Health informatics – Interoperability of telehealth systems and networks –
Part 1: Introduction and definitions

Élément introductif — Élément central — Élément complémentaire

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Foreword

Draft Technical Reports adopted by the technical committees are circulated to the member bodies for voting prior to publication.

All portions of this ISO Technical Report are informative, including annexes.

This ISO Technical Report has been prepared by ISO/TC 215, “Health Informatics”, Working Group 2 “Healthcare Messaging and Communication”.

INTRODUCTION

Delivery of health care services by means of telehealth is advancing rapidly. Telehealth enables providing these services with the use of information and telecommunications technologies. This includes a broad spectrum of capabilities including acquisition, storage, presentation, and management of patient information (represented in different digital forms such as video, audio, or data), and communication of this information between care facilities with the use of communications links.

Telehealth interactions may be carried out in three ways: real-time, store-and-forward or with the use media streaming methods. While real-time interactions imply that all parties directly participate in the telehealth session, store-and-forward interactions involve sending, reviewing, and returning an opinion over a period of time. Streaming is a method of delivery real-time or stored data such as audio, video, documents, still images, or other data type across networks with a reasonable amount of Quality of Services (QoS). With streaming, a receiving system can start displaying (or playing) the data before the entire content arrives.

Real-time telehealth sessions usually involve synchronous data transmission while store-and-forward can usually be regarded as asynchronous. Streaming uses time-synchronized streams of continuous media during transmission. However, data presentation uses buffering, if the receiving system receives data more quickly than required. If the data is not received quickly enough, the presentation of the data is interrupted.

Interoperability of telehealth systems and networks is critical in ensuring the telehealth technology serves well the care recipients and providers and meets their expectations. While this requirement is essential to the long-term sustainability of telehealth, interoperability is difficult to achieve. There are many reasons that make telehealth interoperability difficult, however, the following three need urgent addressing: (1) too broad definition of telehealth, (2) lack of standards specifically designed for telehealth, (3) collaboration between the information technology and telecommunications industries.

There are multiple definitions of telehealth. The services provided by telehealth cover a broad spectrum of activities ranging from videoconferencing through exchange of health information to providing care services in emergency and complex clinical cases. From a technology perspective, the scope of these services is too broad and this makes it difficult to develop telehealth standards and products.

There is no 'official' telehealth standard. The telehealth industry uses high-level health care guidelines and technical standards developed for various technology sectors including multimedia conferencing, information technology, data communications, and security. They focus on functional and operational requirements and do not address interoperability. To further complicate the problem, all of these standards as well as the telehealth needs and practices are rapidly changing.

Telehealth, more than any other recent development, bridges the boundaries between telecommunications and information technologies. The business goals and attitudes of these two industries are different. Telecommunications industry has a history of regulation, standardization, and control of the customer premises equipment. Interoperability and reliability have been the key factors to growth. The information technology industry (the desktop computing industry in particular) has achieved success through encouraging innovation, diversity, and tremendous cost-efficiency not always paying attention to interoperability aspects of the technology. The marriage of these two cultures and the integration of their respective technologies proved to be challenging.

To address the needs for interoperable telehealth systems and networks, telehealth services must be clearly defined in terms of their scope and interrelationships with other health-related services, a set of telehealth-specific standards must be developed, and subsequently implemented by the respective industries.

This two-part ISO Technical Report addresses interoperability issues in telehealth systems and networks. This document has been structured as follows:

Part 1: Introduction and Definitions. Covers an introduction to telehealth and includes the definitions of telehealth, interoperability, and related terms.

Part 2: Real-Time Systems. Defines the scope of the technical standards related to real-time applications, (including video, audio, and data conferencing), identifies gaps and overlaps in the standards, defines requirements for interoperable telehealth systems and networks, and identifies building blocks for interoperable telehealth solutions.
This Technical Report is to be complemented by two other documents that will cover interoperability of store-and-forward and media streaming telehealth applications.

The target users of these documents are care providers and health care organizations, telehealth equipment vendors and implementers of telehealth solutions, professional organizations, and governments.
Health informatics — Interoperability of telehealth systems and networks — Part 1: Introduction and definitions

1 Scope

The scope of this document titled Interoperability of telehealth systems and networks - Part 1: Introduction and definitions includes a brief introduction to interoperability of telehealth systems and networks and definitions of telehealth and related terms.

An appendix describing the Telehealth Technical Reference Architecture has been also been included to define more clearly the various components of a telehealth system and the elements that need to be addressed in formulating a set of requirements for these various components.

The scope of this document does not include the conformance and interoperability tests or functional specifications for telehealth systems and networks.

A more detailed description of issues concerning the interoperability of telehealth systems and networks capable of operating in real-time mode (including audio, video, and data conferencing) is included in Part 2. Real-Time Systems. That document identifies standards for real-time telehealth systems, examines interoperability aspects of telehealth applications, and defines interoperability requirements for telehealth systems and networks. Other documents will describe the issues surrounding interoperability of telehealth systems that use store-and-forward and media streaming technologies.

2 Normative References

This ISO Technical Report incorporates by dated or 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 Report only when incorporated in it by amendment and revision.

For undated references, the latest edition of the publication referred to applies.


ITU-T Recommendation 243 (1997) Procedures for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s.
3 TERMS AND DEFINITIONS

The following definitions are not meant to be universal in ISO work in Health Informatics, only to facilitate the understanding of this ISO Technical Report. For the purposes of this ISO Technical Report, the following definitions apply:

Accreditation

Procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks

A-law

A variant of the G.711 audio encoding used primarily in North America and Japan. Related terms: µ-law, G.711

Asynchronous Transmission

Transmission of individual bytes without time-dependency between the bytes.

Audiographics Terminal

A terminal that has audio and graphics capabilities, but no video capability.

Audiovisual Terminal
A terminal that has audio, video, and graphics capabilities.

**BRI (Basic Rate Interface)**

An ISDN service comprising two B (bearer) channels operating at 64 Kbps each and one D (data) channel operating at 16 Kbps.

**Call**

Point-to-point multimedia communication between two H.32x endpoints.

**Call setup**

The process of establishing a group of communication users and includes the initialization of any shared application and other resources which the user may require to be available.

**Call Signalling Channel**

Reliable channel used to convey call setup messages following Q.931.

**Call teardown**

The process of ending a call and freeing any resources reserved for that call.

**CCD**

Charge coupled device used in cameras as an optical scanning mechanism. It consists of a shift register that stores samples of analog signals. An analog charge is sequentially passed along the device by the action of stepping voltages and stored in potential wells formed under electrodes. The charge is moved from one well to another by the stepping voltages.

**Centralized Multipoint Conference**

A call in which all participating terminals communicate in a point-to-point fashion with an MCU.

**Certification**

Procedure by which a third party gives written assurance in the form of a certificate of conformity that a product, process or service conforms to specified requirements.

**CIF (Common Intermediate Format)**

An ITU-T standard video picture scanning format where information is stored in luminance (brightness) and two color difference (chrominance) components. It represents 352 pixels/line by 288 lines/image for luminance and 176 pixels/line by 144 lines/image for chrominance. See also QCIF.

**Codec**

A codec/decoder, used to covert analog signals into digital (and vice versa), and perform encoding / decoding and compression / decompression of the digital data.

**Composite Video**

A type of video signal in which all information -- the red, blue, and green signals (and sometimes audio signals as well) -- are mixed together. Composite video is used by NTSC-compliant devices (see NTSC Standard).

**Conformance**

Conformance refers to the ability of a system to perform a set of functions according to the specifications. Conformance to a set of specifications is a prerequisite to interoperability. However, conformance to the specifications alone does not guarantee interoperability of systems.

**Conformance Statement**
A conformance statement is a statement that identifies conformance points of a specification and the behaviour that must be satisfied at these points. Conformance statements occur in standards intended to define some feature of a real implementation and offer the possibility of testing.

Conformance Testing

Conformance testing is the process of assessing whether a product meets the requirements of a particular specification or set of specifications. The primary output of conformance testing is a test report, which specifies the conformance statements, the actual results of testing, and the conformance status (i.e., whether or not the given product passed the test).

CSU (Channel Service Unit)

A type of interface used to connect a terminal or computer to a digital medium in the same way that a modem is used for connection to an analogue medium.

Decentralized Multipoint Conference

A conference in which the participating terminals multicast to all other participating terminals without an MCU.

DSU (Data Service Unit)

A device used in digital transmission for connecting a CSU (Channel Service Unit) to Data Terminal Equipment (a terminal or computer), in the same way that a modem is used for connection to an analogue medium. Also see CSU.

Endpoint

A Terminal, Gateway, or MCU.

G.711

An ITU-T recommendation for the digital representation of speech up to 3.4 KHz of frequency producing a 64 Kbps data stream. Commonly used in telephone networks. It comes in two variants: A-law and μ-law.

G.722

An ITU-T recommendation for the digital representation of audio up to 7 KHz of frequency producing a 64 Kbps data stream with a much higher quality than G.711.

G.728

An ITU-T recommendation for the digital representation of audio producing a 16 Kbps data stream producing near-telephone quality audio.

Gatekeeper

An H.323 entity that provides address translation, control access, and sometimes bandwidth management to the LAN for H.323 terminals, Gateways, and MCUs.

Gateway

An H.323 entity, which provides real-time, two-way communications between H.323 terminals on the LAN and other ITU terminals on a WAN, or to another H.323 Gateway.

GCC (Generic Conference Call)

A set of conference services described in the ITU-T T.124 Recommendation.

H.221

An ITU-T recommendation defining how to multiplex video and audio into frames using 64-1920 Kbps channels for switched and leased network services, excluding packetized networks.
ISO-IEC

H.225D
An ITU-T recommendation that specifies messages for call control including signaling, registration and admissions, and packetization/synchronization of media systems.

H.230
An ITU-T recommendation that specifies the frame-synchronous control and indication signals for audiovisual systems.

H.231
An ITU-T recommendation that specifies the multipoint control unit.

H.235
An ITU-T recommendation that defines the security framework used to provide authentication, encryption, and integrity for H.323 systems.

H.242
An ITU-T recommendation that specifies how to establish the communication between audiovisual terminals using digital channels with speeds up to 2 Mbps.

H.243
An ITU-T recommendation that specifies the establishment of communication between three or more audiovisual terminals using digital channels with speeds up to 2 Mbps.

H.245
An ITU-T recommendation that specifies messages for opening and closing channels for media streams, and other commends, requests and indications between two H.323 endpoints.

H.261
An ITU-T recommendation that specifies the video encoding and compression algorithm for two video resolutions: 352 x 288 CIF (common intermediate format) and 176 x 144 QCIF (quarter common intermediate format). It is used in both H.320 and T.120.

H.263
An ITU-T recommendation that specifies a new video codec for video over packet-switched networks or POTS. It optimizes H.261 for very low bit rate of video coding below 64 Kbps. H.263 provides better motion compensation, more accurate motion vectors, optimized quantization for very low bit rates, and arithmetic coding.

H.310
A family of ITU-T standards ratified in 1995. Describes the technical specifications for adapting narrow-band ISDN visual telephone terminals, as defined in H.320, to broadband ISDN (BISDN) and ATM environments. H.310 adds the MPEG-2 video-compression algorithm that provides MPEG-2 video quality.

H.320
A family of ITU-T standards, ratified in 1990, specifies how voice and video conferencing systems communicate over ISDN or leased networks, using a bandwidth from 64 Kbps to 1920 Kbps.

H.323
This family of ITU-T standards, ratified in 1996, extends H.320 to computer networks, including LANs and the Internet. H.323 supports both point-to-point and multipoint operations. In addition, H.323 shares many components of the H.32x specification, such as the H.261 video codec, the G.711 audio codec, the H.263 video codec, G.722, G.723 and G.728. As a new feature, H.323 specifies a gatekeeper component that allows LAN administrators to
ISO-IEC_

manage video traffic for QoS. The H.323 specification also defines a LAN/H.320 gateway that permits a H.323 node to interoperate with H.320/H.324 terminals.

H.324

This family of ITU-T standards, ratified in 1996, allows video conferencing over standard analog phone lines with features similar to those in H.320. The H.324 standard uses H.263, which contains a better codec for POTS than H.261. H.263 is an improved version of H.261 that adds a 128 x 96 sub-QCIF (SQCIF) format. By using a 28.8 or 36.6 Kbps modem, H.263 may produce frame rates approaching those achieved by H.320 systems over ISDN.

Interoperability

Interoperability refers to 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 Testing

Since conformance 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 conformance of an implementation. Two systems can be interoperable but still not compliant to the standard or specification.

µ-law

A variant of the G.711 audio encoding used primarily in North America and Japan. See also G.711 and A-law.

MCU (Multipoint Control Unit)

An endpoint on the LAN which enables three or more terminals and Gateways to participate in a multipoint conference. The MCU includes a mandatory Multipoint Controller and optional Multipoint Processors.

MC (Multipoint Controller)

An entity that provides for the control of three or more terminals in a multipoint conference.

MP (Multipoint Processor)

An entity that provides for the processing of audio, video, and/or data streams in a multipoint conference. The MP provides for the mixing, switching, or other processing of media streams under the control of the MC.

Multipoint Conference

A conference between three or more terminals, which may be on the LAN or on the Circuit Switched Network.

NTSC Standard

A standard for television broadcasting established by the National Television Standards Committee. Used in North America, Japan and some other countries. NTSC format: Lines / frame: 525; Frames per second (fps): 30; Interlace ratio: 2:1; Aspect ratio: 4:3; Color matrix equation: \( Y = 0.3\times R + 0.59\times G + 0.11\times B \); \( I = 0.6\times R - 0.28\times G - 0.32\times B \); \( Q = 0.21\times R - 0.52\times G + 0.31 \times B \); where R = red, G = green, and B = blue.

Pulse Code Modulation

A technique of used for the digital sampling of sound. The input waveform with a bandwidth up to 4.0 KHz is sampled at the recommended rate of 8,000 samples per second. Each sample is converted to one of 212 digital values and then compressed on either the A-law or the µ-law. This sampling scheme is adequate for voice communication.

Quality of Service (QoS)
A set of network technologies that enable a network to handle data traffic with a minimum amount of negative effects in a network environment used by many other users. Subscribers of QoS specify requirements in service-level agreements (SLAs) regarding throughput, packet loss, latency, and jitter.

**Point-to-Point Protocol**

The protocol defined in RFC 1661, the Internet standard for transmitting network layer datagrams (e.g. IP packets) over serial point-to-point links.

**PRI (Primary Rate Interface)**

An ISDN service comprising 23 B (bearer) channels operating at 64 Kbps each and one D (data) channel operating at 16 Kbps.

**ACIF (Quarter Common Intermediate Format)**

Represents 176 pixels/line by 144 lines/image for luminance and 88 pixels/line by 72 lines/image for chrominance. See also CIF

**RTP (Real-time Transport Protocol)**

A data communication protocol capable of delivering real-time data such as live or interactive audio and video over IP packet-switched networks. RTP runs over UDP and uses its multiplexing and error checking features.

**RTSP (Real-time Streaming Protocol)**

An application-level protocol that establishes and controls one or more time-synchronized streams of continuous media. It has been designed to serve up multimedia from a cluster of hosts and acts as a network remote control for multimedia servers.

**SMIL (Synchronized Multimedia Integration Language)**

Enables simple authoring of interactive audiovisual presentations. SMIL is typically used for rich media/multimedia presentations, which integrate streaming audio and video with images, text or any other media type.

**Synchronous Transmission**

Data communications in which transmissions are sent at a fixed rate, with the sending and receiving devices synchronized.

**T.120**

This family of ITU-T standards, ratified in 1996. They define collaborative document sharing and whiteboard activities. The T.120 standards provide the audiographic portion of the H.320, H.323 and H.324 families. They also work independently as an audiographic conference for a low-bandwidth channel. The whiteboard capability provides document-sharing functions for multiple users so that they can simultaneously view and annotate a document with pens, highlighters and drawing tools. This specification also allows data-only T.120 sessions when no video communications are required or provided. In addition, T.120 supports multipoint meetings in which the participants use different transmission media.

**T.121**

This standard provides a generic application template (GAT), which specifies a common set of guidelines for building application protocols and the management facility that controls the resources used by the application. T.121 also describes how an application protocol, such as T.127 for file transfer, performs the following functions:

- Registers itself with the conference.
- Applies its capabilities locally and remotely.
- Interoperates and negotiates capabilities with other applications.

To ensure application consistency, T.121 is a required standard for products developed under T.120. The ITU also recommends that non-standard applications incorporate T.121 to provide product interoperability.
T.122
This standard defines the multipoint services, which allow one or more participants to send data as part of a conference. These multipoint services are implemented by T.125, which provides the mechanism for transporting the data. Together, the T.122 and T.125 standards make up the T.120 multipoint communication services (MCS).

T.123
This standard is responsible for transporting and sequencing data, and for controlling the flow of data across networks, including connect, disconnect, send, and receive functions. For data transport, T.123 defines a series of network interface profiles. Also, T.123 provides an error-correcting mechanism that ensures accurate and reliable data delivery.

T.123 Annex B, an addition to the T.123 data conferencing standard, also defines the protocol for secure data conferencing.

T.124
This standard provides the generic conference control (GCC) for initiating and administering multipoint data conferences. The GCC performs the following functions:

- Serves as the information centre, directing users and data in and out of conferences and monitoring progress so that the latest conference information is always available.
- Maintains lists of conference participants and their applications; the GCC identifies compatible applications and features so that products can interoperate.
- Tracks MCS resources so that conflicts do not occur when conference participants use multiple application protocols, such as T.127 for file transfer and T.128 for application sharing.

T.125
This standard specifies how data is transmitted within a conference. T.125 defines the private and broadcast channels that transport the data, and ensures accurate and efficient communication among multiple users. T.125 also implements the multipoint services defined by T.122.

T.126
This standard specifies how an application sends and receives whiteboard information, in either compressed or uncompressed form, for viewing and updating among multiple conference participants. The role of T.126 is to manage the multi-user workspace provided by the whiteboard.

T.127
This standard (also known as T.MBTF for Multipoint binary file transfer) defines how files are transferred simultaneously among conference participants. T.127 enables one or more files to be selected and transmitted in compressed or uncompressed form to all or selected participants during a conference.

T.128
This standard specifies the program sharing protocol, defining how participants in a T.120 conference can share local programs. Specifically, T.128 enables multiple conference participants to view and collaborate on shared programs.

T.134
A protocol that provides point-to-point and multipoint distribution of text messages within the T.120 conference. It provides real-time or near-real-time text communications for those applications where audio communication is not available.

T.135
A protocol that allows a user to reserve and control multipoint conference resources. It defines conferencing reservation protocols in a T.120 environment, typically between a client application and a scheduling system which reserves resources for multipoint control units (MCUs) or bridges.

T.136

A protocol that specifies how Remote Device Control and configuration may be performed using T.120 as the transport protocol.

T.140

A protocol for multimedia application text conversation. The protocol for text chat within T.120, goes with T.134.

T.AVC

A protocol that describes the control of audio and video capabilities present in a desktop or videoconference. This standard extends the capabilities offered by H.320.

T.RDC

This is a relatively new recommendation that provides control of remote audio and video devices during a conference. It is an extension of H.281 for far End Camera Control.

TCP/IP (Transport Control Protocol/Internet Protocol)

The de facto standard Ethernet protocols incorporated into 4.2BSD Unix. TCP/IP was developed by DARPA for internetworking and encompasses both network layer and transport layer protocols. While TCP and IP specify two protocols at specific protocol layers, TCP/IP is often used to refer to the entire DoD protocol suite based upon these, including telnet, FTP, UDP and RDP.

Telemedicine

Telemedicine - the use of advanced telecommunication technologies to exchange health information and provide health care services across geographic, time, social and cultural barriers.” (Reid, 1996).

Telehealth

Telehealth is the use of telecommunication techniques for the purpose of providing telemedicine, medical education, and health education over a distance.” (GATES, 1994).

Terminal

An endpoint system, which provides for real-time, two-way communications with another Terminal, Gateway, or MCU. A terminal must provide audio and may also provide video and/or data.

User Datagram Protocol

An unreliable networking layer that sits at the same level of the networking stack as TCP.

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

Video Streaming

A method of delivery of multimedia data (e.g. audio, video, images, text, alphanumeric data, time-series, waveform data) across the networks with a reasonable amount of Quality of Service (QoS). The receiving system presents (displays or plays) the data while the data is being transmitted in the background. Typically no storage of data occurs during streaming. The following protocols have been created by the IETF and W3C to achieve data streaming:

- RTP (Real-time Transport Protocol).
ISO-IEC_

- RTSP (Real-time Streaming Protocol)
- SMIL (Synchronized Multimedia Integration Language)

**Zone**

A collection of all Terminals, Gateways, and MCUs managed by a single Gatekeeper. A zone must include at least one Terminal and may include LAN segments connected using routers.

## 4 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACR</td>
<td>American College of Radiologists</td>
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<tr>
<td>ADSL</td>
<td>Asynchronous Digital Subscriber Line</td>
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<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ATM</td>
<td>Asynchronous Transfer Mode</td>
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<td>BRI</td>
<td>Basic Rate Interface</td>
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<tr>
<td>CDC</td>
<td>Charge Coupled Device</td>
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<tr>
<td>CIF</td>
<td>Common Intermediate Format</td>
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<tr>
<td>CMS</td>
<td>Control, Management and Signalling</td>
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<td>CSU</td>
<td>Channel Service Unit</td>
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<td>DSU</td>
<td>Data Service Unit</td>
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<td>GCC</td>
<td>Generic Conference Call</td>
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<td>IETF</td>
<td>Internet Engineering Task Force</td>
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<td>IP</td>
<td>Internet Protocol</td>
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<td>ISDN</td>
<td>Integrated Services Digital Networks</td>
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<td>ITU-T</td>
<td>International Telecommunications Union – Telecommunications</td>
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<td>LAN</td>
<td>Local Area Network</td>
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<td>MC</td>
<td>Multipoint Controller</td>
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<td>MP</td>
<td>Multipoint Processor</td>
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<td>NTSC</td>
<td>National Television Standards Committee</td>
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<td>POTS</td>
<td>Plain Old Telephone System</td>
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<td>PRI</td>
<td>Primary Rate Interface</td>
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<td>QCIF</td>
<td>Quarter Common Intermediate Format</td>
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<td>QoS</td>
<td>Quality of Service</td>
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<td>RTP</td>
<td>Real-time Transport Protocol</td>
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<td>RTCP</td>
<td>Real-Time Control Protocol</td>
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<td>RTSP</td>
<td>Real-time Streaming Protocol</td>
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<tr>
<td>SCN</td>
<td>Switched Circuit Network</td>
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5 TELEHEALTH AND TELEMEDICINE

The terms telehealth and telemedicine mean many things to many people. Many definitions of these terms found in the literature try to be all-embracing and therefore vague. Some current definitions of telemedicine and telehealth include the following:

“Telehealth - the use of advanced telecommunication technologies to exchange health information and provide health care services across geographic, time, social and cultural barriers.” (Reid, 1996).

“Telemedicine involves the use of modern information technology, especially two-way interactive audio/video communications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distances from each other.” (Bashshur, et al., 1997).

“Telemedicine is a system of health care delivery in which physicians examine distance patients through the use of telecommunications technology. Telemedicine, in a strict sense, means live, interactive audiovisual communications between physician and patient or between physician and physician.” (Preston, 1993).

In a report concerning the telehealth industry in Canada generated by Industry Canada in 2000 telehealth was defined as:

"Telehealth is the use of communications and information technology to deliver health and health care services and information over large and small distances.” (Picot and Cradduck, 2000).

The World Health Organization (WHO) makes a distinction between telemedicine and telehealth.

“If telehealth is understood to mean the integration of telecommunications systems into the practice of protecting and promoting health, while telemedicine is the incorporation of these systems into curative medicine, then it must be acknowledged that telehealth corresponds more closely to the international activities of WHO in the field of public health. It covers education for health, public and community health, health systems development and epidemiology, whereas telemedicine is oriented more towards the clinical aspect.” (Antezana, 1997).

The participants of the Global Access Telehealth and Education System (GATES) study sponsored by the UN defined telemedicine as a subset of telehealth, as reflected in the following definitions:

“Telemedicine: a subset of telehealth, telemedicine involves the use of telecommunication techniques for the purpose of providing medical and health care, enhancing diagnoses, expanding research, and improving treatment of illness over a distance.” (GATES, 1994).

“Telehealth: the use of telecommunication techniques for the purpose of providing telemedicine, medical education, and health education over a distance.” (GATES, 1994).

While the word telemedicine that became prominent in the early 1990s focuses on the delivery of medical care at a distance, telehealth is considered more generic and broader. It extends beyond the delivery of medical care and includes health protection, health promotion, medical education, and health education. For the purpose of this report, the term telehealth will be used.

6 INTEROPERABILITY

Although several definitions of interoperability exist, there is no generally accepted definition of this term. Examples of definitions along with their sources are included below:
"The ability of two or more systems or components to exchange information and to use the information that has been exchanged." (IEEE Dictionary).

"A state which exists between two application entities, with regard to a specific task, when one application entity can accept data from the other and perform that task in an appropriate and satisfactory manner without the need for extra operator intervention." (CEN/TC 251/N99-097).

For the purpose of this document, interoperability is defined as follows:

"Interoperability refers to 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."

As this definition implies, there are two aspects of interoperability:

1. The conceptual aspect, which focuses on WHAT, namely:
   a) WHAT information is being exchanged. This is defined by means of information models, which model data entities, their attributes, and the relationships between the entities.
   b) WHAT tasks actually exchange the information. This is defined by means of functional models, which model processes and activities performed by the systems.

2. The implementation aspect, which focuses on HOW to achieve expected results through defining the behavior of the participating systems. This is defined by describing how the tasks actually co-operate and communicate, and how to handle the information communicated by the participating systems.

This document takes into account both aspects of interoperability.

7 Compliance with Standards and Interoperability

Standards and interoperability are critical in ensuring that telehealth deployed at health care facilities meets users' expectations. Standards are needed to ensure that the telehealth systems meet functional, operational, and clinical requirements. They are a means by which interoperability can be achieved. Conformance to standards is not enough for assuring interoperability but is a prerequisite for interoperability.

A successful implementation of the Telehealth Interoperability Standards depends on the maturity of the clinical and technical standards, the level of conformance of the telehealth products to the standards, and the interoperability-focused implementation methodology. The Telehealth Interoperability Standards provide tools and techniques for addressing interoperability of telehealth systems and networks and lead to the development of interoperability-focused implementation methodology.
APPENDIX A. TELEHEALTH TECHNICAL REFERENCE ARCHITECTURE

A technical architecture is the minimal set of requirements governing the arrangement, interaction, and interdependence of technical system parts or elements. The Telehealth Technical Reference Architecture (TTRA) shown in Figure 1 guides the acquisition and development of new and emerging functionality and provides a baseline toward which existing systems should move. It has been used to develop TeleHealth requirements for service areas.

The Communications Controller and NOS (Network Operating System) represent one or many processing units that allow its local devices to communicate with other devices internal to the subsystem or external to that subsystem. 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 telehealth application enabling real-time and/or store and forward processing of patient data.

The Applications Framework 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.

The Output Devices subsystem represents all analog and digital devices used to provide data for analysis, monitoring, control, recording and archiving.
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.

The **Training, Policies and Operational Procedures** are operational requirements carried-forward to the technical architecture 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.
APPENDIX B. (INFORMATIVE) BIBLIOGRAPHY


