TECHNICAL SPECIFICATION

ISO/TS 16058

First edition
2004-07-01

Health informatics — Interoperability of telelearning systems

Informatique de santé — Interopérabilité des systèmes de téléapprentissage

Reference number
ISO/TS 16058:2004(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 16058 was prepared by Technical Committee ISO/TC 215, *Health informatics*.

Introduction

0.1 General

The field of telehealth encompasses a broad delivery of health related services using telecommunication technologies at a distance. One of the areas included in the field of telehealth is "telelearning" which deals with the remote delivery of health related educational content. This Technical Specification for Interoperability of Telelearning Systems has been developed on the basis of the needs of healthcare instructors and learners to deliver health related distance learning. Its main purpose is to ensure that technologies deployed for healthcare telelearning can appropriately support and deliver distance learning as well as interoperate with disparate telelearning systems that comply with this specification.

Throughout this document, specific words are used to indicate whether an item is mandatory, recommended or optional. The usage of those words follows the guidelines in Annex G of ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*.

0.2 Learning definition

Learning, in the context of healthcare, is focused on providing opportunities for continued learning in the area of health provider education and patient education. Types of learning situations include:

- professional development which covers upgrading and improving professional skills and knowledge,
- medical education for physicians and other health care providers,
- patient education to enhance clients' abilities to manage disease, e.g. cardiac disease, osteoporosis,
- academic clinical conferencing where expert content is broadcast to receiving sites for purposes such as teaching rounds for residents and continuing medical education,
- case conferencing and grand rounds which are clinical department focused and content is delivered by departmental and visiting speakers,
- multidisciplinary, patient or problem based teaching with a multidisciplinary team providing specialist advice on pertinent clinical problems or issues, and
- other clinical, technical, educational and administrative teaching such as training for support aids, back clinics, diabetes clinics, general orientation, administrative meetings, discharge planning, just in time training, and computer training for regional employees.

0.3 Telelearning definition

Telelearning describes a learning situation where the instructor and learners are separated by a geographical distance. Telelearning can be defined as follows:

> *"Telelearning is making connections among persons and resources through communications technology for learning-related purposes" (Collis, B. (1996): Tele-learning in a digital world, the future of distance learning.)*

The generally accepted definition of telelearning also covers situations where instructor and learner interactions are separated by both distance and time. For the purposes of this specification, telelearning describes "real-time" learning situations in which interaction between the instructor and learners occurs without substantial time delays.

0.4 Telelearning technology

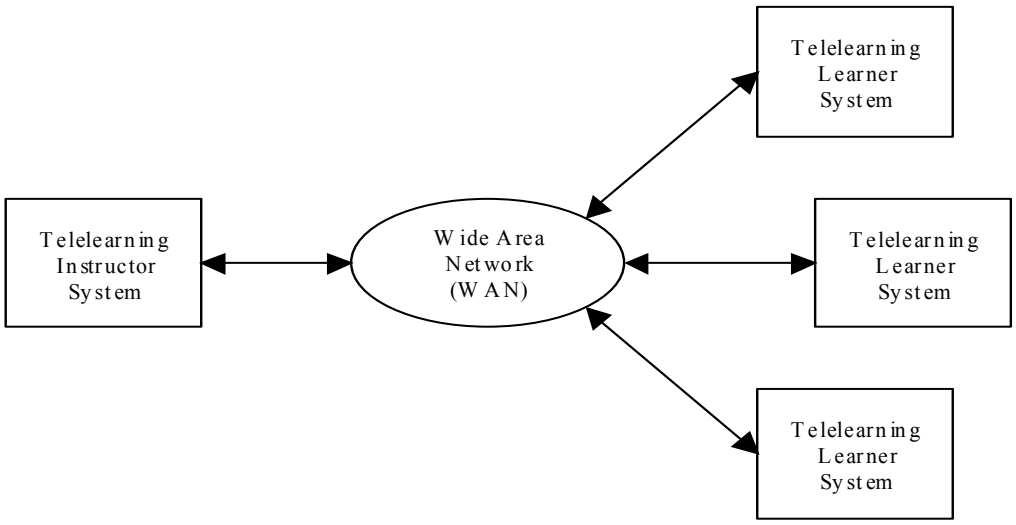

Figure 1. Typical telelearning system

Figure 1 shows the main subsystems of a typical telelearning system. An instructor uses a telelearning instructor system to give presentation to learners at remote learning sites. The instructor and learner systems interface with a wide area network (WAN) to exchange information. The WAN can be a circuit-switched network, a packet-switched network or a combination of both. It must provide sufficient bandwidth and the necessary inter-networking services. Telelearning systems make use of two modes of communications:

- real-time interactive mode typically implemented via videoconferencing technologies; and
- store-and-forward mode typically implemented by electronic mail, file transfer or multimedia messaging systems.
-

The primary component of telelearning uses real-time communications to transmit digitized visual, audio, textual and clinical information between the sending site and one or more receiving sites. Typically, this is accomplished through the use of “real-time” videoconferencing and document sharing technologies.

A secondary aspect of telelearning includes the use of store-and-forward communications for offline activities such as planning, scheduling, preparing, archiving and evaluating telelearning sessions.

The use of store-and-forward communications to deliver telelearning content is not addressed in this specification, which focuses on delivering real-time interactive learning sessions.

0.5 Telelearning workflow

A typical telelearning workflow is shown in Figure 2.

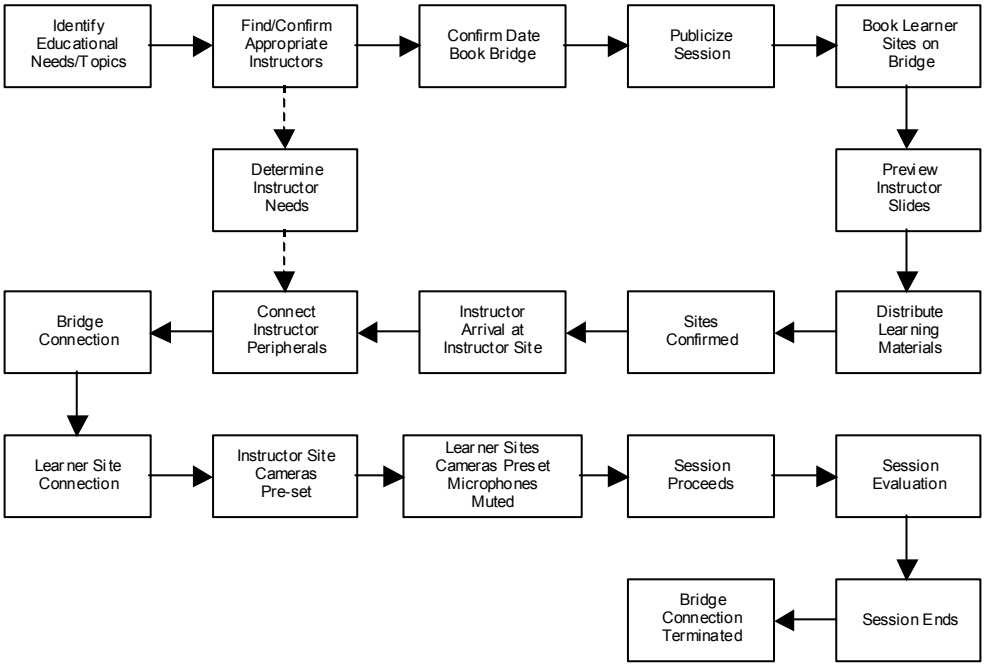

Figure 2. Telelearning workflow

From the workflow, top-level use cases are identified to illustrate the context in which a telelearning system is used. Figure 3 is the top-level use case diagram.

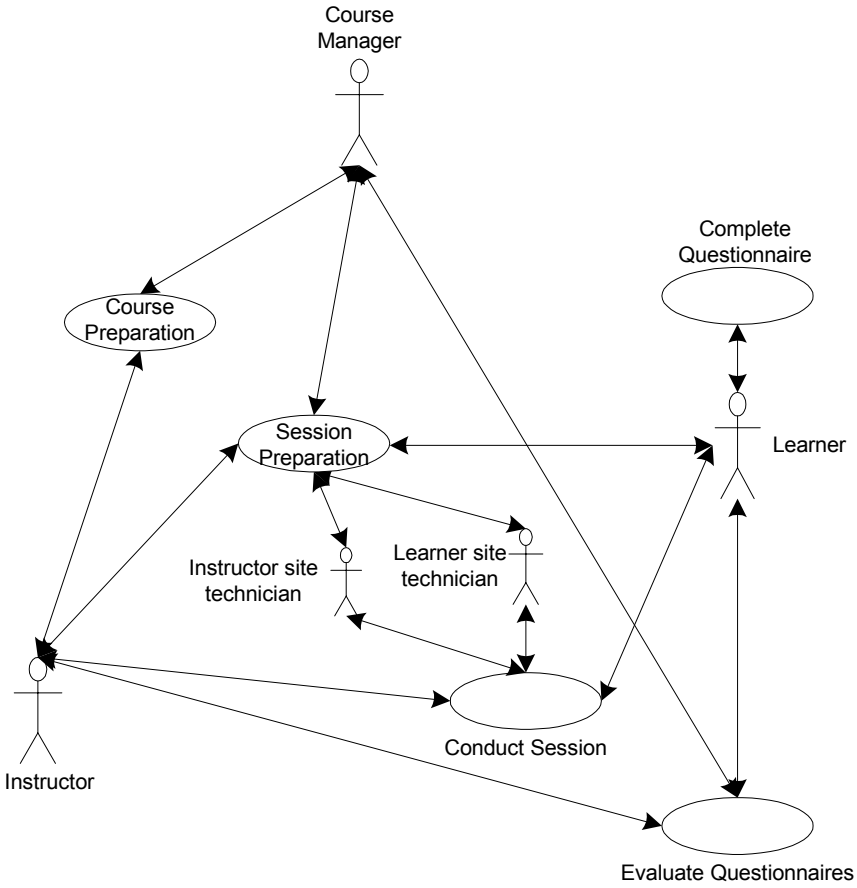

Figure 3. Telelearning top-level use case diagram

0.5.1 Course and session preparation

Telelearning workflow begins with course and session preparation. Course preparation is typically a one time activity that is independent of the time or place where the course is presented. Session preparation occurs each time the course or a portion of the course is delivered. The *Conduct Session* activity is divided into additional use cases representing the instructor and learner sites that are described in the next section. A telelearning system is utilized as part of the *Conduct Session* activity.

The actors within the overall learning context are:

- course manager,
- instructor,
- learner,
- instructor site technician, and
- learner site technician.

Course preparation

i. the educational needs of learners (e.g. staff and patients) are identified and topics for educational sessions are chosen,

ii. appropriate instructors are found, their level of interest, qualifications and capabilities are determined and their availability is confirmed,

iii. the presentation needs of the instructor are determined and support is given for preparation of material, and

iv. it is important that any slides that the instructor will be using are previewed for their suitability for telelearning and changes are made to ensure readability.

Session preparation

a) the date for the session is confirmed and the videoconference bridge (if required), telelearning room and system support technician are booked,

NOTE Ideally this occurs 3 to 10 weeks before the session is held in order to allow time for instructor and systems preparation, publicizing and attracting potential learners.

b) the sessions are publicized by various means (e.g. monthly calendar of events, individual session flyers),

c) learner sites enrol for the telelearning session and the instructor site books additional ports on the videoconference bridge,

d) one day before the session is to occur, learner sites may be asked for final confirmation, and

e) handouts and evaluation questionnaires for the session are distributed to learners in advance of the session.

NOTE The methods by which, and how far in advance of the session, the handouts and evaluation questionnaires are distributed, may vary.

Conduct session

a) one hour before the session, the instructor arrives at the instructor site. The telelearning system support technician gives an introduction to instructor system,

b) the telelearning system support technician connects the instructor peripherals to the instructor system,

c) the telelearning system support technician turns on the instructor system and connects to the videoconference bridge ideally 30 minutes before the session is to begin,

d) the learner sites connect to the videoconference bridge, preferably 20-30 minutes before the session,

e) the cameras at the instructor site are pre-set to focus in on the instructor,

f) the cameras at the learner sites are pre-set appropriately and the microphones are muted,

g) the session proceeds and the system support technicians monitor the session to ensure fluid movement of the session (if needed, learner sites are dropped and cues are given to learner sites to mute microphones etc.). The telelearning system support technician ensures that all peripherals are working and assists the instructor as needed. In a multipoint telelearning session, the instructor site technician can change the presentation mode of the multipoint control unit (MCU) bridge,

> **Example** At the beginning of the session, the presentation mode is set to voice-activated to conform/welcome the remote learner sites. When the session starts, it is changed to continuous-presence mode or presenter mode. During the question period, it is then switched back to voice-activated mode.

h) all learners are encouraged to complete the evaluation questionnaire at the end of the session,

i) the session ends, and

j) the telelearning system support technician informs the WAN provider of the end-of-session, the videoconference bridge is dropped and the telelearning system is turned off.

Complete questionnaires
Learners complete the questionnaires after the session and learner site sends the completed questionnaires to the instructor site.

NOTE This is usually an offline activity.

Evaluate questionnaires

Course manager gives the completed questionnaires to the instructor for evaluation. The course manager sends the evaluations to the learner site.

NOTE This is usually an offline activity.

0.6 Telelearning use cases for the conduct session activity

Further analysis of the workflow pertaining to the *Conduct Session* activity produces these use cases for the instructor system and the learner system.

0.6.1 Telelearning instructor system use case

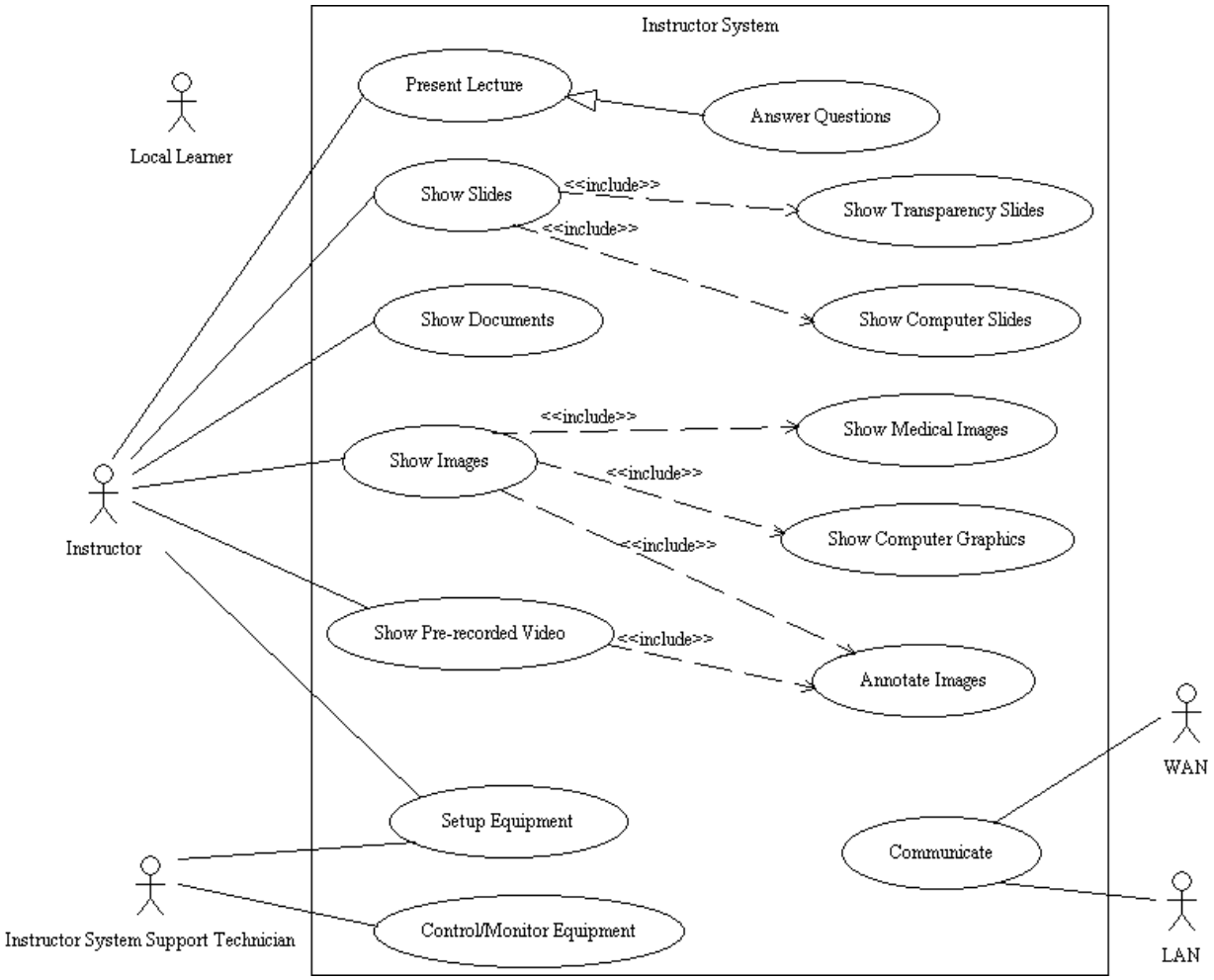

Figure 4. Telelearning instructor system use case diagram

The instructor system support technician (the technician) sets up the telelearning instructor system (the system) before the telelearning session begins. The first phase of equipment setup includes:

- going through a checklist to verify that the system is functioning,
- providing the instructor with an orientation to the system, and
- assisting the instructor in setting up the presentation equipment.

> **Example** Putting the slide tray into slide projector, placing paper documents under or next to document camera, connecting laptop computer to system and checking LAN connection for accessing presentation material.

Next, (typically while the local learners are arriving) the technician makes a WAN connection to the videoconference bridge (for multiply learner site sessions) or remote learner site (for single learner site) and confirms that connections to all telelearning learner systems are established. The technician may alternatively wait for a connection request from the remote learner site if that was agreed upon in the session preparation phase.

The technician ensures that one of the instructor system cameras is focused on the instructor and that another camera is focused on the local learners. Finally, the technician switches on the instructor's microphone and signals that the telelearning session is ready to begin.

Throughout the telelearning session, the technician monitors the status of the system and the videoconference connection. The technician communicates with other system support technicians at the remote learner sites in the background (e.g. through a text messaging channel), to control and adjust the instructor system accordingly to ensure the smooth operation of the telelearning session.

The instructor gives the lecture to the remote learners via the telelearning instructor system. A microphone captures the instructor's voice while a video camera captures the instructor's movements and gestures. The system sends the captured voice and video of the instructor to the remote learner systems via the videoconference connections. The local learners can hear the instructor's voice on the speakers in the room as well.

A lecture is usually presented using transparency or computer (e.g. MS PowerPoint®) slides. The instructor uses a remote control, pointing device or keyboard to advance or reverse the slides as needed. The instructor system provides a document camera to allow the showing of paper documents or close-up views of small objects to the learners. A videocassette player is used to playback pre-recorded video (e.g. beating heart, fetus movements, surgical procedure) to the learners. Frequently, healthcare lecture material includes computer-generated graphics and medical images such as x-rays and ultrasound pictures that are stored on a computer. The instructor system may provide the capability of allowing the instructor to annotate still images or freeze-frame video images in order to draw the learners' attention to specific areas of interest.

Both the local and remote learners interact with the instructor by asking questions. The questioning process requires moderation and coordination so that learners from different sites do not attempt to ask questions simultaneously. One effective method of moderation involves the Instructor asking each site, in turn, if there are questions. When a local or remote learner posts a question, the learner's voice and image are captured by a microphone and a video camera and sent to all connected telelearning sites so that learners at all the sites can see and hear the person asking the question.

When a telelearning session ends, the technician terminates the WAN connection to the videoconference bridge or the remote learner system and disconnects the instructor's presentation equipment from the instructor system.

0.6.2 Telelearning learner system use case

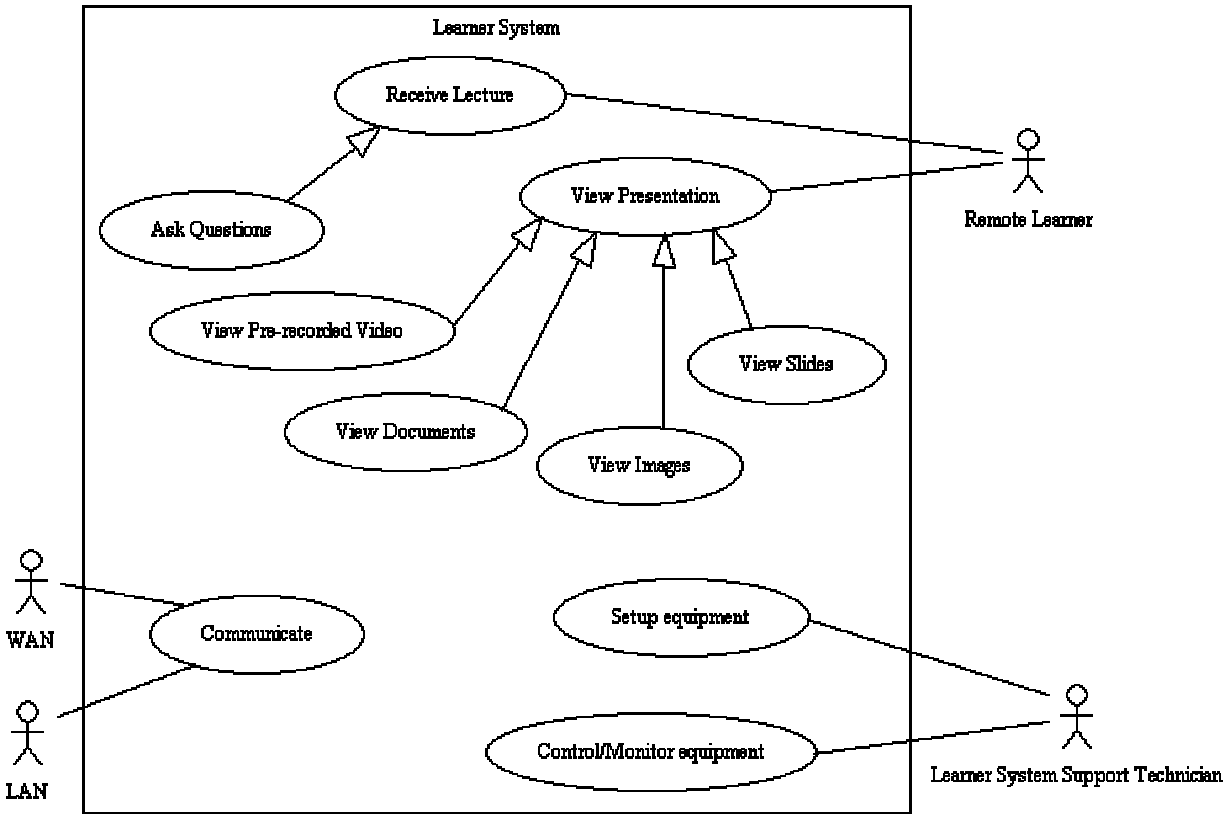

Figure 5. Telelearning learner system use case diagram

The learner system support technician (the technician) sets up the telelearning equipment before the telelearning session begins. The first phase of equipment setup includes:

- going through a checklist to verify that the telelearning learner system is functioning, and
- sets a video camera to get a view of the learners' sitting area and mutes all microphones.

Next, (typically while the learners are arriving) the technician makes a WAN connection to the videoconference bridge (for multiply learner site sessions) or remote instructor site (for single learner site) and confirms that a connection to the telelearning instructor system is established. The technician may also simply wait for a connection request from the remote instructor site if that was agreed upon in the session preparation phase.

When the technician receives indication from the instructor site that the telelearning session is about to begin, the instructor's video image is shown on a video monitor and the instructor's voice is played on the speakers. With the instructor's permission, the telelearning session may be recorded on videotape for viewing or reviewing by learners at a later date.

Throughout the telelearning session, the technician monitors the status of the learner system and the videoconference connection. The technician communicates with the instructor system support technician in the background (e.g. through a text messaging channel) to control and adjust the learner system accordingly to ensure the smooth operation of the telelearning session.

The instructor's lecture is received via the telelearning learner system. To enhance the learning experience, the learner system may provide video display capability that allows the instructor and the presentation to be viewed concurrently. Such capability may include:

a) having one video monitor showing the instructor and one video monitor displaying the lecture presentation, which includes slides, images, documents and pre-recorded video, or

b) a large video display with multiple screen views showing the instructor and presentation material simultaneously. (e.g. picture-in-picture or split screen).

If the instructor system provides the instructor with the ability to annotate images or freeze-frame video to draw the learners' attention to the areas of interest, the annotation appears on the learner system's presentation viewing monitor or screen with minimal time delay.

Learners at all sites interact with the instructor by asking questions. When a learner is ready to ask a question, the technician switches on a microphone and zooms a video camera to the questioner. If the microphone closest to the learner has voice activation capability, the microphone is switched on automatically. The learner's voice and video image are shown on a video display at all connected telelearning sites so that other learners can see and hear the questioner. That video display is usually the same one showing the instructor's image and therefore may require the use of picture-in-picture or split screen to show both the questioner and the instructor. The presentation material may be shown on the second video display so that if a question is related to a particular slide, image, document or a pre-recorded video frame, both the questioner and the presentation material may be viewed simultaneously. When the conversation related to the question is over, technician switches off the microphone and the video camera is zoomed back out to get a group view.

When a telelearning session ends, the technician terminates the WAN connection to the videoconference bridge or the instructor system.

0.7 Reference architecture

0.7.1 General

There are various different telehealth systems and equipment implemented by vendors, hospitals and health districts that can be used to help define an interrelated set of three architectures views:

- operational,
- systems, and
- technical.

Figure 6 identifies these three architectural views and shows the relationship among them. These three architectural views, their relationships and their respective definitions have been taken from the [DOD Joint Technical Architecture Version 4.0 – 21 June 2002].

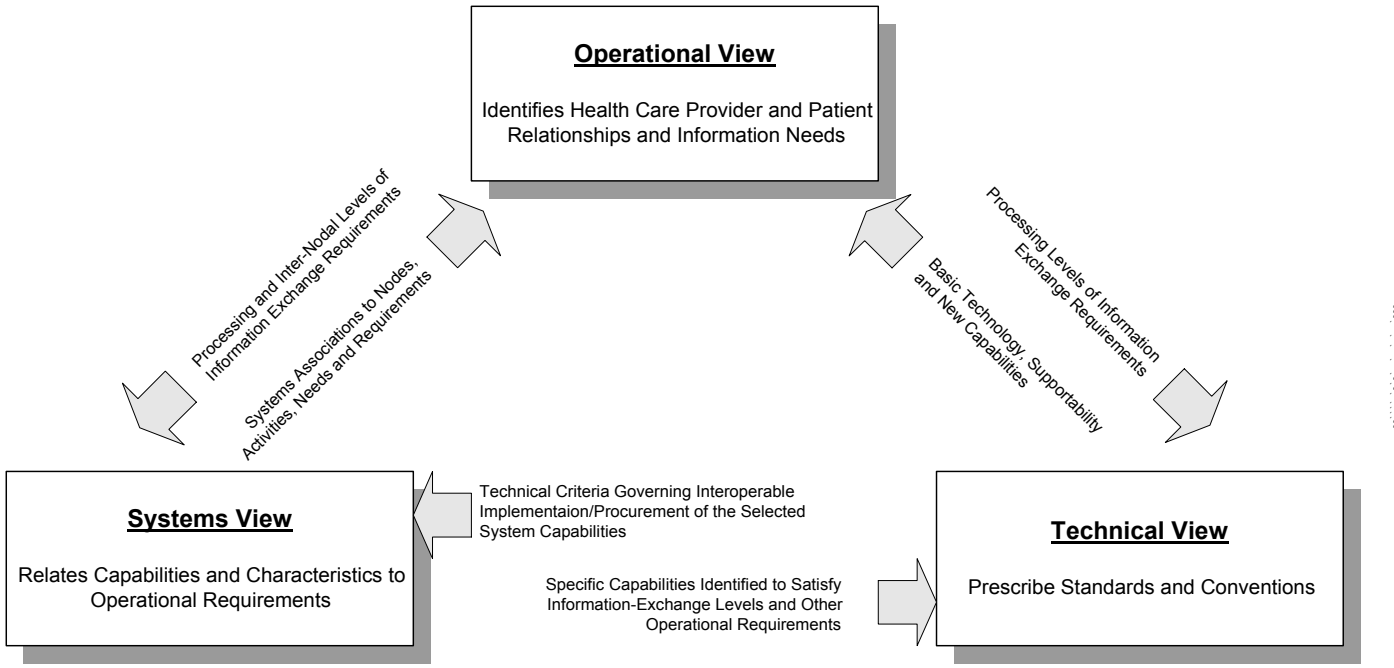

Figure 6. Architectural Views Relationships

0.7.2 Operational architecture view

The operational architecture (OA) view is a description of the tasks and activities, operational elements, and information flows required to accomplish or support telelearning related services and activities. It contains descriptions (often graphical) of the operational elements, assigned tasks and activities, and information flows required to support the delivery of these services. It defines the types of information exchanged, the frequency of exchange, which tasks and activities are supported by the information exchanges, and the nature of information exchanges in detail sufficient to ascertain specific interoperability requirements.

0.7.3 Systems architecture view

The systems architecture (SA) view is a description, including graphics, of systems and interconnections providing for, or supporting, the delivery of telelearning services or functions. The systems architecture view typically shows how multiple systems link and interoperates, and may describe the internal construction and operations of particular systems within the architecture. The systems architecture view includes the physical connection, location, and identification of key nodes, circuits, networks, consulting platforms, etc., and it specifies system and component performance parameters (e.g., traffic bandwidth, mean time between failure, maintainability, availability).

0.7.4 Technical architecture view

The technical architecture (TA) view is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements, whose purpose is to ensure that a conformant system satisfies a specified set of requirements. The technical architecture view provides the technical systems-implementation guidelines upon which engineering specifications are based, common building blocks are established, and product lines are developed.

The technical architecture view includes a collection of the technical standards, conventions, rules and criteria that govern system services, interfaces, and relationships for particular systems architecture views and that relate to particular operational views.

0.7.5 Telelhealth reference architecture

A telehealth reference architecture has been developed that includes aspects of all three architectural views. It is intended to provide a broad grouping of related architectural components that can apply to all telehealth systems as a high level basis and starting point. Figure 7 represents the telehealth reference architecture using a logical representation and grouping of architectural and/or subsystems (components) that will compose the telehealth system. In the context of this specification it is applicable to a telelearning system.

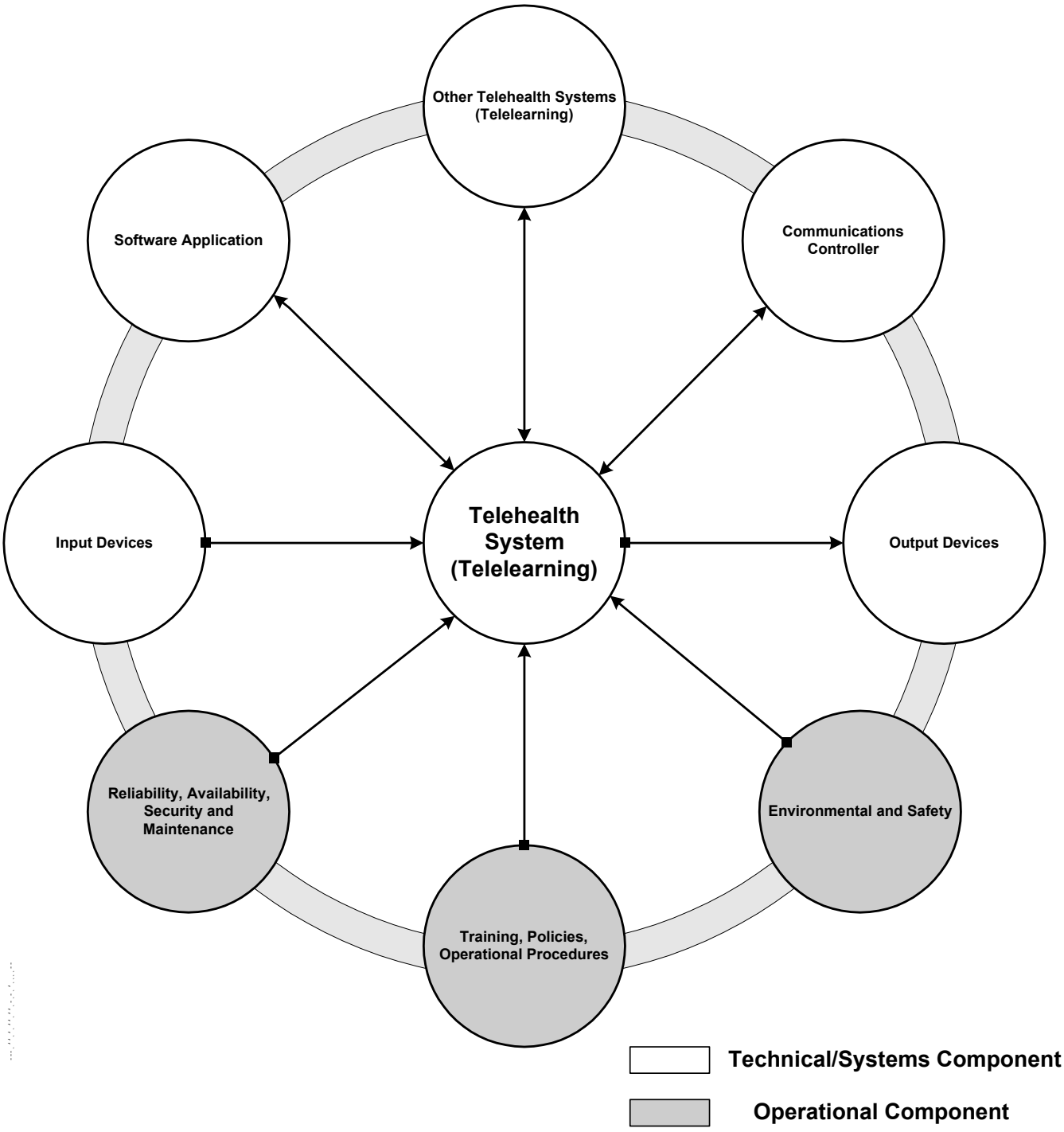

Figure 7. Telehealth reference architecture

The major subsystems of the telehealth reference architecture are:

- the communications controller represents one or many processing units that allow its local devices to communicate with other devices internal or external to the system. Considering the inherited need to network these devices a network operating system is recommended as it covers most of the open systems interconnect (OSI) layered model. This subsystem permits coupling with the software application enabling real-time and/or store and forward processing of health related information,
- the software applications is a collection of software applications, scripts and APIs that allow the user to interact with a specialized software applications and the rest of the subsystems,
- the input devices subsystem represents all analog and digital input devices used to provide data into the system. Examples of input devices are computer mouse, videoconference camera and microphone,
- the output devices subsystem represents all analog and digital devices used to provide data for analysis, monitoring, control, recording and archiving.

  Examples video monitor, speaker and videocassette recorder.

- the environmental and safety provides the physical requirements as captured in various standards and regulations to ensure a secure and safe operation of system components,
- the reliability, security, maintenance and diagnostic represent system level quality factors like reliability requirements; policy based mandated security settings and built in maintenance and diagnostic requirements, and
- the training, policies and operational procedures are operational requirements establishing a defined set of process and functional requirements. These requirements are non-physical but are required in order to operate the system components in a specific medical environment.

Health informatics – Interoperability of telelearning systems

1 Scope

This specification addresses the technical and system components of the telehealth reference architecture for telelearning systems (see Figure 7). It does so by defining technical requirements to be satisfied for a compliant telelearning system. A compliant system will help to ensure that the telelearning technologies deployed for healthcare telelearning are capable of appropriately supporting and delivering distance learning as well as interoperating with disparate telelearning systems that are also compliant with this specification.

This specification deals with both the telelearning instructor and learner systems and addresses the interfaces of these systems to telecommunication networks.

The specification also focuses on the use of real-time interactive communication in telelearning sessions. Most of the telelearning lecture and study material are delivered and distributed to all the learners prior to a telelearning session. This material is usually delivered in non-real time using the store-and-forward communications mode such as FTP download, email, fax or postal/courier services. The use of store-and-forward communications to deliver learning material is not addressed in this specification.

It is recognized that a telecommunications network is integral and critical in the delivery of telelearning services (see Figure 1). In order for the telelearning systems to interoperate, the network needs to provide certain services. However, the network service requirement is diverse and complex and it is beyond the scope of this specification. Network-related issues in the context of telehealth are discussed in the ISO Technical Report, ISO/TR 16056-2 *Interoperability of telehealth systems and networks.*

2 Normative references

This Technical Specification incorporates by dated and undated reference, provisions from other publications. These normative references are cited in the appropriate places in the text, and the publications are listed hereafter.

For dated references, subsequent amendments and revisions of any of these publications apply to this ISO Technical Specification only when incorporated in it by amendment and revision. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8802-3	*Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*
ISO/IEC 17000:2004	*Conformity assessment – Vocabulary and general principles*
ITU-T Recommendation G.711 (1988)	*Pulse code modulation (PCM) of voice frequencies*.
ITU-T Recommendation G.722 (1993)	*7 KHz audio - coding within 64 kbit/s*.
ITU-T Recommendation G.723.1	*Speech coders: Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 kbit/s*
ITU-T Recommendation G.728 (1992)	*Coding of speech at 16 kbit/s using low-delay code excited linear prediction*
ITU-T Recommendation G.729	*Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear-prediction (CS-ACELP)*
ITU-T Recommendation H.221 (1993)	*Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices*
ITU-T Recommendation H.225.0	*Call signalling protocols and media stream packetization for packet-based multimedia communication systems*
ITU-T Recommendation H.230 (1997)	*Frame-synchronous control and indication signals for audiovisual systems.*
ITU-T Recommendation H.231	*Multipoint control unit for audiovisual systems using digital channels up to 1920 kbit/s*
ITU-T Recommendation H.233	*Confidentiality system for audiovisual services*
ITU-T Recommendation H.234	*Encryption key management and authentication system for audiovisual services*

ITU-T Recommendation H.242 (1996)	*System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s*.
ITU-T Recommendation H.243 (1997)	*Procedures for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s*.
ITU-T Recommendation H.245	*Control protocol for multimedia communication*
ITU-T Recommendation H.261	*Video codec for audiovisual services at px64 kbits*
ITU-T Recommendation H.263	*Video coding for low bit rate communication*
ITU-T Recommendation H.281 (1994)	*A far end camera control protocol for videoconferences using H.224*.
ITU-T Recommendation H.320 (1996)	*Narrow-band visual telephone systems and terminal equipment*.
ITU-T Recommendation H.323	*Packet-based multimedia communications systems*
ITU-T Recommendation T.120 (1996)	*Data protocols for multimedia conferencing.*
ITU-T Recommendation T.122 (1993)	*Multipoint communication service for audiographics and audiovisual conferencing service definition.*
ITU-T Recommendation T.123 (1994)	*Protocol stacks for audiographic and audiovisual teleconference applications.*
ITU-T Recommendation T.124 (1995)	*Generic conference control.*
ITU-T Recommendation T.125 (1994)	*Multipoint communication service protocol specification.*
ITU-T Recommendation T.126 (1995)	*Multipoint still image and annotation protocol.*
ITU-T Recommendation T.127 (1995)	*Multipoint binary file transfer protocol.*

3 Terms and definitions

For the purposes of this ISO Technical Specification, the following definitions apply.

3.1
centralized multipoint conference
A call in which all participating terminals communicate in a point-to-point fashion with an MCU

3.2
COder/DECoder
COmpression/DECompression
CODEC
hardware and/or software used with interactive video systems that converts an analog signal to digital, then compresses it so that lower bandwidth telecommunications lines can be used

NOTE The signal is decompressed and converted back to analog output by a compatible CODEC at the receiving end. The compression method (algorithm) may be proprietary or standards -based.

3.3
composite video
a video signal combining luminance, chrominance and synchronization data on a single coax cable using RCA connectors and color-coded yellow

3.4
conformity assessment
demonstration that specified requirements relating to a product, process, system, person or body are fulfilled

NOTE Conformity to a set of specifications is a prerequisite to interoperability. However, conformity to the specifications alone does not guarantee interoperability of systems.

3.5
decentralized multipoint conference
a conference in which the participating terminals multicast to all other participating terminals without an MCU

3.6
input device
an analog and digital device used to configure and control the telelearning system or to provide audio, video or data information to the telelearning system

3.7
interface
a boundary across which two systems communicate

NOTE An interface might be a hardware connector used to link to other devices, or it might be a convention used to allow communication between two software systems.

3.8
interoperability
the ability of two or more systems (computers, communication devices, networks, software, and other information technology components) to interact with one another and exchange information according to a prescribed method in order to achieve predictable results.

3.9
interoperability testing
an assessment of the ability of two or more systems to interact with one another and exchange usable electronic data

NOTE As conformity to the specifications alone does not guarantee interoperability of systems, interoperability testing is required to assess the ability of two or more systems to interact with one another and exchange usable electronic data. Interoperability testing does not include assessment of performance, robustness or reliability nor does it measure the conformity of an implementation. Two systems can be interoperable but still not compliant to the standard or specification.

3.10
multipoint conference
a conference between three or more terminals, which may be on the LAN or on the circuit switched network

3.11
specified requirement
need or expectation that is stated

NOTE Specified requirements can be stated in normative documents such as regulations, standards and technical specifications. Specific requirements are intended to define some feature of a real implementation and offer the possibility of testing.

3.12
system
an aggregation of end products and enabling products to achieve a given purpose

3.13
telehealth
the use of telecommunication techniques for the purpose of providing telemedicine, medical education, and health education over a distance

3.14
telemedicine
use of advanced telecommunication technologies to exchange health information and provide health care services across geographic, time, social and cultural barriers

3.15
testing of conformity
determination of whether one or more characteristics of an object of conformity assessment fulfils specified requirements, according to a procedure

NOTE "Testing" typically applies to materials, products or processes. The primary output of conformity testing is a test report, which includes the specified requirements, the actual results of testing, and the conformity status (i.e., whether or not the given product passed the test).

3.16
videoconferencing
electronic form of communications that permits people in different locations to engage in face-to-face audio and visual communication. Also, a collection of technologies that integrate video with audio, data, or both to convey in real-time over distance for meeting between dispersed sites

4 Abbreviations

CIF	Common Intermediate Format
CODEC	COder/DECoder (also COmpression/DECompression)
DOD	Department of Defense (USA)
IP	Internet Protocol

ISDN	Integrated Services Digital Networks
ITU-T	International Telecommunications Union – Telecommunications
LAN	Local Area Network
MCU	Multipoint Controller Unit
NTSC	National Television Standards Committee
QCIF	Quarter Common Intermediate Format
RTP	Real-time Transport Protocol
SW56	Switched 56 Network
VCR	Video Cassette Recorder
WAN	Wide Area Network

5 Telelearning instructor system

5.1 System context

The primary purpose of the telelearning instructor system is to provide the physical and functional environment through which a healthcare educational presentation is delivered to remote learner sites. The context diagram of a conceptual telelearning instructor system is shown in 0. It is a physical view of the instructor system.

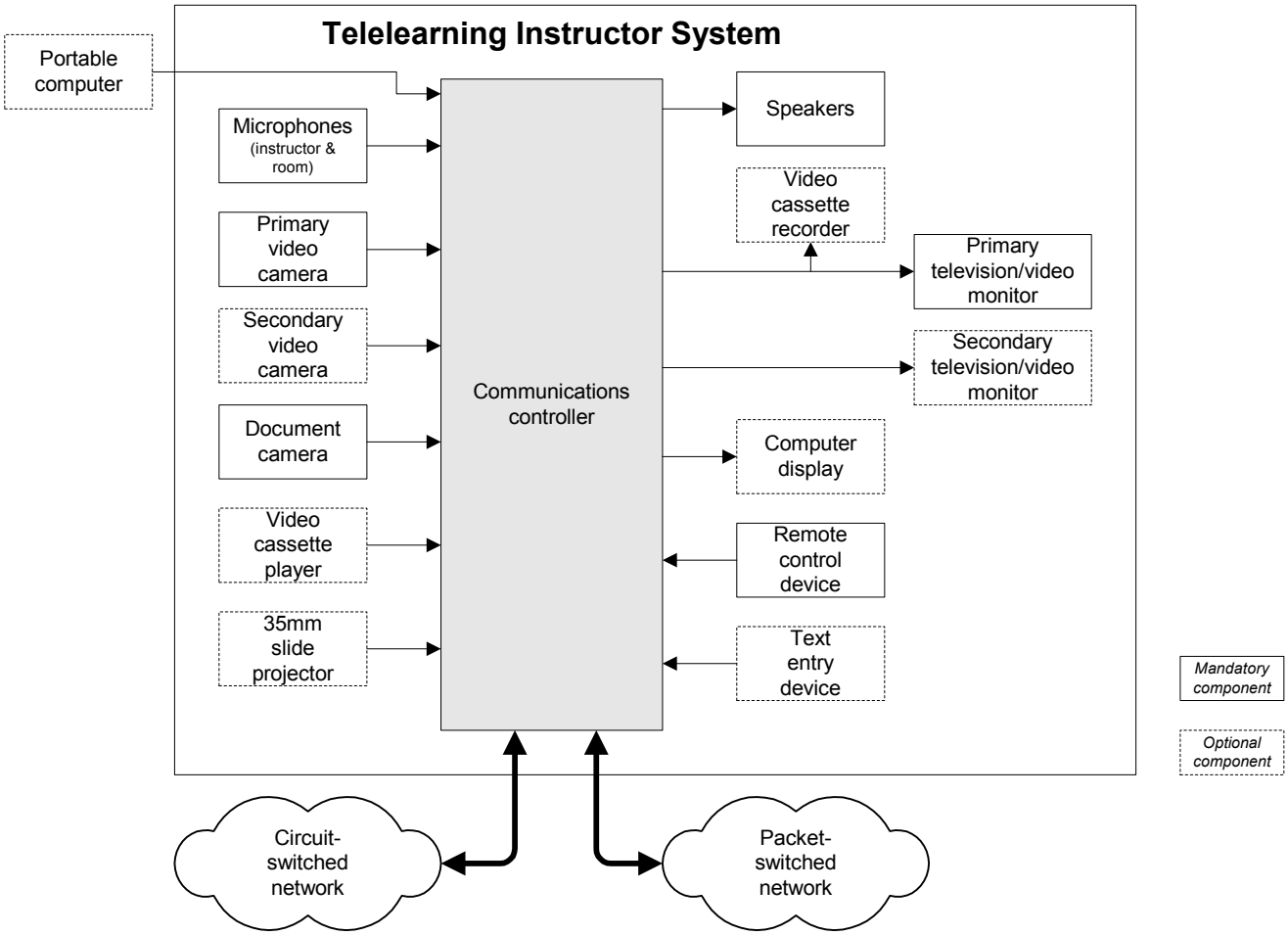

Figure 8. Telelearning instructor system context diagram

The main subsystem of the conceptual instructor system is the communications controller, which interfaces to possibly two telecommunications networks and a number of information input/output subsystems. The information input/output subsystems are considered internal components of the instructor system as they reside within its boundary. The telecommunications networks are external to the instructor system. The interfaces between the networks and the communications controller of the instructor system are described and specified in the "Telelearning system interoperability" chapter.

A vendor's implementation may have each subsystem as a stand-alone unit, or may integrate a number of the subsystems as a single unit.

NOTE It is not the intent of this specification document to dictate the implementation of the instructor system. Rather, this document captures the functional and technical requirements of each subsystem with the purpose of providing the vendors with sufficient design guidelines while maintaining the focus on interoperability with other systems.

5.2 Communications controller

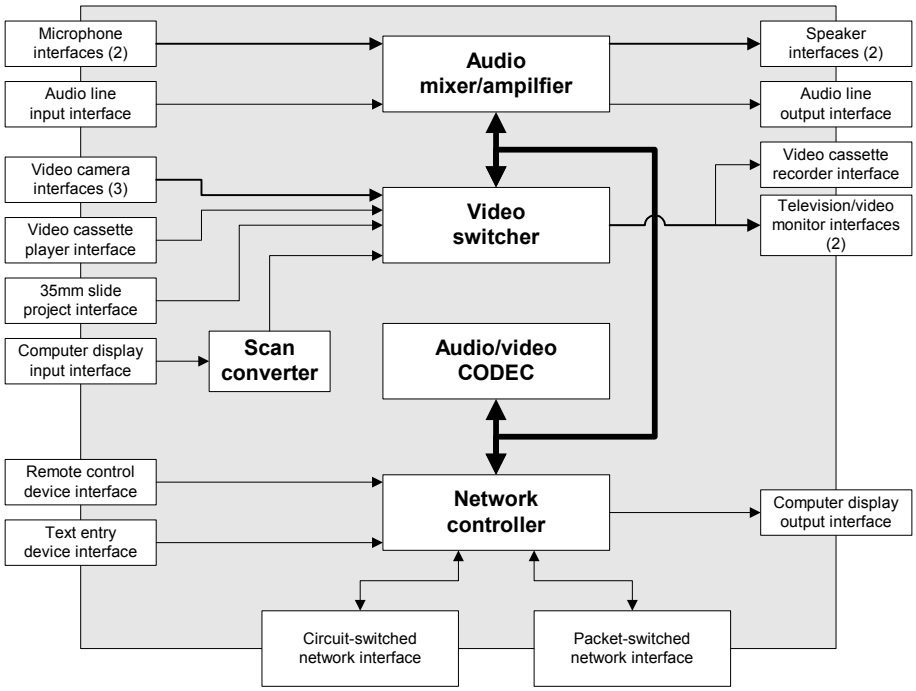

Figure 9. Instructor system communications controller context

The communications controller allows internal input and output subsystems to communicate with one another, or with the external telecommunications system. It decodes data received from the telecommunications system and directs the decoded information to the appropriate output subsystems; it encodes information from input subsystems and sends the encoded data to the telecommunications system.

The functional requirements and recommendations of the communications controller's components are outlined in the following sections while the interface requirements and recommendations are detailed in the telelearning system interoperability clause.

5.2.1 Network controller

5.2.1.1 General

A network controller directs the flow of data and signals among the internal processing components of the communications controller and the external telecommunications networks. It has a user interface that allows a user to set-up, monitor and control the operation of the communication controller.

5.2.1.2 Requirements and recommendations

The communications controller shall have a network controller. The network controller:

a) shall have a real-time clock, as follows:

   i) the real-time clock shall allow the date and time be adjusted, and
   ii) the real-time clock shall maintain date and time adjustment over power on/off cycles.

b) shall support one remote control device,

c) should support one text entry device,

d) should support one computer display output device,

e) shall support connection to a circuit-switched network, and

f) shall support connection to a packet-switched network.

5.2.2 Audio/video CODEC

5.2.2.1 General

An audio/video CODEC encodes signals from local audio/video input devices into formats suitable for transmission over a telecommunications network. It also decodes far-site audio/video data received from the telecommunications network into signals suitable for playback on local audio/video output devices.

5.2.2.2 Requirements and recommendations

The communications controller shall have an audio/video CODEC to support videoconferencing. The audio/video CODEC:

a) shall provide Acoustic Echo Cancellation (AEC),

b) shall provide Automatic Gain Control (AGC),

c) shall provide a minimum of 1 television/video monitor output for the combined display of local and far-site video from a videoconferencing session, and

d) should provide 2 television/video monitor outputs for the separate display of local and far-site video.

5.2.3 Video switcher

5.2.3.1 General

The communication controller interfaces with various video input devices, including:

- videoconferencing room camera(s),
- document camera,
- 35mm slide projector,
- videocassette player, and
- computer graphics card.

A video switcher allows the selection of video input source. It directs the selected source to the audio/video CODEC as outgoing videoconference video source and/or to the local television/video monitor(s).

5.2.3.2 Requirements and recommendations

The communication controller shall have a video switcher. The video switcher shall:

a) support a minimum of 6 video inputs, and

b) be capable of directing any one of the video inputs to both the audio/video CODEC and a local television/video monitor.

5.2.4 Audio mixer/amplifier

5.2.4.1 General

An audio mixer/amplifier is used in medium to large room installations where 2 or more learners attend a telelearning session. The audio mixer/amplifier allows the selection of audio sources from the microphones, the audio input line and the audio/video CODEC. It directs the selected source to the speakers, the audio output line and/or the audio/video CODEC as the videoconferencing audio source.

5.2.4.2 Requirements and recommendations

The communications controller should have an audio mixer/amplifier. The audio mixer/amplifier:

a) shall support a minimum of 2 microphone inputs,

b) shall support one audio line input,

EXAMPLE Audio from a video cassette player goes into the audio mixer/amplifier's audio input line.

c) shall provide acoustic noise reduction,

d) shall allow the gain of each input channel to be separately adjusted manually,

e) should provide an automatic detection and activation of microphones closest to the person speaking. The microphone automatic detection and activation feature should allow manual enable or disable,

f) shall allow the gain of its audio output be adjusted manually, and

g) should be capable of mixing audio from the far-site via the audio/video CODEC and a local microphone to provide a composite audio signal as the line-level audio output or speaker output.

5.2.5 Scan converter

5.2.5.1 General

A scan converter converts computer video graphic adaptor output to television video signal suitable for showing on a television/video monitor.

5.2.5.2 Requirements and recommendations

The communications controller shall have a scan converter. The scan converter:

a) shall convert the graphics adaptor output signal VGA (640x480) for input to the video switcher, and

b) should convert the graphics adaptor output signals SVGA (800x600), XVGA (1024x768) and SXGA (1280x1024) for input to the video switcher,

5.3 Telelearning software application

5.3.1 General

The telelearning software application permits interaction through a software user interface to facilitate learning administration (e.g. scheduling, registration, billing, and evaluation), WAN connectivity, delivery of multimedia content between learning sites and session technical support.

The telelearning software application may consist of a single software application or comprise of a number of separate integrated software applications.

5.3.2 Requirements and recommendations of WAN connection/disconnection software

Telelearning sites are connected on a WAN. In allowing connection and disconnection to the WAN, the software application:

a) shall allow the user to establish a WAN connection by directly entering the destination site name or number using text or numerical entry,

b) shall allow the user to establish a WAN connection by the selection of a pre-programmed site name (phone book),

c) shall allow the user to create and edit speed dial numbers and phone book entries within the (phonebook) in order to establish a WAN connection,

d) should provide the ability to automatically connect to a designated site on the WAN at a preset time,

e) shall provide the user at both the calling and answering sites with receive audible and/or visual indication of call status including ring/busy indication, connection pass/fail, and disconnection indication,

f) shall provide a privacy function that will enable the user to enable/disable the transmission of local audio at any time during a call,

g) should provide a privacy function that will enable the user to enable/disable the transmission of local video at any time during a call,

h) should provide an auto-answer function that will enable the user to enable/disable the ability of the system to automatically answer an incoming call after a specified number of rings or time limit,

i) shall close or disconnect all WAN connections initiated by any software application when the main software application is closed,

j) shall clearly inform the users by displaying an error message if the WAN is unavailable or the system has become disconnected, and

k) should provide the user with instructions on how to troubleshoot WAN connections and/or how to reconnect if the WAN is unavailable or the system has become disconnected.

5.3.3 WAN bandwidth control software

5.3.3.1 General

The bandwidth between two points connected for real-time communications is dependent on the physical capabilities of the WAN medium being used. Some communication sessions may require higher audio quality at the expense of video quality, or vice versa.

5.3.3.2 Requirements and recommendations

The system shall provide WAN bandwidth control software. The WAN bandwidth control software:

a) shall allow the users to manually display and select from a list of available connection bandwidths,

b) shall allow the users to display the current connection bandwidth during connection to the remote site,

c) should allow the users to select the target frame rate for transmission of video,

d) should allow the users to select the picture resolution for transmission of video,

e) should allow the users to select the video compression algorithm for transmission of video,

f) should allow the users to select the audio compression algorithm for transmission of audio,

g) should allow the users to select the target data rate for transmission of in-band data using the ITU-T T.120 specification,

h) should allow the users to receive an indication of negotiated parameters for audio, video and data transmission, and

i) should provide a notification to the users when the selected audio, video and data bandwidth control settings could not be negotiated with the remote systems. The software application should allow the users to enable and disable the generation of the notification.

5.3.4 Content delivery software

5.3.4.1 General

Telelearning is accomplished through the use of videoconferencing technology to transmit and display audio, motion video and still images in the context of a real-time, point-to-point or multi-point learning session. The quality of the presentation is very important, and minimal system delay is highly desirable. The telelearning system incorporates real-time audio/video conferencing supplemented with switched video presentation of digital images from a portable computer or high quality document camera.

NOTE Telelearning content is delivered in “real-time”, that is, in such a way that interaction occurs between the instructor and learners without substantial time delay. The content to be delivered can be categorized as:

- motion audio-video that captures the actions and words of session participants in real-time (includes live and pre-recorded material), and
- static data that supplements the motion audio-video (includes paper documents, 35mm slides, stored digital images, computer presentations, X-rays, and photographs).

The use of videoconferencing technologies and standards provide a way to capture, transmit and display both types of content in real-time with a reasonable level of quality over low-to-medium bandwidth network connections (e.g. ISDN).

Another consideration is the simultaneous presentation of content and live video on the learner system (i.e. at the site receiving instruction). This is important to keep the interest of learners and generally enhances the learning session. Two approaches are envisioned to meet this need.

In the first approach a high quality freeze frame image is captured and transmitted to the learner system briefly interrupting the live video presentation of the instructor. On the learner system the freeze frame image is buffered and the instructor system returns to live video transmission. The learner system then displays the still image on one monitor and the live video presentation of the instructor on a second display monitor. The advantage of this approach is low latency and good synchronization of content and live instructor video with good image resolution (704 x 576 with H.261 Annex D freeze frame). The main disadvantage of this approach is that it is not currently adapted as a standard.

The second possibility for simultaneous presentation of content and instructor video is the use of a T.127 file transfer over an H.221 MLP data channel in the CODEC bit stream. This approach allows very high quality presentation of content at the remote site. Disadvantages of this approach are the delay to send the content image and the impact on instructor video during the content data transfer.

The use of T.120 protocols and services to support applications such as whiteboard sharing, annotated image exchange, hard copy image exchange, remote computer application piloting and screen sharing are optional.

5.3.4.2 Requirements and recommendations

The software application shall deliver the telelearning content. The content delivery software application:

a) shall provide user configurable presets that allow selection of pre-defined equipment settings including, local video source, room camera settings, and audio source selection,

b) should support user input from a remote control device,

c) dshall support point-to-point and multipoint communication modes,

d) should support the capture of high-resolution digital images. The captured digital image shall be in one of the following formats:

   i) BMP,
   ii) JPEG, or
   iii) TIFF

e) shall provide the capability to control the volume of the received audio from the remote site during a connection,

f) shall provide the user with the capability to select the transmission of video from one of the listed video sources to the remote site or sites, e.g. room camera(s), document camera, video cassette player, personal computer (PC) with scan converter,

g) should provide a means for disabling audio delay compensation under user or application control,

h) shall support the concurrent transmission of audio and freeze frame video images,

i) should support the capability to simultaneously display a freeze frame image and live video from a remote site on separate display monitors,

j) shall provide the capability for the user to mute audio inputs at anytime after the establishment of a connection,

k) should provide the capability for the user to blank (disconnect) video inputs at anytime after the establishment of a connection,

l) shall support the concurrent local display of video transmitted to remote site and video from the remote site during a point-to-point call,

m) shall support the concurrent display of video transmitted to the remote site and video from the videoconference bridge (MCU) during a multipoint call, and

n) shall always display the local video source (before during and after call establishment) except when simultaneously displaying live video and still image content from a remote site.

5.3.5 System technical support software

5.3.5.1 General

Effective telelearning sessions reqiure system technical support capability, including system configuration and timely correction of technical problems.

5.3.5.2 Requirements and recommendations

The system technical support software application:

a) shall provide the capability for remote administration of telelearning equipment. The remote administration software application:

   i) shall be access-controlled,

   EXAMPLE An access code or password is required to gain access to the remote administration software application.

   ii) should display operational status of local and remote equipment,

   iii) should display the current configuration (i.e. operating parameters) of local and remote equipment,

   iv) should allow the execution of online and offline diagnostics to verify correct system operation and diagnose system failures,

   v) should allow the logging of administrator commands and equipment responses including any unsolicited responses from equipment,

   vi) should allow the modification of operating parameters of managed equipment,

   vii) should allow enabling and disabling of operating parameters modification by system end-user, and

   viii) should be compliant with the simple network management protocol (SNMP) family of protocols and employs a web browser interface with the SNMP Manager.

b. should provide a means of capturing and reporting session usage to include, at a minimum, the following information:

   i) called number,

   ii) site identifiers, and

   iii) elapsed time of call.

5.3.6 Software application user interface

5.3.6.1 General

The intended user for the telelearning application usually only has a brief introduction to the system operation and has infrequent opportunities to use the system.

5.3.6.2 Requirements and recommendations

a) The user interface shall be based on manipulating icons and menus,

b) Unix based interaction between the software application and the user shall be implemented using the Common Desktop Environment (CDE) integrated graphical user interface,

c) Microsoft Windows based interaction between the software application and the user shall be implemented using the Microsoft Windows Desktop environment,

d) All icons and text shall be visible and distinguishable against the background text and video,

e) Selected icons shall be distinguishable from unselected icons,

f) Feedback should be provided (e.g. hour glass symbol) during task processing that exceeds 5 seconds, and

g) For task processing that may exceed 60 seconds in duration, the duration and completion progress of the task should be indicated.

5.4 Input devices

5.4.1 Text entry device

The system should have a text entry device. The text entry device shall be capable of entering numeric and alphanumeric text.

EXAMPLE A computer keyboard is an example of a text entry input device.

5.4.2 Remote control device

The system shall have a remote control device. The requirements of the remote control device are as follows:

a) A single remote control device shall be provided to access and control the software application, and

b) A single remote control device should be capable of controlling input and output devices that support infrared/RF wireless control in addition to the software application.

5.4.3 Microphone

Telelearning systems incorporating videoconferencing or capture of audio data require microphone or other audio input devices to transmit and/or capture audio information.

The system shall have a minimum of 2 microphones. Each microphone input device shall have an input frequency range of minimum 300 Hz to 3000 Hz to allow the adequate capture of voice frequencies.

A wireless wear-able microphone should be provided.

5.4.4 Video camera

5.4.4.1 General

A video camera allows the capture of real-time video for transmission to the far-site(s).

5.4.4.2 Requirements and recommendations

The system shall have a minimum of 1 video camera. The video camera:

a) shall have a device resolution compatible with the television video standard at the jurisdiction in which the device operates,

b) shall have a minimum zoom capability of 10x,

c) shall have a wide-angle lens with a field of view of not less than 60 degrees, when used to capture room images,

d) shall have auto and manual focus modes,

e) shall have a minimum of 200 degrees of pan movement, and a minimum of 50 degrees of tilt movement,

f) shall have powered zoom in/out, and

g) shall be capable of being controlled by a hand held remote control for pan, tilt, and zoom functions.

5.4.5 Document camera

5.4.5.1 General

A document camera is a specialized video camera used for close up shots of paper images, transparencies, photos, X-rays and other types of documents or small objects.

5.4.5.2 Requirements and recommendations

The system shall provide a document camera. The document camera:

a) shall have a shooting area that is at least letter size (i.e. 8.5 inches x 11 inches),

b) shall have powered zoom in/out,

c) shall have a minimum zoom capability of 10x,

d) shall have a device resolution compatible with the television video standard at the jurisdiction in which the device operates,

e) shall support manual or powered pan and tilt operation,

f) shall have auto and manual focus modes,

g) should be capable of being controlled via a remote control interface, and

EXAMPLE A hand-held remote controller or a serial interface that controls the zoom and white-balance.

h) shall provide a light box (backlight) and arm lights.

5.4.6 Video cassette player

5.4.6.1 General

The video cassette player as an input device is used to playback previously recorded clinical or educational material on the telelearning system.

5.4.6.2 Requirements and recommendations

The system should provide a video cassette player. The video cassette player:

a) shall include the following functions: play, stop, pause, fast forward, rewind,

b) should provide the following functions: freeze frame, and forward and backwards single frame advance,

c) shall be capable of being controlled by a hand held remote control for such operations as play, stop, pause, rewind and fast-forward, and

d) should provide a stereo line level audio output.

5.4.7 35mm slide projector

5.4.7.1 General

A 35mm slide projector with a video output enables an instructor to make a slide presentation to a local (live) audience and supply the same presentation material to remote sites through a video input to the communications controller.

The system should provide a 35mm slide projector. The 35mm slide projector:

a) shall provide overheating protection with an auto reset thermal protection device,

b) shall have a device resolution compatible with the television video standard at the jurisdiction in which the device operates,

c) shall provide powered zoom, focus and iris adjustment, and

d) shall be capable of being controlled by a hand held remote control.

5.5 Output devices

5.5.1 General

Output devices are analog and digital devices used to output data from the telelearning system for analysis, monitoring, control, recording and archiving.

5.5.2 Speaker

5.5.2.1 General

Telelearning systems incorporating videoconferencing or playback of audio data require speakers or other devices to output audio information. The purpose of the audio speaker is the playback of audio signals from a videoconference session or audio playback from a local source (e.g. VCR).

5.5.2.2 Requirements and recommendations

The system shall provide a minimum of 1 speaker. The speaker:

a) shall have a frequency response of 20 Hz to 15 kHz, and

b) should have an audio power amplifier with volume control.

5.5.3 VCR

5.5.3.1 General

A VCR records the audio and video content generated during a learning session.

5.5.3.2 Requirements and recommendations

The system should have a VCR. The VCR:

a) shall be capable of recording audio output from the audio mixer/amplifier of the communications controller and video output from the video switcher of the communications controller, and

b) shall provide stereo line level audio inputs.

5.5.4 Television/video monitor

5.5.4.1 General

A television/video monitor is used for the display of local and far-site camera video. A minimal installation consists of a single monitor that displays a picture-in-picture presentation of local and remote video. In other installations, one monitor is used to display remote video and a second monitor is used to display local video.

5.5.4.2 Requirements and recommendations

The system shall have a minimum of 1 colour television/video monitor. The television/video monitor:

a) shall be capable of displaying both the local video from one of the video input devices along with the remote video transmitted during a videoconferencing connection,

b) shall have a device resolution compatible with the television video standard at the jurisdiction in which the device operates,

c) shall be capable of being controlled by a hand held remote control, and

d) shall have minimum diagonal viewable screen measurement of 51 cm (20 inches).

5.5.5 Computer display

5.5.5.1 General

Computer display devices include computer display monitors and computer video (e.g. LCD) projectors. A computer display monitor or projector is provided for local display of computer presentations.

5.5.5.2 Requirements and recommendations

The system should have a computer display device. The computer display device:

a) shall have minimum diagonal viewable screen measurement of 43 cm (17 inches),

b) shall support VGA, SVGA, and XGA resolutions at a maximum of 16.7 million colours, and

c) should have antiglare and antistatic screen coating.

6 Telelearning learner system

6.1 System context

The primary purpose of the telelearning learner system is to provide the physical and functional environment through which a healthcare educational presentation is received from the instructor site and presented to the learners. The context diagram of a conceptual telelearning learner system is shown in Figure 10. It is a physical view of the learner system.

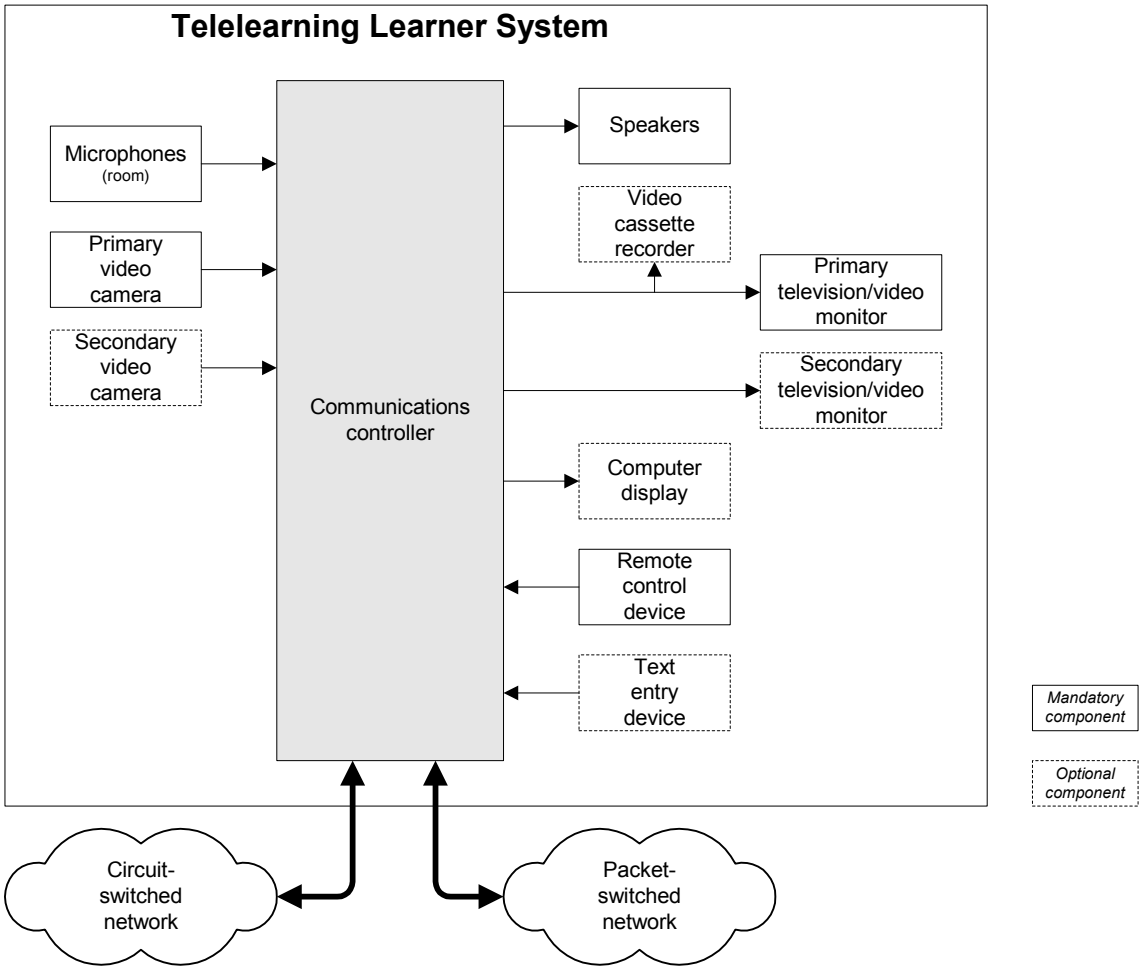

Figure 10. Learner system context diagram

The main subsystem of the conceptual learner system is the communications controller, which interfaces to possibly two telecommunications networks and a number of information input/output subsystems. The information input/output subsystems are considered internal components of the learner system as they reside within its boundary. The telecommunications networks are external to the learner system. The interfaces between the networks and the communications controller of the learner system are described and specified in Clause 6.

A vendor's implementation may have each subsystem as a stand-alone unit, or may integrate a number of the subsystems as a single unit. It is not the intent of this specification document to dictate the implementation of the instructor system. Rather, this document captures the functional and technical requirements of each subsystem with the purpose of providing the vendors with sufficient design guidelines while maintaining the focus on interoperability with other systems.

6.2 Communication controller

In a telelearning learner system, the communications controller is the subsystem that interfaces directly to the external telecommunications system. It includes hardware and software, or firmware, units and consists of a number of information processing elements. Figure 11 shows the conceptual block diagram of a learner system's communications controller.

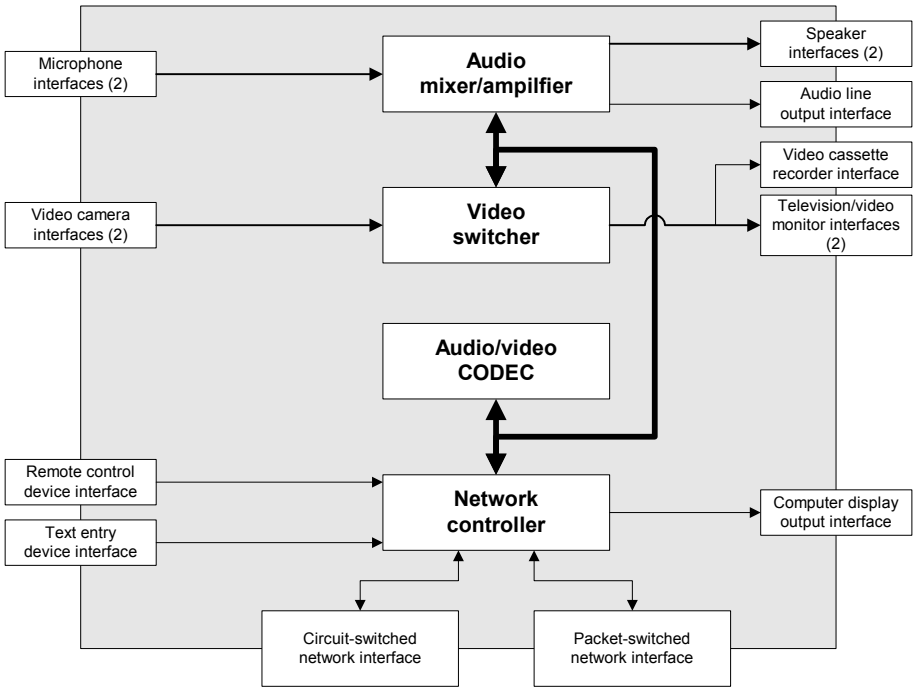

Figure 11. Learner system communications controller context diagram

The communications controller allows internal input and output subsystems to communicate with one another or with the external telecommunications system. It decodes data received from the telecommunications system and directs the decoded information to the appropriate output subsystems; it encodes information from input subsystems and sends the encoded data to the telecommunications system.

6.2.1 Network controller

6.2.1.1 General

A network controller directs the flow of data and signals among the internal processing components of the communications controller and the external telecommunications networks. It has a user interface that allows a user to set-up, monitor and control the operation of the communication controller.

6.2.1.2 Requirements and recommendations

The communications controller of a telelearning learner system shall have a network controller. The network controller shall have the same functional characteristics as that of a telelearning instructor system, as specified in Clause 5.2.1.

6.2.2 Audio/video CODEC

6.2.2.1 General

An audio/video CODEC encodes signals from local audio/video input devices into formats suitable for transmission over a telecommunications network. It also decodes far-site audio/video data received from the telecommunications network into signals suitable for playback on local audio/video output devices.

6.2.2.2 Requirements and recommendations

A communications controller of a telelearning learner system shall have an audio/video CODEC to support videoconferencing. The audio/video CODEC shall have the same functional characteristics as that of a telelearning instructor system, as specified in Clause 5.2.2.

6.2.3 Video switcher

6.2.3.1 General

The communication controller interfaces with various video input devices, including:

- videoconferencing room camera(s),
- document camera,
- 35mm slide projector,
- videocassette player, and
- computer graphics card.

A video switcher allows the selection of video input source. It directs the selected source to the audio/video CODEC as outgoing videoconference video and/or to the local television/video monitor(s).

6.2.3.2 Requirements and recommendations

The communication controller of a telelearning learner system shall have a video switcher. The video switcher:

a) shall support a minimum of 2 video inputs, and

b) shall be capable of directing any one of the video inputs to both the audio/video CODEC and a local television/video monitor.

6.2.4 Audio mixer/amplifier

6.2.4.1 General

An audio mixer/amplifier is used in medium to large room installations where 2 or more learners attend a telelearning session. The audio mixer/amplifier allows the selection of audio sources from the microphones, the audio input line and the audio/video CODEC. It directs the selected source to the speakers, the audio output line and/or the audio/video CODEC as the videoconferencing audio source.

6.2.4.2 Requirements and recommendations

The communications controller of a telelearning learner system should have an audio mixer/amplifier. The audio mixer/amplifier:

a) shall support a minimum of 2 microphones inputs,

b) shall provide acoustic noise reduction,

c) shall allow the gain of each input channel to be separately adjusted manually,

d) should provide an automatic detection and activation of microphones closest to the person speaking. The microphone automatic detection and activation feature should allow manual enable or disable,

e) shall allow the gain of its audio output be adjusted manually, and

f) should be capable of mixing audio from the far-site via the audio/video CODEC and a local microphone to provide a composite audio signal as the line-level audio output or speaker output.

6.3 Telelearning software application

6.3.1 General

The telelearning software application permits interaction through a software user interface to facilitate learning administration (e.g. scheduling, registration, billing, and evaluation), WAN connectivity, delivery of multimedia content between learning sites and session technical support. The software application may consist of a single software application or comprise of a number of separate integrated software applications.

6.3.2 WAN connection/disconnection software

Telelearning sites are connected on a Wide Area Network (WAN). The software application shall allow connection and disconnection to the WAN. The requirements as specified in Clause 5.3.2 apply to a telelearning learner system and they ensure that the software application's support of connection to the WAN is simple to use.

6.3.3 WAN bandwidth control software

The bandwidth between two points connected for real-time communications is dependent on the physical capabilities of the WAN medium being used. Some communications may have a requirement for higher audio quality at the expense of video quality, or vice versa. The user or the software application shall be able to set the preference in the form of bandwidth control. The requirements as specified in Clause 5.3.3 apply to a telelearning learner system.

6.3.4 Content delivery software

Telelearning is accomplished through the use of videoconferencing technology to transmit and display audio, motion video and still images in the context of a real-time point-to-point or multi-point learning session. The quality of the presentation is very important, and minimal system delay is highly desirable. The telelearning system incorporates real-time audio/video conferencing supplemented with switched video presentation of digital images from a portable computer or high quality document camera. The requirements as specified in Clause 5.3.4 apply to a telelearning learner system.

6.3.5 Session technical support software

Proper system configuration and timely correction of technical problems are required for effective telelearning sessions. The requirements as specified in Clause 5.3.5 apply to a telelearning learner system.

6.3.6 Software application user interface

The intended user for the telelearning application usually only has a brief introduction to the system operation and may have infrequent opportunities to use the system. The requirements as specified in Clause 5.3.6 apply and they ensure the system is simple and intuitive to use.

6.4 Input devices

6.4.1 General

Input devices are analog or digital devices used to configure and control the telelearning system or to provide audio, video or data information to the telelearning system.

6.4.2 Text entry device

The system should have a text entry device. The requirements as specified in Clause 5.4.1 apply to a telelearning learner system.

6.4.3 Remote control device

The system shall have a remote control device. The requirements as specified in Clause 5.4.2 apply to a telelearning learner system.

6.4.4 Microphone

Telelearning systems incorporating videoconferencing or capture of audio data require microphone or other audio input devices to transmit and/or capture audio information. The requirements as specified in Clause 5.4.3 apply to a telelearning learner system.

6.4.5 Video camera

A video camera allows the capture of real-time video for transmission to the far-site(s). The requirements as specified in Clause 5.4.4 apply to a telelearning learner system.

6.5 Output devices

6.5.1 General

Output devices are analog and digital devices used to output data from the telelearning system for analysis, monitoring, control, recording and archiving.

6.5.2 Speaker

Telelearning systems incorporating videoconferencing or playback of audio data require speakers or other devices to output audio information. The purpose of the audio speaker is the playback of audio signals from a videoconference session or audio playback from a local source (e.g. VCR). The requirements as specified in Clause 5.5.2 apply to a telelearning learner system.

6.5.3 Video cassette recorder

A video cassette recorder (VCR) records the audio and video content generated during a learning session. The requirements as specified in Clause 5.5.3 apply to a telelearning learner system.

6.5.4 Television/video monitor

A television/video monitor is used for the display of local and far-site camera video. A minimal installation consists of a single monitor that displays a picture-in-picture presentation of local and remote video. In more advanced rooms, one monitor is used to display remote video and a second monitor is used to display local presentations, document camera or room camera video. The requirements as specified in Clause 5.5.4 apply to a telelearning learner system.

6.5.5 Computer display

Computer display devices include computer display monitors and computer video (e.g. LCD) projectors. A computer display monitor or projector is provided for local display of computer presentations. The requirements as specified in Clause 5.5.5 apply to a telelearning learner system.

7 Telelearning system interoperability

7.1 Overview

Interoperability is defined as “the ability of two or more systems (computers, communication devices, networks, software, and other information technology components) to interact with one another and exchange information according to a prescribed method in order to achieve predictable results.“ Interoperability problems arise mainly at the interfaces between systems and with the formats of the information being exchanged. By specifying open standards for information exchange and for interfaces at both physical and protocol levels, interoperability issues are mitigated. In order to ensure interoperability among telelearning systems, all inter-working systems need to follow the specifications described herein.

There are two types of interfaces in a telelearning system: external and internal. External interfaces are connections made from a telelearning system to external systems such as a telecommunications system. Information is communicated through external interfaces between telelearning systems in real-time or store-and-forward mode over public and/or private networks. Internal interfaces are connections between subsystems or components within a telelearning system, and they can be hardware and/or software interfaces.

7.2 External interfaces

7.2.1 Telecommunications network access

At the instructor and/or learner sites, there are generally two types of telecommunications network access available to support interactive telelearning sessions:

- circuit-switched network, e.g. ISDN, SW56, and
- packet-switched network, e.g. Ethernet, Internet/Intranet.

To support real-time communication of audio and visual information over these networks, ITU-T Recommendations H.320 and H.323 for videoconferencing operation are specified. Figures 12 and 13 illustrate the key network elements and protocol standards for each type of operation. The approach taken in this specification is to identify the protocol standards elements at key peer-to-peer level, e.g. H.261 and G.711. Service provider interfaces within a protocol stack (vertical layer), e.g. real-time transport protocol (RTP) services for audio/video applications in Figure 13, are outside the scope of this specification.

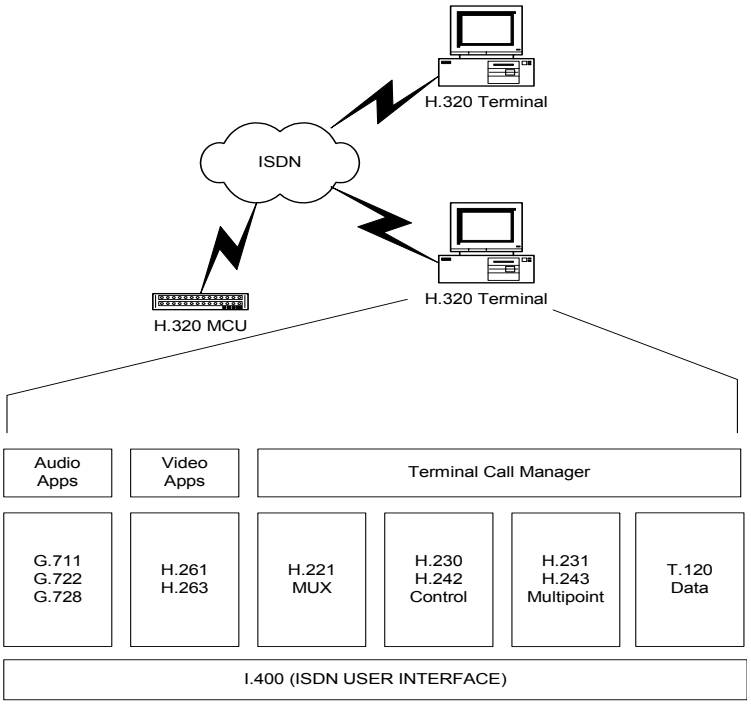

Figure 12. H.320 interoperability

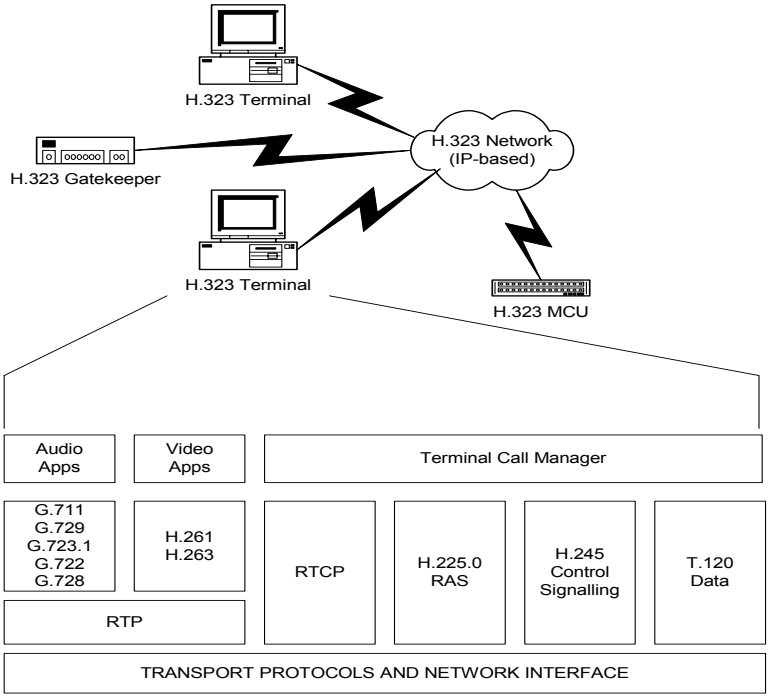

Figure 13. H.323 interoperability

7.2.2 Interaction diagrams

Activities among instructor system, learner systems and WAN as related to the real-time videoconference operation, as derived from the use cases, are shown in the following interaction diagrams of Figure 14. In these interaction diagrams, the WAN is shown as a single entity. In reality, however, the WAN is a collection of hubs, switches, bridges, circuits, gateways, controllers or gatekeepers. Interoperability requirements related to the WAN are specified in Clause 7.

The purpose of Clause 7 is to identify the interfacing requirements that a telelearning instructor system and a telelearning learner system need to meet in order to interoperate with one another. Specific protocol elements, which directly affect the interoperability of the telelearning systems, from the respective ITU-T Recommendation are identified.

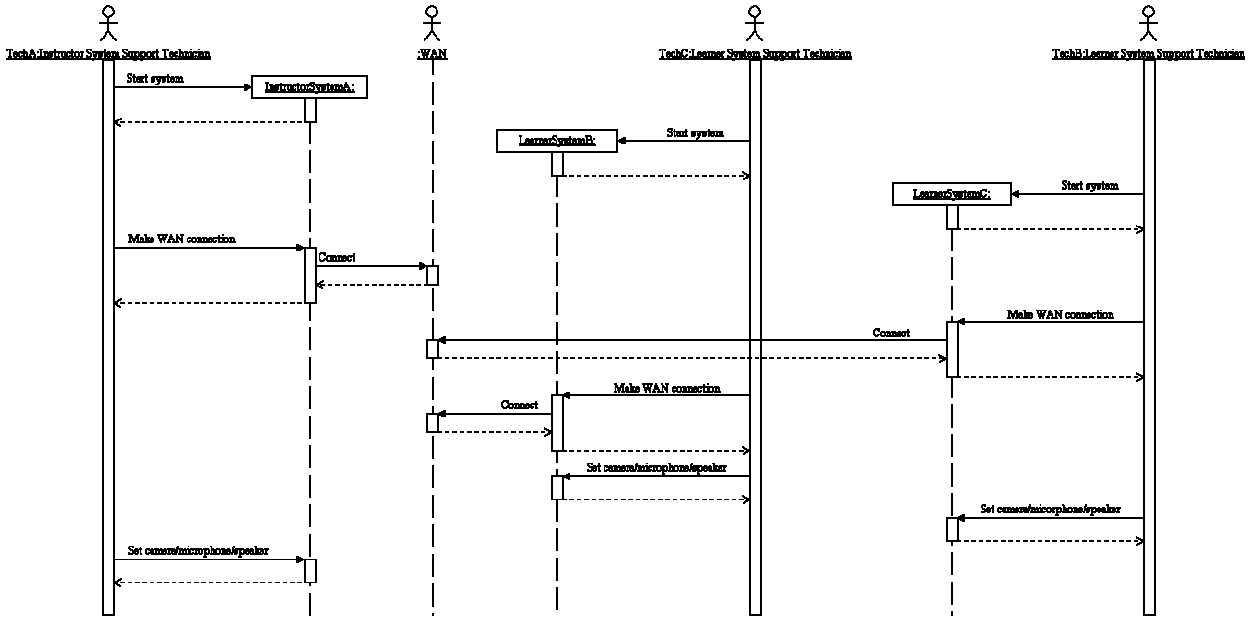

Figure 14. System startup interactivities

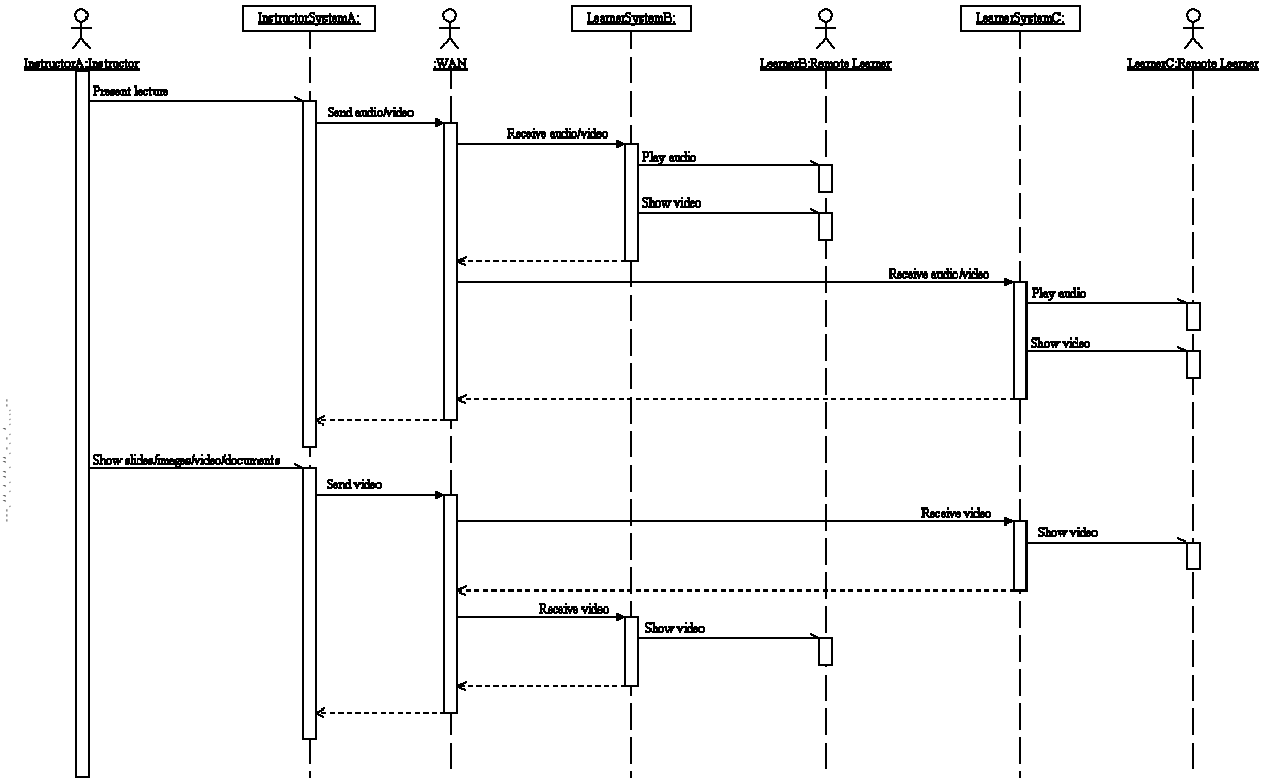

Figure 15. Lecture presentation interactivities

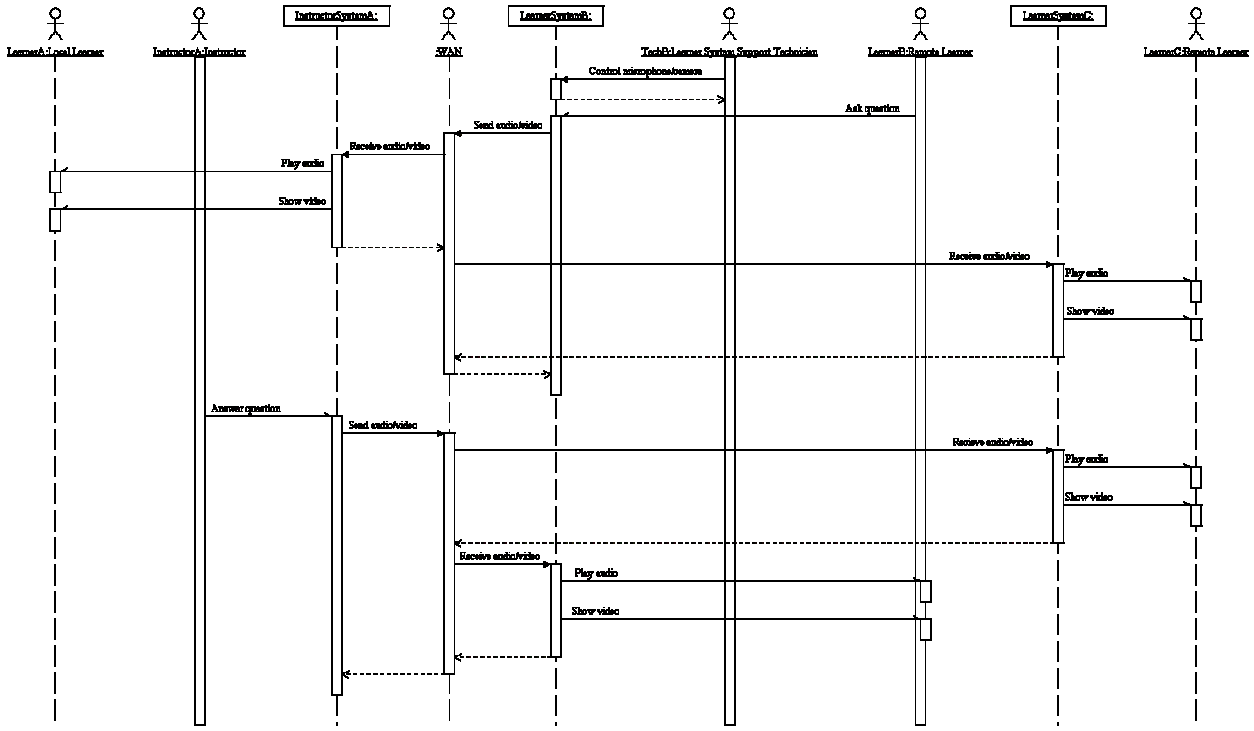

Figure 16. Q&A interactivities

7.2.3 Cabling and connecting

7.2.3.1 General

Common external interface connections of a system are power and communications. A communications connection can be made to a Local Area Network (LAN), e.g. Ethernet, or a Wide Area Network (WAN), e.g. ISDN.

7.2.3.2 Requirements and recommendations

The system's:

a) external interface connectors shall each be accessible directly, either on the equipment exterior or by removing an access cover that does not require the use of any tools,

b) external interface connectors should all be located on the same external face of the equipment to make connection as convenient as possible,

c) external communication connectors should each allow connection and disconnection with its associated cable without the use of tools,

d) external communication cables shall all attach securely to the system utilizing some form of positive locking,

e) external connection cables shall all have minimum length of 1.82 meters (6 feet),

f) power cords and plugs shall be of hospital grade for power connection,

g) external power connectors that are capable of sourcing electrical current shall all have recessed contacts to prevent shorting,

h) external power connectors that are capable of sourcing electrical current shall all be uniquely keyed or cross-gendered to prevent connection with other power drawing connectors or signal connectors, and

i) external communications connectors and cabling supplied shall all be labelled and/or colour-coded to uniquely identify cable type and placement.

7.2.4 Circuit-switched network interface

7.2.4.1 Circuit-switched network physical conncection

The system shall provide a physical connection to a circuit-switched network. The circuit-switched network's interface connector shall be RJ-45 type. The interface connection shall be NT terminated.

7.2.4.2 ITU-T H.320 recommendation

7.2.4.1.1 General

ITU-T H.320 is a recommendation that covers technical requirements for narrow-band visual telephone services where channel rates do not exceed 1920 kbits/s.

7.2.4.1.2 Requirements and recommendations

The circuit-switched network interface of the system:

a) shall conform to "ITU-T H.320, *Narrow-band visual telephone systems and terminal equipment,*"

b) should support operation at nominal bit rates of px64000 bits per second (bit/s), where p is an integer that can range from 1 to 30,

c) shall, at a minimum, support operation at nominal bit rates of px64000 bits per second (bit/s), where p is an integer that can range from 1 to 6 (inclusive),

d) shall be able to operate with other systems on unrestricted (64,000 bit/s) and restricted channels (56,000 bit/s),

e) should be able to operate with available channel capacity when one or more channels are lost or unavailable,

f) shall support point-to-point bi-directional operation,

g) should support multipoint bi-directional operation,

h) if it incorporates encryption of multiplexed audio and video signals, the encryption should be according to ITU-T H.233 and, where a key-management system is required, one of the schemes in ITU-T H.234 should be used, and

i) should provide the capability to signal and respond to the "mode-preference" indications defined in Section 9.5, "*Procedure for influencing the Mode transmitted from remote endpoint*", of ITU-T H.242 (05/99).

7.2.4.1.3 H.320 video transport

The circuit-switched network interface of the system shall provide video transport for H.320 operation, in particular:

a) the circuit-switched network interface of the system shall provide a video CODEC that complies with "ITU-T H.261, *Video codec for audiovisual services at px64 kbits* " such that the H.261 video CODEC:

i) shall provide full-colour operation using QCIF and CIF picture format at up to 29.97 frames per second in accordance with H.261,

ii) decoder should support the capability to detect and correct errors as specified in Section 5.4, "*Forward error correction for coded video signal*", of ITU-T H.261, and

iii) should support the transmission and reception of freeze-frame images by means of the technique described in ITU-T H.261 Annex D.

b) the circuit-switched network interface of the system shall provide a video CODEC that complies with "ITU-T H.263, *Video coding for low bit rate communication* " such that the H.263 video CODEC:

i) shall provide full-colour operation using QCIF and CIF picture format at up to 29.97 frames per second in accordance with H.263, and

ii) should support the transmission and reception of freeze-frame images by means of the technique described in Annex L of ITU-T H.263 for full-picture freeze request or full-picture snapshot tag.

c) the video CODEC shall be negotiated between terminals using H.242 and H.320 such that, if optional source formats (picture formats and picture clock frequencies) are supported, the optional formats shall be negotiated using ITU-T H.242, and

d) the video bitstream shall be formatted as described in H.221.

7.2.4.1.4 **H.320 audio transport**

The circuit-switched network interface of the system shall provide audio transport for H.320 operation, in particular:

a) the circuit-switched network interface of the system shall provide an audio CODEC that conforms to ”ITU-T G.711, *Pulse code modulation (PCM) of voice frequencies*”,

b) the circuit-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.722, *7 kHz audio-coding within 64 kbit/s*”,

c) the circuit-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.728, *Coding of speech at 16 kbit/s using low-delay code excited linear prediction*”,

d) the audio CODEC shall be negotiated as described in H.320 and H.242, and

e) the audio bitstream shall be formatted as described in H.221.

7.2.4.1.5 **H.320 multiplexing**

To allow for the synchronization of multiple connections and the control of multiplexing audio, video, data, and other signals, the circuit-switched network interface of the system shall conform to "ITU-T H.221, *Frame structure for a 64 to 1920 Kbit/s channel in audiovisual teleservices*".

7.2.4.1.6 **H.320 control**

The system shall have a control mechanism. The requirements of the control mechanism shall be such that the circuit-switched network interface of the system shall conform to:

a) “ITU-T H.242, *System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s*”, and

b) "ITU-T H.230, Frame-synchronous control and indication signals for audiovisual systems".

7.2.4.1.7 **H.320 multipoint operation**
The system shall be capable of multipoint operation when connected to a circuit switched network. The circuit-switched network interface of the system:

a) should be capable of multipoint operation using by communicating with an MCU described in "ITU-T H.231, *Multipoint control unit for audiovisual systems using digital channels up to 1920 kbit/s*", and

b) should conform to "ITU-T H.243, *Procedure for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s*".

7.2.4.1.8 **H.320 data transport**
The system should be capable of transporting data over an H.320 circuit-switched network interface. If this capability is provided, then the following requirements are applicable:

a) the circuit-switched network interface of the system shall implement the T.120 series of applications as specified in paragraph 7.2.6 as part of an H.320 call,

b) data shall be supported on logical channels defined in H.221 at data rates defined in Annex A, "*Definitions and tables of BAS values*", of ITU-T H.221, and

c) the telelearning system shall provide a software application that allows the user to configure and access the T.120 logical data channel as part of an H.320 call.

7.2.4.1.9 **H.320 far-end camera control**
The system should provide remote control capability. If this capability is provided, then the circuit-switched network interface of the system shall conform to "ITU-T H.281, *A far-end camera control protocol for videoconferences using H.224*".

7.2.5 Packet-switched network interfaces

7.2.5.1 Packet-switched network physical connection

The system shall provide a physical connection to a packet-switched network. The packet-switched network interface shall be Ethernet. The Ethernet network interface:

a) shall conform to ISO/IEC 8802-3 (2001-02) "*Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*",

b) connection type shall be a RJ-45 connector, and

c) should provide LED status indication of link activities.

7.2.5.2 ITU-T H.323 recommendation

ITU-T H.323 is a recommendation that covers technical requirements for packet based network multimedia communication systems which may not provide a guaranteed quality of service. The packet-switched network interface of the system shall conform to "ITU-T H.323, *Packet-based multimedia communication systems* ".

7.2.5.3 H.323 video transport

The packet-switched network interface of the system shall provide video transport for H.323 operation, in particular:

a) the packet-switched network interface of the system shall provide a video CODEC that complies with "ITU-T H.261, *Video codec for audiovisual services at px64 kbits* " such that the H.261 video CODEC:

   i) shall provide full-colour operation using QCIF and CIF picture format at up to 29.97 frames per second in accordance with H.261,

   ii) decoder should support the capability to detect and correct errors as specified in Section 5.4, "*Forward error correction for coded video signal*", of ITU-T H.261, and

   iii) should support the transmission and reception of freeze-frame images by means of the technique described in ITU-T H.261 Annex D.

b) the packet-switched network interface of the system shall provide a video CODEC that complies with "ITU-T H.263, *Video coding for low bit rate communication* " such that the H.263 video CODEC:

   i) shall provide full-colour operation using QCIF and CIF picture format at up to 29.97 frames per second in accordance with H.263, and

   ii) should support the transmission and reception of freeze-frame images by means of the technique described in Annex L of ITU-T H.263 for full-picture freeze request or full-picture snapshot tag.

c) the video source formats shall be negotiated as described in H.323 and H.245, and

d) the video bitstream shall be formatted as described in ITU-T H.225.0.

7.2.5.4 H.323 audio transport

The system shall be capable of transporting audio over an H.323 packet switched network interface having the following characteristics, in particular:

a) the packet-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.711, *Pulse code modulation (PCM) of voice frequencies*”,

b) the packet-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.722, *7 kHz audio-coding within 64 kbit/s*”,

c) the packet-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.728, *Coding of speech at 16 kbit/s using low-delay code excited linear prediction*”,

d) the packet-switched network interface of the system should provide an audio CODEC that conforms to “ITU-T G.729, *Coding of speech at 8 kbit/s using conjugate structure algebraic-code-excited linear-prediction (CS-ACELP)*”

e) the packet-switched network interface of the system shall provide an audio CODEC that conforms to “ITU-T G.723.1, *Speech coders: Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 kbit/s*”,

f) the audio CODEC shall be negotiated as described in H.323 and H.245, and

g) the audio bitstream shall be formatted as described in H.225.0.

7.2.5.5 H.323 multiplexing
The packet-switched network interface of the system shall conform to ITU-T H.225.0, *Call signalling protocols and media stream packetization for packet-based multimedia communication systems*.

7.2.5.6 H.323 control
The packet-switched network interface of the system shall conform to ITU-T H.245, *Control protocol for multimedia communication.*

7.2.5.7 H.323 multipoint operation
The system shall be capable of multipoint operation when connected to a packet switched network. The packet-switched network interface should provide a multipoint capability as described in "ITU-T H.323: *Packet-based multimedia communication systems*".

7.2.5.8 H.323 data transport
The system should be capable of transporting data over an H.323 packet switched network interface If this capability is provided, then the following requirements are applicable. The packet-switched network interface shall implement the T.120 series of applications as specified in paragraph 7.2.6 as part of an H.323 call, in particular:

a) data shall be supported on T.120 connections as part of an H.323 call as described in H.323 and H.245, and

b) the packet-switched network interface shall provide a software application that allows the user to configure and access the T.120 logical data channel as part of an H.323 call.

7.2.6 Data transport protocols in multimedia conferencing
The system should be capable of transporting data. If this capability is provided, then:

a) support should be provided for “ITU-T T.120, *Data protocols for multimedia conferencing*”,

b) support shall be provided for “ITU-T T.122, *Multipoint communications service - Service definition*”,

c) support shall be provided for “ITU-T T.123, *Network-specific protocol stacks for multimedia conferencing*”,

d) support shall be provided for “ITU-T T.124, *Generic conference control*”,

e) support shall be provided for “ITU-T T.125, *Multipoint communications service protocol specification*”,

f) support shall be provided for “ITU-T T.126, *Multipoint still image and annotation protocol*”, and

g) support shall be provided for”ITU-T.127, *Multipoint binary file transfer protocol*”.

7.3 Internal interfaces
The main purpose of specifying interoperability requirements for system internal interfaces is to allow ease of subsystem interchange and replacement. Requirements and recommendations for all internal interfaces identified in the communications controller context diagrams are specified in the following sections. The interfaces are applicable when the devices or subsystem connecting to the communications controller are not integrated with the communications controller unit as a whole.

7.3.1 Cabling and connecting
The requirements for the system's internal connectors are as follows:

a) internal connection cables shall connect securely to the system utilizing positive locking and/or strain relief where permissible by the applicable connector standard,

b) internal connection cables shall be contained and secured in a cable harness, cable tray and cable ties, and

c) internal connectors and cabling supplied should be labelled and/or colour-coded to identify cable type and placement.

7.3.2 Text entry device interface

The system should have a text entry device interface. The requirements of the interface are as follows:

a) the text entry device interface type shall be infrared (IR) or radio frequency (RF) wireless, and

b) for radio frequency (RF) interface type, the transmitter shall comply with the radio transmission regulations in the jurisdiction in which the system operates.

7.3.3 Remote control device interface

The system shall have a remote control device interface. The requirements of the interface are as follows:

a) the remote control device interface type shall be infrared (IR) or radio frequency (RF) wireless, and

b) for radio frequency (RF) interface type, the transmitter shall comply with the radio transmission regulations in the jurisdiction in which the system operates.

7.3.4 Microphone interface

For each microphone, the system shall provide a microphone interface. The microphone interface:

a) type shall be a phone jack/plug, a mini-phone jack/plug or XLR connector,

b) shall be a balanced connection,

c) shall provide phantom power through signal connection, and

d) should have matching impedance.

7.3.5 Audio line input interface

The system should provide an audio line input interface. The audio line input interface:

a) type shall be a RCA connector, and

b) should have matching impedance.

7.3.6 Video camera interface

The system shall provide a video camera interface. The requirements of the interface are as follows:

a) the video input interface type shall be a 4-pin mini-DIN (S-Video) or a RCA connector,

b) for S-Video input connector, the signal shall be S-Video,

c) for RCA input connector, the signal shall be composite video compatible with the video standard in the jurisdiction in which the system operates,

EXAMPLE The television video standard in Canada and the United States is National Television System Committee (NTSC).

d) for video camera input, a camera control interface shall be provided for pan, tilt and zoom (PTZ) operations.

7.3.7 Video cassette player interface

The system should provide a video cassette player interface. The requirements of the interface are as follows:

a) the video cassette player interface type shall be a 4-pin mini-DIN (S-Video) or a RCA connector,

b) for S-Video input connector, the signal shall be S-Video, and

c) for RCA input connector, the signal shall be composite video compatible with the video standard in the jurisdiction in which the system operates.

EXAMPLE The television video standard in Canada and the United States is National Television System Committee (NTSC).

d) The video cassette player should provide a serial interface to allow the software application to determine the state of and to control the video cassette player.

7.3.8 Video cassette recorder interface

The system should provide a video cassette recorder interface. The requirements of the interface are as follows:

a) the video output interface type shall be a 4-pin mini-DIN (S-Video) or a RCA connector,

b) for S-Video output connector, the signal shall be S-Video, and

c) for RCA output connector, the signal shall be composite video compatible with the television video standard in the jurisdiction in which the system operates.

EXAMPLE The television video standard in Canada and United States is National Television System Committee (NTSC).

7.3.9 35mm slide project interface

The system may have a 35mm slide projector interface. The requirements of the interface are as follows:

a) the video input interface type shall be either a 4-pin mini-DIN (S-Video) or a RCA connector,

b) for S-Video input connector, the signal shall be S-Video,

c) for RCA input connector, the signal shall be composite video compatible with the television video standard in the jurisdiction in which the system operates, and

EXAMPLE The television video standard in Canada and United States is National Television System Committee (NTSC).

d) the 35mm slide projector shall provide a serial interface to allow the software application to access the slide advancement/reversal, powered zoom, focus and iris adjustment features.

7.3.10 Computer display input interface

The system should provide a computer display input interface. The requirements of the interface are as follows:

a) the computer display input interface type shall be a VGA15-pin D-SUB connector,

b) the computer display input interface shall support VGA 640 x 480 x 32 bpp as the display resolution and colour depths,

c) the computer display input interface should support the following display resolutions and colour depths:

- SVGA 800 x 600 x 32 bpp,
- XVGA 1024 x 768 x 24 bpp, and
- SXGA 1280 x 1024 x 32 bpp.

7.3.11 Speaker interface

The system shall provide a speaker interface. The requirements of the interface are as follows:

a) the speaker interface type shall be a phone jack/plug, a mini-phone jack plug *or* a XLR connector, and

b) the audio line input interface should have matching impedance.

7.3.12 Audio line output interface

The system should provide an audio line output interface. The requirements of the interface are as follows:

a) the audio line output interface type shall be a RCA connector, and

b) the audio line input interface should have matching impedance.

7.3.13 Television/video monitor interface

The system shall provide a television/video monitor interface. The requirements of the interface are as follows:

a) the video output interface type shall be a 4-pin mini-DIN (S-Video) connector or a RCA connector,

b) for S-Video output connector, the signal shall be S-Video, and

c) for RCA output connector, the signal shall be composite video compatible with the television video standard in the jurisdiction in which the system operates.

EXAMPLE The television video standard in Canada and the United States is National Television System Committee (NTSC).

7.3.14 Computer display output interface

The system should provide a display output interface. The requirements of the interface are as follows:

a) the computer display output interface type shall be a VGA15-pin D-SUB connector,

b) the computer display output interface shall support all of these display resolutions and colour depths:

- VGA 640 x 480 x 32 bpp,
- SVGA 800 x 600 x 32 bpp, and
- XVGA 1024 x 768 x 24 bpp.

c) the computer display output interface should support SXGA 1280 x 1024 x 32 bpp as the display resolution and colour depth.

ICS 35.240.80

Price based on 37 pages