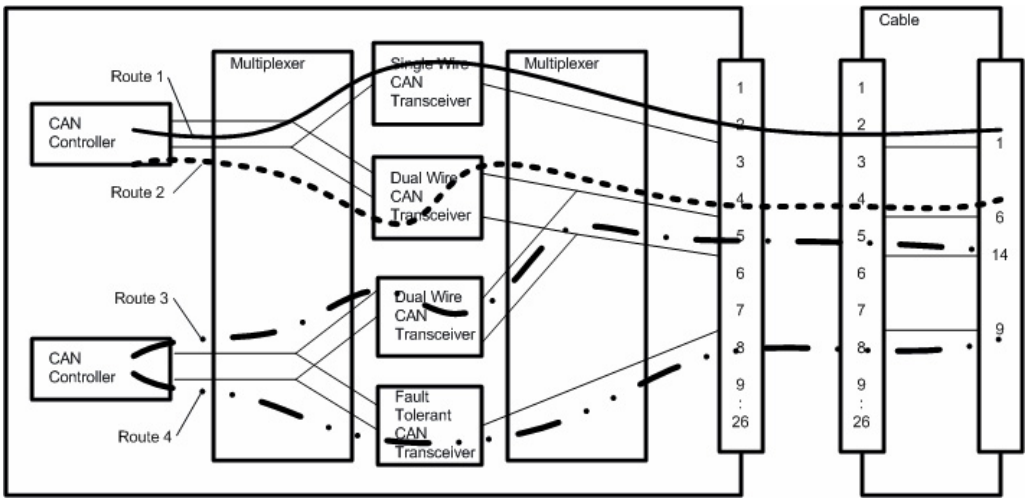


Figure G.5 — Available routes and selection logic

Annex H
(informative)

D-PDU API partitioning

H.1 Functional partitioning of a D-PDU API

H.1.1 ODX data base

Provides data describing the vehicle under test, including connector information, protocol information, vehicle network topology, ECU information, and vehicle data service information.

H.1.2 MVCI D-Server

H.1.2.1 Com Primitive Creator/Handler

Requests by an MVCI D-Server Job or application for data retrieval from an ECU. No information about the protocol or ECU is necessary for the requestor. All information about how to generate a D-PDU, check for valid results, extract the data, and finally convert the data into correct units is done by the Com Primitive Creator/Handler.

H.1.2.2 Rx Logical Data Request

API for requesting logical data from an ECU.

H.1.2.3 D-PDU Builder

Builds a PDU message to be requested from the ECU. The information is data only (header bytes and formatting is accomplished by the D-PDU API/VCI protocol module).

H.1.2.4 D-PDU Checker

Checks the validity of PDU data returned by the MVCI protocol module.

H.1.2.5 Data Extractor

Extracts the desired information from the PDU data, converts the data to appropriate units and passes the information along to the application.

H.1.3 VCI protocol module

H.1.3.1 D-PDU API

The D-PDU API processor provides the link between the MVCI protocol module and the MVCI D-Server (or application). It processes all of the function calls received from the D-Server and distributes them to the appropriate processing module. It is also responsible for passing the appropriate responses back to the D-Server.

H.1.3.2 D-PDU scheduler

The D-PDU Scheduler controls when Send ComPrimitives are queued up for transmission via the ComLogicalLink. For cyclic Send ComPrimitives, the Scheduler is responsible for restarting a timer after the transmission has been queued, and for keeping track of the number of send cycles that have been completed.

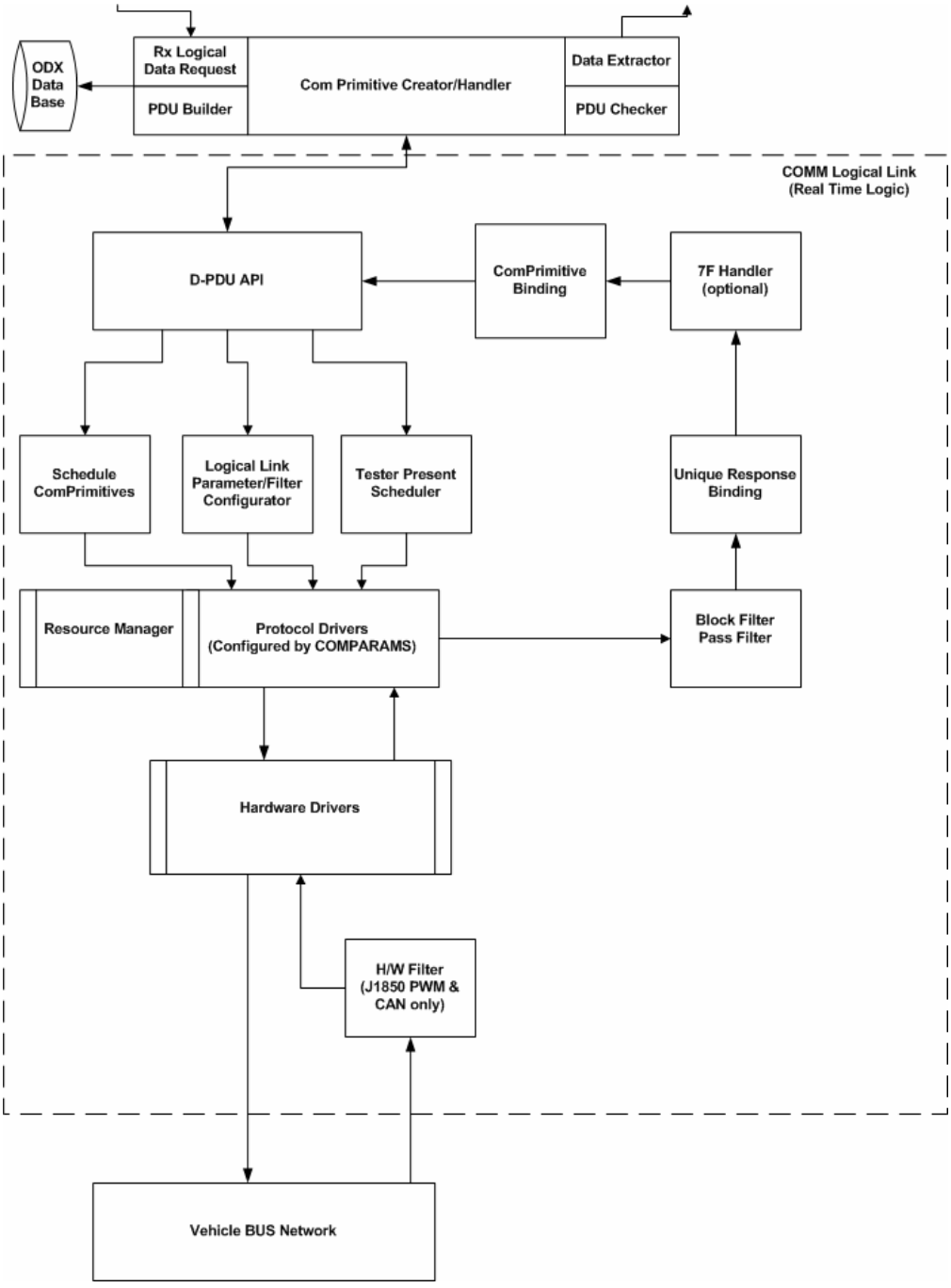


Figure H.1 — Modular VCI protocol module functional partitioning diagram

H.1.3.3 Logical link parameter/filter configuration

Handles configuring a ComLogicalLink and all associated resources assigned to the Logical Link.

H.1.3.4 Tester present scheduler

This scheduler controls the transmission of a Tester Present message for protocols that require this functionality. This scheduler controls what is transmitted on the vehicle bus and when it is transmitted.

H.1.3.5 Resource manager

Manages the resources on the physical module.

H.1.3.6 Protocol driver

Protocol specific driver. (There are 9 currently defined for the D-PDU API.) Handle specific timing and formatting requirements for a protocol implementation.

H.1.3.7 Hardware driver

Provides the firmware interface to the MVCI protocol module's hardware devices (e.g. UARTs and CAN controllers).

H.1.3.8 Hardware filters

Some types of controllers (e.g. CAN controllers and the PWM version of the SAE J1850 interface) have filter capability built into them. Other protocols require that filtering be handled by the MVCI protocol module's firmware (see H.1.3.9).

H.1.3.9 Software filters

H.1.3.9.1 Block filter

Messages that are accepted by this filter are discarded.

H.1.3.9.2 PASS filter

Messages that are accepted by this filter are passed on.

H.1.3.10 ISO 15765 USDT/UUDT Frames

Each USDT CAN Frame for ISO_15765 protocol shall have a matching entry in the UniqueRespIdTable to be handled in the transport layer. If the frame is USDT and a first frame, then this table is used to send out the correct Flow Control frame. If the CAN ID is a UUDT type of frame or is not in the table, then the message is accepted without any further format checking. The frame data is then checked against the ExpectedResponseStructure to bind the frame to a ComPrimitive.

H.1.3.11 Negative response Code 0x7F filter handler

If Negative Response Handling is enabled, each valid Message/Frame received is checked for a negative response service ID (0x7F), and a known response code (0x21, 0x23, 0x78). If there is a match to the response code, then the proper re-transmission or new receive time handling is started.

H.1.3.12 Unique response binding

Match the received message header information to an entry in the table of Unique Response Ids. The matching algorithm is protocol specific (e.g. some protocols will use CAN Ids, others will use Target Addresses, ECU Sources address, etc.).

H.1.3.13 ComPrimitive binding

Once a UniqueRespIdentifier is found, the payload data is attempted to be matched to the ExpectedResponseStructure (see 11.1.4.18) of all active ComPrimitives (starting with the active SENDRECV ComPrimitive).

H.1.4 Vehicle bus network

The MVCI protocol module interfaces to the vehicle's ECUs via the vehicle bus network. The MVCI protocol module accesses this network via the Data Link Connector (DLC) as described in the ODX Data Base.

Annex I
(informative)

Use case scenarios

I.1 Negative response handling scenarios

I.1.1 General

This annex covers the special handling of the Negative Response Codes 0x21, 0x23, and 0x78 for diagnostic protocols such as ISO_14230_4 or ISO_15765_3.

NOTE Not all of the Negative Response Codes are defined for each protocol.

The processing of handling Negative Response Codes is mainly determined by the CP_RCxxHandling ComParams.

If Negative Response Codes are received in other cases than specified here, they are simply reported to the application as a ResponseItem. The same applies if any of the Negative Response Codes 0x21, 0x23, or 0x78 are received even though the respective handling ComParam CP_RCxxHandling does not allow usage of the response code.

In the given figures, the handling of the Negative Response Codes 0x21 and 0x23 is identical. Therefore, only the handling of NRC 0x21 is presented.

In cases where an errorItem (PDU_ERR_EVT_RX_TIMEOUT) is sent back to the client application, an additional PDU_XTRA_ERR_... error code may be supplied to give detailed information about the nature of the timeout event.

I.1.2 Physical addressing

Figure I.1 — Response handling for RC21/RC23, CP_RCXXHandling = 0 shows the processing performed when Negative Error Code 0x21 or 0x23 or 0x78 is received with CP_RCXXHandling = 0 (disabled). It is up to the client application to handle the negative responses from an ECU. For a negative response RC78, the client application would have to have specified a receive only ComPrimitive to bind the eventual positive response from the ECU.

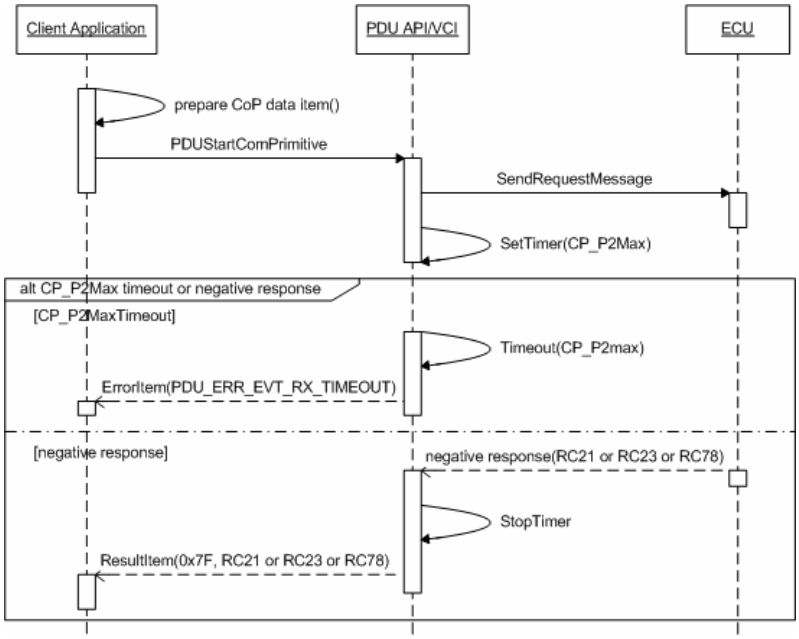


Figure I.1 — Response handling for RC21/RC23, CP_RCXXHandling = 0

The Figure I.2 — Response handling for RC21/RC23, CP_RCXXHandling = 1 shows the processing performed when Negative Error Code 0x21 or 0x23 is received with CP_RCXXHandling = 1 (continue handling negative responses until RCXX_CompletionTimeout). The ECU is too busy to perform the request, and the request is not started. Re-requests are continued until the timeout occurs or until a positive response is received.

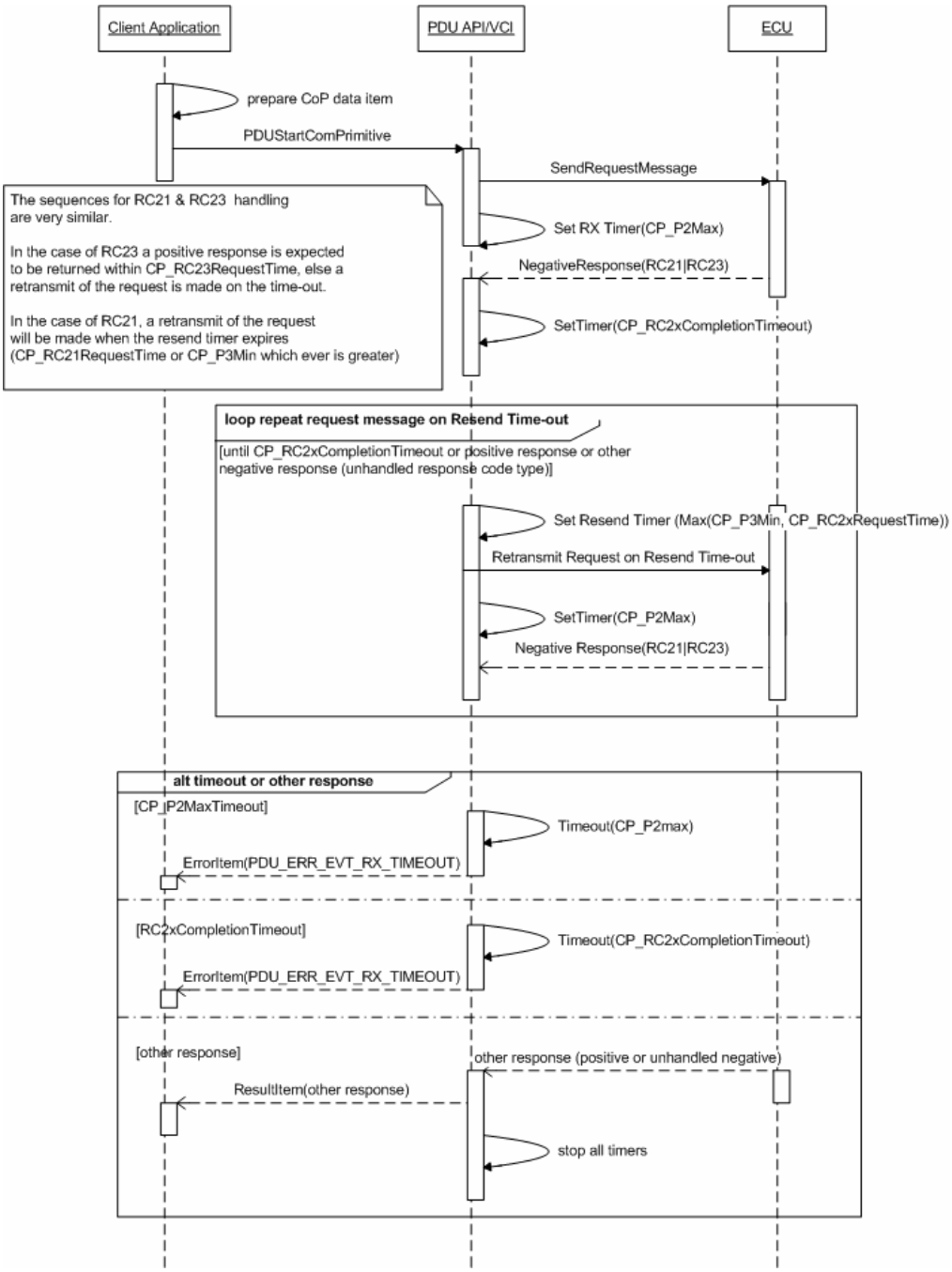


Figure I.2 — Response handling for RC21/RC23, CP_RCXXHandling = 1

Figure I.3 — Response handling for RC21/RC23, CP_RCXXHandling = 2 shows the processing performed when Negative Error Code 0x21 or 0x23 is received with CP_RCXXHandling = 2 (repeat unlimited). The ECU is too busy to perform the request. The request message is resent until a timeout occurs or a non-error response is received.

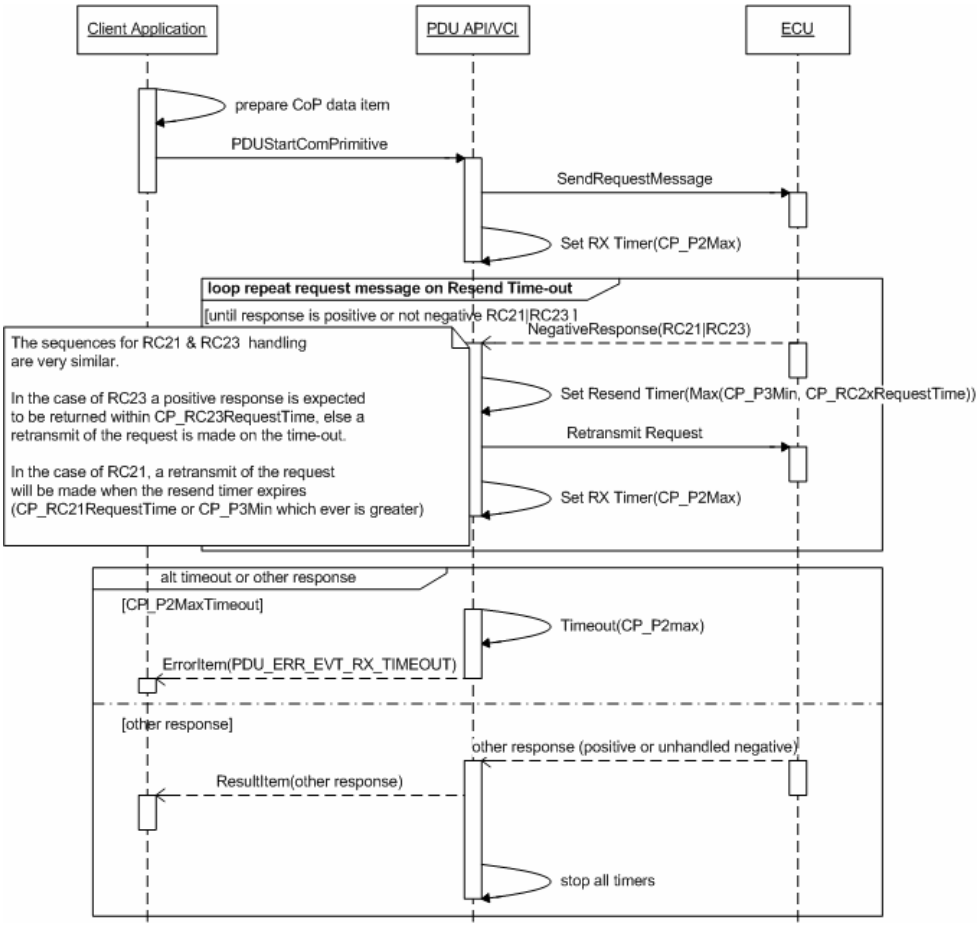


Figure I.3 — Response handling for RC21/RC23, CP_RCXXHandling = 2

Figure I.4 — Response handling for RC78, CP_RC78Handling = 1 shows the processing performed when Negative Error Code 0x78 is received with CP_RC78Handling = 1 (continue handling negative responses until CP_RC78CompletionTimeout). Negative responses are received until either a timeout occurs or a non-negative response is received.

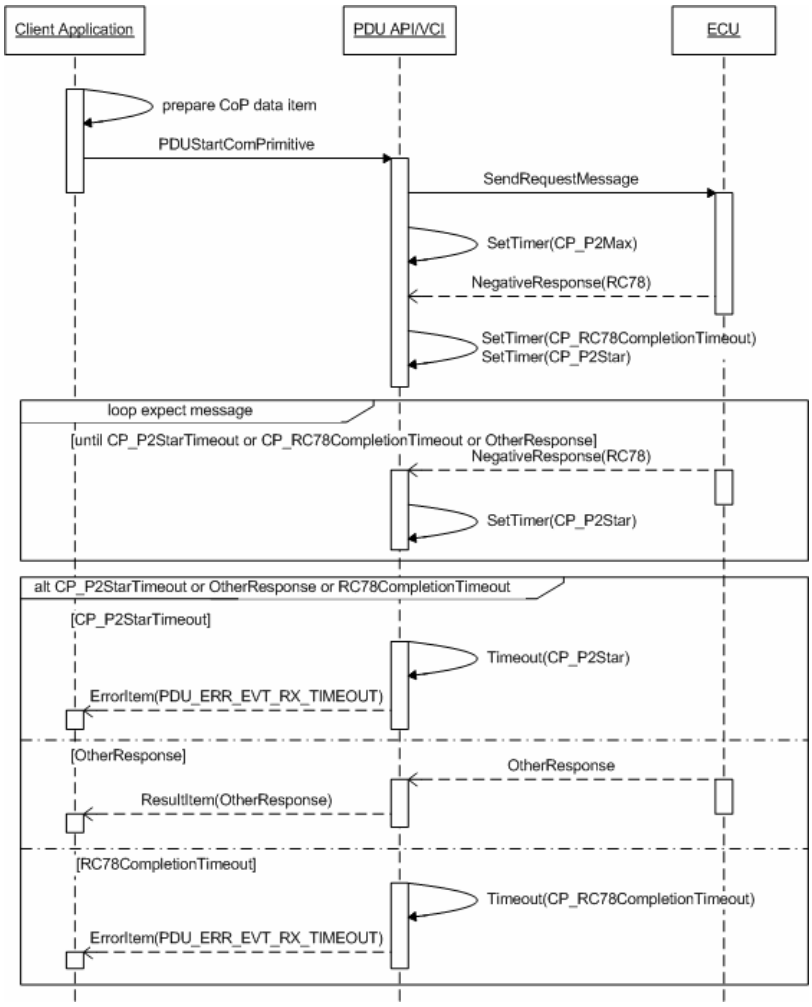


Figure I.4 — Response handling for RC78, CP_RC78Handling = 1

Figure I.5 — Response handling for RC78, CP_RC78Handling = 2 shows the processing performed when Negative Error Code 0x78 is received with CP_RC78Handling = 2 (continue handling unlimited). Negative responses are received until either a timeout occurs or a non-negative response is received.

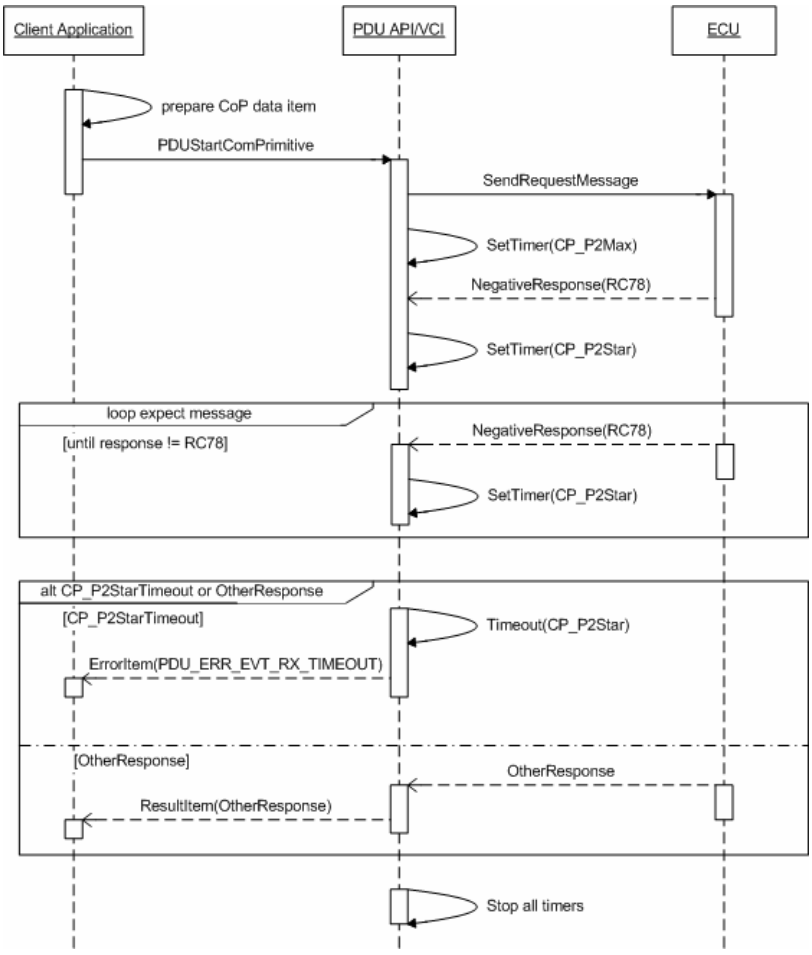


Figure I.5 — Response handling for RC78, CP_RC78Handling = 2

I.1.3 Functional addressing

Figure I.6 — Response handling for RC21/RC23, CP_RCXXHandling = 1 (Functional addressing) shows the processing performed when Negative Error Code 0x21 or 0x23 is received with CP_RCXXHandling = 1 (continue handling negative responses until RCXX_CompletionTimeout) with functional addressing. The ECU(s) is too busy to perform the request. The request is resent until all ECUs have responded positively, or a timeout occurs. The D-PDU API will ensure that each ECU with a positive response(s) does not send duplicate PDU_IT_RESULT items back to the client application, even though one or more functional re-requests were made on the vehicle bus.

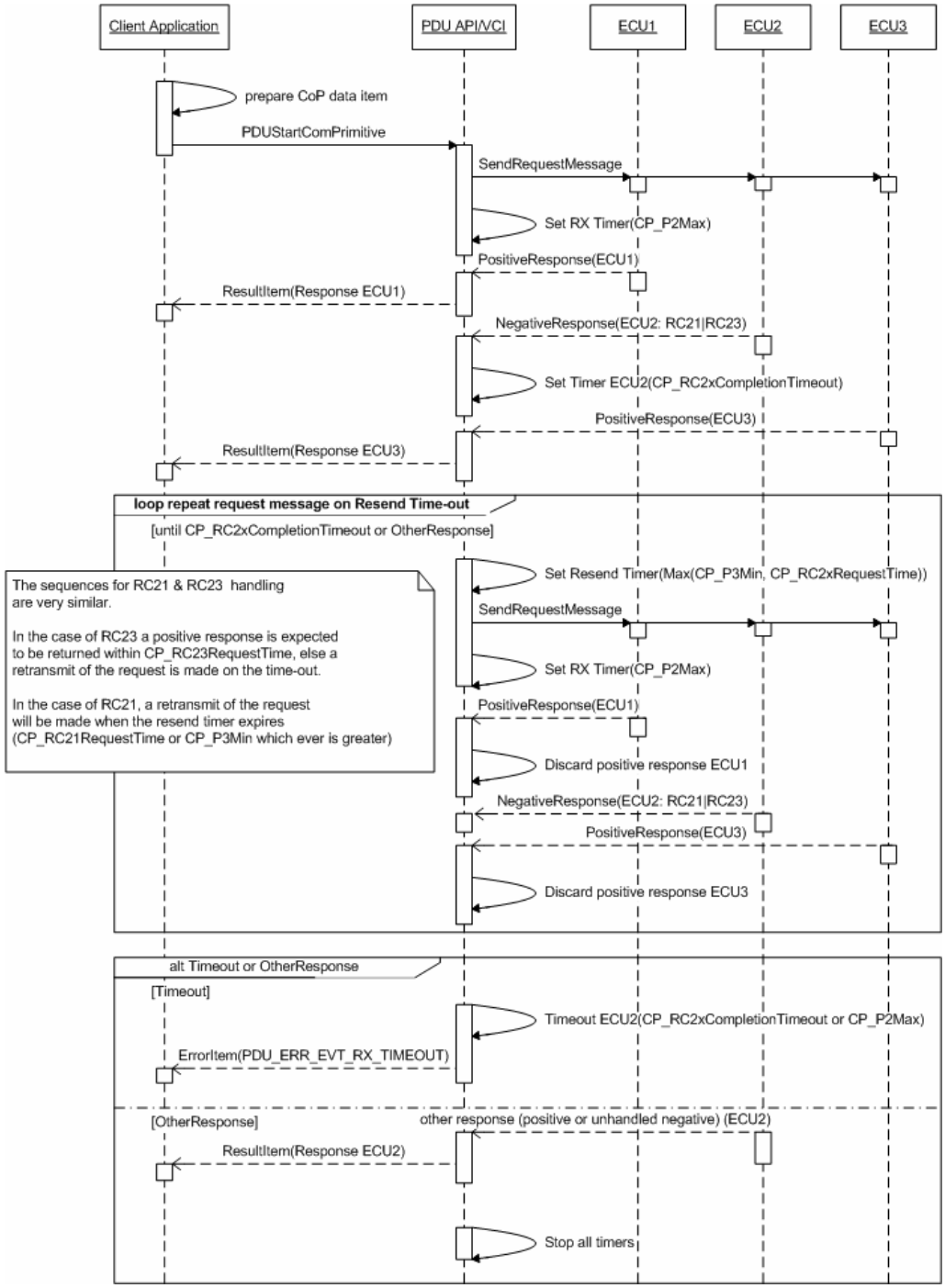


Figure I.6 — Response handling for RC21/RC23, CP_RCXXHandling = 1 (Functional addressing)

Figure I.7 — Response handling for RC78, CP_RC78Handling = 1 (Functional addressing) shows the processing performed when Negative Error Code 0x78 is received with CP_RC78Handling = 1 (continue handling negative responses until RC78_CompletionTimeout) with functional addressing. The ECU(s) is too busy to perform the request. The request is resent until all ECUs have responded positively, or a timeout occurs.

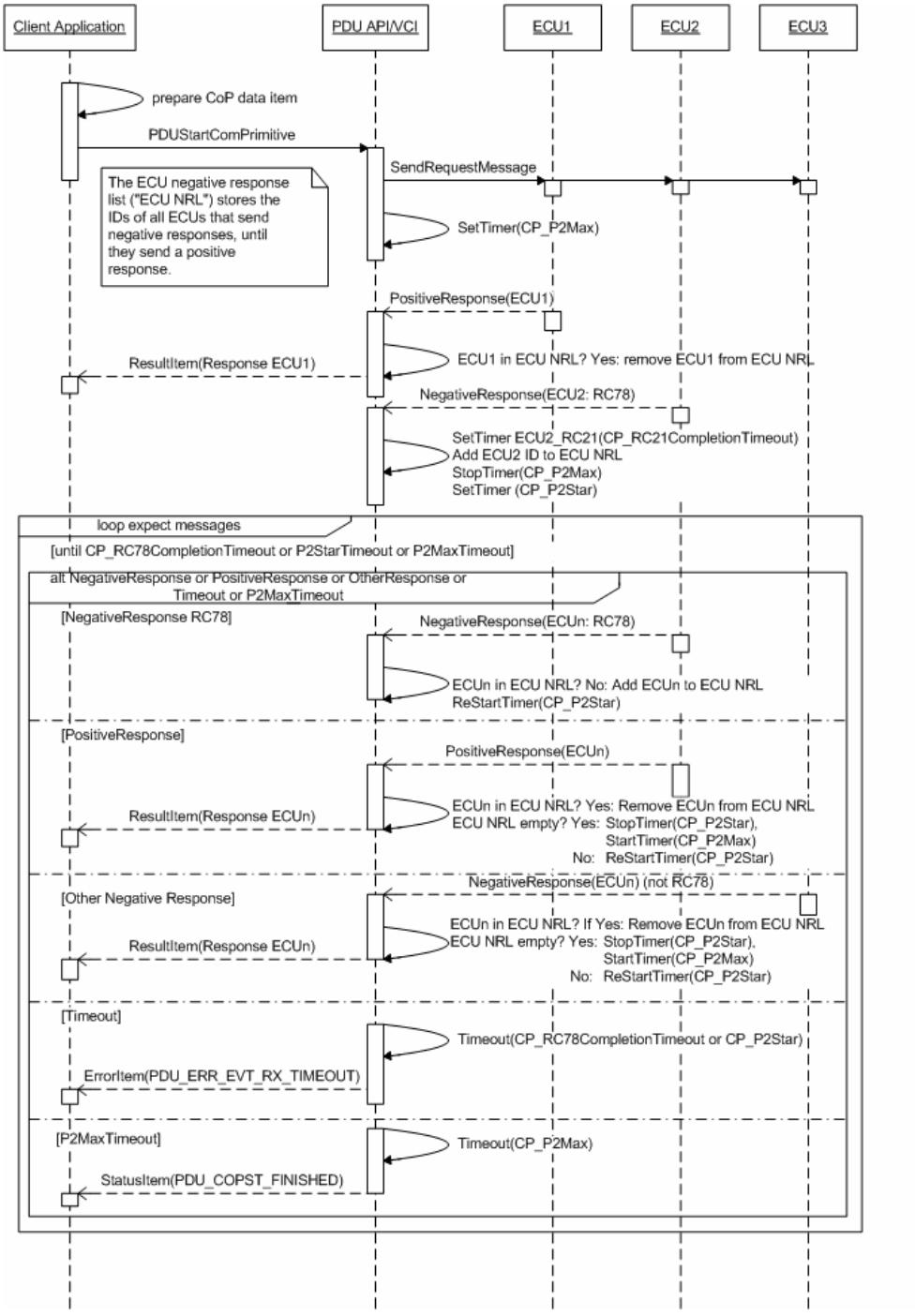


Figure I.7 — Response handling for RC78, CP_RC78Handling = 1 (Functional addressing)

I.1.4 Additional RC23/RC21 handling description for SAE J1850 VPW and ISO 14230 protocols

I.1.4.1 General

Additional handling description for RC23 and RC21 shall be explained to handle differences between protocols.

I.1.4.2 Setup assumptions

There is an active SendRecv CoP with at least 1 expected response filter set for a 0x7F 0xSID.

Assume CP_RC23Handling is != 0.

I.1.4.3 Steps

a) When the Protocol Handler receives a RC23 to an active CoP, it sets the message receive timer to CP_RC23RequestTime to wait for a positive response from the ECU.

   — In the case for SAE J1850 VPW the CP_RC23RequestTime = 1 second.

   — In the case for ISO 14230-3 the CP_RC23RequestTime = 0. There will not be a “final” response from the ECU. The tester has to re-request the service after a negative response with RC23 to obtain a positive response. The tester waits CP_P3Min before re-transmitting the request.

b) If the negative response handling flag (CP_RC23Handling) is set to 1 (Continue handling negative responses until CP_RC23CompletionTimeout), the Protocol Handler keeps a timestamp of this first negative response.

   — If there are no positive responses (even after numerous re-requests) within CP_RC23CompletionTimeout, then the Protocol Handler gives up on this CoP and will send an Error Event indicating that the ComPrimitive has a receive timeout.

   — The CP_RC23CompletionTimeout shall be > CP_RC23RequestTime.

   — The greater value between CP_RC23RequestTime and CP_P3Min is used.

c) If the message receive timer times-out without a positive response from the ECU, then a re-request is made to the ECU.

   — For ISO 14230-3, there is no expected response after receiving the RC23. The re-request is made when CP_P3Min has expired. On a re-request, the ECU will respond with a Negative Response code of 0x21 if the ECU is still busy processing the previous request.

   — It is assumed that a SAE J1850 VPW ECU will respond with either a positive response on the re-request or another negative response code of 0x23. Response code 0x21 is NOT supported by most SAE J1850 VPW protocol implementations.

d) **Physical addressing**: If a positive response (NumReceiveCycles = 1) is received before the message receive timer times out (CP_P2Max or CP_RC23RequestTime), then the CoP is set to finished (PDU_COPST_FINISHED).

e) **Functional addressing**:

   — Each ECU which responds with a negative 0x23 response is placed in a negative response list. The first ECU gets the timer for CP_RC23RequestTime. Each of the other ECU's gets a timestamp value.

   — Once an ECU which had previously responded with RC 0x23, now responds with a positive response, it is then removed from the negative response list.

— If there are no other ECUs in the negative response list, the receive timer is then set to CP_P2Max for other ECU responses.

— If there is another ECU in the negative response list, the receive timer is set to CP_RC23RequestTime – (current_time – initial_time) (whatever remaining time to resend the request)

— Only when there is a CP_P2Max timeout and no ECUs are in the negative response list will the CoP then be set to finished.

— Each ECU that gives one or more positive responses is placed in a functional positive response List. Therefore, on a re-request ONLY the ECU's which had not previously responded with a positive response will have their messages passed up to the client application. This supports the requirement that the D-PDU API does not pass duplicate ECU responses to the client application during functional addressing. Ignore negative response from ECU's which already responded with a positive response.

I.2 ISO 14229-1 UDS

I.2.1 Suppress positive response scenarios

The UDS protocol implements a suppress positive response feature for some services. When this bit is set in the payload data (set by the client application using the D-PDU API), the ECU will not respond to the request. The D-PDU API needs to be informed by the client application when this feature has been selected so that a receive timeout will not generate an error item, and handling of negative responses/followed by positive responses are handled correctly. The client application sets the SUPPRESS_POS_RESP bit in the TxFlag parameter used in PDUStartComPrimitive function (see D.2.1).

Figure I.8 — ISO 14229-1 UDS, suppress positive response (normal execution) shows the processing performed when the Suppress Positive Response Bit is set for the normal case. No errors are indicated to the client application.

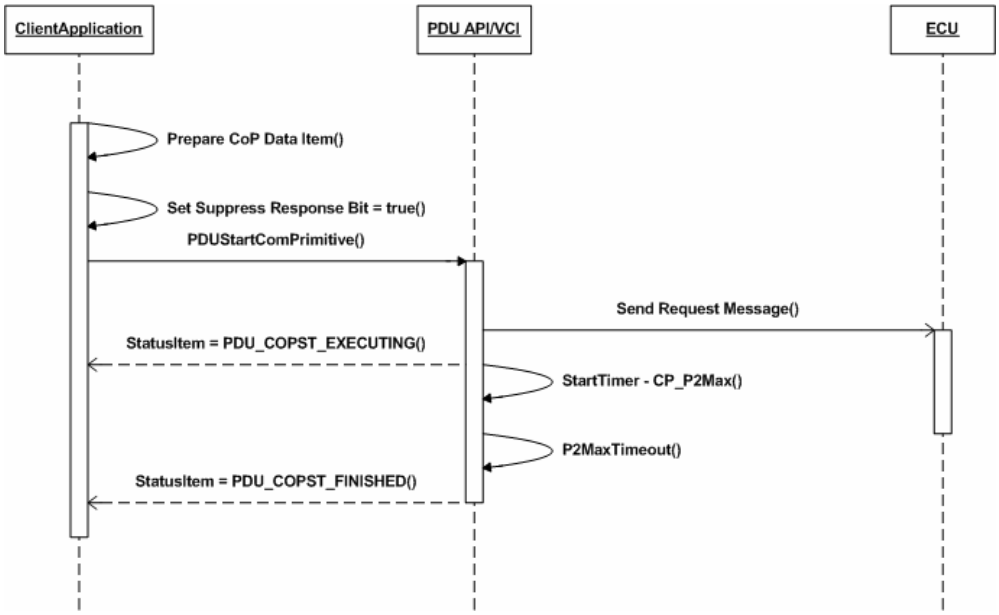


Figure I.8 — ISO 14229-1 UDS, suppress positive response (normal execution)

Figure I.9 — UDS — Suppress positive response (negative response (0x78)) shows the processing performed when the Suppress Positive Response Bit is set and the ECU responds with 0x78. For this case, the ECU will respond to the request (after more time), and the PDU API shall suppress the response. No errors are indicated to the client application.

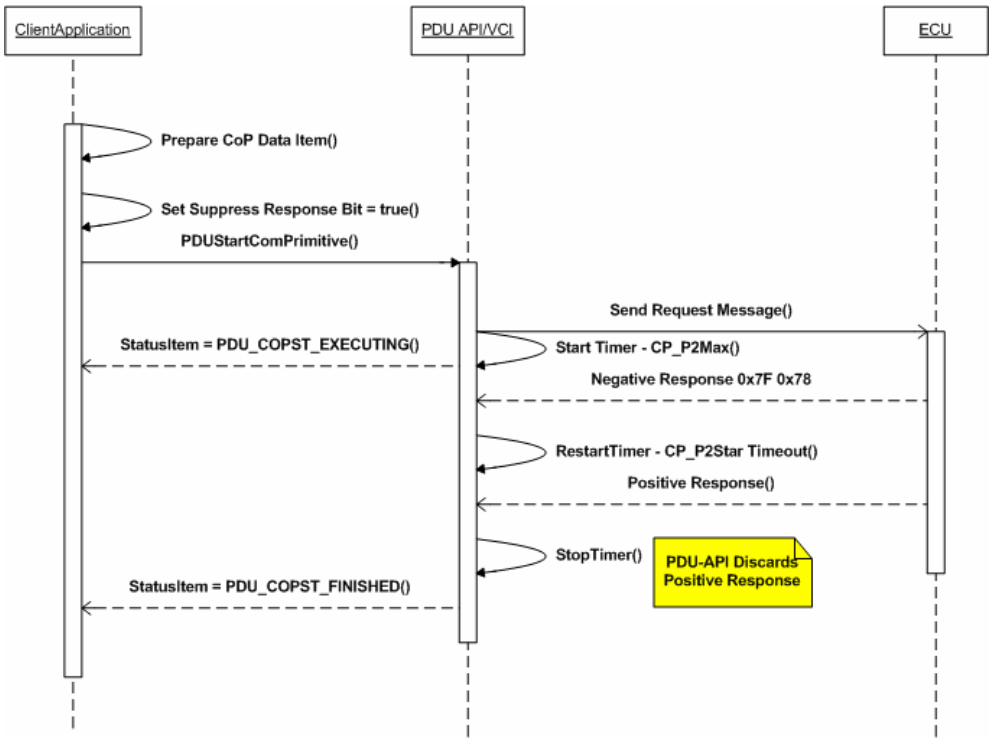


Figure I.9 — UDS — Suppress positive response (negative response (0x78))

Figure I.10 — UDS — Suppress positive response (negative response (not 0x78, 0x21, 0x23)) shows the processing performed when the Suppress Positive Response Bit is set and the ECU responds with a negative response other than 0x78, 0x21 0x23. For this case, the negative response will be sent to the client as a Result Item, but no error will be indicated to the client application.

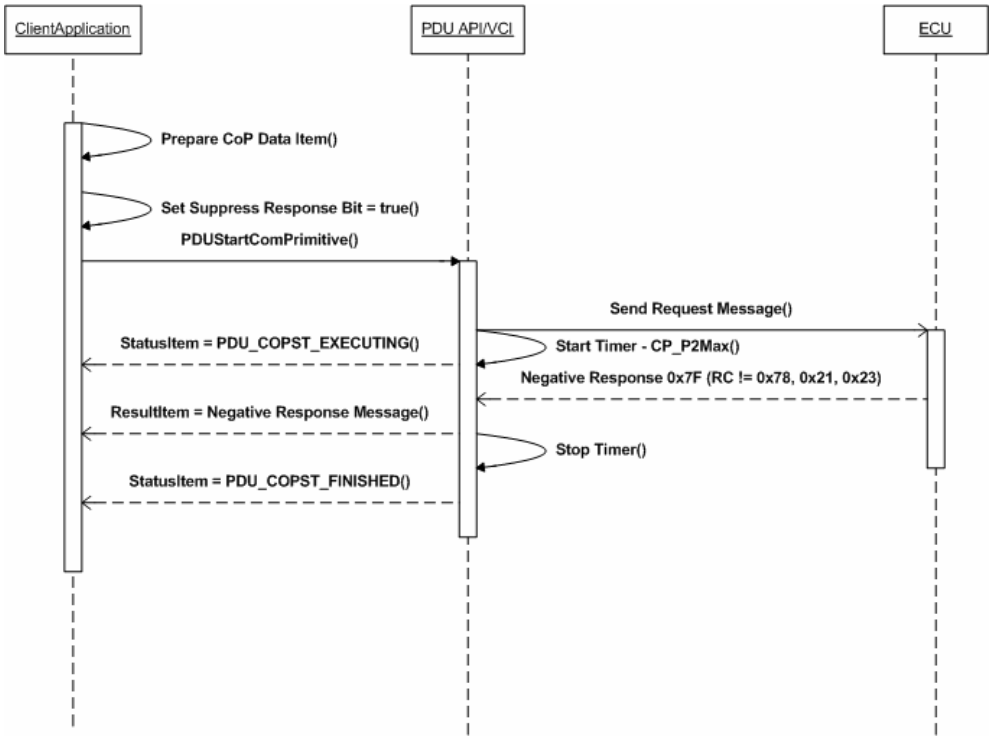


Figure I.10 — UDS — Suppress positive response (negative response (not 0x78, 0x21, 0x23))

Figure I.11 — UDS — Suppress positive response (unexpected positive response) shows the processing performed when the Suppress Positive Response Bit is set and the ECU responds with a positive response. For this case, an error (unexpected positive response) will be indicated to the client application.

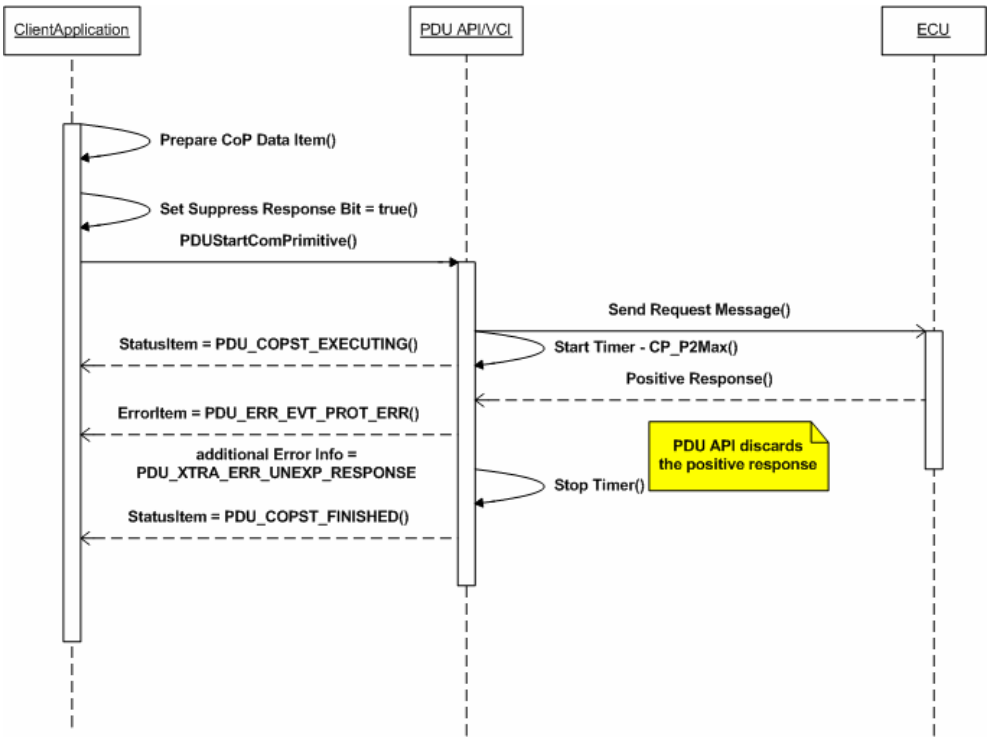


Figure I.11 — UDS — Suppress positive response (unexpected positive response)

Figure I.12 — UDS — Suppress positive response OFF (no response) shows the processing performed when the Suppress Positive Response Bit is not set and the ECU does not respond. For this case, an error (RX timeout) will be indicated to the client application.

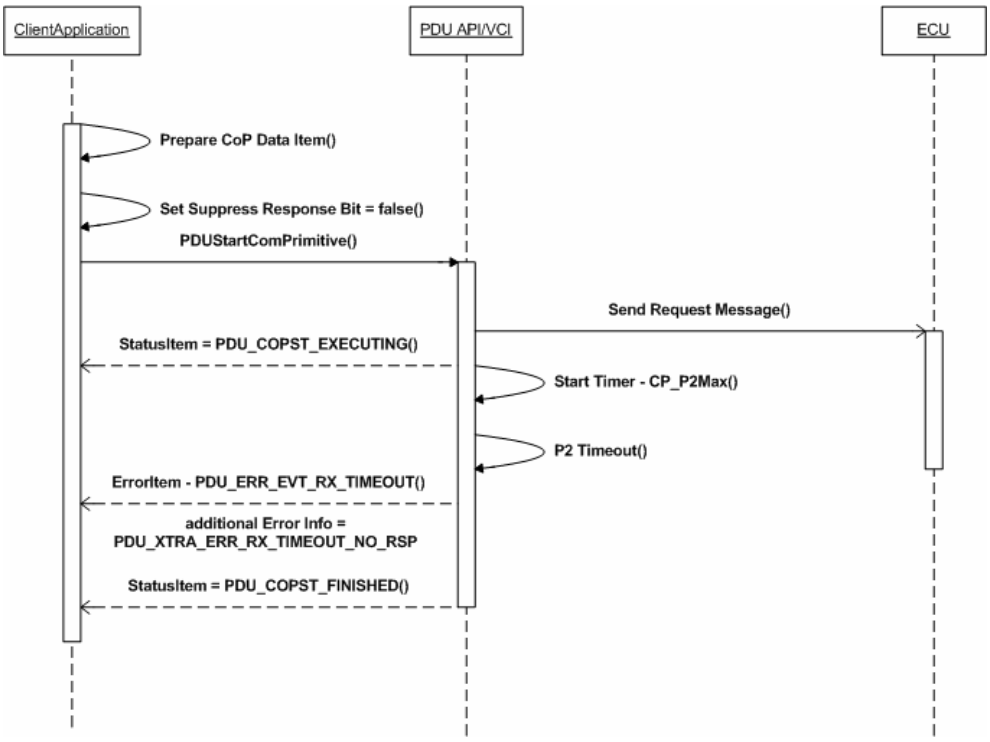


Figure I.12 — UDS — Suppress positive response OFF (no response)

I.2.2 Service 0x2A use case scenario

I.2.2.1 General

For service 0x2A there exists a problem in identifying the proper response. Service 0x2A allows for two types of responses per single ECU, either data is retrieved using USDT responses or UUDT responses only. Furthermore there is an initial positive USDT response.

I.2.2.2 Overview

The problem exists for the periodic identifier 0x6A. The request/response messages would look as follows:

Request	USDT CAN Id	**0x2A**	mode	*0x6A*		
Initial positive response	USDT CAN Id	**0x6A**				
Response type #1	USDT CAN Id	**0x6A**	*0x6A*	data	data	…
Response type #2	UUDT CAN Id	*0x6A*	data	data	data	...

— The MVCI PDU API performs a filtering of incoming messages on a hierarchical order, first looking at the address information and then evaluating the payload data.

— On the ComLogicalLink level the filtering is done on address base by the use of the UniqueResponseIdTable. This filtering takes into account only the CAN Id portion of the incoming message and a potential extended address (for the example given no extended address is used).

— On the ComPrimitive level the filtering is done on payload data content by the use of ExpectedResponse structures. This filtering takes into account the payload of the messages that have passed the UniqueResponseIdTable based filtering.

I.2.2.3 Response type #1

In case of response type #1 the ExpectedResponse structures are set up as follows.

— Only 1 ComPrimitive is needed and is configured to receive infinite responses (NumReceiveCycles = -1).

— First entry in the expected response list is the periodic response. It shall be the first entry so that the MVCI does not match the first positive response to a periodic response.

— For the initial positive response only a 0x6A (Service id) is configured, marked as a positive response.

— In case of response type #1 another ExpectedResponse structure is configured for 0x6A 0x6A (service Id and periodic identifier), also marked as a positive response.

Request	USDT CAN Id	**0x2A**	mode	*0x6A*

Periodic responses	USDT CAN Id	**0x6A**	*0x6A*	data	data	…
Expected response structure #1		0x6A	0x6A			
ResponseType=positive						

Initial negative response	USDT CAN Id	0x7F	**0x2A**	RC
Expected response structure #2		0x7F	0x2A	
ResponseType=negative				

Initial positive response	USDT CAN Id	*0x6A*		
Expected response structure #3		0x6A		
ResponseType=positive				

I.2.2.4 Response type #2

In case of response type #2 the ExpectedResponse structures are set up as follows.

— Two ComPrimitives are needed.

— The first ComPrimitive is used to receive the initial positive response or initial negative response. Once this information is received from the ECU, the ComPrimitive is finished (PDU-COPST_FINISHED).

— The second ComPrimitive is a receive only ComPrimitive (NumSendCycles = 0, NumReceiveCycles = –1). This ComPrimitive is used to receive the periodic UUDT responses.

CoP 1(SendRecv)

Request	USDT CAN Id	**0x2A**	mode	0x6A

Initial negative response	USDT CAN Id	0x7F	**0x2A**	RC
Expected response structure #1		0x7F	0x2A	
ResponseType=negative				

Initial positive response	USDT CAN Id	**0x6A**		
Expected response structure #2		0x6A		
ResponseType=positive				

CoP 2(Recv Only)

	UUDT CAN Id					
Periodic responses		**0x6A**	0x6A	data	data	…
Expected response structure #1						
ResponseType=positive		0x6A	0x6A			

I.2.2.5 Negative response handling any periodic identifier set to 7F

There exists similar issues with the periodic identifier 0x7F in conjunction with a negative response message 0x7F, but this can be solved within the PDU API by the use of a ComParam that indicates whether the negative response is USDT, UUDT or don't care.

EXAMPLE In the case of a USDT reception and the ComParam set in a way that it indicates that USDT messages are negative response messages, then the PDU API will check the ExpectedResponse structures with ResponseType set to “negative”. In case of a UUDT receive for that scenario only the ExpectedResponse structures with ResponseType set to “positive” will be checked.

	USDT CAN Id				
Request		**0x2A**	mode	*0x7F*	*0x6A*

CoP 1 (Send/Recv)

— Expected initial positive response and suppress positive response types.

	USDT CAN Id			
Initial negative response		**0x7F**	**0x2A**	RC
Expected response structure #1		*0x7F*	*0x2A*	
ResponseType=negative				

— This is necessary to handle a positive response after a RC78 negative response.

— If the TXFlag is set to SUPPRESS_POS_RESP, then this entry is not used until a previous 0x7F 0x78 response was received for this CoP.

	USDT CAN Id			
Initial positive response		**0x6A**		
Expected response structure #2		*0x6A*		
ResponseType=positive				

CoP 2 (Recv Only) (Setup different based on UUDT or USDT responses)

	UUDT CAN Id					
Periodic responses		0x7F	data	data	data	...
Expected response structure #1		*0x7F*				
ResponseType=positive						

Periodic responses	USDT CAN Id	**0x6A**	0x7F	data	data	...
Expected response structure #2		*0x6A*	*0x7F*			
ResponseType=positive						

I.3 Service shop use case scenario

The service shop uses modular VCI-compliant hardware and software. They are also equipped with a PC connected to the Internet/Intranet.

When a vehicle needs to be diagnosed, the technician connects the MVCI to the vehicle's diagnostic connector.

The Display Unit provides a menu with a “Vehicle Identification” selection. The MVCI establishes a “hands-free” OBD protocol initialization in order to read the VIN (Vehicle Identification Number) from the emissions-related system(s).

The VIN is used to further identify the vehicle with regard to:

— OEM

— Model Year

— Vehicle Model

This information is used to automatically connect to the OEM's Web Server (or PC with OEM specific CD ROM), which has stored all ODX (Open Diagnostic Data Exchange) compliant XML files. The “Vehicle ODX” file contains references to all ECU ODX filenames. All relevant ODX files are downloaded to the PC and stored on the HDD. Now the technician selects from the menu those systems he wants to test from the Display Unit of the MVCI. The selected system files are now downloaded to the MVCI D-Server application. If additional MVCI-specific protocol software needs to be downloaded into the MVCI, this will also happen at this time.

The MVCI system is now ready to communicate to the vehicle. The technician can now diagnose the vehicle system(s).

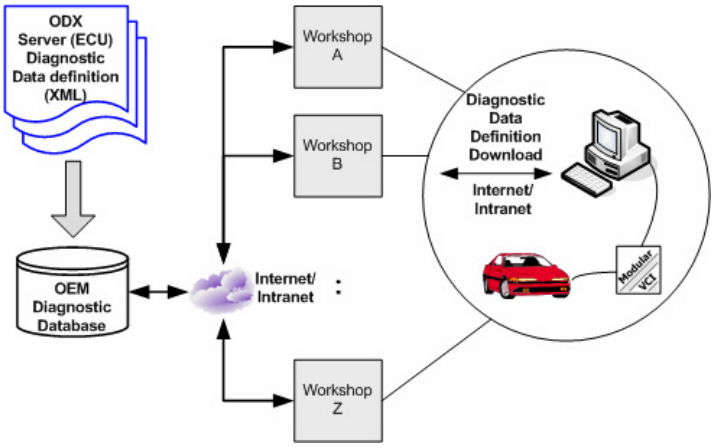


Figure I.13 — Example of service shop diagnostic tool support

I.4 Vehicle bus baud rate changing scenario

I.4.1 General overview

Some vehicle protocols (and their hardware) allow the Vehicle Bus' baud rate to be changed via a vehicle communication message. The process is rather complex and requires setting up ComParams and ComPrimitives. The Table I.1 — Example vehicle bus baud rate changing scenario provides an example of the steps that could be taken in order to change a vehicle bus' baud rate from low speed to high speed and back to low speed.

It is possible to configure the MVCI protocol module to act as an ECU emulator. In an emulator mode, the application would configure the CP_xxx_Ecu (xxx represents all ComParams with suffix _Ecu) ComParams and use receive only type of ComPrimitives to handle the automatic request.

It is important that any MVCI protocol module developer which supports multiple ComLogicalLinks with multiple physical resources on the same physical bus enforce correct hardware configuration of all resources that use the shared bus. Therefore, if the baud rate changes on one resource, it shall also be changed on the other resources sharing the physical bus.

I.4.2 Device use

a) Tester:

   — Configure a message that is used as a trigger for a baud rate transition. The trigger point is the determination of the successful *transmission* of this message.

   — Trigger action: Enable a configured baud rate, i.e. it shall be possible to specify a baud rate.

   — Optionally enable a pull-down resistor (e.g. required for a SAE J2411 SW-CAN physical layer) when the trigger occurs.

   — Delay any transmission for a certain time in order to give the network time to settle the baud rate.

b) ECU:

   — Configure a message that is used as a trigger for a baud rate transition. The trigger point is the determination of the successful reception of this message.

   — Trigger action: Enable a configured baud rate, i.e. it shall be possible to specify a baud rate.

c) Monitor mode:

   — The requirements for a network monitor are identical to the ECU requirements in regard to what needs to be able to be configured: trigger message, baud rate. The trigger point is also the successful reception of the configured message.

   — The monitoring unit does NOT enable a special pull-up resistor. The special pull-up resistor is only required for the tester in accordance with SAE J2411 (SW-CAN) when transitioning to 83,33 kBit/s.

I.4.3 Example scenarios

Table I.1 — Example vehicle bus baud rate changing scenario describes an example scenario for changing the baud rate using the applicable ComParams.

Table I.1 — Example vehicle bus baud rate changing scenario

Seq	Action	ComParams/RxFlag Info	Description
1	Application determines if the ECU supports a Baud Rate Change for the ECU.		ComPrimitive Messages are sent to an ECU. The application determines if the ECU supports the Change Baud Rate Action.
2	Application pre-configures the Speed Change ComParams for the Protocol.	CP_ChangeSpeedRate = 88,33K CP_ChangeSpeedResCtrl = AUTO_LOAD_SWCAN_ RESISTOR CP_ChangeSpeedCtrl = 0 (NO_SPDCHANGE) NOTE Change Speed is OFF. CP_ChangeSpeedTxDelay = 30 ms CP_ChangeSpeedMessage = 0xA5 0x03	The application uses PDUSetComParam to modify the working buffer of ComParams followed by a PDUStartComPrimitive of type PDU_COPT_UPDATEPARAM to set the ComParam values in the active MVCI protocol module buffer.
3	Application configures the Speed Change ComParam to be used as TempComParam for a ComPrimitive	CP_ChangeSpeedCtrl = 1 (ENABLE_SPDCHANGE)	The application uses PDUSetComParam to modify the working buffer of ComParams.
4	Application creates the ComPrimitive which contains the message for the ECU to change to high speed (0xA5 0x03), which shall match the CP_ChangeSpeedMessag. This ComPrimitive would normally use the TempParamUpdate Flag feature.	MVCI protocol module changes the Baud rate ComParam after successful completion of the ComPrimitive. The MVCI protocol module will also enable the resistor when changing to the new baud rate (Auto Resistor Switching is enabled). The Temporary ComParam is restored to its previous state. CP_Baudrate = 83,33K CP_ChangeSpeedCrl = 0 (NO_SPDCHANGE) set to 0 due to it being a temporary ComParam for this ComPrimitive. Result data: RxFlag: SPD_CHG_EVENT set. No data bytes	The MVCI protocol module monitors the bus on a transmit and a receive for a match to the CP_ChangeSpeedMessage. SendOnly: MVCI protocol module waits for the transmit to be complete. Sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and enables the resistor (Auto Resistor Switching is enabled). SendRecv: MVCI protocol module waits for a positive response. When a positive response is received within the wait time (P2Max), the MVCI protocol module sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and enables the resistor (Auto Resistor Switching is enabled). RecvOnly: The MVCI protocol module binds a received PDU to the ComPrimitive (via the Expected Response Structure). The MVCI protocol module sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and enables the resistor (Auto Resistor Switching is enabled).
5	Wait before transmitting any messages on the vehicle bus.	Wait CP_ChangeSpeedTxDelay	The MVCI protocol module delays CP_ChangeSpeedTxDelay time before allowing another transmit on the physical bus (via any ComLogicalLink sharing the physical bus).
6	All further communications to the ECU will be at the higher speed rate.		High Speed Communication between MVCI protocol module and ECUs on the serial bus.

Table I.1 (*continued*)

Seq	Action	ComParams/RxFlag Info	Description
7	Application configures the Speed Change ComParams for return to normal mode.	CP_ChangeSpeedRate = 33,33K CP_ChangeSpeedResCtrl = (AUTO_UNLOAD_RESISTOR) CP_ChangeSpeedMessage = 0x20 CP_ChangeSpeedTxDelay = 1 000 ms	The application uses PDUSetComParam to modify the working buffer of ComParams followed by a PDUStartComPrimitive of type PDU_COPT_UPDATEPARAM to set the ComParam values in the active MVCI protocol module Buffer.
8	Application configures the Speed Change ComParam to be used as TempComParam for a ComPrimitive.	CP_ChangeSpeedCtrl = 1 (ENABLE_SPDCHANGE)	The application uses PDUSetComParam to modify the working buffer of ComParams.
9	Application creates the ComPrimitive which contains the message for the ECU to change to normal speed (0x20), which shall match the CP_ChangeSpeedMessag. This ComPrimitive would normally use the TempParamUpdate Flag feature.	MVCI protocol module changes the Baud rate ComParam after successful completion of ComPrimitive. The MVCI protocol module also disables the termination resistor when changing to the new baud rate. The Temporary ComParam is restored to its previous state. CP_Baudrate = 33,33K. CP_ChangeSpeedCtrl = 0 (NO_SPDCHANGE) set to 0 due to it being a temporary ComParam for this ComPrimitive. Result data: RxFlag: SPD_CHG_EVENT set. No data bytes.	Send Only: MVCI protocol module waits for the transmit to complete. Sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and disables the resistor. SendRecv: MVCI protocol module waits for a positive response. When a positive response is received within the wait time, the MVCI protocol module sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and disables the resistor. RecvOnly: The MVCI protocol module binds a received PDU to the ComPrimitive (via the Expected Response Structure). The MVCI protocol module sets ALL physical resources sharing the same physical bus to CP_ChangeSpeedRate and enables the resistor.
10	Wait before transmitting any messages on the vehicle bus.	Wait CP_ChangeSpeedTxDelay	The MVCI protocol module delays CP_ChangeSpeedTxDelay time before allowing another transmit on the physical bus (via any ComLogicalLink sharing the physical bus).
11	All further communications to the ECU will be at the lower speed rate.		Low/Normal Speed Communication between MVCI protocol module and ECUs on the serial bus.

I.5 SAE J1939 Use Cases

I.5.1 SAE J1939 CAN ID Formation

Table I.2 — Example SAE J1939 CAN ID formation describes an example of CAN ID formation based on ComParams and PGN from ComPrimitive data.

Table I.2 — Example SAE J1939 CAN ID formation

ComParam	PGN:59904 (0xEA00)	PGN : 58112 (0xE300)	PGN: 55040 (0xD700) (DM16) (multipacket)	PGN:65226 (0xFECA) (DM1)
CP_J1939DataPage	0	0	0	0
CP_J1939PDUSpecific	0	0	0x00	0xCA
CP_J1939PDUFormat	0xEA	0xE3	0xD7	0xFE
CP_TesterSourceAddress (address claimed by tester, based on Preferred address list in CP_J1939PreferredAddress)	0x81	0x81	0x81	0x81
CP_MessagePriority	0x06	0x06	0x06	0x06
CP_J1939TargetAddress	0x01	0x01	0xFF (irrespective of whether PF >=239. If multipacket, use this parameter)	Don't care
CAN ID of tester	0x18EA0181	0x18E30181	For BAM: 0x1CECFF81 (The PGN 0xD700 would be part of BAM data bytes.) For TP.DT: 0x1CEBFF81 (in accordance with SAE J1939-21:2006, 5.10.3).	For this case the tester does not send a request. The CAN ID from the ECU is 0x18FECA01.

I.5.2 Setting up ComParams for a SAE J1939 ComLogicalLink

Below is a theoretical set of ComParams and data used to receive and send some common SAE J1939 commands for the PDU1 and PDU2 format style messages.

— CP_J1939Name = 0x31 0x32 0x33 0x34

NOTE 1 This is not a valid NAME.

— CP_J1939TargetName = 0x34 0x35 0x36

NOTE 2 This is not a valid NAME.

— CP_J1939PreferredAddress = 0x81, 0x82 (the two source IDs that the tester will try to claim)

— CP_CanMaxNumWaitFrames = default

— CP_Cr = default

— CP_Cs = default

— CP_MessagePriority = 0x06

— CP_T3Max = default

— CP_T4Max = default

— CP_T5Max = default

— CP_MessageIndicationRate = default

— CP_J1939DataPage = 0x00

— CP_J1939PDUFormat = 0xEA

— CP_J1939PDUSpecific = NOT APPLICABLE SINCE CP_J1939PDUFormat is less than 240

— CP_J1939TargetAddress = 0x01

— CP_J1939SourceAddress = 0x01 (Set via PDUSetUniqueRespIdTable; alternatively, if the ECU Name is known, CP_J1939SourceName could be set via PDUSetUniqueRespIdTable

I.5.3 Case 1: Receiving active DTC from DM1 PGN 65226 (0xFECA)

a) This would be a receive only ComPrimitive with expected response filters set as below:

   — 0xFF 0xFF 0x01 (mask)

   — 0xCA 0xFE 0x00 (pattern)

b) Where the expected response filter bytes are defined as below

   — Byte 0 = PDU Specific field (PS)

   — Byte 1 = PDU Format field (PF)

   — Byte 2 = Data Page field (DP)

   — Byte 3 = first byte of CAN data

c) Since the UNIQUE_ID ComParams (CP_J1939SourceAddress and/or CP_J1939SourceName) contain the source address for the ECU (possibly derived from a NAME claim) this ComPrimitive will receive only the DM1 messages from the engine ECU.

d) The data in PDU_RESULT_DATA will be sent to the application in the following format:

   *pDataBytes = 0xCA, 0xFE, 0x00, followed by 8 bytes of data (if only one DTC was received). See J1939-73 description for PGN 65226.

   *pExtraInfo->pHeaderBytes = 0x18 0xFE 0xCA 0x01 which is the CAN ID of the active DTC message.

I.5.4 Case 2 Receive PGN 65264 (0xfef0) – ECU Data

This use case describes how to receive ECU data such as Engine PTO Accelerate Switch

a) This would be a receive only ComPrimitive with expected response filters set as below:

   — 0xFF 0xFF 0xFF (mask)

   — 0xF0 0xFE 0x00 (pattern)

b) Where the expected response filter bytes are defined as below

— Byte 0 = PDU Specific field (PS)

— Byte 1 = PDU Format field (PF)

— Byte 2 = Data Page field

— Byte 3 = first byte of CAN data

c) Since the UNIQUE_ID ComParams (CP_J1939SourceAddress and/or CP_J1939SourceName) contain the source address for the ECU (possibly derived from a NAME claim) this ComPrimitive will receive only the PGN 65264 messages from the engine ECU.

d) The data in PDU_RESULT_DATA will be sent to the application in the following format:

*pDataBytes = 0xF0 0xFE 0x00 followed by 8 bytes of data. See J1939-71 description for PGN 65264

I.5.5 Case 3 Request previously active DTC PGN 65227 (0xFECB)

a) This would be a send/receive ComPrimitive with the following data payload sent via PGN 59904 which is set up in the ComParams via CP_J1939PDUFormat:

— PDUStartComPrimitive payload data = 0xCB 0xFE 0x00 (three bytes)

b) The message on the CAN bus would be as shown below:

— DM2: CAN ID is 0x18EA0181, data is 0xCB 0xFE 0x00

NOTE The PS field of the CAN ID would contain the source address of the ECU (either derived from a NAME claim, using CP_J1939TargetName, or from CP_J1939TargetAddress) that the command is being sent to. In this case it is 0x01, but it could be a different value for another ECU.

c) The expected response filters will be set as shown below:

— 0xFF 0xFF 0x01 (mask) -> (for positive response)

— 0xCB 0xFE 0x00 (pattern)

— 0xFF 0xFF 0x00 (mask) -> (ACK PGN 59392 used for a negative response)

— 0x00 0xE8 0x00 (pattern)

d) Where the expected response filter bytes are defined as below

— Byte 0 = PDU Specific field (PS)

— Byte 1 = PDU Format field (PF)

— Byte 2 = Data Page field

— Byte 3 = first byte of CAN data

e) On the CAN bus a positive response would be as shown below:

— CAN ID = 0x18FECB01 with 8 bytes of inactive DTC information (1 DTC for simplicity)

— *pDataBytes = 0xCB 0xFE 0x00 followed by 8 bytes of DTC information. See J1939-73 for description of PGN 65227.

f) On the CAN bus the negative response would be as shown below:

— ECU Negative RESPONSE: (this uses ACK PGN 59392)

— CAN ID = 0x18E8FF01 CAN data is 0x01 0xFF 0xFF 0xFF 0xFF 0xCB 0xFE 0x00

— *pDataBytes = 0x00 0xE8 0x00 followed by the 8 bytes of negative response information 0x01 0xFF 0xFF 0xFF 0xCB 0xFE 0x00

I.5.6 Case 4 Read VIN PGN 65260 (0xFEEC)

a) This would be a send/receive ComPrimitive with the following data payload sent via PGN 59904 which is set up in the ComParams via CP_J1939PDUFormat and:

— PDUStartComPrimitive payload data = 0xEC 0xFE 0x00 (three bytes)

b) The message on the CAN bus would be as shown below:

— CAN ID is 0x18EA0181 data is 0xEC 0xFE 0x00

NOTE The PS field of the CAN ID would contain the source address of the ECU (either derived from a NAME claim, using CP_J1939TargetName, or from CP_J1939TargetAddress) that the command is being sent to. In this case it is 0x01, but could be a different value for another ECU.

c) The expected response filters will be set as shown below.

— 0xFF 0xFF 0x00 (mask) -> (for positive response)

— 0xEC 0xFE 0x00 (pattern)

— 0xFF 0xFF 0x00 (mask) -> (ACK PGN 59392 used for a negative response)

— 0x00 0xE8 0x00 (pattern)

d) On the CAN bus a positive response would be as shown below. This response will be sent using either BAM or RTS/CTS since the response will have more than 8 bytes of data.

— ECU positive RESPONSE:

— For the first frame of the multi-packet message, theCAN ID = 0x18EC8101 and the CAN data is 0x10, 0x00, 0x11, 0x03, 0xFF, 0xEC, 0xFE, 0x00 where the last three bytes are the PGN of the multi-packed response. The VIN data will follow in subsequent frames per J1939-21.

— *pDataBytes = 0xEC 0xFE 0x00 V1 V2 … V17, where V1 thru V17 are the VIN digits recorded in the ECU.

— *pExtraInfo->pHeaderBytes = 0x18 0xEC 0x81 0x01 which is the CAN ID of the connection mode request to send (TP.CM_RTS). See J1939-21 for a detailed description of the RTS/CTS transfer process.

e) On the CAN bus the negative response would be as shown below:

— ECU Negative RESPONSE: (this uses ACK PGN 59392)

— CAN ID = 0x18E8FF01 CAN data is 0x01 0xFF 0xFF 0xFF 0xFF 0xEC 0xFE 0x00

— *pDataBytes = 0x00 0xE8 0x00 followed by the 8 bytes of negative response information 0x01 0xFF 0xFF 0xFF 0xEC 0xFE 0x00

I.5.7 Case 5 Clear specific DTC (DM22) PGN 49920 (0xC300)

a) This would be a send/receive ComPrimitive that is NOT sent via PGN 59904. For this case a separate CLL is required or CP_J1939PDUFormat must be modified to 0xc3. The data payload would be as defined in J1939-73 section 5.7.22.

b) The message on the CAN bus would be as shown below:

— DM22: CAN ID is 0x18C30181 data is 0x01 0xFF 0x?? 0x?? 0x?? 0x?? 0x?? 0x??

NOTE The PS field of the CAN ID would contain the source address of the ECU (either derived from a NAME claim, using CP_J1939TargetName, or from CP_J1939TargetAddress) that the command is being sent to. In this case it is 0x01, but could be a different value for another ECU.

c) The expected response filters will be set as shown below. Note that in this case the first byte of the data payload is being used to discriminate between the positive and negative response. In this case, the PS field of the CAN Id in the response will be set to the ECU ID of the requesting device (the tester) which in this case is equal to 0x81. However, the PGN returned in the pDataBytes is the DM22 PGN, which is 0xC300.

— 0xFF 0xFF 0x00 0xFF (mask) -> (for positive response)

— 0x00 0xC3 0x00 0x02 (pattern)

— 0xFF 0xFF 0x00 0xFF (mask) -> (for a negative response)

— 0x00 0xC3 0x00 0x03 (pattern)

d) On the CAN bus a positive response would be as shown below:

— CAN ID = 0x18C38101 CAN data is 0x02 0xFF 0x?? 0x?? 0x?? 0x?? 0x?? 0x??

— *pDataBytes = 0x00 0xC3 0x00 0x02 followed by the remaining 7 bytes of information from PGN 49920. See J1939-73 for more information on the data format.

e) On the CAN bus the negative response would be as shown below:

— CAN ID = 0x18C38101 CAN data is 0x03 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x??

— *pDataBytes = 0x00 0xC3 0x00 0x03 followed by the remaining 7 bytes of information from the DM22 PGN 49920. See J1939-73 for more information on the data format.

I.5.8 Case 6 Read VIN in raw mode PGN 65260 (0xFEEC)

a) This would be a send/receive ComPrimitive with the following data payload sent via PGN 59904 which is set up entirely in the payload data of PduStartComPrimitive. In addition, the result data in *pDataBytes will now contain the CAN ID in bytes 0 thru 3. The PGN of the message will be in bytes 4 thru 6 for all received messages regardless of data size. This will provide the application with a consistent point to filter on the received PGN. The PDU API will be responsible for the segmentation and reassembly of messages with data greater than 8 bytes.

— PDUStartComPrimitive payload data = 0x18 0xEA 0x01 0x81 0xEC 0xFE 0x00 (seven bytes)

b) The message on the CAN bus would be as shown below:

— CAN ID is 0x18EA0181 data is 0xEC 0xFE 0x00

c) The expected response filters will be set as shown below.

— 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 (mask) -> (for positive response)

— 0x00 0x00 0x00 0x00 0xEC 0xFE 0x00 (pattern)

— 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 (mask) -> (ACK PGN 59392 used for a negative response)

— 0x00 0x00 0x00 0x00 0x00 0xE8 0x00 (pattern)

d) On the CAN bus a positive response would be as shown below. This response will be sent using either BAM or RTS/CTS since the response will have more than 8 bytes of data.

— ECU positive RESPONSE:

— For the first frame of the multi-packet message, if sent via RTS/CTS, the CAN ID = 0x18EC8101 and the CAN data is 0x10, 0x11, 0x00, 0x03, 0xFF, 0xEC, 0xFE, 0x00 where the last three bytes are the PGN of the multi-packed response. The VIN data will follow in subsequent frames per J1939-21. The CAN ID of the first frame will be placed in *pDataBytes.

— *pDataBytes = 0x18 0xEC 0x81 0x01 0xEC 0xFE 0x00 V1 V2 … V17, where V1 thru V17 are the VIN digits recorded in the ECU.

NOTE The PF field of (second byte) of the CAN ID is 0xEC which is part of PGN 60416, the connection management PGN. The PS field of PGN 65260 (0xFEEC) is coincidentally also 0xEC. These fields should not be confused.

e) On the CAN bus the negative response would be as shown below:

— ECU Negative RESPONSE: (this uses ACK PGN 59392)

— CAN ID = 0x18E8FF01 CAN data is 0x01 0xFF 0xFF 0xFF 0xFF 0xEC 0xFE 0x00

— *pDataBytes = 0x18 0xE8 0xFF 0x01 0x00, 0xE8, 0x00 followed by the 8 bytes of negative response information 0x01, 0xFF, 0xFF, 0xFF, 0xEC, 0xFE, 0x00

I.5.9 Case 7 Data Security in raw mode (DM18) PGN 54272 (0xD400)

a) This would be a send/receive ComPrimitive with the following data payload sent via PGN 54272. In this case, the data in PduStartComPrimitive would contain the CAN ID and the payload data, but since the data length is greater than 8 bytes the Protocol Handler transport layer will transform the message into BAM or RTS/CTS format based on CP_J1939TargetAddress. For this case, CP_J1939TargetAddress = 0x01 and the transport mode is RTS/CTS.

— PDUStartComPrimitive payload data = 0x18 0xD4 0x01 0x81 0x08 0x01 0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x88 (four bytes for CAN ID and ten data bytes)

b) The first message on the CAN bus would be as shown below:

— CAN ID is 0x18EC0181 data is 0x10 0x0A 0x00 0x02 0xFF 0x00 0xD4 0x00 (The connection mode request to send message, TP.CM.RTS)

This would be followed by the ECU sending the clear to send (TP.CM.RTS), the diagnostic tester sending the two data transfer messages (TP.DT), and finally by the ECU sending the acknowledge (TP.CM_EndOfMsgACK)

c) The expected response filters will be set as shown below.

— 0x00 0x00 0x00 0x00 0x00 0xFF 0x00 0x00 0x0E (mask) -> (Memory Access Response PGN 55296 used for positive response, status = proceed)

— 0x00 0x00 0x00 0x00 0x00 0xD8 0x00 0x00 0x00 (pattern)

— 0x00 0x00 0x00 0x00 0x00 0xFF 0x00 0x00 0x0E (mask) -> (Memory Access Response PGN 55296 used for a negative response, status = operation failed)

— 0x00 0x00 0x00 0x00 0x00 0xD8 0x00 0x00 0x0A(pattern)

d) The result data for both the positive and negative responses would be as shown below.

— *pDataBytes = 0x18 0xD8 0x81 0x01 0x00 0xD8 0x00 followed by the eight bytes of memory access response data.

I.6 Multiple clients use cases

I.6.1 Definition

The D-PDU API is “multiple clients capable”, meaning that the D-PDU API enables multiple independent clients to communicate at the same time, with different ECUs, through the same MVCI protocol module.

NOTE “Independent” clients are those that do not coordinate themselves.

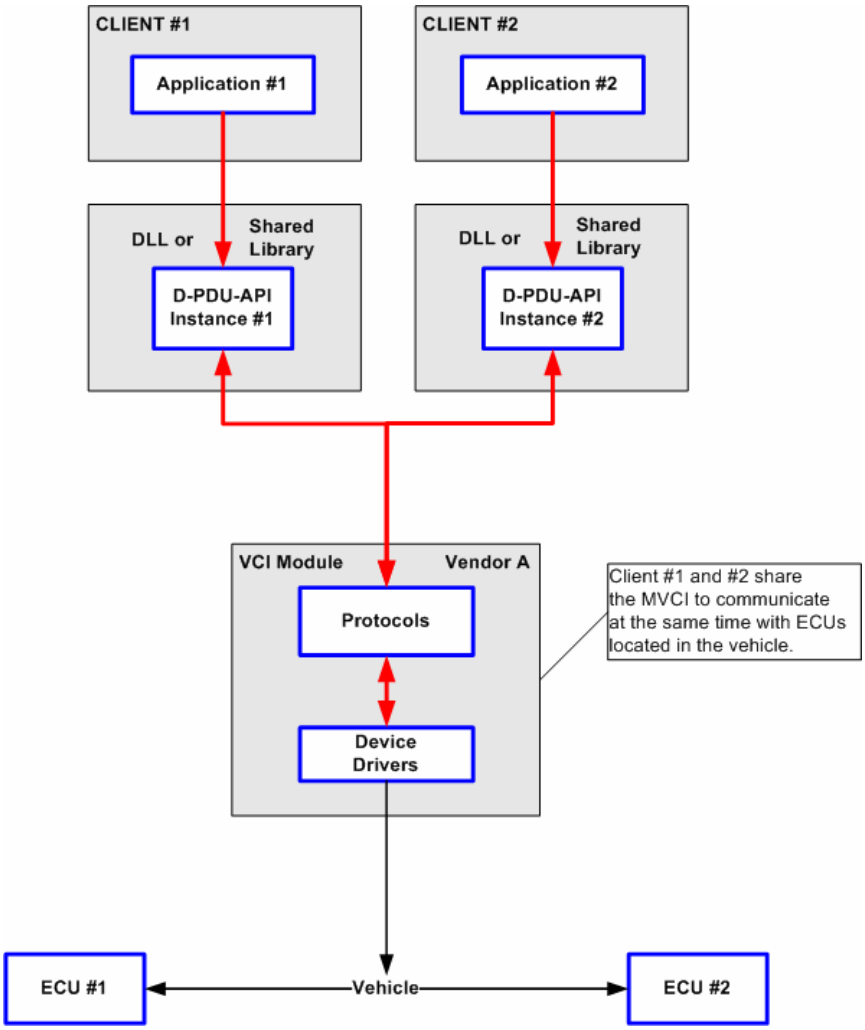


Figure I.14 — Sharing a MVCI by multiple clients

The ability of the MVCI protocol module to support multiple clients is vendor specific.

I.6.2 Multiple clients configurations

I.6.2.1 General

This subclause presents three possible multiple clients use cases:

a) MVCI used by two processes in two separate hosts,

b) MVCI used by two processes in a single host,

c) MVCI used by two independent threads in a single process.

I.6.2.2 Case #1: MVCI used by two processes in two separate hosts

It is the case where two applications physically located in two different hosts use the same MVCI to communicate.

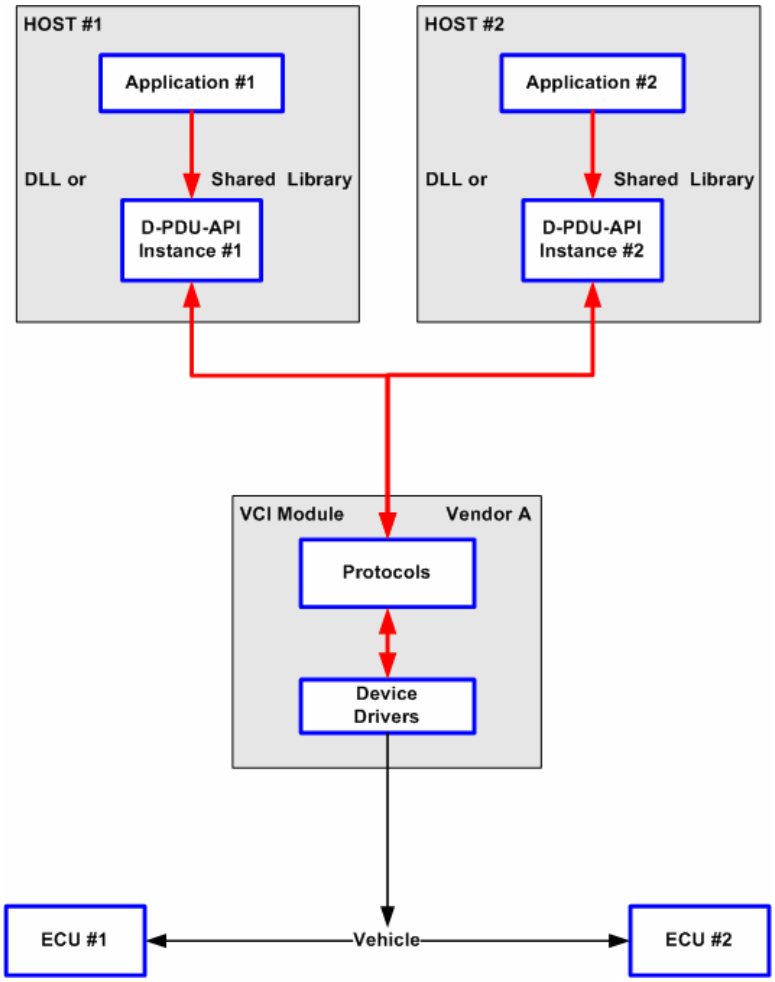


Figure I.15 — MVCI used by two processes in two separate hosts

I.6.2.3 Case #2: MVCI used by two processes in a single host

It is the case where two applications located in the same host use the same MVCI to communicate.

The API is loaded two times in memory (two instances of the DLL).

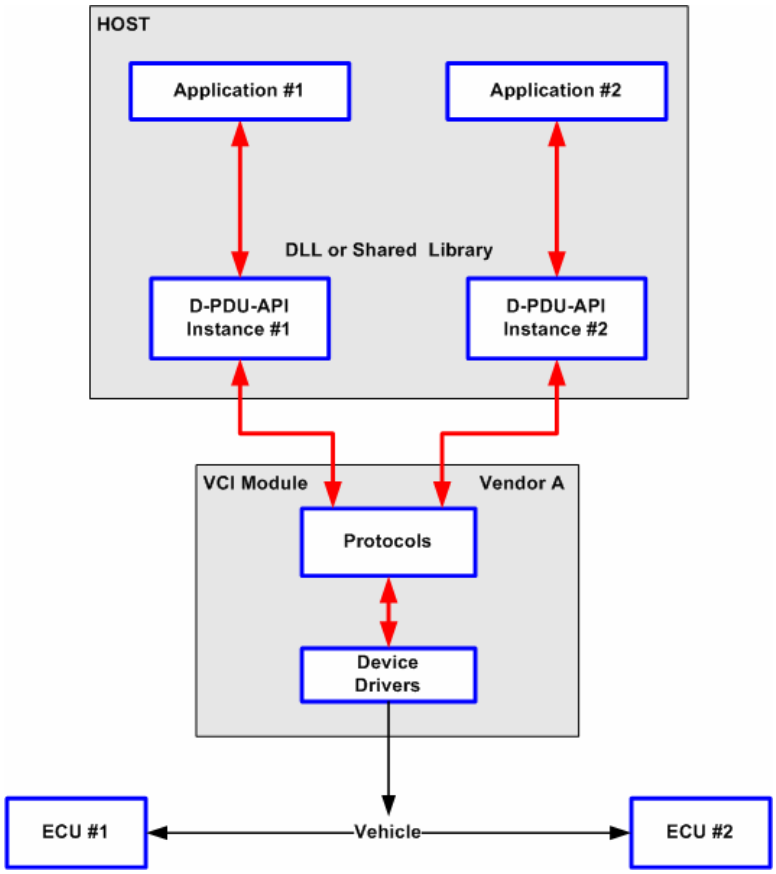


Figure I.16 — MVCI used by two processes in a single host

I.6.2.4 Case #3: MVCI used by two independent threads in a single process

It is the case where one application creates two independent tasks that use the same MVCI to communicate.

The API is loaded only one time in memory.

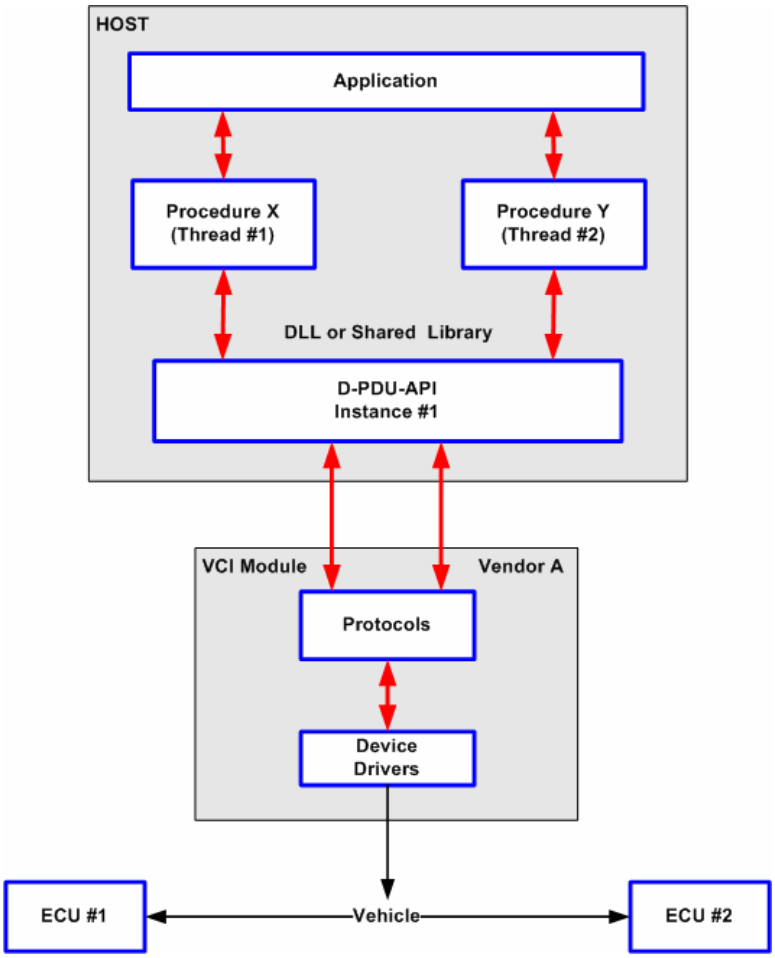


Figure I.17 — MVCI used by two independent threads in a single process

For case #3, the following restrictions have to be taken into account:

a) Only one PDUConstruct call can be made to the D-PDU API instance,

b) Only one PDUDestruct call can be made to the D-PDU API instance,

c) Only one callback can be registered per object (System, Modules and CLLs).

Then, Procedures X and Y cannot be completely independent.

I.6.3 Example scenarios

EXAMPLE 1 The MVCI protocol module supports two communication sessions.

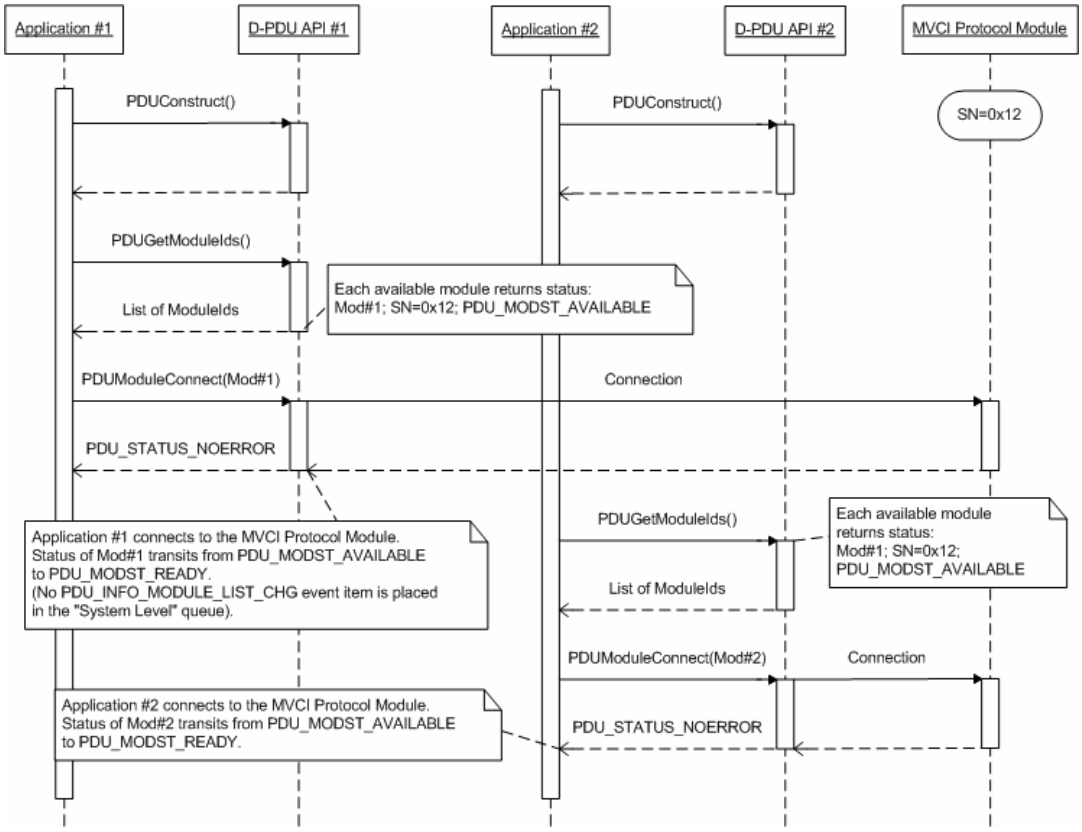


Figure I.18 — MVCI protocol module supporting two communication sessions

EXAMPLE 2 The MVCI protocol module accepts only one communication session.

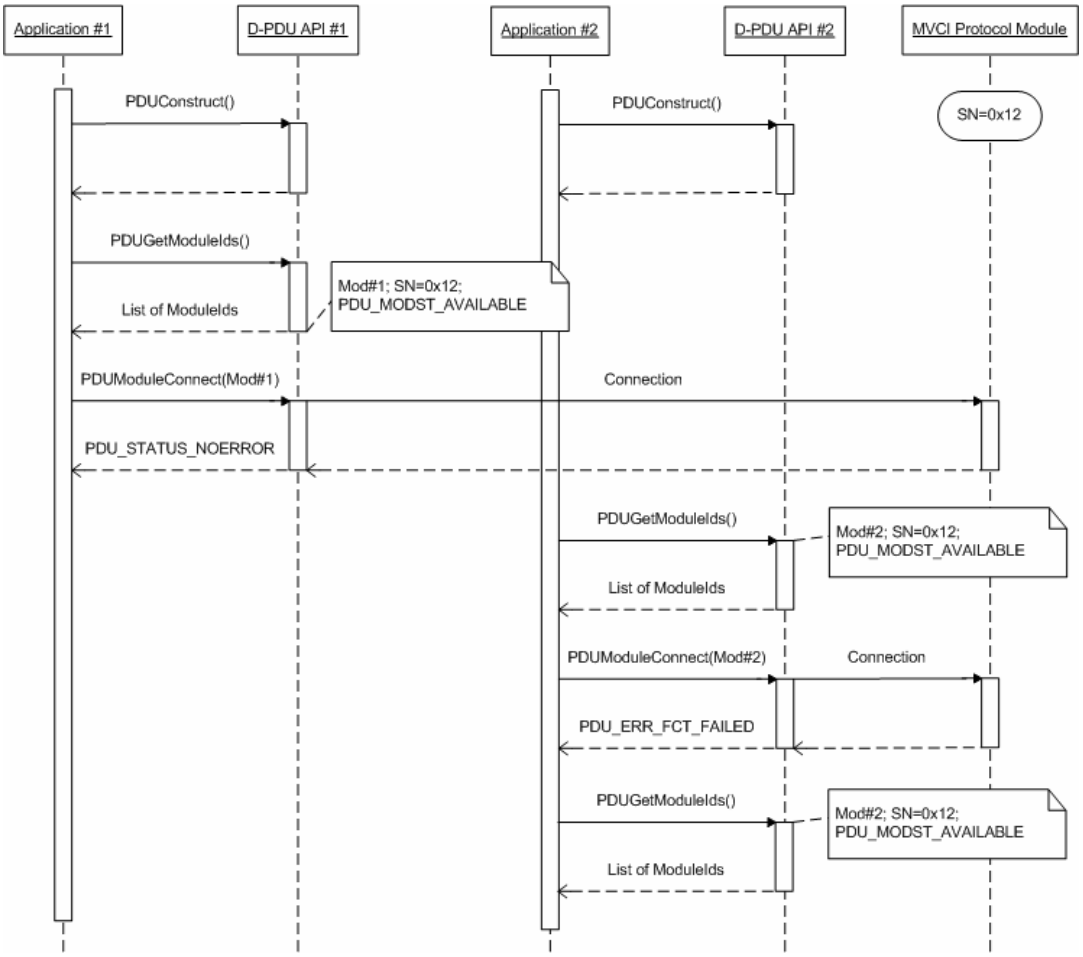


Figure I.19 — MVCI protocol module accepting only one communication session

Annex J
(normative)

OBD protocol initialization

J.1 OBD application

J.1.1 OBD concept

An OBD application is responsible for performing an automatic hands-off determination of the communication interface used to provide OBD services on the vehicle. The following list of protocols is supported by an OBD application:

— ISO 9141-2

— SAE J1850 41,6 kbps PWM (pulse width modulation)

— SAE J1850 10,4 kbps VPW (variable pulse width)

— ISO 14230-4 (Keyword protocol 2000)

— ISO 15765-4 (CAN)

— SAE J1939-73 (CAN)

J.1.2 Automatic OBD protocol determination

J.1.2.1 OBD protocol determination concept

The OBD application shall have an “automatic hands-off determination of the communication interface” built-in to determine the communication protocol used on a given vehicle.

The tests to determine the communication interface and protocol may be performed in any order and, where possible, may be performed simultaneously (i.e. automatic protocol determination can use multiple ComLogicalLinks).

The MVCI protocol module shall not cause bus failures such as CAN bus off.

J.1.2.2 OBD protocol determination using the D-PDU API

a) The OBD application carries out the initialization by opening the predefined com logical links to scan the communication interface and protocol in a convenient sequence, or simultaneously where possible. The application tries to start communication on each logical link and checks for success.

b) Certain parts of the initialization sequence are internally supported by the D-PDU API.

   — Automatic determination of ISO 14230-4 or ISO 9141-2 protocol during a 5-Baud Initialization.

   — CAN baud rate detection.

— SAE_J1850 determination. Either a SAE J1850 PWM or a SAE J1850 VPW link can be supported on a vehicle. The D-PDU API supports an internal algorithm to determine which SAE J1850 protocol is being used on a vehicle.

c) If the MVCI protocol module is not fully OBD-compliant, the initialization procedure will receive an error when trying to open a com logical link on a resource which is unknown to the D-PDU API, and therefore not contained in the MDF file. So the OBD application is able to inform the user about the incomplete OBD-compliance.

J.1.3 Simultaneous protocol scan sequence using the D-PDU API

J.1.3.1 General

To achieve the best performance, the OBD application may run three scan sequences in parallel:

— Scan Sequence on SAE J1850 (PWM and VPW)

— Scan Sequence on K-Line (ISO 9141-2 and ISO 14230)

— Scan Sequence on CAN (ISO 15765 and SAE J1939)

The following applies:

a) In each sequence one or more com logical links are opened for scanning (PDUCreateComLogicalLink).

b) The Unique Response Identifier table is configured for all possible OBD responses (PDUSetUniqueRespIdTable).

c) Send a Start Comm Message for each com logical link (usually a mode 0x01 PID 0x00) (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

d) If scanning succeeded on one of the com logical links, the OBD application uses this com logical link for all future OBD diagnostic procedures.

e) The OBD application can then close the other com logical links that did not succeed (PDUDestroyComLogicalLink).

f) The details of each scan sequence are described in the following subclauses.

J.1.3.2 OBD SAE J1850 protocol determination

J.1.3.2.1 General D-PDU API information on OBD SAE J1850 protocol

There are 2 possible bus types for the D-PDU API protocol “ISO OBD on SAE J1850”. Table J.1 — SAE J1850 OBD protocol defaults describes the default differences between the protocols.

Table J.1 — SAE J1850 OBD protocol defaults

	SAE J1850 PWM (Pulse Width Modulation)	SAE J1850 VPW (Variable Pulse Width)
BusType	**SAE_J1850_PWM**	**SAE_J1850_VPW**
Default ComParams		
CP_Baudrate	41600	10400
CP_Networkline	0 (BUS_NORMAL)	n/a
CP_RequestAddrMode	2 (Functional)	2 (Functional)
CP_HeaderFormatJ1850	3 (3 byte header)	3 (3 byte header)
CP_FuncReqFormatPriorityType	0x61	0x68
CP_FuncReqTargetAddr	0x6A	0x6A
CP_TesterSourceAddress	0xF1	0xF1
Default URID Table (id set to PDU_ID_UNDEF)		
CP_EcuRespSourceAddress	Variable per ECU on the bus (initial = 0xFF (invalid id))	Variable per ECU on the bus (initial = 0xFF (invalid id))
CP_FuncRespFormatPriorityType	0x41	0x48
CP_FuncRespTargetAddr	0x6B	0x6B
CP_PhysReqFormatPriorityType	n/a	n/a
CP_PhysReqTargetAddr	n/a	n/a
CP_PhysRespFormatPriorityType	n/a	n/a

The D-PDU API supports the protocol “ISO OBD on SAE J1850” which has combined both the SAE J1850 VPW and SAE J1850 PWM protocols into a single protocol id. The reason for this is that the SAE J1850 protocols share a common pin and cannot be tested for simultaneously on two different ComLogicalLinks. The application shall run a two-step scan sequence to determine the bus type (PWM or VPW), using two ComLogicalLinks differing by bus type.

J.1.3.2.2 OBD SAE J1850 VPW scan sequence

Scan for protocol SAE J1850 VPW OBD support on the vehicle:

a) Open a ComLogicalLink for protocol “ISO_OBD_on_SAE_J1850”, and bus type “SAE_J1850_VPW”. Pins selected should be DLC pin 2 (PDUCreateComLogicalLink and PDUConnect).

b) Set ComParams:

   — CP_Baudrate = 10400,

   — CP_FuncReqFormatPriorityType = 0x68,

   — CP_FuncRespFormatPriorityType = 0x48.

c) Prepare and execute a start communication primitive.

   — Set the PDU data to service 0x01 PID 0x00. (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

   — Set the expected response for any ECU responding with a pattern 0x41 0x00.

— Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the initialization service.

d) A positive response indicates successful initialization. Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

J.1.3.2.3 OBD SAE J1850 PWM scan sequence

Scan for protocol SAE J1850 PWM OBD support on the vehicle:

a) Open a ComLogicalLink for protocol “ISO_OBD_on_SAE_J1850” and bus type “SAE_J1850_PWM”. Pins selected should be DLC pins 2 and 10 (PDUCreateComLogicalLink and PDUConnect).

b) Set ComParams:

— CP_Baudrate = 41600,

— CP_FuncReqFormatPriorityType = 0x61,

— CP_FuncRespFormatPriorityType = 0x41.

c) Prepare and execute a start communication primitive.

— Set the PDU data to service 0x01 PID 0x00. (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

— Set the expected response for any ECU responding with a pattern 0x41 0x00.

— Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the initialization service.

d) A positive response indicates successful initialization. Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

J.1.3.3 OBD ISO K-Line protocol determination

J.1.3.3.1 General D-PDU API information on OBD ISO K-Line protocol

There are two logical links for protocol “ISO OBD on K-Line”. These logical links are used to scan with either fast initialization or with 5 baud initialization.

During a 5 baud initialization sequence the keybytes of the protocol are returned to the tester. From these keybytes, the tester can determine whether the vehicle supports the ISO 9141-2 protocol or the ISO 14230-4 protocol.

Table J.2 — K-Line OBD protocol defaults describes the default differences between the protocols:

Table J.2 — K-Line OBD protocol defaults

	ISO 9141-2	ISO 14230-4
BusType	**ISO_9141_2_UART**	**ISO_14230_1_UART**
Default ComParams		
CP_Baudrate	10400	10400
CP_5BaudAddressFunc	0x33	0x33
CP_5BaudMode	0 (OBD Init)	0 (OBD Init)
CP_InitializationSettings	1 (5 Baud Init)	First -> 2 (fast init) Second -> 1 (5 Baud init)
CP_RequestAddrMode	2 (Functional)	2 (Functional)
CP_HeaderFormatKW	4 (3 byte header always)	4 (3 byte header always)
CP_FuncReqFormatPriorityType	0x68	0xC0
CP_FuncReqTargetAddr	0x6A	0x33
CP_TesterSourceAddress	0xF1	0xF1
Default URID Table (id set to PDU_ID_UNDEF)		
CP_EcuRespSourceAddress	Variable per ECU on the bus (initial = 0xFF (invalid id))	Variable per ECU on the bus (initial = 0xFF (invalid id))
CP_FuncRespFormatPriorityType	0x48	0x80
CP_FuncRespTargetAddr	0x6B	n/a = TesterSourceAddress
CP_PhysReqFormatPriorityType	n/a	n/a
CP_PhysReqTargetAddr	n/a	n/a
CP_PhysRespFormatPriorityType	n/a	n/a

The D-PDU API supports the protocol “ISO OBD on K Line” which has combined both the ISO 9141-2 and ISO 14230-4 protocols into a single protocol id. The reason for this is that the protocols are on a common pin and cannot be tested for simultaneously on two different ComLogicalLinks. It is more efficient for the D-PDU API to determine the correct K-Line protocol being supported by the vehicle by doing the test in sequence.

The OBD application should first attempt a fast initialization on the K-Line followed by a 5 baud initialization.

During a 5 baud initialization, the D-PDU API will internally determine the correct protocol supported by the vehicle, by examining the keybytes returned.

Keybytes specified by OBD:

— 0x08, 0x08 /* ISO 9141-2

— 0x94, 0x94 /* ISO 9141-2

— 0x8F, 0xE9 /* ISO 14230-4

— 0x8F, 0x6B /* ISO 14230-4

— 0x8F, 0x6D /* ISO 14230-4

— 0x8F, 0xEF /* ISO 14230-4

NOTE ComParam CP_P2max is set to 25 000 (25 ms) for fast init, and to 0 (0 ms) for 5 Baud Init.

J.1.3.3.2 OBD ISO K-Line scan sequence (fast init)

a) Open a ComLogicalLink for protocol “ISO_OBD_on_K_Line”. Pins selected should be DLC pins 7 (K-line) and 15 (L-line) (PDUCreateComLogicalLink and PDUConnect).

b) Set ComParam CP_InitializationSettings to 2 (fast init).

c) Start Communications. Set the PDU data to service 0x81. (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

   — Set a positive expected response for any ECU responding with a pattern 0xC1.

   — Set a negative expected response for any ECU responding with a pattern 0x7F 0x81.

   — Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the initialization service.

d) A positive response indicates successful initialization. Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

e) Set the URID table for all ECU's which have responded. (PDUGetUniqueRespIdTable and PDUSetUniqueRespIdTable). Note: it is possible for the application to determine which protocol is being supported on the vehicle by reading the CP_FuncRespFormatPriorityType byte in the URID table (i.e. ISO 9141-2= 0x48 and ISO 14230-4 = 0x80).

J.1.3.3.3 ISO 14230-4 protocol defined key bytes

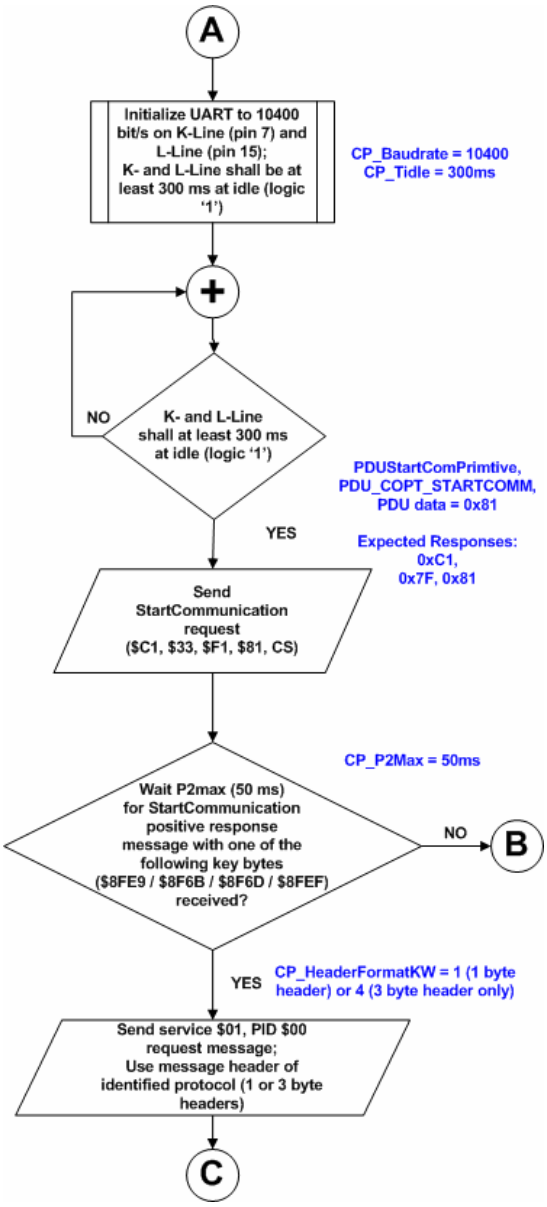
Table J.3 — ISO 14230-4 key bytes specifies the key bytes to be supported by the external test equipment for the ISO 14230-4 protocol.

Table J.3 — ISO 14230-4 key bytes

Key byte #2 High Byte	Key byte #1 Low Byte	Description	Normal timing
0x8F	0xE9	Key byte = 202510: 3 byte header including target and source address	P1 = 0 – 20 ms P2 = 25 – 50 ms P3 = 55 – 5 000 ms P4 = 0 – 20 ms
0x8F	0x6B	Key byte = 202710: 3 byte header including target and source address, with or without additional length byte	
0x8F	0x6D	Key byte = 202910: 1 byte header or 3 byte header including target and source address	
0x8F	0xEF	Key byte = 203110: 1 byte header or 3 byte header including target and source address, with or without additional length byte	

J.1.3.3.4 OBD K-line protocol fast initialization flow chart

Figure J.1 — K-Line fast initialization sequence shows the fast initialization flow chart to be used for an OBD Init for ISO 14230-4 protocol.



Key

A start fast initialization

B protocol is not ISO 14230-4 with fast initialization support

C protocol is ISO 14230-4 with fast initialization support

Figure J.1 — K-Line fast initialization sequence

J.1.3.3.5 OBD ISO K-Line scan sequence (5 baud init)

a) Open a ComLogicalLink for protocol “ISO_OBD_on_K_Line”. Pins selected should be DLC pins 7 (K-line) and 15 (L-line) (PDUCreateComLogicalLink and PDUConnect).

b) Set ComParam CP_InitializationSettings to 1 (5 baud init).

c) Start Communications with 5 baud initialization (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

— Set a positive expected response for any ECU responding with a pattern 0x41, 0x00.

— Set a negative expected response for any ECU responding with a pattern 0x7F 0x01.

— Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the service.

— Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table

d) When a positive init sequence has been completed, D-PDU API Protocol handler will determine the correct transport layer based on the key bytes returned by the ECU (i.e. a KWP2000 TP layer or an ISO 9141 TP layer).

e) Start PDUStartComPrimitive of type PDU COPT SENDRECV. Set the PDU data to service 0x01 PID 0x00 (supported PIDs request):

— Set a positive expected response for any ECU responding with a pattern 0x41, 0x00.

— Set a negative expected response for any ECU responding with a pattern 0x7F 0x01.

— Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the service.

— Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

f) Set the URID table for all ECU's which have responded (PDUGetUniqueRespIdTable and PDUSetUniqueRespIdTable).

NOTE It is possible for the application to determine which protocol is being supported on the vehicle by reading the CP_FuncRespFormatPriorityType byte in the URID table (i.e. ISO 9141-2 = 0x48 and ISO 14230-4 = 0x80).

J.1.3.3.6 ISO 9141-2 protocol defined key bytes

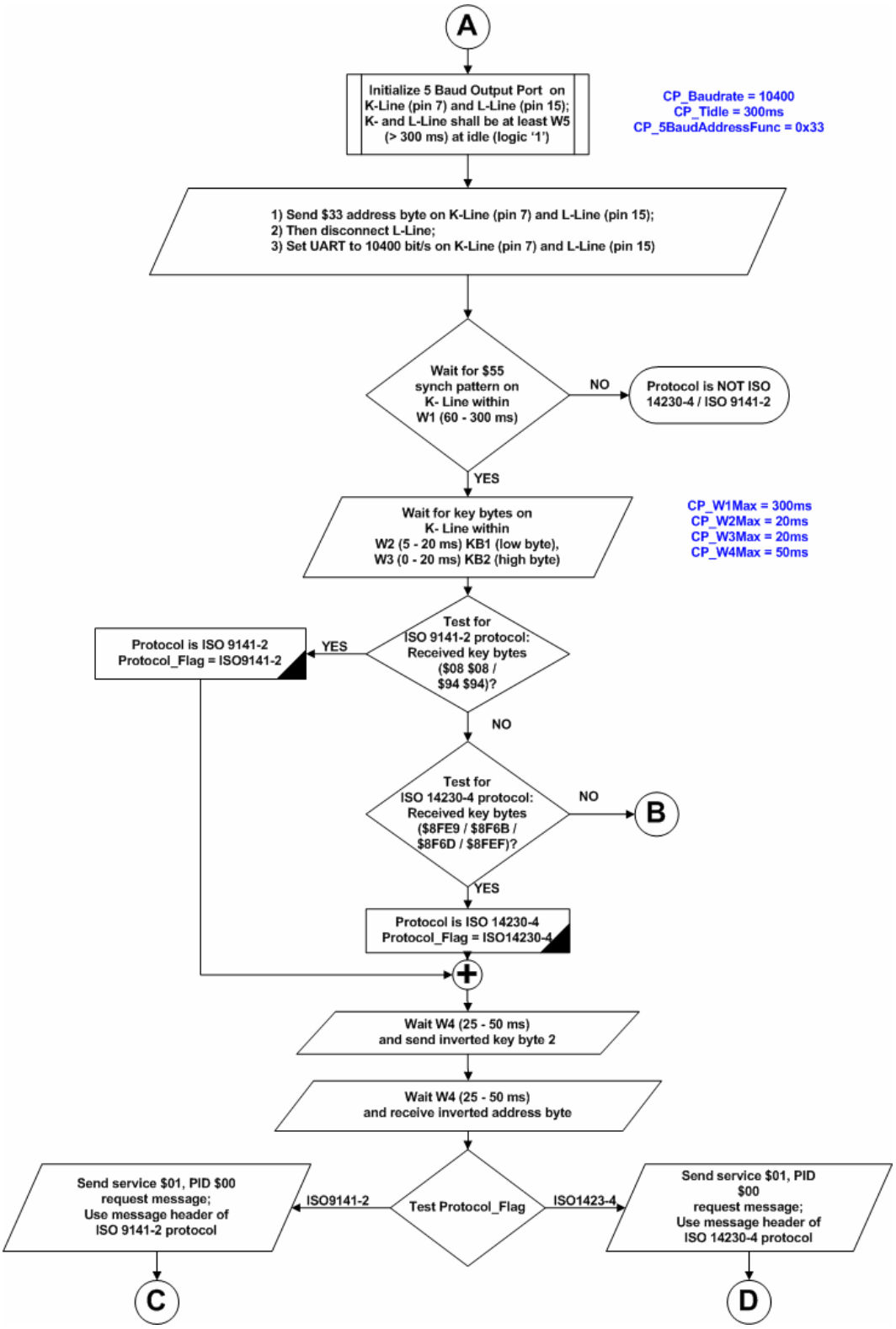
Table J.4 — ISO 9141-2 key bytes specifies the key bytes to be supported by the external test equipment.

Table J.4 — ISO 9141-2 key bytes

Key byte #2 High Byte	Key byte #1 Low Byte	Description	Timing parameter
0x08	0x08	Key byte = 103210: this key byte informs the external test equipment that the server(s)/ECU(s) shall wait at least P2min = 25 ms when sending a response message	P1 = 0 – 20 ms P2 = 25 – 50 ms P3 = 55 – 5 000 ms P4 = 0 – 20 ms
0x94	0x94	Key byte = 258010: this key byte informs the external test equipment that the server(s)/ECU(s) may send the response message immediately (P2min = 0 ms) after receiving a request message	P1 = 0 – 20 ms P2 = 0 – 50 ms P3 = 55 – 5 000 ms P4 = 0 – 20 ms

J.1.3.3.7 OBD ISO K-Line protocol 5 baud initialization flow chart

Figure J.2 — K-Line 5 baud initialization sequence shows the initialization flow chart to be used for a 5 baud OBD Init for K-Line protocols.



Key

A start 5 Baud initialization with 0x33 address

B protocol is NOT ISO 14230-4 with 5 Baud initialization support

C protocol is ISO 9141-2 initialized with 5 Baud

D protocol is ISO 14230-4 initialized with 5 Baud

Figure J.2 — K-Line 5 baud initialization sequence

J.1.3.4 OBD CAN protocol determination

J.1.3.4.1 General D-PDU API information on OBD CAN protocol

There are 2 possible CAN ID size configurations for protocol “ISO OBD on CAN” (11-bit and 29-bit). The D-PDU API protocol handler may optionally first “listen” to the bus (i.e. if the CAN controller hardware supports the feature and the vehicle bus is active) to determine the correct baud rate and bit configuration prior to transmitting the start communication message.

The parameter CP_CanBaudrateRecord shall be used to specify the type of initialization to be performed. If the CP_CanBaudrateRecord parameter contains a single baud rate, then a single baud rate initialization sequence shall be performed using the specified single baud rate (e.g. 500 kBit/s). If the CP_CanBaudrateRecord parameter contains multiple baud rates, then a multiple baud rate initialization sequence including a baud rate detection procedure shall be performed using the specified multiple baud rates (e.g. 250 kBit/s and 500 kBit/s).

NOTE If CP_CanBaudrateRecord has no entries, then the CP_Baudrate parameter will be used. Table J.5 — Default ComParams for OBD on CAN describes the default setup for an ISO_OBD_on_ISO15765_4 for different CAN Id sizes.

Table J.5 — Default ComParams for OBD on CAN

	11–bit CAN Id size	**29-bit Can id Size**
BusType	**ISO_11898_2_DWCAN**	**ISO_11898_2_DWCAN**
Default ComParams		
CP_Baudrate	0	Set to known baud rate from 11-bit initialization sequence
CP_CanBaudrateRecord	500 000 bps, 250 000 bps	0
CP_RequestAddrMode	2 (Functional)	2 (Functional)
CP_CanFuncReqFormat	0x05	0x07
CP_CanFuncReqExtAddr	n/a	n/a
CP_CanFuncReqId	0x7DF	0x18DB33F1
Default URID Table 1 entry per valid OBD CAN Id (URID value set to PDU_ID_UNDEF)		
CP_CanPhysReqFormat	0x05	0x07
CP_CanPhysReqId	0x7E0	0x18DA10F1
CP_CanPhysReqExtAddr	n/a	n/a
CP_CanRespUSDTFormat	0x05	0x07
CP_CanRespUSDTId	0x7E8	0x18DAF110
CP_CanRespUSDTExtAddr	n/a	n/a
CP_CanRespUUDTFormat	n/a	n/a
CP_CanRespUUDTExtAddr	n/a	n/a
CP_CanRespUUDTId	n/a	n/a

Table J.6 — 11 bit legislated-OBD CAN identifiers

CAN identifier	Description
0x7DF	CAN identifier for functionally addressed request messages sent by external test equipment
0x7E0	Physical request CAN identifier from external test equipment to ECU #1
0x7E8	Physical response CAN identifier from ECU #1 to external test equipment
0x7E1	Physical request CAN identifier from external test equipment to ECU #2
0x7E9	Physical response CAN identifier from ECU #2 to external test equipment
0x7E2	Physical request CAN identifier from external test equipment to ECU #3
0x7EA	Physical response CAN identifier from ECU #3 to external test equipment
0x7E3	Physical request CAN identifier from external test equipment to ECU #4
0x7EB	Physical response CAN identifier ECU #4 to the external test equipment
0x7E4	Physical request CAN identifier from external test equipment to ECU #5
0x7EC	Physical response CAN identifier from ECU #5 to external test equipment
0x7E5	Physical request CAN identifier from external test equipment to ECU #6
0x7ED	Physical response CAN identifier from ECU #6 to external test equipment
0x7E6	Physical request CAN identifier from external test equipment to ECU #7
0x7EE	Physical response CAN identifier from ECU #7 to external test equipment
0x7E7	Physical request CAN identifier from external test equipment to ECU #8
0x7EF	Physical response CAN identifier from ECU #8 to external test equipment
While not required for current implementations, it is strongly recommended (and may be required by applicable legislation) that for future implementations the following 11-bit CAN identifier assignments be used: — 0x7E0/0x7E8 for ECM (engine control module); — 0x7E1/0x7E9 for TCM (transmission control module).	

Table J.7 — 29 bit legislated-OBD CAN identifiers

CAN identifier	Description
0x18 DB 33 F1	CAN identifier for functionally addressed request messages sent by external test equipment.
0x18 DA xx F1	Physical request CAN identifier from external test equipment to ECU #xx.
0x18 DA F1 xx	Physical response CAN identifier from ECU #xx to external test equipment.

The maximum number of legislated-OBD ECUs in a legislated-OBD-compliant vehicle shall not exceed eight (8). The physical ECU diagnostic address of an ECU (“xx” hex) embedded in the physical CAN identifiers shall be unique for a legislated-OBD ECU in a given vehicle.

J.1.3.4.2 OBD ISO CAN scan sequence

J.1.3.4.2.1 General

Open a ComLogicalLink for protocol “ISO_OBD_on_ISO_15765_4”. Pins selected should be DLC pins 6 and 14. (PDUCreateComLogicalLink and PDUConnect).

J.1.3.4.2.2 11-bit CAN ID

a) Set ComParams and Unique Response Identifier Table to 11-bit CAN Id settings. Setup BaudrateRecord ComParam for auto detection of the baud rate on the vehicle bus.

b) Set CP_TransmitIndEnable to enabled (1). This will allow a successful transmit on the CAN bus to generate a result item to the application indicating a correct baud rate has been detected. This baud rate value will be copied to CP_baudrate (see J.1.3.4.3).

c) Start Communications. Set the PDU data to service 0x01, 0x00 (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

   — Set a positive expected response for any ECU responding with a pattern 0x41.

   — Set a negative expected response for any ECU responding with a pattern 0x7F 0x01.

   — Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the initialization service.

d) A result item containing the Rx_Flag bit TX_INDICATION, indicates that the transmit completed successfully and therefore a correct baud rate has been detected.

e) A positive ECU response indicates not only a successful baud rate detection but also a successful CAN Id detection (11-bit). Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

f) Set the URID table for all ECU's which have responded (PDUGetUniqueRespIdTable and PDUSetUniqueRespIdTable).

g) If no positive ECU responses were received, continue with a 29-bit Can ID. The correct baud rate should already have been determined. Verify CP_Baudrate is non-zero.

J.1.3.4.2.3 29-bit CAN Id (ISO 15765-4)

a) 29-bit CAN Id is tried after an 11-bit Baud rate detection (see Figure J.3 — CAN baud rate detection flow chart (11-bit)).

b) Set ComParams and Unique Response Identifier Table to 29-bit CAN Id settings for ISO 15765-4.

c) Start Communications. Set the PDU data to service 0x01, 0x00 (PDUStartComPrimitive of type PDU_COPT_STARTCOMM).

   — Set a positive expected response for any ECU responding with a pattern 0x41.

   — Set a negative expected response for any ECU responding with a pattern 0x7F 0x01.

   — Enable the TxFlag ENABLE_EXTRA_INFO. Extra header byte information will be returned which can be used to determine all ECU source addresses which respond to the initialization service.

d) A positive response indicates successful initialization. Each response will contain the URID of PDU_ID_UNDEF until the application configures the URID Table.

e) Set the URID table for all ECU's which have responded (PDUGetUniqueRespIdTable and PDUSetUniqueRespIdTable).

J.1.3.4.3 OBD CAN baud rate detection

The transmit procedure given as follows shall guarantee that in all cases the external test equipment will detect that it uses the wrong baud rate for the transmission of the request message and will stop disturbing the CAN bus immediately. Under normal in-vehicle conditions (i.e. no error frames during in-vehicle communication when the external test equipment is disconnected), the external test equipment will disable its CAN interface prior to the situation where the internal error counters of the OBD ECU(s) reach critical values.

To achieve this, the external test equipment shall support the following features:

— Possibility to stop sending immediately during transmission of any CAN frame. The CAN interface should be disconnected within 12 µs from reception of a bus error signal. The maximum time for the disconnection is 100 µs. With the CAN interface disconnected, the external test equipment shall not be able to transmit dominant bits on the CAN bus.

— Possibility to immediately detect any error on the CAN bus.

Figure J.3 — CAN baud rate detection flow chart (11-bit) shows the baud rate detection flow chart to be used for an ISO OBD CAN Init.

a) The external test equipment shall set up its CAN interface using the first baud rate contained in the CP_CanBaudrateRecord. It shall use the CAN bit timing parameter values defined for this baud rate.

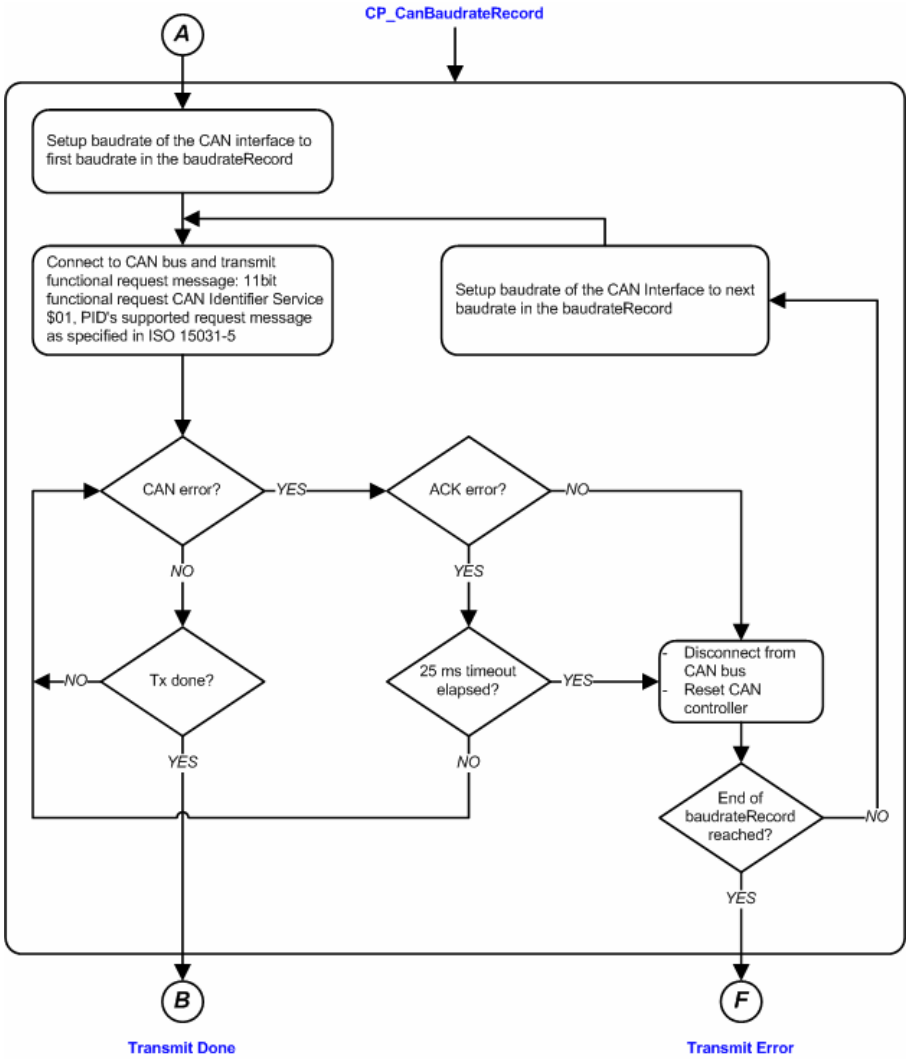
b) Following the CAN interface set-up, the external test equipment shall connect to the CAN bus and transmit a functionally addressed service 0x01 PID 0x00 request message (read-supported PIDs) using the legislated-OBD 11 bit functional request CAN identifier.

c) The external test equipment shall check for any CAN error. If the request message is transmitted onto the CAN bus, it shall indicate a successful transmission. See RxFlag bit TX_INDICATION, which indicates a successful transmission in the PDU_RESULT_DATA structure.

d) If an acknowledge check error is detected, then the external test equipment shall continue to retry the transmission of the request message until a 25 ms (N_As) timeout is reached.

e) If any other CAN error occurred, or an acknowledge check error occurred after the 25 ms timeout was reached, then the external test equipment shall disconnect its CAN interface from the CAN bus. With a disconnected CAN interface, the external test equipment shall not be able to transmit dominant bits on the CAN bus. It shall check whether more baud rates are contained in the CP_CanBaudrateRecord. If no further baud rate is contained in the CP_CanBaudrateRecord, it shall indicate that the request was not transmitted successfully.

f) If the end of the CP_CanBaudrateRecord is not reached, the external test equipment shall set up its CAN interface using the next baud rate in the CP_CanBaudrateRecord. Following the CAN interface set-up, the external test equipment shall connect to the CAN bus and transmit the request message once again [continue from b)].



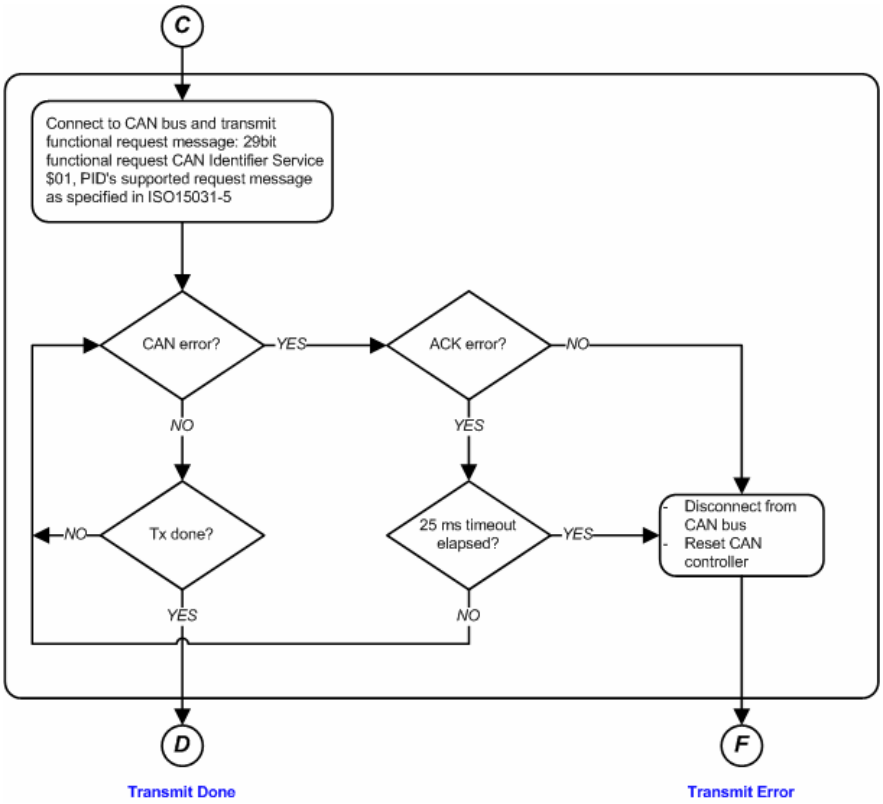
Key

A start an 11-bit baud rate detection

B baudrate detected (no Bus errors). If a response is received then the CAN Id is 11-bit.

F no baud rates in the baud rate record are valid

Figure J.3 — CAN baud rate detection flow chart (11-bit)



Key

C baudrate is known, but the 11-bit CAN ID request returned no responses. Try 29-bit Ids.

D if a response is received then the CAN ID is 29-bit

F incorrect baud rate being used

Figure J.4 — CAN 29-bit Id detection

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