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Foreword

This ETSI Technical Report (ETR) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETSI Technical Report (ETR) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1 Scope

This ETR presents the results of a study of communication protocols and formats related to multimedia communication services and applications.

The study covers protocols and formats that are standardized and under study within standardization organisations. The study represents a general survey and certain de facto standards, including some relating to the Internet, are also included. However, it should be noted that the survey does not provide an exhaustive coverage of these types of specifications, and does not make reference to signalling protocols carried by Local Area Networks (LANs).

The objective of this ETR is to present an executive overview over the communication protocols and formats related to multimedia communication services and applications. This ETR does not present all detail about these protocols. Some general analysis and recommendations are made to indicate to the Technical Committees of ETSI where further analysis is required.

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

ATM Adaptation Layer (AAL): The functional description of the B-ISDN ATM adaptation layer can be found in ITU-T Recommendation I.362 [1].

B-channel: A 64 kbit/s channel in the Integrated Services digital Network (ISDN).

bearer service: See CCITT Recommendation I.112 [2], § 2.2, definition 202.

Common Intermediate Format (CIF): A picture format defined in ITU-T Recommendation H.261 [3].

conversational service: Telecommunication services where voice communication is the only or one of the media.

NOTE 1: This definition is more restrictive than the definition of conversational services in ITU-T Recommendation I.113 [4], § 2.1, definition 106.

D-channel: The signalling channel in the ISDN.

fallback: A mechanism whereby a request for a teleservice, which include an indication that an alternative teleservice is acceptable, results in a connection using the alternative teleservice.

NOTE 2: Further information about fallback in the ISDN can be found in subclause 7.2.3.

G3C: A facsimile group 3 option having the capability to operate at a rate of 64 kbit/s over the ISDN. This option is defined in ITU-T Recommendation T.4 [5].

G3F: A facsimile group 3 option having the capability to operate at a rate of 64 kbit/s over the ISDN. This option is defined in ITU-T Recommendation T.4 [5]. This option can interwork with facsimile group 4 class 1.

H0 channel: A 384 kbit/s channel.

H11 channel: A 1 536 kbit/s channel.

H12 channel: A 1 920 kbit/s channel.

hypermedia: A concept similar to hypertext where several media can be used.

hypertext: Block of texts that are chained together by electronic links. The user may browse through linked, cross-references or annotated texts in a non or multisequential manner.

intercommunication: Communication between terminals attached to the same network but supporting different services.

NOTE 3: This term is used in ETSI ISDN teleservice stage one descriptions. The term interworking is also used both in ETSI standards and ITU-T Recommendations.

Internet: Is a network of computer networks based on the Internet (TCP/IP) protocols. It is organised by a non-profit organisation, the Internet Society (ISOC).

interworking: Communication between different types of networks, e.g. Public Switched Telephone Network (PSTN) and ISDN or between different applications.

messaging services: See ITU-T Recommendation I.113 [4], § 2.1, definition 114.

Multipoint Control Unit (MCU): A piece of equipment located in a node of the network or in a terminal that connects several terminals and, according to certain criterion, processes audiovisual signals and distributes them to the connected terminals.

Quarter Common Intermediate Format (QCIF): A picture format defined in ITU-T Recommendation H.261 [3].

retrieval service: See ITU-T Recommendation I.211 [6], § 1.3.

Request For Comments (RFC): An identification of informal standards on Internet protocols.

service; telecommunications service: See CCITT Recommendation I.112 [2], § 2.2, definition 201.

supplementary service: See CCITT Recommendation I.210 [7], § 2.4.

TCP/IP: The protocol suite used on Internet.

telematic services: Telecommunication services which include information communication between two (or more) terminals, e.g. facsimile.

teleservice: See CCITT Recommendation I.112 [2], § 2.2, definition 203.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

AAL	ATM Adaptation Layer
ACSE	Association Control Service Element
ADF	Application profile for DFR
ADPCM	Adaptive Differential Pulse Code Modulation
ADSL	Asymmetrical Digital Subscriber Line
AGC	Audio Graphic Conference
ANSI	American national Standards Institute
ATM	Asynchronous Transfer Mode
ATU-C	ADSL Transmission Unit - Central Office end
ATU-R	ADSL Transmission Unit - Remote end
AU	Access Unit

AVCS	Audiovisual Conferencing Service
B-ISDN	Broadband Integrated Services Digital Network
BAS	Bitrate Allocation Signal
BC	Bearer Capability
BCLB	Broadband Connectionless Data Bearer Service - type D
BCOB-A	Broadband Connection-oriented Bearer Service - type A
BCOB-X	Broadband Connection-oriented Bearer Service - type X
B-NT1	Network Termination 1 for B-ISDN
B-NT2	Network Termination 2 for B-ISDN
B-TE1	Terminal type 1 for B-ISDN
C&I	Control and Indication
CIF	Common Intermediate Format
CLI	Calling Line Identification
CSDN	Circuit Switched Data Network
CSPDN	Circuit Switched Public Data Network
DAP	Document Application Profile
DCE	Data circuit-terminating Equipment
DCME	Digital Circuit Multiplication Equipment
DCT	Discrete Cosine Transform
DFR	Document Filing and Retrieval
DPCM	Differential Pulse Code Modulation
DTAM	Document Transfer and Manipulation
DTD	Document Type Definition
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
ECS	Encryption Control Signal
EDI	Electronic data Interchange
FAS	Frame Alignment Signal
FMBS	Frame Mode Bearer Service
FTAM	File Transfer, Access and Management
FTP	File Transfer Protocol
G3	Facsimile group 3
G4	Facsimile group 4
GCC	Generic Conference Control
HDTV	High Definition TV
HLC	High Layer Compatibility
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IEC	International Electrotechnical Committee
IPM	Interpersonal Messaging System
IRC	Internet Relay Chat
ISDN	Integrated Services Digital Network
ISOC	Internet Society
ISUP	ISDN User Part
IWF	Interworking Function
JPEG	Joint Photographic Experts Group
LAN	Local Area Network
MCS	Multipoint Communication Service
MCU	Multipoint Control Unit
MHEG	Multimedia and Hypermedia information coding Expert Group
MHS	Message Handling System
MIME	Multipurpose Internet Mail Extensions
MLP	Multi Layer Protocol
MPEG	Moving Picture experts Group
MS	Message Store
MTA	Message Transfer Agent
MTS	Message Transfer System
N-ISDN	Narrowband ISDN
NNTP	Network News Transfer Protocol
NT1	Network Termination 1 for ISDN
NT2	Network Termination 2 for ISDN
OAM	Operations and Maintenance
ODA	Open Document Architecture

OSI	Open Systems Interconnection
PCM	Pulse Code Modulation
PDN	Public Data Network
PDAU	Physical Delivery Access Unit
PNO	Public Network Operator
PSDN	Packet Switched Data Network
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
QCIF	Quarter Common Intermediate Format
RFC	Request For Comment
ROSE	Remote Operation Service Element
RTSE	Reliable Transfer Service Element
SBV	Syntax-Based Videotex
SC	Service Channel
SCF	Synchronisation and Convergence Function
SGML	Standard Generalized Markup Language
SMDL	Standardized Music Description Language
SMSL	Standard Multimedia Scripting Language
SMPT	Simple Mail Transfer Protocol
TE	Terminal Equipment
TE1	Terminal Equipment type 1 for ISDN
TS	Time Slot
UA	User Agent
UDI	Unrestricted Digital Information
UDI-TA	Unrestricted Digital Information with Tones and Announcements
URL	Uniform Resource Locator
VEMMI	Videotex Enhanced Man Machine Interface
VT	Virtual Terminal
VTE	Virtual Terminal Environment
VTR	Video Tape Recorder
WAIS	Wide Area Information Services
WWW	World Wide Web

4 Protocols for teleservices

4.1 ISDN Videotex scheme

The taxonomy of the Videotex standards/recommendations is reflected in figure 1.

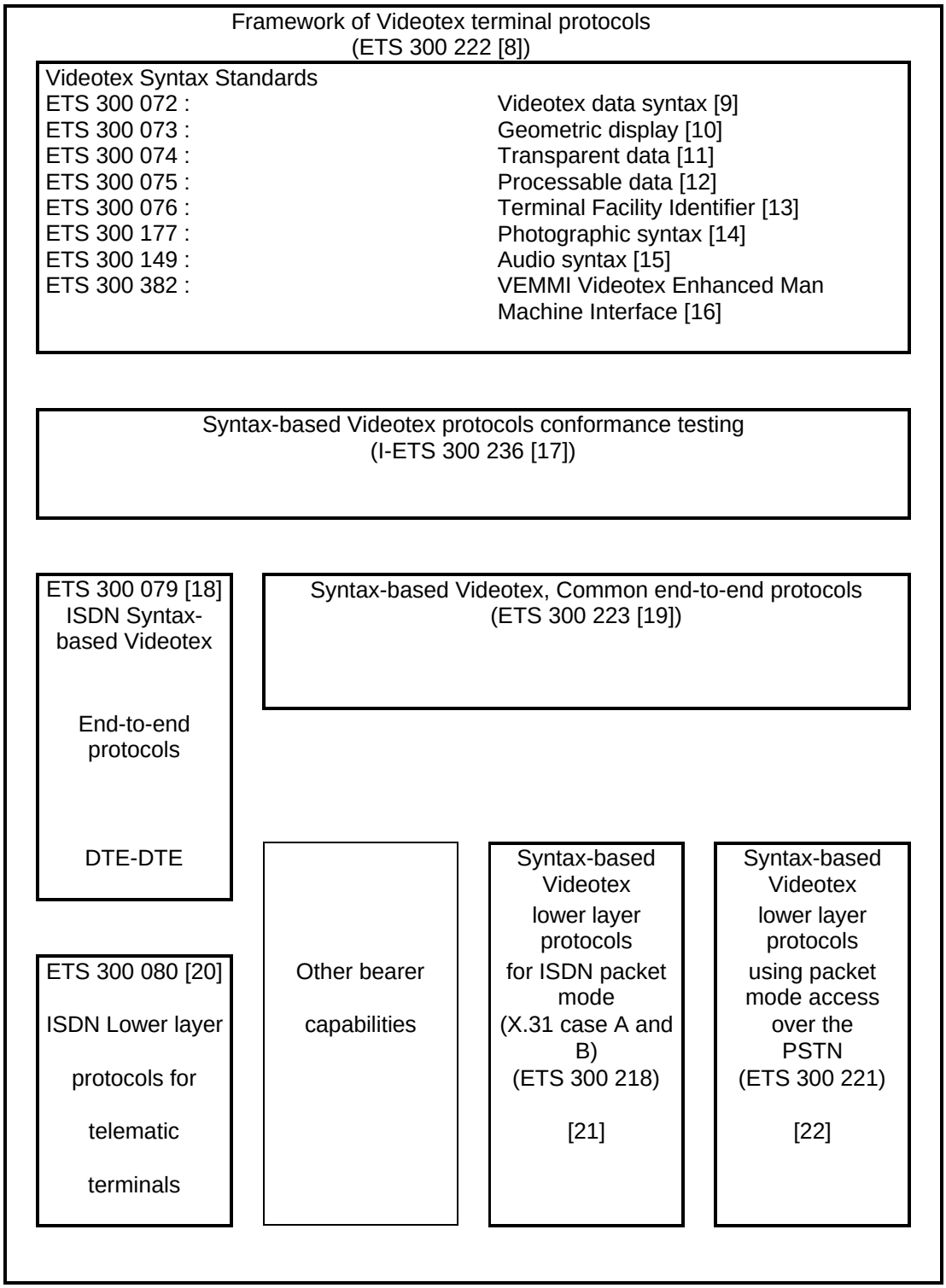

Figure 1: Framework of Videotex terminal protocols

4.1.1 Data syntaxes applicable to Videotex terminals

The representation of application data elements in Syntax-Based Videotex (SBV) systems is accomplished by the use of a number of defined data syntaxes. Videotex services have been implemented in different countries making use of different data syntax profiles which have an equal status. These data syntax profiles are described in ETS 300 072 [9]. Any of these data syntax profiles may be used with the protocols given below (subclauses 4.1.2 to 4.1.4).

In combination with any of these base data syntax profiles, three common enhancements are defined addressing audio, photographic and enhanced man machine interface. These common elements are described in ETS 300 177 [14], ETS 300 149 [15] and ETS 300 382 [16]. The switching mechanism between the data syntax profiles is based on ISO/IEC 2022 [23] and ISO/IEC 9281 [24], as described in ETS 300 072 [9]. The ESC 2/5 F mechanism to introduce a complete coding environment may be used to select the data syntaxes. The ISO/IEC 9281 [24] picture coding environment switching technique based on ESC 7/0 CMI LI is used to establish the common audio, photo and VEMMI extensions.

4.1.2 ISDN "circuit mode"

ETS 300 079 [18] describes the lower layers (1 to 3) applicable to the ISDN circuit mode of operation. In addition, it describes in detail the application layer end-to-end protocol (layer 7) for Syntax-Based Videotex.

ETS 300 080 [20] describes the detailed characteristics, such as the values of the different parameters of the lower layers (1 to 3) protocols for telematic terminals.

4.1.3 ISDN "packet mode"

ETS 300 218 [21] describes the lower layers (1 to 3) for ISDN packet mode operation on the B-channel and the D-channel. It also describes the additional aspects of the end-to-end protocol (layer 7) applicable to ISDN packet mode, referring to ETS 300 223 [19] for the relevant common aspects of the end-to-end protocol (layer 7).

ETS 300 223 [19] describes the end to end protocols (layer 7) common to all the Syntax Based Videotex ETSs.

4.1.4 PSTN "packet mode"

ETS 300 221 [22] describes the lower layers (1 to 3) for packet mode operation over the PSTN. It also describes the additional aspects of the end-to-end protocols (layer 7) operation, making references to ETS 300 223 [19] for the relevant common aspects of the end-to-end protocol.

4.1.5 Conformance testing

I-ETS 300 236 [17] describes the conformance testing for the Syntax-Based Videotex protocols.

4.1.6 Protocol stack for ISDN Videotex

Layer	D-channel	B-channel
7	ETS 300 079 [18] ETS 300 072 [9], ETS 300 073 [10], ETS 300 074 [11], ETS 300 075 [12], and ETS 300 076 [13]	
	ETS 300 149 [15] ETS 300 177 [14]	
6	null (note 1)	
5	null	
4	null	
3	ETS 300 102-1 [25] (Q.931)	ISO 8208 [26]
2	ETS 300 125 [27] (Q.921)	X.75 [28] (note 2) or ISO 7776 [29]
1	ETS 300 011 [30] (I.431) or ETS 300 012 [31] (I.430)	

NOTE 1: The main purpose of layer 6, the conversion from the "abstract syntax" to the "transfer syntax" is not necessary, because, in this case, the abstract data syntax in layer 7 is identical to the transfer data syntax. Also, all other features of the layer 6 are not used and therefore "null" is inserted for layer 6. The abstract syntax in layer 7 and the coding in layer 6 correspond to the data syntaxes DS I, DS II and DS III in ITU-T Recommendation T.101 [32].

NOTE 2: ITU-T Recommendation X.75 [28] as modified in ETS 300 080 [20].

Figure 2: Protocol stack ISDN Videotex

The lower layer (layer 1 to layer 3) protocols are as specified in ETS 300 080 [20] for the DTE/DTE connection using ISDN circuit mode.

The application layer protocol is defined in ETS 300 223 [19]. The data syntax used for ISDN SBV is defined in ETS 300 072 [9], ETS 300 073 [10], ETS 300 074 [11], ETS 300 075 [12], ETS 300 076 [13], ETS 300 149 [15] and in ETS 300 177 [14].

4.2 ISDN facsimile scheme

4.2.1 Overview

Facsimile on the ISDN is defined with Group 4 facsimile using the 64 kbit/s unrestricted bearer service. Group 3 facsimile, which uses the PSTN, is not specified in any ETSI standard for use on the ISDN using the 64 kbit/s unrestricted bearer service. However, within the ITU-T Recommendation optional capabilities to operate on the ISDN are defined. Also, due to the direct communication between PSTN and ISDN (speech and 3,1 kHz audio bearer services), Group 3 facsimile can also exist on the ISDN using the 3,1 kHz audio bearer service.

4.2.2 Protocols for group 4 facsimile on ISDN

ETS 300 120 [33] defines the service requirements for Group 4 facsimile. ETS 300 087 [34] describes the characteristics of the Group 4 terminal. ETS 300 080 [20] describes the protocols for the lower layers (2 to 4) of the B-channel and for the layers 1 to 3 of the D-channel for telematic terminals on the ISDN (e.g. facsimile Group 4). ETS 300 112 [35] describes the protocol for the upper layer (5 to 7) of the B-channel for Group 4 facsimile.

ETSI STC TE2 has been working on some guidance for the fallback mechanisms between Group 4/Group 3 and Group 3 terminals on the ISDN.

Figure 3 summarises the protocol stack for Group 4 facsimile on the ISDN.

<table>
<tr><td>7</td><td colspan="2">ETS 300 087 [34]</td><td rowspan="3">ETS 300 112 [35]</td></tr>
<tr><td>6</td><td colspan="2"></td></tr>
<tr><td>5</td><td colspan="2">ITU-T Recommendation T.62 [36]</td></tr>
<tr><td>4</td><td colspan="2">ITU-T Recommendation T.70 [37]</td><td rowspan="4">ETS 300 080 [20] (B-channel layers 2 to 4, D-channel layer 1 to 3)</td></tr>
<tr><td>3</td><td>ETS 300 102-1 [25] (note 1)</td><td>ISO 8208 [26]</td></tr>
<tr><td>2</td><td>ETS 300 125 [27] (note 2)</td><td>X.75 [28] (note 3)</td></tr>
<tr><td>1</td><td colspan="2">ETS 300 011 [30] or ETS 300 012 [31]</td></tr>
<tr><td></td><td>D-channel</td><td>B-channel</td><td></td></tr>
</table>

NOTE 1: A second edition of ETS 300 080 [20] intends to replace the references to ETS 300 102-1 [25] by references to ETS 300 403 [38].

NOTE 2: A second edition of ETS 300 080 [20] intends to replace the references to ETS 300 125 [27] by references to ETS 300 402 [39].

NOTE 3: A second edition of ETS 300 080 [20] intends to replace the references to ITU-T Recommendation X.75 [28] by references to ISO 7776 [29].

Figure 3: Protocol stack for Group 4 facsimile on the ISDN

4.2.3 Conformance testing for group 4 facsimile

ETS 300 280 [40] defines the tests for the Group 4 terminal. ETS 300 155 [41] defines the tests which apply to ETS 300 112 [35] (layers 5 to 7).

The tests which apply to ETS 300 080 [20] (D-channel and lower layers of B-channel) are under study.

4.2.4 Protocols for group 3 facsimile on ISDN

ETS 300 242 [42] defines the protocols and the tests for Group 3 facsimile on the PSTN. Group 3 can also be used on the ISDN since the protocol (in the B-channel) is the same as for the PSTN. For the D-channel, ETS 300 080 [20] defines the D-channel signalling to use and ITU-T Recommendation T.90 [43], annex F and appendix I provide respectively rules to initiate and answer facsimile terminals operating at 64 kbit/s (G4, G3C and G3F) on the ISDN.

4.3 Audiovisual basic scheme

4.3.1 Basic scheme for ISDN

4.3.1.1 Overview

To provide audiovisual services where audio, video and data are simultaneously transmitted a scheme for:

- controlling and multiplexing of audio, video, data and other signals;
- signalling between the terminals to identify and switch to the working modes of a terminal;
- synchronising two or more digital channels (e.g. B-channels),

is required.

ETS 300 144[1] [44] describes the frame structure and the syntax for end-to-end inband signalling for audiovisual services and end to end data communication between equipment using single or multiple

[1] ETS 300 144 is the ETSI equivalent to ITU-T Recommendations H.221 and H.230.

digital channels (B, H0, H11 or H12) up to 1 920 kbit/s. ETS 300 143[2] [45] specifies inband signalling procedures for establishing communication between audiovisual terminals. The system is based on the frame structure and associated syntax as specified in ETS 300 144 [44]. The procedures are required to establish a compatible mode upon call set-up, to switch between modes during a call and to allow for use of supplementary services.

4.3.1.2 Description

A single 64 kbit/s channel is structured into octets transmitted at 8 kHz. Each bit position of the octets may be regarded as a sub-channel of 8 kbit/s (see figure 4). The eighth sub-channel is called the Service Channel (SC), consisting of several parts as described below.

An H0, H11 or H12 channel is regarded as consisting of a number of 64 kbit/s time-slots (TS) (see figure 5). The lowest numbered TS is structured exactly as described for a single 64 kbit/s channel, while the other TS have no such structure. In the case of multiple B- or H0 channels, all channels have a frame structure; that in the initial channel controls most functions across the overall transmission, while the frame structure in the additional channels is used for synchronisation, channel numbering and related controls.

The term "I-channel" is applied to the initial or only B-channel, to TS1 of initial or only H0 channel, and to TS1 of H11, H12 channels. The audio information is transported in the I-channel.

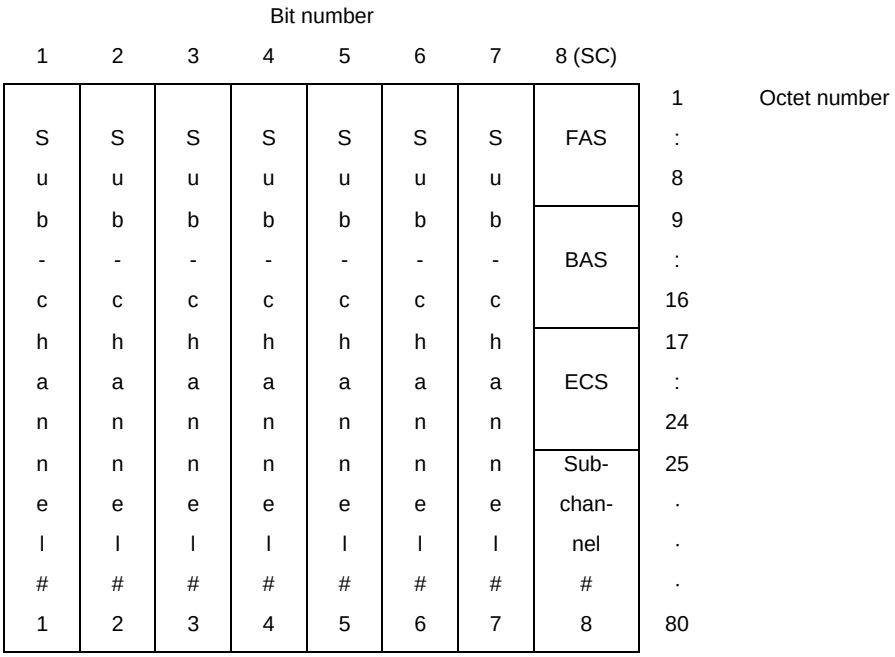

Figure 4: Frame structure of a single 64 kbit/s channel (B-channel)

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2 ETS 300 143 is the ETSI equivalent to ITU-T Recommendation H.242.

125 microseconds

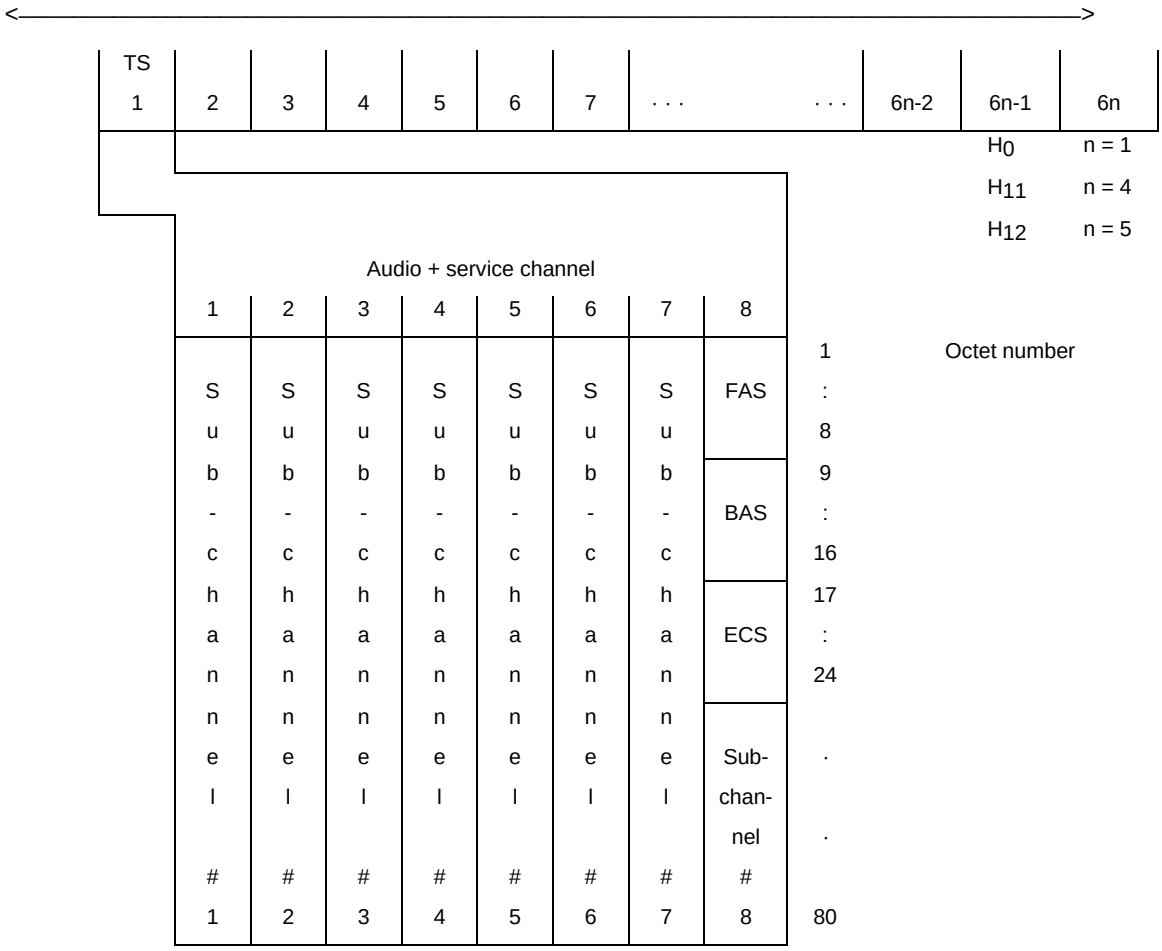


Figure 5: Frame structure of higher-rate single channels (H_0, H_{11}, H_{12} channels)

In the Service Channel the Frame Alignment Signal (FAS), the Bitrate Allocation Signal (BAS) and the optional Encryption Control Signal (ECS) are transmitted as described in table 1.

The FAS is used for framing, channel numbering, control and alarm information, as well as error check information to control end-to-end error performance.

The BAS is used to identify the capabilities of a terminal and to switch the terminals to the desired mode of operation. The BAS codes are defined in ETS 300 144 [44].

ETS 300 143 [45] defines the basic signalling sequences:

- capability exchange;
- mode switching;
- frame reinstatement.

which are used as the building blocks for the procedures required. The procedures are also defined in ETS 300 143 [45].

The structure of the transmitted information (e.g. the position of the audio bits) is defined in ETS 300 144 [44].

4.3.2 Basic scheme for B-ISDN

4.3.2.1 Overview

ITU-T SG 15 works on two terminal recommendations for audiovisual communication on B-ISDN. Simple block diagrams for these are given in figure 6.

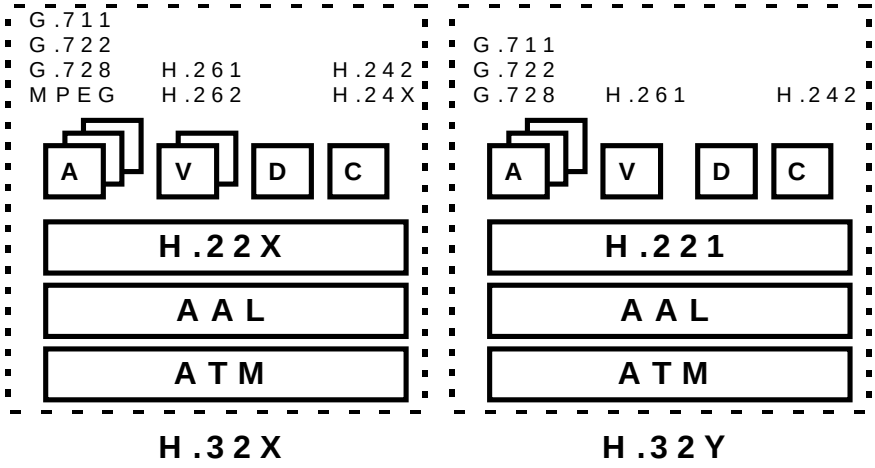


Figure 6: H-series audiovisual terminals for B-ISDN

4.3.2.2 Adaptation of N-ISDN audiovisual terminals to B-ISDN

Draft ITU-T Recommendation H.32Y [46] specifies the adaptation of ITU-T Recommendation H.320 [47] terminals to B-ISDN. The restrictions on bandwidth are the same as for ITU-T Recommendation H.320 [47] (≥ 2 Mbit/s), and recommendations of the H-series are reused. System control, end-to-end signalling and Control and Indication (C&I) are covered by ITU-T Recommendations H.221 [48], H.230 [49] and H.242 [50].

4.3.2.3 Broadband audiovisual communication

Draft ITU-T Recommendation H.32X [51] specifies broadband audiovisual communication systems and Terminal Equipment (TE). To provide broadband audiovisual services on B-ISDN where audio, video and data are simultaneously transmitted a scheme for:

- controlling and multiplexing of audio, video, data and other signals;
- signalling between the terminals to identify and switch to the working modes of a terminal;
- synchronising two or more Virtual Channels (VCs) or Virtual Paths (VPs);

is required.

The parallel to ITU-T Recommendation H.221 [48] will be the planned ITU-T Recommendation H.2221 [52] which includes draft ITU-T Recommendation H.2220 [53] (common text with ISO/IEC 13818-1). Possible functions for ITU-T Recommendation H.2221 [52] are:

- multiplexing;
- timebase recovery;
- jitter removal;
- media synchronisation;
- buffer management;
- security and access control;
- inband signalling.

The motivation in ITU-T SG 15 for having a joint ITU-T Recommendation H.2220/ISO/IEC 13818-1 [53] is "to promote interworking between different applications in the deeper level of the protocol stack by indicating wider support of the standard".

Capability exchange will be done using the planned ITU-T Recommendation H.24X [54]. It is possible that ITU-T Recommendation H.24X [54] will be merged with ITU-T Recommendation H.2221 [52]. ITU-T Recommendation H.242 [50] may be used for compatibility with Narrowband ISDN (N-ISDN) audiovisual services terminals.

4.3.3 Very low bitrate visual telephony

This is primarily a scheme for modem based transmission of audiovisual services on the PSTN, but it may be extended to mobile environments as well. It is necessary to provide for multiplexing of simultaneously transmitted audio, video and data. A scheme is required for:

- controlling and multiplexing of audio, video, data and other signals;
- signalling between the terminals to identify and switch to the working modes of a terminal.

This work is on its way in ITU-T SG 15, and figure 7 gives a simple block diagram for what is intended to end up as ITU-T Recommendation H.32P [55]. The planned ITU-T Recommendation H.22P [56] will be the parallel to ITU-T Recommendation H.221 [48], but will not use the same principles. It is reported that a standard LAP protocol, possibly with small extensions, is intended to be used for the multiplex function. Procedures for basic end-to-end signalling will be defined in the planned ITU-T Recommendation H.24P [57].

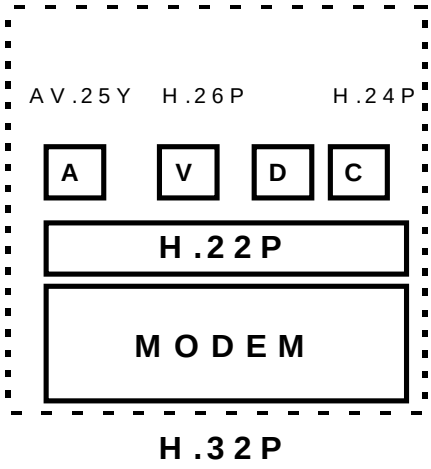


Figure 7: Simple block diagram for very low bitrate visual telephony terminal

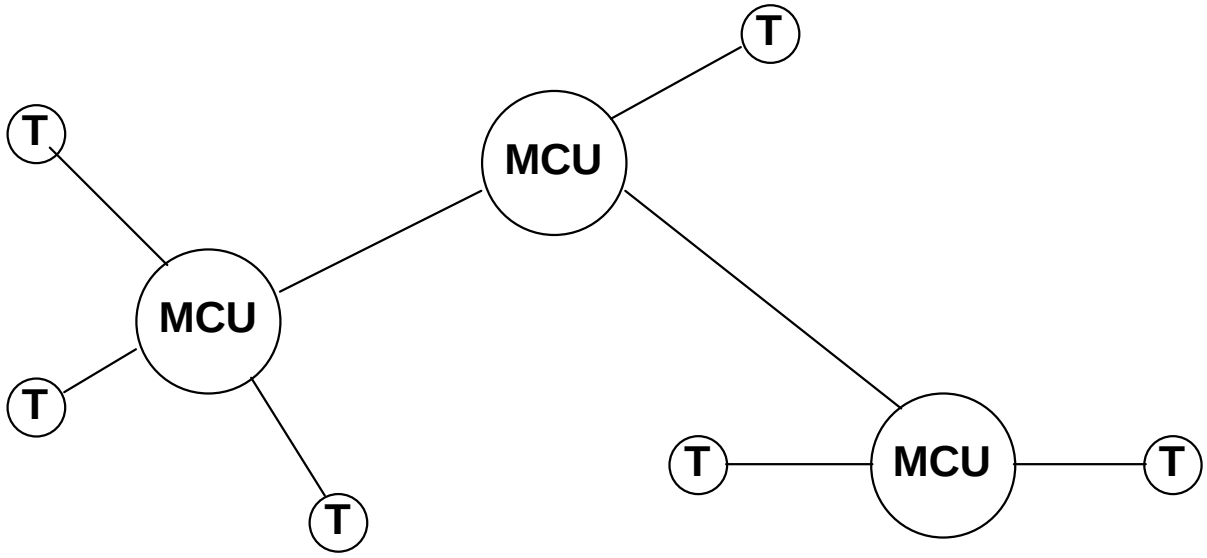
4.4 Multipoint communication scheme

4.4.1 Overview

Within the context of the ITU-T Audiovisual Conferencing Service (AVCS), a conference refers to a group of geographical dispersed nodes joined together and that are capable of exchanging audiographic and audiovisual information across various communication networks. Participants taking part in a conference may have access to various types of media handling capabilities such as:

- audio only (telephony);
- audio and data (audiographics);
- audio and video (audiovisual);
- audio, video and data (multimedia).

The ETS 300 143 [45] and ETS 300 144 [44] and corresponding ITU-T Recommendations in the F, H and T series provide a framework for the interworking of audio, video and graphics terminals on a point-to-point basis through existing telecommunication networks. They also provide the capability for three or more terminals in the same conference to be interconnected by means of an Multipoint Control Unit (MCU), see figure 8.



MCU.....Multipoint Control Unit
T.....Audiographic Terminal

Figure 8: Multipoint scenario

For Audiographic Conferencing the ITU-T T.120 series of Recommendations are relevant. Figure 9 gives an overview of those Recommendations which form the set of Recommendations to develop a fully functional terminal or MCU.

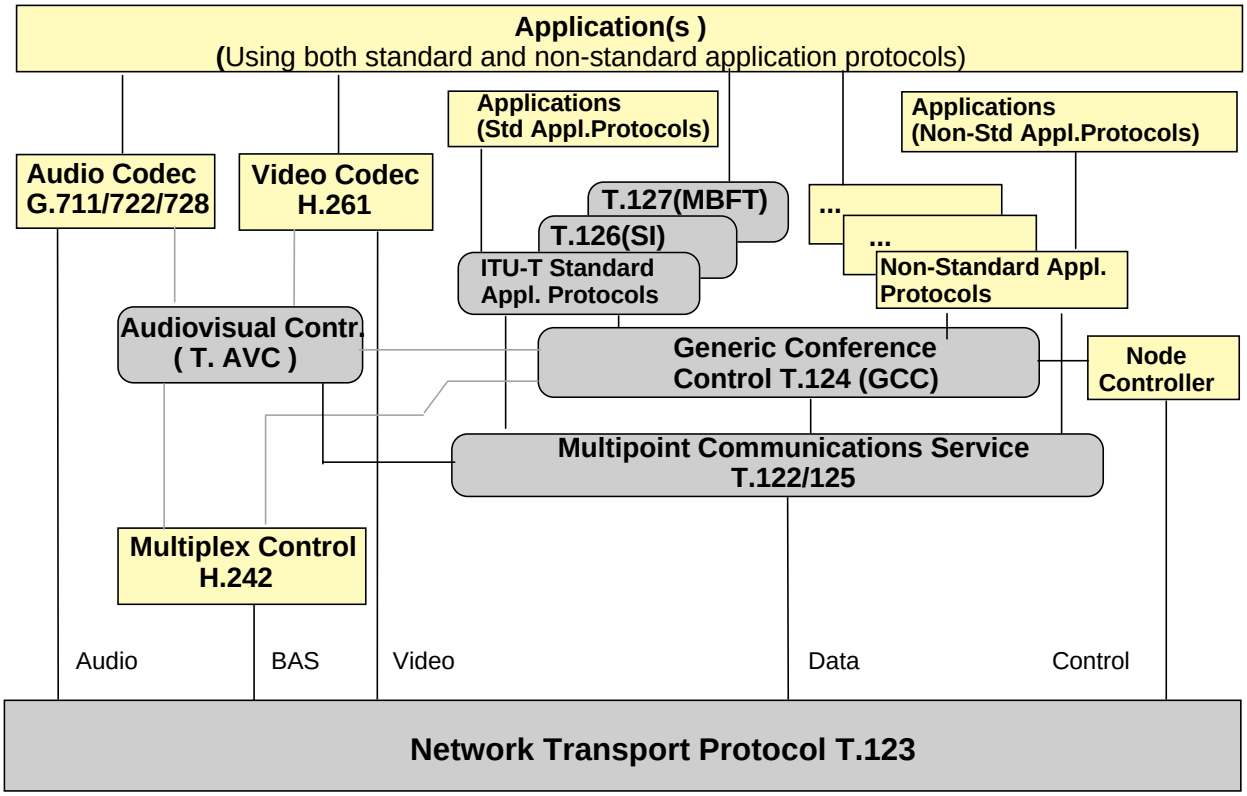


Figure 9: ITU-T T.120 series of Recommendations

ITU-T Recommendations T.122 [58] and T.125 [59] respectively, define the multipoint delivery mechanism in OSI layer 7. ITU-T Recommendation T.122 [58] specifies the service definition of the Multipoint Communication Service (MCS), and ITU-T Recommendation T.125 [59] provides the protocol specification of the MCS. The application layer supports additional applications by providing application layer protocols such as ITU-T Recommendation T.126 [60] (Multipoint still image and annotation protocol), ITU-T Recommendation T.127 [61] (Multipoint Binary File Transfer), ITU-T Recommendation T.AVC (High level audio and video) and ITU-T Recommendation T.RES (Reservations for conference). A high-level framework for conference management is given in ITU-T Recommendation T.124 [62].

The Node Controller is the entity at a node (terminal or an MCU), dealing with the aspects of a conference that apply to the entire node. The Node Controller interacts with the Generic Conference Control (GCC), ITU-T Recommendation T.124 [62]) but may not interact directly with MCS (ITU-T Recommendations T.122 [58] and T.125 [59]).

Client Applications (both standardized or non-standardized) also interact with GCC, and with specific application layer protocols (not with MCS directly).

ITU-T Recommendation T.123 [63] specifies the Audio Visual Protocol Stacks for each of the networks supported. More information about the protocol stack is given in subclause 4.4.2.

In addition an ITU-T Recommendation T.RES (Reservation System) is planned with several "input" possibilities to make reservations and "output" possibilities to control MCUs directly or via another Reservation System.

4.4.2 Protocol stacks

The framework for the protocols of the Audio Graphic Conference (AGC) protocol suite is shown in figure 10. The network aspects are specified in ITU-T Recommendation T.123 [63]. There is one profile for each network supported. The networks currently identified are ISDN, Circuit Switched Data Network (CSDN), Packet Switched Data Network (PSDN), and PSTN. The Transport layer is based on CCITT Recommendation X. 224 [64], class 0. The Network layer is null for the User Plane and contains a Synchronisation and Convergence Function (SCF) based on ITU-T Recommendation Q.933 [65] for the Control Plane. The Data link layer is specified in ITU-T Recommendation Q.922 [66] except from the PSDN profile.

The PSDN profile is for layers 2 and 3 based on ITU-T Recommendation X.25 [67].

The profiles are shown in figure 11.

An extended mode is described. It includes the Session layer (CCITT Recommendation X.225 [68]) and Presentation layer (CCITT Recommendation X.226 [69]).

The extension of ITU-T Recommendation T.123 [63] to include future broad band networks is envisaged, and is a matter for further study. A proposal is shown in figure 12.

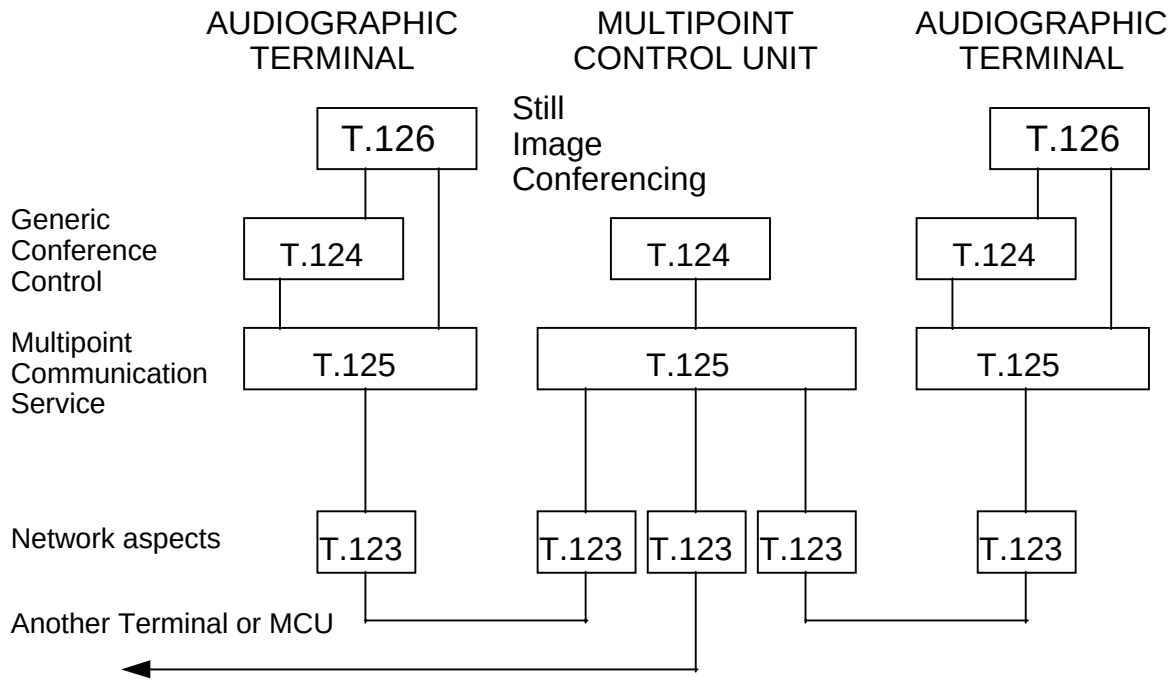
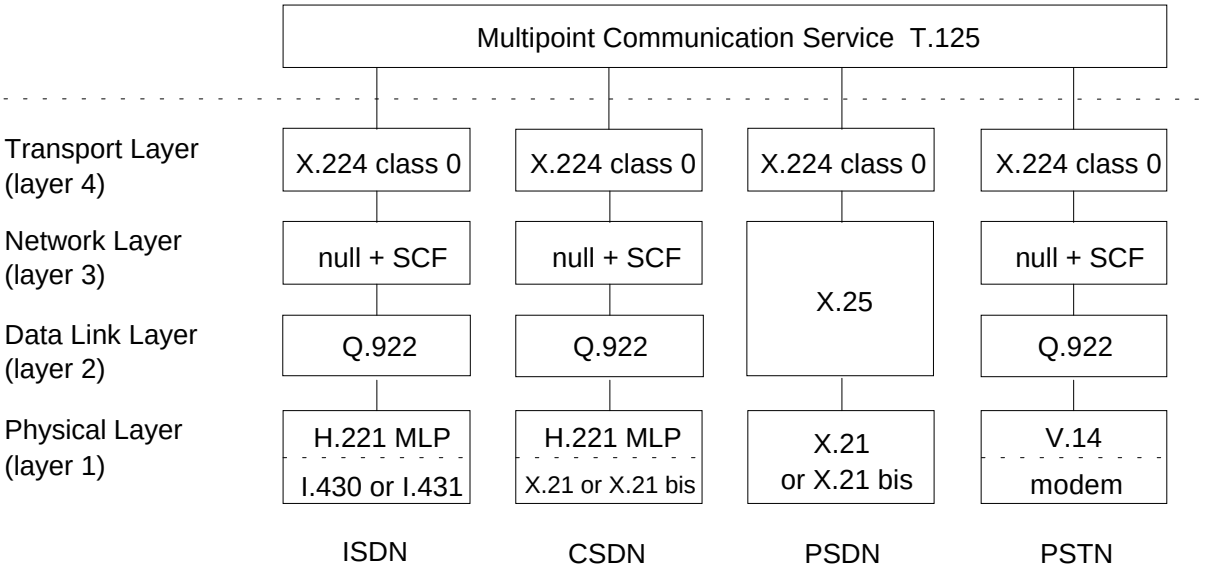


Figure 10: Framework of the AGC protocol suite



NOTE 1: The ETSI equivalent to ITU-T Recommendation H. 221 is ETS 300 144 [44]

NOTE 2: The ETSI equivalent to ITU-T Recommendation I.430 is ETS 300 012 [31].

NOTE 3: The ETSI equivalent to ITU-T Recommendation I.431 is ETS 300 011 [30].

Figure 11: Basic mode profiles general structure

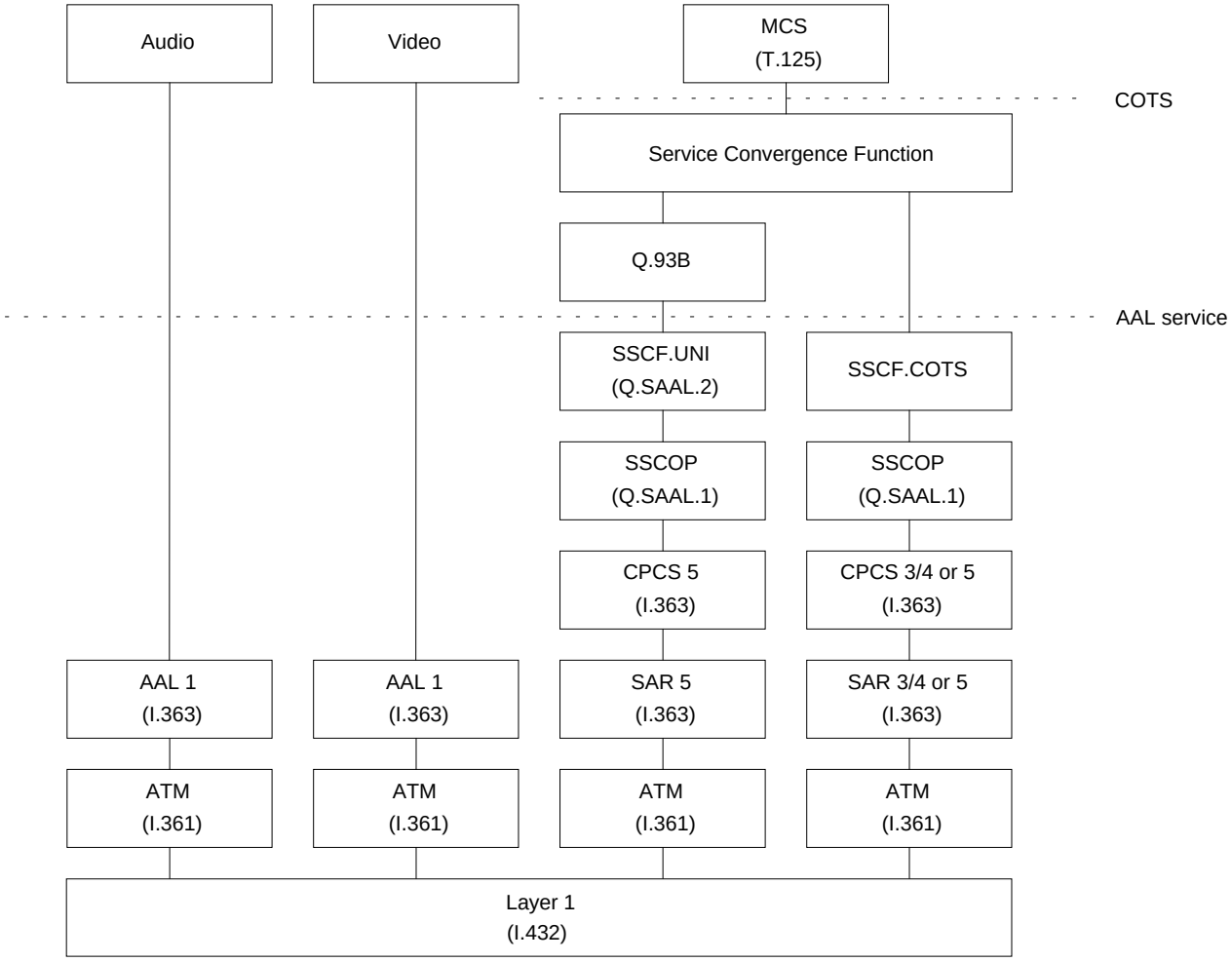


Figure 12: A possible profile for Broadband ISDN (B-ISDN)

The profiles, which are for terminals and multipoint control units (MCU), provide the reliable point to point elements of terminal-to-terminal or terminal to MCU conferences, and for MCU to MCU links. In the case of networks providing an n x 64 kbit/s service the lower layer provides synchronous multiplexing of audio and video plus data for conference control and multimedia applications. In cases where the audio and video network elements of the multipoint conference are provided separately, the channel for control and enhancement data of the telephone conference may be provided via PSDN or PSTN, physically separate from the audio and video elements.

Profiles for both the basic and the extended modes are defined in detail in section 6 of ITU-T Recommendation T.123 [63]. Section 9 is dealing with synchronisation and convergence Function.

Annex A deals with the synchronous integration of multimedia signals in 64 kbits/s channels framed according to ITU-T Recommendation H.221 [48].

4.4.3 Status of T.120 series of Recommendations

The status of these recommendations is:

	Title	Target date	Last status
T.120	Overview of the T.120 series	Adoption * February 1996	D203
T.121			Reserved
T.122	MCS Service definition	Approved March 1993	TD 2053
T.123	Audiovisual protocol stacks	Adopted March 1993, Revised July 1994	WC37 + TD2100 COM R8-32-E
T.124	Generic Conference Control	Adoption* March 1995	WC62+TD2123
T.125	MCS protocol specification	November 1993	COM 8-R21-E
T.126	Multipoint still image and annotation protocol	Adoption* March 1995	COM 8-62+D197
T.127	Multipoint binary file transfer	Adoption* March 1995	
T.AVC	High level audio and video	Draft March 1995	
T.RES	Reservations for conference	Draft March 1995	

Adoption* means an unanimous vote for approval under Resolution No. 1 at SG8 meeting.

5 Protocols for data communication services

5.1 Introduction

The development of data communication services has roughly been split up in two directions; a set of standards from the standardization bodies known as Open Systems Interconnection (OSI) and the de facto standards of Internet. Others exist, but are not considered in this ETR.

The OSI model is meant to serve as a framework for handling the complexity experienced with communication between different data systems. This reference model is divided into 7 layers. Each layer collects the functions that perform similar or strongly related tasks on that particular function layer, and different layers divide the functions which are unrelated to each other. The OSI protocol stack is described in figure 13.

Internet has a range of standards covering the layers of 3 to 7 in the OSI protocol stack. The Internet, composed of several thousand networks around the world, is using the TCP/IP protocol suite. Most of the Internet application protocols are based on TCP/IP. The Internet protocol stack is described in figure 14.

	FTAM ISO 8571	**X.400 ITU-T X.400**	**X.500 ITU-T X.500**	**VT ISO 9040**	**DFR ISO/IEC 10166-1, 10166-2**	**DTAM-DM ITU-T T.435 ITU-T T.436**
7	ACSE ISO 8649		ROSE		RTSE	
6	ISO 8823 (ITU-T X.226)					
5	ISO 8327 (ITU-T X.225)					
4	ISO 8073 (ITU-T X.224)					
3	CLNP ISO 8473			ISO 8208		
2	LLC1 ISO 8802/2	HDLC ISO 7776		ISO 7776		
1	CSMA/CD ISO 8802/2			ETS 300 011 (I.431) or ETS 300 012 (I.430)		

Figure 13: OSI protocol stack

7/6	**WWW**	**Gopher**	**Telnet**	**WAIS**	**FTP**	**SMPT /MIME**
5	Socket interface					
4	TCP RFC 793					
3	IP RFC 791					

Figure 14: Internet protocol stack

5.2 OSI protocol stack

5.2.1 Electronic mail

X.400 MHS is a distributed application based on the seven layers OSI model. This means that the functional elements of the MHS communicate among each other using OSI protocols. ITU-T Recommendation X.400 [71] defines the MHS and the layer seven protocols for communication between the different MHS components.

In figure 15 the functional model of this MHS is depicted.

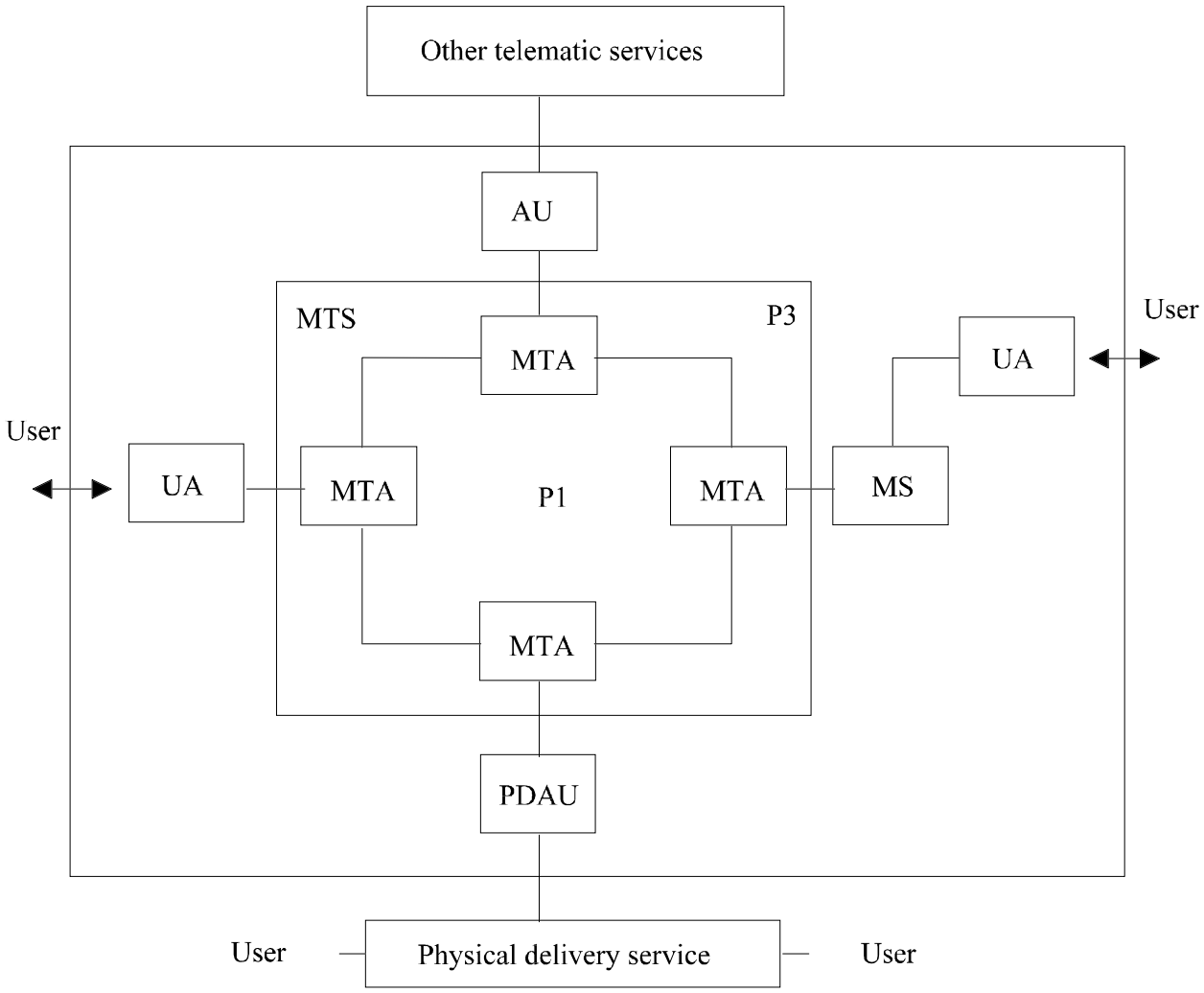


Figure 15

The following CCITT/ITU-T recommendations and ISO international Standards cover the MHS Protocol and Service:

- X.400 (10021-1) [71], MHS System and Service Overview;
- X.402 (10021-2) [72], MHS Overall Architecture;
- X.407 (10021-3) [73], MHS Abstract Service Definition.

Conventions:

- X.411 (10021-4) [74], MHS MTS Abstract Service Definition and Procedures;
- X.413 (10021-5) [75], MHS MS Abstract Service Definition;
- X.419 (10021-6) [76], MHS Protocol Specifications;
- X.420 (10021-7) [77], MHS Interpersonal Messaging System (IPM);
- X.403 [78], Conformance testing comparable to ISO 9646;
- X.408 [79], MHS Encoded Information Type Conversion Rules;
- T.330 [80], Telematic Access to IPMS;
- X.435 [81], MHS Electronic Data Interchange Messaging System;
- X.440 [82], MHS Voice Messaging System;
- F.400 [83], MHS System and Service overview, identical to X.400 [71];
- F.401 [84], MHS Naming & Addressing for Public MH Services;
- F.410 [85], MHS The Public Message Transfer Service;
- F.415 [86], MHS Intercommunication with Public Physical Delivery Services;
- F.420 [87], MHS The Public IPM Service;
- F.421 [88], MHS Intercommunication Between IPM Service and Telex;
- F.422 [89], MHS Intercommunication Between IPM Service and Teletex.

The MHS protocols are:

- P1 or Message Transfer Protocol

This protocol is used in the communication between Message Transfer Agents (MTAs).

- P3 or MTS Access Protocol

This protocol is used between a User Agent or Message Store (MS) and a Message Transfer Agent (MTA).

- P7 or MS Access Protocol

Used between a User Agent and a Message Store.

The backbone of the MHS is formed by a network of MTAs. This backbone sees the message as an envelope with content and transfers this content transparently. The UAs and MSs need to be aware of the structuring of this content to provide the user with meaningful information. These content types can be seen as protocols between UAs.

Currently four content types are standardized:

1) P2 or Interpersonal Messaging System (IPM): This is the first and most used content type and often referred to as email. It can be used to convey information encoded as text, facsimile or binary data.

2) P22: This is the 1988 version of IPM. This version is enhanced and can be used to convey all kinds of information types standardized or not. Standardized information types are: Voice, Electronic Data Interchange (EDI), Text, Facsimile, Files, Binary Data, Open Document Architecture (ODA).

3) Pedi: This content type is defined for the purpose of Electronic Data Interchange. Besides the transfer of EDI interchanges supplementary information of different types can be included. These types are similar to the ones used in P22.

4) Pvoice: For the communication between VoiceMail systems this content type could be used. Again, in addition to voice, other information types can be used.

ETSI STC TE3 has produced, and is producing, functional profiles or standards for the different X.400 protocols. It does not produce ETSs but ENVs (European Prestandard) and pDISPs (proposed Draft International Standardized Profiles). These profiles have the following numbers in the M-IT-02 taxonomy:

Based on the 1984 series of recommendations:

- A/312 = ENV 41 201 Private MHS: UA and MTA: PRMD to PRMD(P1 and P2 protocol);
- A/311 = ENV 41 202 MHS: UA plus MTA: Access to an ADMD(P1 and P2 protocol).

Based on the 1988 and beyond recommendations:

- A/MH11 = ENV 41 214, MHS common facilities MTA and MTS (P1 protocol);
- A/MH12 UA to MS (P7) = ENV 41 218;
- A/MH13 MTS-user to MTA (P3) = ENV 41 219;
- A/MH31 EDI-UA to EDI-UA (Pedi over P1) = ENV 41 220.

Content specific profiles:

IPM

- A/MH21 IPM UA to IPM UA (P2 over P1) this will be covered in ISPs AMH21 en AMH22;
- A/MH22 IPM UA to IPM MS (P2 over P7) this will be covered in ISP AMH24;
- A/MH23 IPM UA or IPM MS to MTA (P2 over P3) this will be covered in ISP AMH23.

EDI

- A/MH32 EDI UA to EDI MS (Pedi over P7) this will be covered in ISP AMH34;
- A/MH33 EDI UA or EDI MS to MTA (Pedi over P3) this will be covered in ISP AMH33.

International Standardized Profiles (ISPs): These profiles have the following numbers in the ISO/IEC TR 10000 [90] taxonomy:

- AMH1n: Common messaging, a five part profile, ISO/IEC ISP 10611-n.[91]:

  - Part 1: MHS Service Support (10611-1);
  - Part 2: Specification of ROSE, RTSE, ACSE, Presentation and Session Protocols for use by MHS (10611-2);
  - Part 3: AMH11 - Message Transfer (P1) (10611-3),comparable to A/MH11: ENV 41 214;
  - Part 4: AMH12 - MTS Access (P3) (10611-4), comparable to A/MH13: ENV 41 219;
  - Part 5: AMH13 - MS Access (P7) (10611-5), comparable to A/MH12: ENV 41 218.

- AMH2n: MHS - Interpersonal Messaging, a five part profile, ISO/IEC ISP 12062-n [92]:

  - Part 1: IPM MHS Service Support;
  - Part 2: AMH21 - IPM Content;
  - Part 3: AMH22 - IPM Requirements for Message Transfer (P1);
  - Part 4: AMH23 - IPM requirements for MTS Access (P3);
  - Part 5: AMH24 - IPM requirements for MS Access (P7).

- AMH3n: MHS - Electronic Data Interchange Messaging, a five part profile, ISO/IEC DISP 12063-n [93]:

  - Part 1: EDI MHS Service Support;
  - Part 2: AMH31 - EDI Content;
  - Part 3: AMH32 - EDI Requirements for Message Transfer (P1);
  - Part 4: AMH33 - EDI requirements for MTS Access (P3);
  - Part 5: AMH34 - EDI requirements for MS Access (P7).

5.2.2 Interactive multimedia services

5.2.2.1 MHEG

The Multimedia and Hypermedia information coding Expert Group (MHEG) is working on a draft standard for representing multimedia and hypermedia information objects, ISO/IEC CD 13522-1 [94]. The standard does not define any content format, it only provides rules regarding the structuring of objects. MHEG accepts the use of any standard format for monomedia content.

MHEG categorises the objects in classes which share behaviour and characteristics. MHEG defines content classes for each relevant media type, a selection class for interaction, an action class for rendering objects, a link class for hyperlinks and a composite class for grouping related objects.

MHEG represents objects in a final form with the aim of direct presentation. It is thus unsuitable as an input format for hypermedia authoring applications. A potential approach is to use MHEG as the output format of hypermedia application taking HyTime as input. This would benefit from both the expressive power of HyTime and the runtime efficiency of MHEG.

The responsible organisations for MHEG are ISO/IEC JTC/SC29/WG12 and ITU SG8/Q11. MHEG is on CD-level (ISO/IEC CD 13522-1 [94]). The following ITU-T recommendations are planned:

	Title	Target date
T.170 [95]	AVI systems: General introduction, principles, concepts and models	Draft exists.
T.171 [96]	Coded representation of multimedia and hypermedia objects	Resolution 1 March 1995
T.172 [97]	Description of AVI scriptware requirements	Draft exists.
T.173 [98]	Coded representation of scriptware	Working draft level in ISO, CD ballot at beginning of 1995.
T.175 [99]	Protocols for real-time interchange of AVI scriptware	Draft exists.
T.176 [100]	Protocols for real-time (Timing-relationship) interchange of AVI scriptware	Draft exists.

5.2.3 Data conferencing

Cooperative Document Handling (CDH) is a new work item within ITU SG8/Q15 with the aim to define a framework and a set of protocols for collaborative document editing and sharing. They are working on a model of incorporating document handling inside Multipoint Communication Scheme (T.120 series recommendations). Other possible models are to use DTAM, DFR or MHS.

ETS 300 498-1 [101] specifies ODA document communication services to be provided on top of existing base standards or profiles, giving constraints on them and rules on how to use and combine them.

ETS 300 498-1 [101] specifies the basic service, like storing-and retrieval or manipulation. Complex services, such as asynchronous and sequential document production, joint synchronous editing or joint document presentation/viewing, are founded on basic services, and are to be specified in Part 2 of this ETS (to be produced). Some of these complex services are presented in ETS 300 498-1 [101], in order to more clearly understand the complex services that could be built on the top of the basic ones. Furthermore, a methodology for the specification of services is defined, although it is only applied to basic services.

Two group of basic services are considered:

a) basic services that, apart from being used for specifying complex services, can be implemented as stand-alone services, and then provided to the users;

b) basic services that can only be used for specifying complex services.

The basic services that belong to the first group are:

- storing;
- distribution;
- retrieval;
- storing-and-retrieval;
- manipulation.

Storing and distribution basic services apply to full documents only, while retrieval, storing-and retrieval and manipulation basic services apply to full documents and to document fragments.

The basic services to the second group are:

- pointing;
- multi-pointing;
- token-interchange.

Pointing and multi-pointing basic services only apply to document fragments, while token-interchange basic service is independent of documents.

There are some subset relationship between some of the basic services, but a complete hierarchy between the does not exist. The relationships are:

- storing is a subset of distribution;
- storing is a subset of storing-and-retrieval;
- retrieval is a subset of storing-and-retrieval;
- storing-and-retrieval is a subset of manipulation;
- pointing is a subset of multi-pointing.

5.2.4 File transfer

There are two file transfer profiles defined in ETSI for use over the ISDN. One profile is based on a full OSI protocol stack using the file transfer protocol FTAM. The FTAM profile is described in ETS 300 388 [102]. The second file transfer profile is based on the Eurofile file transfer protocol. The Eurofile profile is described in ETS 300 383 [103].

5.2.4.1 Protocol stack for file transfer using the FTAM profile (ETS 300 388)

<table>
<tr><td>7</td><td colspan="2">FTAM ISO 8571 profiled according to ETS 300 388
ACSE ISO 10607</td></tr>
<tr><td>6</td><td colspan="2">ISO 8823 (ITU-T X.226)</td></tr>
<tr><td>5</td><td colspan="2">ISO 8327 (ITU-T X.225)</td></tr>
<tr><td>4</td><td colspan="2">ISO 8073 (ITU-T X.224)</td></tr>
<tr><td>3</td><td>ETS 300 102-1 (Q.931)</td><td>ISO 8208</td></tr>
<tr><td>2</td><td>ETS 300 125 (Q.921)</td><td>X.75 (note)
or
ISO 7776</td></tr>
<tr><td>1</td><td colspan="2">ETS 300 011 (I.431)
or
ETS 300 012 (I.430)</td></tr>
</table>

Layer D-channel B-channel

NOTE: ITU-T Recommendation X.75 [28] as modified in ETS 300 080 [20].

Figure 16: Protocol Stack for FTAM

The lower layer (layer 1 to layer 3) protocols are as specified in ETS 300 080 [20] for the DTE/DTE connection using ISDN circuit mode.

5.2.4.2 Protocol stack for file transfer using the Eurofile Transfer Profile (ETS 300 383)

7	ETS 300 075 profiled according to ETS 300 383 ETS 300 079	
6	null (note 1)	
5	null	
4	null	
3	ETS 300 102-1 (Q.931)	ISO 8208
2	ETS 300 125 (Q.921)	X.75 (note 2) or ISO 7776
1	ETS 300 011 (I.431) or ETS 300 012 (I.430)	
Layer	D-channel	B-channel

NOTE 1: The main purpose of layer 6, the conversion from the "abstract syntax" to the "transfer syntax" is not necessary, because in this case the abstract data syntax in layer 7 is identical to the transfer data syntax. Also all other features of the layer 6 are not used and therefore "null" is inserted for layer 6. The abstract syntax in layer 7 and the coding in layer 6 correspond to the data syntaxes DS I, DS II and DS III in ITU-T Recommendation T.101 [32].

NOTE 2: ITU-T Recommendation X.75 [28] as modified in ETS 300 080 [20].

Figure 17: Protocol Stack for Eurofile

The lower layer (layer 1 to layer 3) protocols are as specified in ETS 300 080 [20] for the DTE/DTE connection using ISDN circuit mode.

5.2.5 Virtual Terminal

The purpose of Virtual Terminal (VT) (ISO 9040 [104]) is to create an open system for remote terminal access. Virtual Terminal Environments (VTE) defines a set of profiles for both asynchronous and synchronous communications. VTE defines a set of profiles for different terminal types (3270-type, etc,...).

VT is defined in:

- ISO 9040 [104], Virtual Terminal Basic Class Service;
- ISO 9041 [105], Virtual Terminal Basic Class Protocol;
- FVT 2nn(n) VT Control Objects, ISO number ISP 11185 [106];
- FVT 1nn Environment Profiles, ISO number DISP 11184 [107];
- AVT nn Application Profiles, ISO number pDISP 11187 [108].

The three distinct types of services defined in AVT nn are:

a) forms mode (Data entry);
b) paged mode (Block mode, 3270 etc,...);
c) generalized Telnet (migration from TCP/IP).

5.2.6 Document Filing and Retrieval (DFR)

DFR provides for managing documents and other objects inside remote document stores in distributed office systems. An information model describes the hierarchical structure of document stores, and an operational model defines the abstract operations to be performed on document stores.

DFR communication applications are based on the end-to-end communication principle. The communication entities have a client/server relationship.

The DFR services are contained in the DFR Service element (SE) and are defined in ISO/IEC 10166-1 [109].

The DFR protocol is specified in ISO/IEC 10166-2 [109]. The DFR protocol makes use of the Association Control Service Element (ACSE), the Remote Operation Service Element (ROSE) and the presentation service. The Reliable Transfer Service Element (RTSE) can be used optionally.

Two groups of Application profiles for DFR (ADF), which define functional subsets of DFR, have been specified.

The first group of application profiles, ADF1, is intended to be used for common filing and retrieval applications, and contains the following profiles:

- ADF11: read only profile;
  the DFR operations included in this profile allow only to retrieve stored documents or to search for documents, but the do not allow to store new information or to change existing information.

- ADF12: archiving profile;
  the DFR operations included in this profile allow to store new documents and to read them, but do not allow changes to stored information.

- ADF13: document store manipulation profile;
  all DFR operations are included in this profile.

The ADF1 profiles are defined hierarchically with ADF11 having the lowest functionality and ADF13 the highest. The ADF11 read only profile is a subset of the ADF12 archiving profile, and the ADF12 archiving profile is a subset of the ADF13 document store manipulation profile.

The second group of application profiles, ADF2, is intended to be used for remote store management, and contains the following profiles:

- ADF21: simple management profile;
  this profile provides a minimum functionality for list and search operations to support other inner document handling applications.

- ADF22: full management profile;
  this profile provides for list, search and manipulation (but without read and create) operations, to support other document handling applications.

The ADF21 simple management profile is a subset of the ADF22 full management profile.

5.2.7 Document Transfer and Manipulation (DTAM)

DTAM comprises several protocols. The most important ones are DTAM bulk Transfer Normal Mode and DTAM Document manipulation.

They are described in the following subclauses.

5.2.7.1 Document Transfer and Manipulation - Bulk Transfer - Normal Mode

Document Transfer and Manipulation-Bulk Transfer-Normal Mode (DTAM-BT-NM) is used to transfer documents between two communicating entities. It is designed as a common protocol platform for telematic services. DTAM-BT-NM communications applications are based on the end-to-end communication principle, and allow the negotiation of application capabilities between communication entities during the association establishment phase.

The DTAM-BT-NM services are contained in the DTAM SE and are subdivided into several functional units. It makes use of the DTAM association use control functional unit for association establishment and termination, the DTAM capability functional unit for capability negotiation purposes, and the DTAM document bulk transfer functional unit for the data transfer phase.

The DTAM-BT-NM protocol makes use of RTSE, ACSE and the presentation service. DTAM-BT-NM is defined in CCITT recommendation T.522 [110].

DTAM-BT-NM is used to transfer complete ODA documents. Document Application Profile (DAP) levels, specifying the degree of complexity of the ODA documents, among other capabilities, can be negotiated during the association establishment phase.

5.2.7.2 Document Transfer and Manipulation - Document manipulation (DTAM-DM)

DTAM-Document Manipulation (DTAM-DM) is used to manipulate document fragments of documents at a remote communicating entity.

DTAM-DM communication applications are based on the end-to-end communication principle. DTAM-DM allows the negotiation of application capabilities between communicating entities during the association establishment phase.

The DTAM-DM abstract services are contained in the DTAM-DM SE and are defined in ITU-T Recommendation T.435 [111].

The DTAM-DM protocol is specified in ITU-T Recommendation T.436 [112]. The DTAM-DM protocol makes use of ACSE, ROSE and the presentation service.

Three manipulation levels for DTAM-DM abstract services, which define functional subsets of DTAM-DM, are specified:

- basic read only level;
  the DTAM-DM abstract operations included in this level allow only to get and search document fragments, but they do not allow to add new information or to change existing information,

- basic manipulation level;
  the DTAM-DM abstract operations included in this level allow to get and search document fragments, and, additionally, to add new information, to delete or to change information,

- extended level;
  all DTAM-DM abstract operations on document fragments are included in this level.

The manipulation levels are defined hierarchically with the basic read only level having the lowest functionality and the extended level the highest. The basic read only level is a subset of the basic manipulation level, and the basic manipulation level is a subset of the extended level.

The DTAM-DM abstract point service, which allows to identify document fragments, is optionally available in each manipulation level.

An abstract interface for the manipulation of ODA documents is defined in part 3 of ISO/IEC 8613 [113], that specifies how to manipulate ODA document fragments.

Two groups of Application profiles for ODA (AOD), which define functional subsets of the abstract interface for the manipulation of ODA documents, have been specified.

The first group of application profiles, AOD1, whose abstract interface operations are intended to be used in conjunction with the corresponding abstract services of DTAM-DM, contains the following profiles:

- AOD11: DTAM/Read-only profile;
  abstract interface operations included in this profile are intended for reading and searching document fragments,

- AOD12: DTAM/Insert profile;
  abstract interface operations included in this profile are intended for reading, searching, creating, copying and reserving document fragments,

- AOD13: DTAM/manipulation profile;
  all abstract interface operations for manipulating document fragments are included in this profile.

The AOD1 profiles are defined hierarchically with AOD11 having the lowest functionality and AOD13 the highest. The AOD11 DTAM/Read-only profile is a subset of the AOD12 DTAM/Insert profile, and the AOD12 DTAM/Insert profile is a subset of the AOD 13 DTAM/Manipulation profile.

A mapping of operations and operation arguments between the abstract interface for the manipulation of ODA documents and the DTAM-DM abstract services is provided in annex A of ISO/IEC 8613-3 [113].

The second group of application profiles, AOD2, is intended to be used in conjunction with Message Handling Systems (MHS).

DTAM-DM is used for the remote interactive manipulation of ODA documents. DTAM-DM abstract services are aligned and combined with the operations of the abstract interface for the manipulation of ODA documents.

The DTAM-DM AOD1 profiles can be combined with DFR ADF profiles for applications that provide for the possibility of working on a document store and also on document fragments inside the documents. This combination is done by the communication applications using these profiles.

5.3 Internet protocol stack

5.3.1 Electronic mail

RFC821 [114], the Simple Mail Transfer Protocol (SMTP), is the protocol used in Internet for transferring mail messages. SMTP defines a simple mechanism for transferring a message between two computers connected to the Internet.

There exist gateways between SMTP and X.400 systems and vice versa. X.400 mail message systems also exist inside Internet using TCP/IP so that users connected to Internet may choose X.400 as a mail protocol.

RFC822 [115] specifies a syntax for text messages. This protocol applies only to the format and some of the semantics of message contents. It contains no specification of the information in the envelope.

Multipurpose Internet Mail Extensions (MIME) is an extension to the RFC822 [115] framework both to enable standard use of non-text body parts and to provide for the use of RFC822 [115] messages for non-ASCII languages. At its most basic level, MIME defines a mechanism (RFC1521 [116]) for declaring different content types within a message, i.e. bodypart types. The content types defined are:

- **Text:** plain US-ASCII or ISO 8859 [117] text;

- **Multipart:** a body type which consists of multiple body types. Used to give structure to a multimedia document;

- **Message:** a body part which is itself a fully formatted RFC822 [115] conforming message which may contain its own different content-type;

- **Application:** raw data, typically uninterpreted binary data;
- **Image:** data that may require a graphical display device such as a graphical terminal, printer or fax to view the information;

- **Audio:** data that requires an audio output device;

- **Video:** a body part which requires the capability to display moving images, typically including specialised hardware and software;

- **X-private:** private content-types defined by bilateral agreement.

5.3.2 Interactive information services

5.3.2.1 World Wide Web

The World Wide Web (WWW) is a multimedia networked information system used in Internet. It is a client - server architecture that facilitates the distribution of multimedia documents using the Hypertext Transfer Protocol (HTTP).

HTTP specifies a stateless client-server protocol for queries from and retrieval of multimedia hypertext documents stored in a HTTP-server using a reliable 8-bit byte stream connection.

The native document format used is HyperText Markup Language (HTML), but any document format may be transferred between the server and client over HTTP.

Uniform Resource Locator (URL) (RFC1630 [118]) is a universal addressing mechanism to information used within Internet. It defines the protocol, the computer address (IP), path and information object (filename) needed to retrieve the information object. The URL has quickly become the universal addressing mechanism for all information retrieving systems, i.e. gopher, FTP, WWW.

5.3.2.2 Wide Area Information Services

Wide Area Information Services (WAIS) is a system for indexing and searching for information in a computer network. It offers a rapid search capability as well as relevant feedback. This means that the results of one search may be used to successively refine future searches, thus making it easier to find what you are looking for. WAIS clients allow the user to specify searches as simple as English-language queries, without any complicated logical expressions or command syntax.

WAIS supports the Init and Search Services of the ANSIZ39.50-(1988) protocol [119], where each service is made up of a request from the client followed by a response by the server. WAIS is a stateless service.

5.3.2.3 Gopher

Gopher is a network information system used for interactive information retrieval. It has a client-server architecture. The information structuring on Gopher is more rigid than the WWW as is uses a simple hierarchical system of menus and files.

Gopher supports only text, but there are developments to extend the system to cover arbitrary information objects. The Internet Gopher protocol (RFC1436 [120]) is a stateless system.

5.3.3 Data conferencing systems

5.3.3.1 Network News

Network News is an asynchronous bulletin-board and data conferencing system to be used to exchange messages between users connected to a computer network. The system is organised in different news groups each covering different topics.

The Network News Transfer Protocol (NNTP) specifies a protocol (RFC977 [121]) for the distribution, inquiry, retrieval, and posting of news articles using a reliable stream-based transmission of news among the ARPA-Internet community. NNTP is designed so that news articles are stored in a central database allowing a subscriber to select only those items he wishes to read. Indexing, cross-referencing, and expiration of aged messages are also provided.

5.3.3.2 Internet Relay Chat

Internet Relay Chat (IRC) is a synchronous data conferencing system for user-to-user communication with text in "real-time". IRC supports a world-wide network of servers and clients and defines a client-server protocol (RFC1459 [122]).

The system allows several communication sessions to take part at the same time using different communication modes:

- one-to-one communication - message sent to a specific user;
- one-to-many - message sent to a group of users;
- one-to-all - a broadcast message sent to all users connected to server.

5.3.4 File Transfer

The File Transfer Protocol (FTP), RFC959 [123], specifies the protocol used to transfer files between two computers in Internet.

The objectives of FTP are:

- promote the sharing of files;
- encourage indirect or implicit usage of remote computers;
- shield the user from variations in file storage systems among hosts;
- transfer data reliably and efficiently.

5.3.5 Virtual Terminal

The protocol for the virtual terminal in Internet is "Telnet". The purpose of the Telnet Protocol (RFC854 [124]) is to provide a general, bi-directional oriented communications facility. Its primary goal is to allow a standard method of interfacing terminal devices and terminal-oriented processes to each other. It is envisioned that the protocol may also be used for terminal-terminal communication ("linking") and process-process communication (distributed computation).

6 media formats

6.1 Video coding schemes

6.1.1 Overview

There exists several video coding schemes already standardized or under way by ITU-T and ISO/IEC. Table 1 shows the planned and standardized schemes and some relevant data. There also exist several proprietary coding schemes for video coding, but they will not be covered here.

CCITT Recommendation H.120 [125] was the first video coding standard from CCITT. The coding technique used in this recommendation is conditional replenishment supplemented by adaptive digital filtering, Differential PCM (DPCM) in the spatial domain, and variable-length coding.

Then follows a group of standards based on the basic hybrid DPCM/transform scheme. This group consists of:

- ITU-T Recommendation H.261 [3];
- ISO/IEC 11172-2 [126] (MPEG-1, Video);
- ITU-T Recommendation H.262 and ISO/IEC 13818-2 [127] (MPEG-2, Video) (identical standards);
- ITU-T Recommendation H.26P [128].

The coding schemes for these standards are similar, but not identical. The hybrid DPCM/transform standards have the following common features:

a) the encoding process is weakly defined while the format of transmitted information and the decoding process is strictly defined. The weak definition of the encoder opens for variation in complexity (quality) and cost of the TE. The strict definition of the transmission format and the decoder ensures compatibility between the TE following the same standard;

b) a DPCM loop is used for reducing temporal redundancy. Motion compensation is mandatory for the decoder. Motion estimation is optional for the encoder;

c) a Discrete Cosine Transform (DCT) is used to reduce spatial redundancy;

d) lossless coding of parameters is performed using variable length and runlength coding.

Both ITU-T and ISO/IEC are planning further work (ITU-T recommendation H.26P/L [129] and ISO/IEC MPEG-4 Video [130]). The only decision made for these activities is that they will be based on new techniques, and not follow the hybrid DPCM/transform scheme. The goal is to achieve considerably better quality at very low bitrates. ITU-T recommendation H.26P/L [129] and ISO/IEC MPEG-4 [130] Video might end up being identical.

6.1.2 Applications and requirements

The different video coding standards are partly intended to be used for different applications. A coarse division can be made between real-time conversational applications and non-real-time distributive applications. These 2 types of applications put different requirements on the coding standards.

ITU-T recommendation H.262 and ISO/IEC MPEG-2 Video (ISO/IEC 13818-2) [127] are identical texts, describing a generic coding standard. Some subsets of the functionalities the standard provides are defined and named Profiles. Different Profiles meet different sets of requirements. In this way one standard meets the requirements of both ITU-T and ISO/IEC.

6.1.2.1 Real-time conversational applications

The ITU-T recommendations are mainly designed for conversational services such as real-time interactive videotelephony or conferencing. Basic requirements have been:

- low delay: long delay reduces the quality of the communication;

- balanced encoder/decoder: TE will consist of both encoder and decoder and both need to be affordable.

6.1.2.2 Non-real-time distributional like applications

The ISO/IEC standards are mainly designed for applications such as storage on and retrieval from digital storage media and broadcast of. For these applications delay is not a big issue, and longer delays have been allowed to reach higher quality. Also encoder complexity is allowed to be considerably higher than decoder complexity, since most applications will contain only the decoder. Instead we find requirements more relevant to broadcast and storage and retrieval are found. Some examples are:

- good quality for general video material: the coding scheme should work well also for TV and movie type of sequences. Extra delay may be added to obtain better quality. The coding scheme should allow for clean cuts when channel hopping is performed;

- VTR kind of functionality: it should be possible to perform operations such as fast forward, fast backward, etc,... These are useful functions for video database kind of applications.

The Digital Storage Media Control Command (DSM-CC) protocol is an application protocol intended to provide the control functions of operations specific to managing ISO/IEC 11172 [126] and ISO/IEC 13818 [127] bitstreams. ISO/IEC 13818-1 [53], annex A (normative), provides a specification of the syntax and semantics for a simple environment of single-user-to-single-DSM applications. Systems are also deployed, however, in more diverse and heterogeneous network environments for many applications including, for example Video-On-Demand (VOD) and interactive video. This will be an integral part of ISO/IEC 13818 [127].

6.2 Still picture

6.2.1 JPEG

The main method for coding of continuos tone colour still picture is ISO/IEC 10918 [131][3], known as JPEG. It can be used for many different formats and for both lossless and lossy codings. The build up of the picture quality can be done either hierarchical (gradually over the whole picture) or sequential (directly part by part of the picture).

JPEG has many common building blocks with ITU-T Recommendation H.261 [3], ISO/IEC 11172-2 [126] and ITU-T Recommendation H.262/ISO/IEC 13818-2 [127].

6.2.2 ITU-T Recommendation H.261 still picture mode

This is an “ad hoc” mode of ITU-T Recommendation H.261 [3] to obtain a higher resolution still picture transmission. It was added as an annex to ITU-T Recommendation H.261 [3] when it was revised in 1992. By using 4 CIF pictures for building up one still picture, the resolution is twice the CIF resolution both horizontally and vertically. In the text of ITU-T Recommendation H.261 [3]. ITU-T gives preference to JPEG for still picture transmission also in ITU-T Recommendation H.320 [47][4] systems, and the ITU-T Recommendation H.261 [3] still picture mode is not recommended for inter-regional use.

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3 ITU-T Recommendation T.81 is equivalent to ISO/IEC 10918.

4 The ETSI Standard equivalent to ITU-T Recommendation H.320 [34] is ETS 300 145 [135]. ETS 300 145 [135] is, however, restricted to 1B and 2B modes.

Table 1: Video coding algorithms

Recommendation/ Standard:	Standardized by:	Bitrate:	Source format: Hor x Ver x frames/s	Applications (main):	Transmission media (main):
H.120:	ITU-T (CCITT)	2 Mb/s	IO format: 625 lines x 50 fields or 525 lines x 60 fields	Video conferencing	Primary digital group
H.261: Video codec for audiovisual services at px64 kbit/s	ITU-T (CCITT)	~64 kbit/s - 2 Mb/s	Progressive scan (not interlaced), 352 x 288 x 29,97 (CIF) 176 x 144 x 29,97 (QCIF)	Video telephony, Video conferencing (real-time and interactive)	Basic and primary rate ISDN
ISO/IEC 11172-2 MPEG-1 (Video)	ISO/IEC	~1.5 Mb/s	Progressive scan, ~CIF	Storage and retrieval from digital storage media, Broadcast	ADSL, ISDN
H.262≡MPEG-2 part 2 (Video)	Joint work by ITU-T and ISO/IEC (1995)	~MPEG-1 rates and upwards	Interlaced and progressive scan, ~CIF - HDTV	Video telephony, Video conferencing, Video On Demand, Storage and retrieval from digital storage media, TV broadcast	B-ISDN, ATM, satellite, terrestrial
H.26P	ITU-T (1995)	< 64 kbit/s	Progressive scan, QCIF < QCIF (not yet defined)	Very low bit rate visual telephony	PSTN, mobile
H.26P/L≡(?)MPEG-4	ITU-T, ISO/IEC, possibly joint (1998)	< (?)64 kbit/s	Not yet defined	Very low bitrate visual telephony, Video mail and messaging, ...	

6.3 Audio coding schemes

6.3.1 Introduction

In telecommunications terminology it is common to divide the audio signals to be coded into three classes:

- telephony bandwidth (400 Hz - 3,5 kHz);
- wideband (~50 Hz - 7 kHz);
- audio (~20 Hz - 20 kHz).

Telephony bandwidth and wideband are usually associated with telephone transmission, with speech as the dominant input signal. Audio covers the whole spectre of audio input signals.

We can divide the audio coding schemes into three main categories:

a) **source coders** models the vocal tract, and extracts the parameters to control the model. They are used at the low end bitrates (2 kbit/s to 8 kbit/s). The quality is not very good. Typically used for telephony bandwidth;

b) **waveform coders** try to imitate the waveform of the input signal as faithfully as possible. Waveform coders need higher bitrates (8 kbit/s- 64 kbit/s). Give higher quality than the source coders. Perform well for bandwidths from wideband and upwards;

c) **hybrid coders** combines methods from source and waveform coders. They work in the area between source and waveform coders, with bandwidths up to wideband.

Some of the objectives for audio coding are:

1) to reduce the bitrate needed for transmission or storage of audio with a certain quality;
2) to make the signal less sensitive to errors on the transmission channel or storage device;
3) to ensure secure communication (encryption).

The first and second items are working against each other in the way that reducing the bitrate is partly done by reducing the redundancy and less redundancy makes a signal more sensitive to errors. The first two objectives are discussed but the encryption part is omitted.

6.3.2 Requirements

Different applications result in different requirements. One set of requirements is set up by parameters of the signal to be transmitted:

- bandwidth of transmitted signal;
- capability to perform with single or multiple speakers;
- capability to transmit music;
- capability to transmit voice-band data;
- capability to transmit DTMF;
- capability to perform with background noise.

Other requirements are related to the transmission, network and storage media:

a) available bitrate;
b) tandeming capability;
c) transcoding capability;
d) robustness to specified error characteristics.

A third general group of requirements is closely linked with the application:

- complexity allowed (measure on cost);
- quality needed;
- maximum end-to-end delay.

Requirements may be conflicting, and when necessary a trade-off needs to be made between the requirements on the requirements list.

6.3.3 Standards

Table 2 lists some coding schemes that are standardized in different standardization bodies.

Table 2: Audio coding schemes

Standard (method name)	Organisation	Bandwidth/	Bitrate (net)	Quality	Transmission media (main)
G.711 [133] (μ-/A-law PCM)	CCITT	Telephony	64/56 kbit/s	Toll	ISDN, digital trunks
G.726 [134] (ADPCM)	CCITT	Telephony	40/32/24/16 kbit/s	Toll	ISDN, digital trunks
G.728 [135] (LD-CELP)	CCITT	Telephony	16 kbit/s	Toll	ISDN
G.722 [136] (SBC-ADPCM)	ITU-T	Wideband	64/56/48 kbit/s	High	ISDN
ETS 300 580-2 [137] GSM full rate (RPE-LPC)	ETSI	Telephony	13 kbit/s	Good	Mobile
IS-54-B full rate [138] (VSELP)	TIA	Telephony	8 kbit/s	Good	Mobile
Inmarsat M [139] (IMBE)	Inmarsat	Telephony	3,8 kbit/s	Fair	Mobile satellite
ISO/IEC 11172-3 [213] (MPEG audio)	ISO/IEC	Audio	32 kbit/s - 192 kbit/s pr channel	Very high (<≈CD quality)	Digital storage media and nets

Work is on its way in ITU-T for a toll quality speech coder at 6,4 kbit/s - 9.6 kbit/s. Work is initialised in ITU-T on a 16 kbit/s wideband speech coder, and is planned to be adopted as an ITU-T Recommendation in 1998. Work is on its way for half rate GSM and TIA (to double the capacity of a given link).

6.4 Multimedia document formats

6.4.1 ODA

The Open Document Architecture (ODA) (ITU-T T.400-series of Recommendations) is a set of recommendations designed to facilitate transmission of compound documents between open systems. It has its focus on blind interchange - the originator need not know anything about the recipient's system. An ODA document may easily be transferred from one word processor to another (if both support ODA). In this case the document is said to be in a "revisable" or "processable" form. ODA also supports a "final" or "formatted" form, i.e. the receiver cannot edit the document.

The ODA recommendations address the interchange of documents in a typical office environment. Examples of documents that can be handled are memoranda, letters, invoices, forms, and reports. Documents may include graphics and images. To meet the increasing interest in new data types, there is also ongoing work to add hypermedia functionality.

The architecture of ODA describes the document in terms of its logical or its layout structure or both. Each structure is organised in a general and a specific structure. The content of the document is structured in a hierarchical manner with the leaf nodes containing the content. The content portions may either consist of characters, raster graphics or geometrical graphics.

The documents may be interchanged in three different ways

1) **formatted form** - only layout information;
2) **processable form** - only logical information;
3) **formatted processable form** - both logical and layout information.

The ODA architecture is structured as (from ITU):

- ITU-T Recommendation T.411 [140], Introduction and general principles;

- ITU-T Recommendation T.412 [141], Document structures;

- ITU-T Recommendation T.414 [142], Document profile;

- ITU-T Recommendation T.415 [143], Open document interchange format (ODIF);

- ITU-T Recommendation T.416 [144], Character content architectures;

- ITU-T Recommendation T.417 [145], Raster graphics content architectures;

- ITU-T Recommendation T.418 [146], Geometric graphics content architecture.

The application profile used for an application is specified in the document application profile (DAP).

- ITU-T Recommendation T.502 [147], Document application profile PM-11;

- ITU-T Recommendation T.505 [148], Document application profile PM-26;

- ITU-T Recommendation T.506 [149], Document application profile PM-36.

There is work going on to add support for hypermedia functionality to ODA (HyperODA). The HyperODA model will support:

- references to data held externally to the document;
- non-linear structures using contextual and independent hyperlinks;
- temporal relationship between document components.

6.4.2 SGML

The SGML standard, ISO 8879 [150] is a metalanguage for defining structured documents. In contrast to ODA, SGML's primary concern is logical structuring of the content. The logical structuring is done by adding semantic mark-ups to content parts.

A mark-up is text that is added to a document to convey semantic information. The mark-up serves two purposes: separating the logical elements of the document from the content, and specifying the processing function to be performed on those elements. It is possible to define classes of documents with a Document Type Definition (DTD). A DTD defines the mark-up structure permitted in the class or application. Neither SGML itself nor the DTD specifies how the document should be formatted - this is application dependent.

Other standards using SGML are:

- HyTime (ISO/IEC 10744 [151]) is an application of SGML;

- HyperText Markup Language (HTML) used in WWW (Internet) uses a SGML DTD;

- Standardized Music Description Language (SMDL), see ISO/IEC CD 10743 [152], uses a SGML DTD;

- MHEG (ISO/IEC CD 13522-1 [94]) has a SGML encoding.

6.4.3 HyTime

The Hypermedia/Time-based Structuring Language (HyTime) is a standardized infrastructure for the representation of integrated open hypermedia documents. HyTime is not a DTD of SGML, but is based on SGML and defines constructs for making HyTime DTDs for hypermedia documents. HyTime can represent hypertext linking, time scheduling, and synchronisation. Links can be made both to documents that conform to HyTime and to other documents.

Objects in a HyTime hyperdocument can be formatted and unformatted documents, audio and video segments, still images, etc,... The documents that constitute a HyTime hyperdocument can conform to any architecture and be represented in any notation permitted by that architecture.

HyTime is intended to be an interchange format for hypermedia applications and not used as an internal representation for such applications. It is highly expressive and may be difficult to optimise for runtime efficiency.

6.4.4 Standard Music Description Language

Standard Music Description Language (SMDL), see ISO/IEC CD 10743 [152], is a language for the representation of music imitation, either alone, or in conjunction with text, graphics, or other information needed for publishing or business purposes. SMDL is a HyTime application.

6.4.5 Hypertext Mark-up Language

Hypertext Mark-up Language (HTML) is defined in terms of SGML and is a simple SGML DTD. It is capable of handling hyperlinks within and outside documents. The hyperlinks are implemented as tags with attributes giving the location of the end of the link. HTML is the native format used within the WWW information system.

HTML is not yet a Internet RFC and the HTML is developed further to include new features as tables, captioned pictures, and fill-in forms for querying remote databases.

6.4.6 Standard Multimedia Scripting Language

Standard Multimedia Scripting Language (SMSL) is proposed as a new work item in ISO/IEC JTC/SC18/WG8(HyTime) and JTC1/SC29/WG12(MHEG) to standardize an open multimedia scripting language. The purpose of SMSL is both to control the presentation of HyTime and MHEG represented objects and for interchange.

6.4.7 MHEG

Multimedia and Hypermedia information coding Expert Group (MHEG), see ISO/IEC CD 13522-1 [94], is a draft standard for representing multimedia and hypermedia information objects. The standard does not define any content format, it only provides rules regarding the structuring of objects. MHEG accepts the use of any standard format for monomedia content (see subclause 5.2.2).

7 User network signalling scheme

7.1 PSTN

The PSTN is the largest network in number of accesses. The transmission is analogue, i.e. transmission of digital information has to make use of modems. The user network signalling scheme is based on three principles,

- low frequency AC voltage;
- DC loop signalling;
- Dual Tone Multifrequency (DTMF).

Activation and deactivation are made by closing and opening the DC-loop.

The calling indication from the network to the terminal is made by using a low frequency AC voltage, normally 25 Hz.

The number selection can be made by loop pulsing or by DTMF. DTMF is a modern and flexible system that can be used for both user-network signalling and end-to-end signalling. The system is standardized worldwide and is also used for invoking supplementary services (e.g. call forwarding).

The signalling frequencies and corresponding codes are described in table 3.

Table 3: Signalling scheme for DTMF signals

		High frequency group			
	Hz	**1 209**	**1 336**	**1 477**	**1 633**
Low frequency group	697	1	2	3	A
	770	4	5	6	B
	852	7	8	9	C
	941	*	0	#	D

There is currently work in ETSI on standards for Calling Line Identification (CLI) and similar services in the PSTN. The information transfer may use DTMF or modem techniques. Modem techniques are more flexible and powerful than DTMF. If this technique is chosen a number of new applications may be introduced.

7.2 ISDN

7.2.1 Basic principles

The ISDN is a digital network which can provide a transparent digital channel between two subscribers. The connection may be circuit-switched or packet-switched, depending on the service requested. At the user-network interface two 64 kbit/s channels (B-channels) and a 16 kbit/s channel (D-channel) are provided. The B-channels are set up independently of each other. The D-channel is primarily used for user-network signalling, but packet information can be transmitted.

A reference configuration for the user-network interface is described in figure 18.

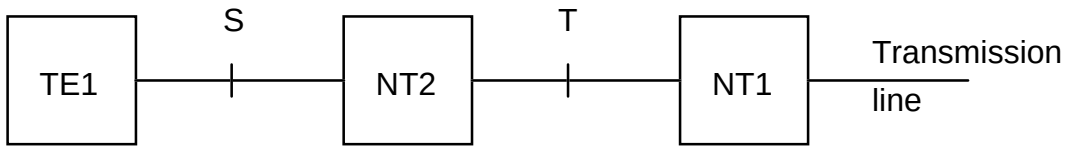

Figure 18: ISDN user-network interface reference configuration

The functional groups are:

- Terminal Equipment type 1 (TE1)
  This functional group includes functions related to protocol handling, maintenance, interfacing and connections to other equipment. Type 1 has an interface that complies with the ISDN user-network standards.

  NOTE 1: Terminal Equipment type 2 (TE2) has an interface that complies with other standards than the ISDN user-network standards, e.g. CCITT X-series Recommendations. These are outside the scope of this ETR.

- Network Termination 1 (NT1)
  This functional group includes functions related to line transmission termination, layer 1 multiplexing, power transfer, layer 1 maintenance and performance monitoring, timing and interface termination.

- Network Termination 2 (NT2)
  This functional group provides the functions of NT1 as well as layer 2 and 3 functions, switching, etc,... Examples of NT2 are PABXs and gateways to LANs.

  NOTE 2: A NT2 may consist of only physical connections.

The ISDN reference points are:

a) the S reference point is provided at the terminal side of a NT2. The protocols and functions will depend on the functions of the NT2 (PABX);

b) the T reference point is provided between the NT1 and NT2;

c) the coincident S and T reference point is provided where there is no NT2.

Some TE standards may be defined for the coincident S and T reference point, others for both the coincident S and T reference point and the S reference point.

7.2.2 Identification of telecommunication services

Telecommunication services are divided into two broad families, i.e.:

- bearer services;

- teleservices.

These services may be modified or supplemented by supplementary services, see also subclause 7.2.4.

The T reference point and the S reference point (including the coincident S and T reference point) are access points for bearer services.

The teleservices and some of the supplementary services cover some terminal functions in addition to those specified by the protocols at the interface.

The telecommunication service requested is identified by information elements in the D-channel signalling messages (e.g. in the SETUP message). The bearer service is identified by the Bearer capability (BC) information element, and the terminal functionality is identified by the High layer compatibility (HLC) information element. A combination of BC and HLC information elements identifies the teleservice.

In the pan-European ISDN the following bearer services are standardized:

1) "Speech". This bearer service is used for voice communication using PCM A-law coding. The service might not be transparent 64 kbit/s, end-to-end, e.g. 32 kbit/s ADPCM might be used in the connection.

2) "3,1 kHz audio". This bearer service is used for communication using PCM A-law coding. All calls originated in the PSTN will use this bearer service. The transmitted information might be speech, modem signals, etc,...

3) "Unrestricted Digital Information (UDI)". This is a transparent 64 kbit/s service.

4) "Unrestricted Digital Information with Tones and Announcements (UDI-TA)". This service is transparent 64 kbit/s. In addition tones and announcements encoded in PCM A-law are provided. This bearer service is also linked to the fallback functionality as specified in subclause 7.2.3.

To identify teleservices, High layer compatibility (HLC) information elements are defined. The High layer compatibility (HLC) information elements that are currently standardized are described in table 4.

Table 4: High layer compatibility information elements

Telephony
Facsimile Group 2/3 (ITU-T Recommendation F.182 [153])
Facsimile Group 4 Class I (ITU-T Recommendation F.184 [154])
Teletex service, basic and mixed mode of operation and facsimile service Group 4, Classes II and III (ITU-T Recommendation F.184 [154])
Teletex service, basic and processable mode of operation (ITU-T Recommendation F.220 [155])
Teletex service, basic mode of operation (ITU-T Recommendation F.200 [156])
Syntax Based Videotex (ITU-T Recommendations F.300 [157] and T.101 [32])
International Videotex interworking via gateways or interworking units (ITU-T Recommendations F.300 [157] and T.101 [32])
Telex service (ITU-T Recommendation F.60 [158])
Message Handling Systems (MHS) (ITU-T Recommendation X.400 series)
OSI application (Recommendation X.200 series [163])
Videotelephony

There is one HLC information element allocated to telephony teleservices. If the bearer service is "Speech", then the resulting teleservice is "3,1 kHz telephony". If the bearer service "UDI" or "UDI-TA", then the resulting teleservice is "7 kHz telephony".

An extended high layer characteristics identification might identify initial channel or subsequent channels for audiovisual teleservices requiring two or more B-channels (e.g. videotelephony 2B modes).

7.2.3 Fallback to an alternative teleservice

The service description of some teleservices specifies that terminals supporting this teleservice shall be capable of supporting other teleservices. One example is ETS 300 264 [159] which specifies that terminals supporting the videotelephony teleservice in the ISDN shall be capable of supporting the 3,1 kHz telephony teleservice.

For some calls the user may wish to establish connection between two terminals having defined functions, e.g. between two videotelephones. If the called user has no videotelephone, the connection should not be established.

For other calls the priority is given to the connection, not the characteristics of the connection. If the called user has no videotelephone, the calling user still wants to speak to him, e.g. the call should be answered by a telephone.

If the user wishes a speech connection as an alternative to a videotelephony connection, the terminal may be programmed to make another call requesting e.g. a telephony 3,1 kHz teleservice if the call is not answered by a videotelephony terminal. This is however a slow procedure, the delay before a connection is established will be 10 seconds to 15 seconds.

To speed up this process a fallback mechanism has been standardized. This mechanism is based on ISUP version 2 and the use of the bearer service "unrestricted digital information with tones/announcements". Where fallback to an alternative bearer service or teleservice is acceptable, the SETUP message shall contain two BC and/or HLC information elements. The first combination will specify the alternative service, the second combination will specify the preferred service. If the network does not support fallback, the first combination will be used, i.e. the alternative service will be specified. The procedures are specified in ETS 300 267-1 [160].

7.2.4 Supplementary services

Supplementary services in the ISDN are used in association with basic bearer services and with basic teleservices. There are several groups of supplementary services:

- Call diversion supplementary services;
- Call completion supplementary services;
- Multiparty supplementary services;
- Community of interest supplementary services;
- Charging supplementary services;
- Additional Information Transfer supplementary services.

A list of those supplementary services that are standardized by ETSI, and the reference to the stage one and stage 3 standards for these supplementary services can be found in annex A to this ETR.

The protocol interactions when two or more supplementary services are implemented, are specified in ETS 300 195-1 [161].

The standards for the supplementary services specify the D-channel protocols. For teleservices based on in-band signalling procedures, there might be a need for a specification of the interaction between D-channel procedures and the in-band signalling procedures. It is mainly the groups where the call is manipulated, i.e. Call diversion, Call completion and Multiparty supplementary services, where these issues need consideration. At present these issues are studied by the relevant terminal STCs in ETSI.

7.3 B-ISDN

7.3.1 Basic principles

The B-ISDN is a digital network which can provide virtual channel connections and virtual path connections between subscribers. Several virtual channels can be multiplexed onto one virtual path. The B-ISDN network is cell switched where each cell is a fixed length packet of 53 octets. The length of the packet is chosen so that both traditionally circuit switched and packet switched services can be supported by the B-ISDN network. At the user-network interface virtual channels and virtual paths with bitrates according to the choice of the subscriber can be provided. In addition, signalling virtual channels can be provided for user-network signalling.

ITU-T Recommendation I.413 [162] describes the reference configuration for the user-network interface shown in figure 19.

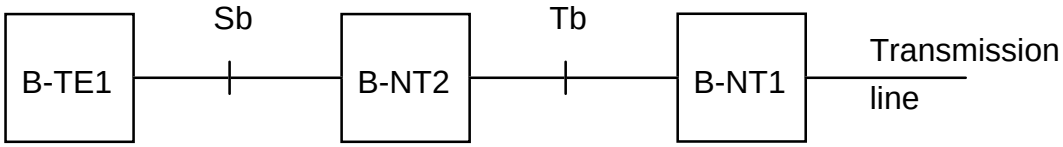

Figure 19: B-ISDN user-network interface reference configuration

The functional groups are:

- TE 1 (B-TE1) for B-ISDN;
  this functional group includes functions broadly belonging to layer 1 and higher layers of the ITU-T Recommendation X.200 [163] reference model. Examples on B-TE functions are: user/user-and-user/machine dialogue and protocol, interface termination and other layer 1 functions, protocol handling for signalling and OAM functions. B-TE Type 1 has an interface that complies with the B-ISDN user-network standards.

  NOTE: TE 2 has an interface that complies with other standards than the ISDN user-network standards, e.g. CCITT X-series Recommendations. These are outside the scope of this ETR.

- Network Termination 1 (B-NT1) for B-ISDN;
  this functional group includes functions broadly equivalent to layer 1 of the OSI reference model. Examples of B-NT1 functions are: line transmission termination, transmission interface handling and OAM functions.

- Network Termination 2 (B-NT2) for B-ISDN;
  this functional group includes functions broadly equivalent to layer 1 and higher layers of the ITU-T Recommendation X.200 [163] reference model. B-NT2 can be null in the case of commonality between Tb and Sb. Examples of B-NT2 functions are: adaptation functions for different media and topologies, buffering, resource allocation, multiplexing/demultiplexing, signalling protocol handling and switching of internal connections. B-NT2 implementations may be concentrated or distributed. In a specific access arrangement, the B-NT2 may consist only of physical connections.

The B-ISDN reference points are:

a) Sb reference point is provided at the terminal side of a B-NT2;

b) Tb reference point is provided between the B-NT1 and B-NT2;

c) Coincident Sb and Tb reference point is provided where there is no B-NT2.

7.3.2 B-ISDN services

Different levels of classification are used to describe services in B-ISDN. In ITU-T recommendation I.211 [6] the different B-ISDN services are classified as conversational services, messaging services, retrieval services and distribution services with or without user individual presentation control. It has been announced that changes to the current classification may occur due to defining multimedia services.

Two recommendations regarding the Broadband Connection-oriented Bearer Service (CCITT Recommendation F.811 [164]) and Broadband Connectionless Data Bearer Service (CCITT Recommendation F.812 [165]) are finalised. The recommendation regarding Broadband Connection-oriented Bearer Service contains information relevant for different types of traditional bearer services such as speech, unrestricted digital information and packed mode services. The recommendation form a general framework and separate recommendations for the individual services will be provided later.

The connection-oriented and connectionless bearer services can be classified according to the service provided by the ATM Adaptation Layer (AAL). To minimise the number of AAL protocols, the AAL service classification is defined based on the following parameters:

- timing relation between source and destination (required or not required);

- bit rate (constant or variable);

- connection mode (connection-oriented or connectionless).

The AAL service classes build based on these requirements is described in table 5.

Table 5: Service classification for AAL

	Class A	Class B	Class C	Class D
Timing relation between source and destination	Required		Not required	
Bit rate	Constant	Variable		
Connection mode	Connection-oriented			Connectionless

To support the different services classes different ATM adaptation layers (AALs) are specified. A functional description of the AAL can be found in ITU-T Recommendation I.362 [1]. AAL type 1 will support services of type A. AAL type 2 will support services of type B. AAL type 2 is for further study. AAL type 3/4 and AAL type 5 supports services of type C. In addition will AAL type 3/4 supports services of type D.

The service requested is identified by information elements in the DSS2 signalling messages (e.g. in the SETUP message). The bearer service is identified by the Broadband Bearer Capability information element and the ATM Adaptation Layer parameters information element.

In the first release of B-ISDN, as specified by ITU, the following bearer services shall be supported:

- Broadband Connection-oriented Bearer Service - type A (BCOB-A);
- Broadband Connection-oriented Bearer Service - type X (BCOB-X);
- Broadband Connectionless Data Bearer Service - type D (BCLB).

For a BCOB-X service no services are requested from the ATM adaptation layer and the network will provide a cell-relay only service. Protocols related to the layers above ATM is dependant on the users involved only. For a BCOB-X service, interworking to the same service in another network cannot be provided.

For the time being only bearer services are specified for the B-ISDN. The planned schedules for providing service descriptions for B-ISDN services are described in table 6.

Table 6: Draft Broadband services recommendations

Recommendation Number	Title	Target Date	Priority
F.813 [166]	Virtual Path Service for Reserved and Permanent Communications	Sept. 1994	High
F.DMS [167]	Multimedia Distribution Services	Feb. 1996	High
F.310 [168]	Broadband Videotex Services	Feb. 1996	Medium
F.722 [169]	Broadband video-telephony Services	May 1995	Medium
F.732 [170]	Broadband video-conference Services	May 1995	Medium
F.821 [171]	Broadband TV distribution Services	Feb. 1996	Medium
F.822 [172]	Broadband HDTV distribution Services	Feb. 1996	Medium
F.MDV [173]	Multimedia Delivery Services	Feb. 1996	High
F.UCTBS [174]	Broadband Unstructured circuit transport (2,048 Mbit/s) bearer service	May 1995	High
F.TG704 [175]	Broadband Transparent transport of G.704 frame bearer service	May 1995	High
F.FG704 [176]	Broadband Transport of individual time slot frames of a G.704 frame bearer service	May 1995	High
F.N64 [177]	Broadband n*64 kbit/s bearer service	May 1995	High

An updated version of CCITT Recommendation F.811 [164] for Broadband Connection-oriented Bearer Service will be finalised by May 1995.

Interworking towards the bearer services supported in ISDN will be provided. No specific supplementary services are planned for B-ISDN. The supplementary services defined for ISDN will be supported in B-ISDN.

7.3.3 Signalling support for multimedia services

In ongoing work to specify the signalling capabilities for the next version of B-ISDN new functionality useful for multimedia services will be provided. In the ITU signalling version CS-2.1 planned to be finalised in spring 1995, the following capabilities will be supported:

- establishment of a call containing several virtual channel connections;
- establishment of a point-to-multipoint call;
- support of Common Route Connection groups.

For the call with multiple connections, it will be possible to add and drop connections during the call. For the point-to-multipoint call it will be possible to add and drop participants during the call.

The different connections belonging to a connection group will be routed through the same switches in the network to reduce the differential delay between the connections.

More flexibility will be added to later versions of the B-ISDN signalling, for instance to support multipoint-to-multipoint virtual connections.

7.4 ADSL

Asymmetrical Digital Subscriber Line (ADSL) is an enhanced transmission system developed for high bitrate transmission on twisted pair copper cables. ADSL requires a single pair.

The principle has been developed in North-America, and ANSI is working on an American standard on ADSL.

A functional description of the blocks and interfaces of the ADSL system is given in figure 20.

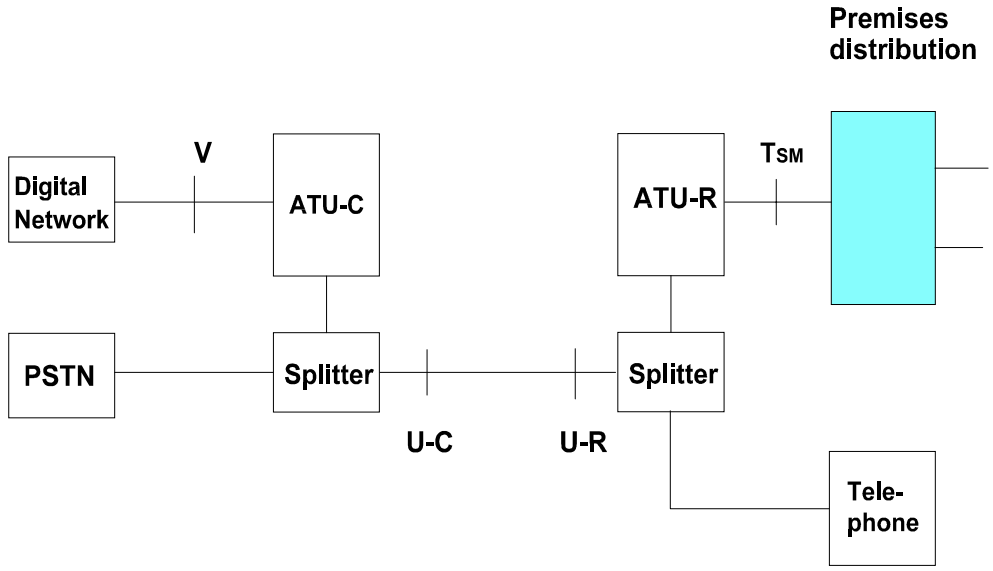

Figure 20: Functional description of the ADSL system

The bitrate of the asymmetric simplex channel network to user has several options. Four different transport classes have been proposed based on multiples of 1,536 Mbit/s bearers being 1,536 Mbit/s, 3,072 Mbit/s, 4,608 Mbit/s and 6,144 Mbit/s. Three different transport classes have been proposed based on multiples of 2,048 Mbit/s bearers being 2,048 Mbit/s, 4,096 Mbit/s and 6,144 Mbit/s. The inclusion of these classes is a result of communication between ANSI and ETSI.

In addition, it has been proposed to have duplex channels with total bitrates of 176 kbit/s, 448 kbit/s or 640 kbit/s depending on the transport class. This bitrate includes control channel C of 16 or 64 kbit/s the bitrate depending on the transport class. Besides these channels a telephone channel may be included using filtering technique. ADSL technology is still in active development and experimental phase.

To define a user data stream a bearer channel concept is defined. ADSL may transport up to seven bearer channels simultaneously, up to four downstream simplex bearers (from network to users) and up to three duplex bearers (bi-directional). Additional upstream simplex bearer channel as well as a duplex channel for operation, maintenance and control is for further study.

The ANSI standard address also aspects such as:

- functional characteristics of central office and remote end transmission units (ATU-C and ATU-R);
- ADSL/telephone splitting;
- electrical characteristics;
- signalling requirements;
- initialisation, online adaptation and reconfiguration;
- maintenance;
- transmission quality (bit error rates etc,...).

The bearer rates and overhead are described in table 7.

Table 7: ADSL bitrates

	Bearer rates based on 1,536 Mbit/s				**Bearer rates based on 2,048 Mbit/s**		
Transport class	1	2	3	4	2M-1	2M-2	2M-3
Simplex bearers							
Maximum capacity (Mbit/s)	6,144	4,608	3,702	1,536	6,144	4,096	2,048
Bearer channel options (Mbit/s)	1,536 3,072 4,608 6,144	1,536 3,072 4,608	1,536 3,072	1,536	2,048 4,096 6,144	2,048 4,096	2,048
Max. active sub-channels	4	3	2	1	3	2	1
Duplex bearers							
Maximum capacity (kbit/s)	640	448	448	176	640	448	176
Bearer channel options (kbit/s)	576 384 160	note 1 384 160	note 1 384 160	160	576 384 160	note 2 384 160	160
Control channel	64 (C)	64 (C)	64 (C)	16 (C)	64 (C)	64 (C)	16 (C)
Max. active sub-channels	3	2	2	2	3	2	2
System overhead (minimum/maximum)							
Downstream (kbit/s)	128/192	128/192	128/192	128/160	128/192	128/192	128/160
Upstream (kbit/s)	96/128	96/128	96/128	96/128	96/128	96/128	96/128

NOTE 1: Whether transport classes 2 or 3 should support the 576 kbit/s optional duplex bearer is for further study.
NOTE 2: Whether transport class 2M-2 should support the 576 kbit/s optional duplex bearer is for further study.

Among the applications that may utilise the ADSL transmission system are VOD and multimedia services. Because of the relatively high bitrate of the two way transport channels ADSL may transport several interactive telecommunications services in addition to video services. However, the standards cover only transmission related aspects, application aspects are outside the scope of the ANSI standard.

8 Interworking

8.1 Terminology

The term interworking is used differently in different contexts. The service descriptions produced by ETSI uses the term **intercommunication** for communication between terminals supporting different services in the same network, while **interworking** is used for communication between different networks.

However, in this ETR, as well as in several other ETSI standards and ITU-T Recommendations the term interworking is used in a wider context, communication between different applications or services in the same network is covered by the term interworking.

8.2 Standards and recommendations on network interworking

ITU-T has prepared a set of recommendations in the ITU-T Recommendation I.500 [178] that describe several network interworking scenarios and principles for interworking between ISDN and other network and services.

Figure 21 describes the organisation of these recommendations. The figure is a reproduction of figure 1 of ITU-T Recommendation I.500 [178]. The recommendations are grouped by a level of detail into:

- general level;
- scenario level;
- functional level;
- protocol level.

ITU-T Recommendation I.500 [178] and ITU-T Recommendation I.510 [179] form the general level. ITU-T Recommendation I.500 [178] given the structure of these recommendations, whilst ITU-T Recommendation I.510 [179] specifies the general principles for ISDN interworking.

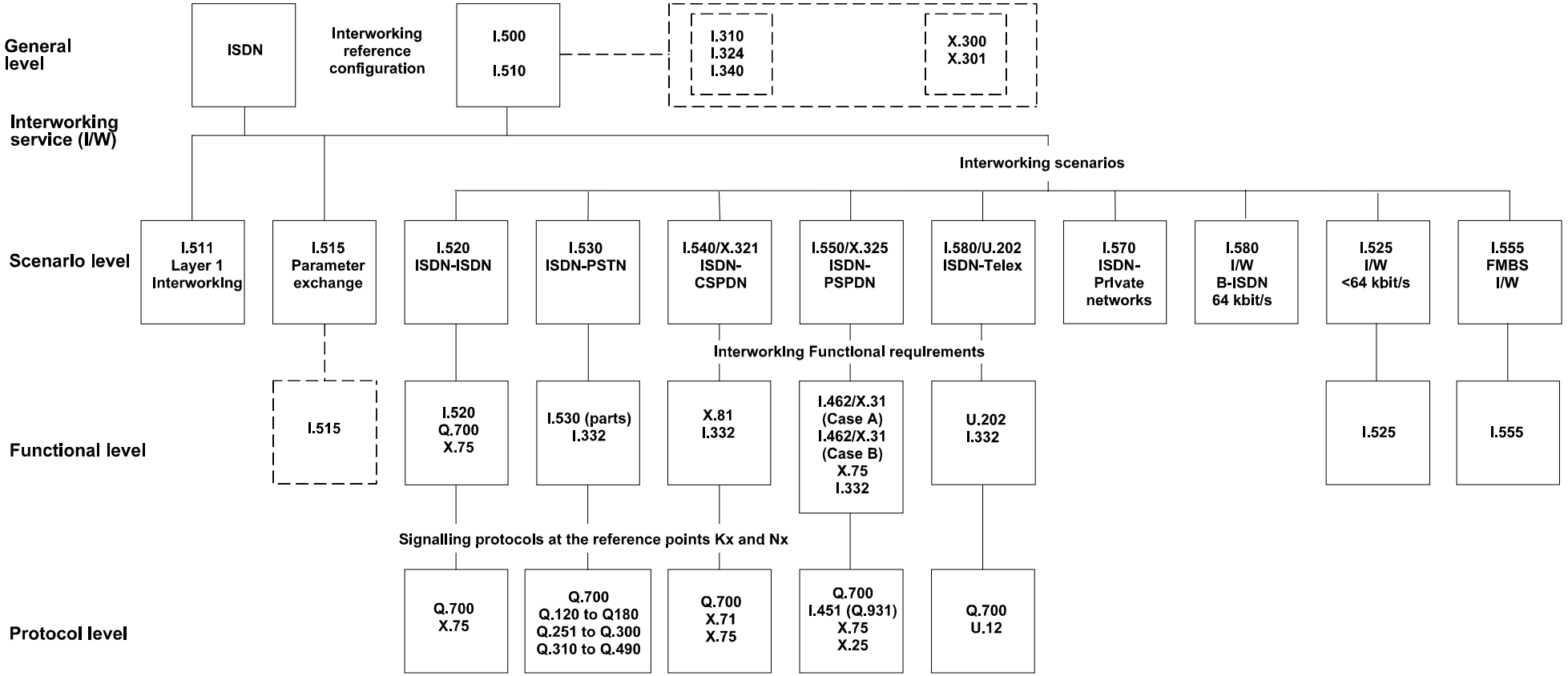

Figure 21: Organisation of ITU-T Recommendations on interworking

The scenario level of recommendations identifies:

- Layer 1 interworking in ITU-T Recommendation I.511 [180];
- the parameter exchange which may be necessary for interworking situations in ITU-T Recommendation I.515 [181];
- ISDN-to-ISDN interconnection in ITU-T Recommendation I.520 [182] **5**;
- interworking between ISDN and PSTN in ITU-T Recommendation I.530 [183];
- interworking between ISDN and CSPDN in ITU-T Recommendations I.540 [184] and X.321 [185];
- interworking between ISDN and PSPDN in ITU-T Recommendations I.550 [186] and X.325 [187];
- interworking between ISDN and Telex in ITU-T Recommendation I.560 [188];
- interworking between ISDN and Private networks in ITU-T Recommendation I.570 [189];
- interworking between ISDN and B-ISDN in ITU-T Recommendation I.580 [190];
- Interworking between ISDN and networks having a transport capacity less than 64 kbit/s in ITU-T Recommendation I.525 [191];
- interworking between the ISDN and the frame mode bearer service (FMBS) in ITU-T Recommendation I.555 [192].

ETS 300 345 [193] describes the general requirements for service interworking between public ISDNs and private ISDNs. It addresses the general aspects related to the services descriptions.

For multimedia applications ITU-T Recommendation I.580 [190] on interworking between 64 kbit/s based ISDN and B-ISDN is important. The recommendation identifies five communication scenarios as described in figure 22.

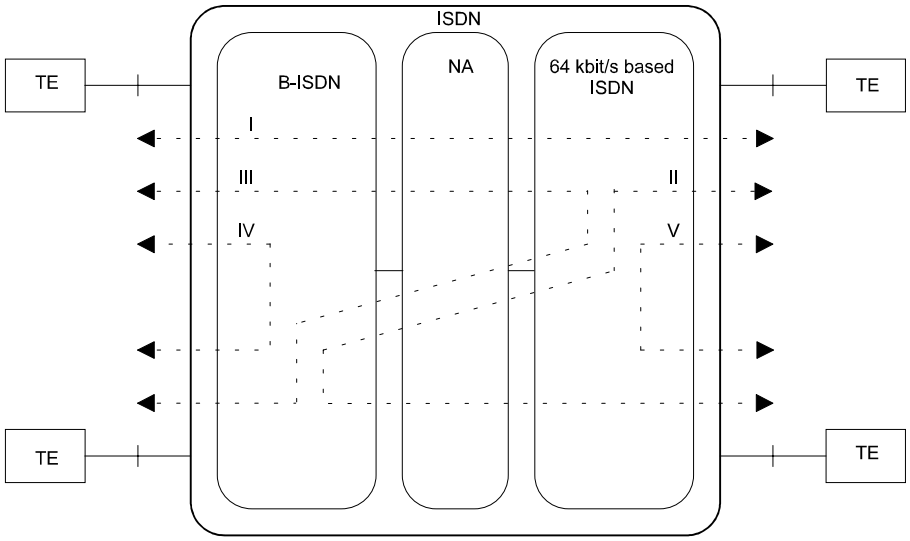

Figure 22: B-ISDN interworking scenarios

These scenarios are:

1) an interconnection scenario between B-ISDN and 64 kbit/s based ISDN;
2) a network concatenation interworking scenario, where the interfaces and services are the same as those which are currently provided by 64 kbit/s based ISDN;

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5 Interworking with restricted networks is described in an appendix to this recommendation.

3) the service capabilities provided between broadband user access points are restricted to 64 kbit/s based ISDN capabilities;

4) broadband capabilities are available end-to-end and services currently provided by 64 kbit/s ISDN are also supported;

5) end-to-end communication is entirely within the 64 kbit/s based ISDN.

Scenarios 4 and 5 are outside the scope of ITU-T Recommendation I.580 [190].

8.3 Service interworking

ITU-T Recommendation I.501 [194] describes general principles of service interworking, and identifies the key interworking requirements needed to support service interworking in ISDNs, between ISDNs, and between ISDNs and other networks.

The recommendation describes principles for fallback. These principles are described in subclause 7.2.3 of this ETR. It is worth noting that the recommendation contains a description of fallback for data and facsimile applications. However, the recommendation is general, and does not provide the necessary details that are necessary to establish successful interworking between services and applications within an ISDN or between an ISDN and other networks.

The services descriptions for the telephony 7 kHz teleservice, ETS 300 263 [195] and videotelephony teleservice, ETS 300 264 [159], specifies that a terminal shall be capable of supporting the telephony 3,1 kHz teleservice as described in ETS 300 111 [196]. Similar requirements will be given in the service description for the audiographic conference teleservice, ETS 300 675 [197]. The work of ETSI STC TE4 on a service description for the videoconference teleservice in the ISDN will also consider these principles. This means that terminals supporting the audiovisual services have a common mode, 3,1 kHz telephony mode. These terminals may also have more common modes, a videoconference terminal will for example support one or more videotelephony modes.

A set of three ETSI standards, ETS 300 105 [198], ETS 300 106 [199] and ETS 300 107 [200] specifies international Videotex interworking between:

- Videotex services;
- a terminal and a host;
- between gateways.

Several network scenarios are specified in these standards.

An analysis made by ETSI STC TE2 identifies the elements of facsimile Group 4 terminals with Group 3 capabilities and ISDN networks that can permit intercommunication between Group 4 and Group 3 terminals. Only use of D-channel call clearing cause values as a tool to invoke fallback is considered, Possible use of the UDI-TA bearer service has not been considered. This analysis assumes that the Group 4 terminal has a 64 kbit/s Group 3 emulation, which emulates a modem signal.

8.4 Analysis of interworking

Interworking cases for MoU-ISDN services have been analysed by ETSI STC NA2 for the ISDN MoU Implementation and Management Group (IMIMG). The results are presented in ETR 030 [201].

Table 8 is a reproduction of table 1 of ETR 030 [201].

Table 8: Service interworking

Existing networks other than ISDN

		Teletex (CSPDN, PSPDN)	Telex	Facsimile (G3 on PSTN)	Data transmission on PSTN	X.25 (PSPDN) data transmission Services	X.21 (CSPDN) data transmission Services	Videotex	X.400 (MHS)
ISDN based	Teletex	note 1	note 2						note 3
	Facsimile G4			note 4					note 3
	X.31 Case A					note 5			
	X.31 Case B (B-channel)					note 5			
	X.31 Case B (D-channel)					note 5			
	Syntax Based Videotex							note 6	
	Videotex photographic mode								
	X.400 (MHS)	note 3	note 3	note 3					
	V.110 adapted Data transmission				note 7				

(continued)

Table 8 (concluded): Service interworking

NOTE 1: Teletex (ISDN) interworking with teletex (PDN) may be subdivided into:
- teletex (ISDN) interworking with teletex (CSPDN);
- teletex (ISDN) interworking with teletex (PSPDN).

For teletex (ISDN) interworking with teletex (CSPDN) no open issues exist. The relevant ITU-T Recommendations for interworking are:
- scenario description ITU-T Recommendation X.321 [185];
- functional description ITU-T Recommendation X.81 [202].

For teletex (ISDN) interworking with teletex (PSPDN) there are open issues regarding routing towards the ISDN and definition of the function level. Relevant ITU-T Recommendation for the scenario description is X.325 [187]. For the functional level on protocol mapping no standard exists yet. Short term and longer term solutions to the unsolved issues are proposed in annex A to ETR 030 [201].

NOTE 2: Teletex (ISDN) interworking with telex is discussed in annex B to ETR 030 [201]. No open issues exist. Interworking based on one-stage selection and two-stage selection may be provided. Relevant ITU-T Recommendations for the description of the general principles for this interworking case are F.201 [203] and U.201 [204]. Description of the functional level to be applied in specific network arrangements, e.g. protocol mapping between teletex (ISDN) and telex signalling, may not be required, since the conversion facility may follow store and forward switching principles. The functional level is defined by specifying the signalling system at each side of the conversion.

NOTE 3: For all ITU-T Recommendation X.400 [71] related cases, no Interworking Functions (IWFs) are required, since message handling systems are interconnected to public networks (ISDN, PSTN, PDNs) on the basis of a customer access. For interconnection between a message handling system and different types of networks, however, different types of ports to the message handling system may be defined in order to cater for the various types of user/network interfaces. These ports are regarded as part of the message handling system. They are defined by the standards specifying the user/networking interfaces and the universal input/output of the message handling system. For a message handling system accessing an ISDN also the requested bearer capability may be of importance taking into account different types of terminal adaption, if applicable. The ISDN port of a message handling system may comply with a TE1-function supporting the capability of a 64 kbit/s UDI bearer or may require adaption to a TE2-function (ITU-T Recommendation V.110 [205], etc,...).

NOTE 4: Terminal adaption for communications between facsimile G4 on the ISDN and facsimile G3 on the PSTN is accomplished within the G4 ISDN terminal. Thus, no specific interworking arrangement between ISDN and PSTN for the support of facsimile is required.

NOTE 5: ISDN access to a packet handler or a PSPDN may be specified as interworking by port access as defined in ITU-T Recommendation X.325 [187], ETS 300 007 [206], ITU-T Recommendation X.31 [207] and the packet handler interface specification ETS 300 099 [208]. No specific interworking arrangement between the packet handler and a PSPDN is required. Interconnection may be accomplished by use of X.75 [28], or an equivalent internal network protocol.

NOTE 6: Videotex services which are defined for and used in a PSTN/PSPDN environment will also be accessible by ISDN syntax-based terminals. The ISDN is only used in an access network between the terminal function and the access function. (The access function is the functional entity which gives access to the Videotex system; it is an integral part of the Videotex service).
No IWF has to be provided by the ISDN.

NOTE 7: The scenario for interworking between ITU-T Recommendation V.110 [205] adapted data transmission in the ISDN and data transmission in the PSTN is shown in ITU-T Recommendation I.515 [181].
The details for that interworking case are under study. The planned Recommendation on this subject will be ITU-T Recommendation I.516.

ETSI STC TE1 is carrying out a study on "Interworking and interoperability of retrieval services and audiovisual services on narrow band networks", ETR 176 [209].

The scope of the study is interworking and interoperability between retrieval services (including Videotex and Videotex with moving video) and audiovisual services (videotelephony, audiographic conferencing and videoconferencing) on narrow band networks (ISDN and PSTN). Various types of terminals may access and retrieve data from a database either directly or via an interworking unit:

- when it is directly, it implies that the protocols and the data syntax (text, graphics, still pictures and moving video encoding) be the same on both the terminal and the database side. The protocols and the data syntax could be either from the Videotex or the audiovisual world;

- when the protocols are different on the terminal and the database sides, an interworking unit has to be inserted to perform the necessary protocol and data syntax conversions;

- in both of the two above mentioned cases, the information from the host to the terminal is described including the data syntax to be used. The commands issued from the terminal to the database are also described. They highly depend on the capabilities of the terminal concerned: DTMF, Videotex commands following ITU-T Recommendation F.300 [157], SBV protocol commands, etc,...

The following terminals are considered:

- a PSTN videophone terminal;
- an H.261 terminal (with a Videotex decoder);
- an H.261 terminal (without a Videotex decoder);
- an H.320 terminal (without a Videotex decoder);
- an H.320 terminal (with a Videotex decoder);
- an audiographic conferencing terminal accessing to a Videotex service centre during a multi-point conference;
- a combined Videotex and audiovisual terminal.

For each terminal type, access to both a native and Videotex database are described.

ETR 045 [210] analyses possible configurations which might occur in interworking between Private Telecommunication Networks and public ISDNs from an abstract modelling point of view.

9 Multimedia protocol platform

9.1 Requirements for multimedia connectivity

9.1.1 Existing fixed public network

The requirements for multimedia connectivity set up in this subclause addresses ISDN and PSTN characteristics and terminals for attachments to these networks. However, most of these requirements are general, although some details may have to be reconsidered to fit the characteristics of the relevant networks. The definitions of terminal types will have to be adapted to the requirements and characteristics of each individual network.

a) The reasonable wishes of the calling (originating) user Uo and the called (destination) user Ud need to be met if possible; if Uo and Ud wishes are in conflict then on the basis that Uo is paying his wishes should be preferred if possible. However it is recognised that some legitimate actions by Ud make it impossible to meet the originator's wishes. In general, the highest level of commonality should be chosen.

b) It should be possible to achieve the technical connectivity of (a) without necessarily subscribing to a teleservice provision of the network operator (PNO), though in such a case the users may not enjoy the special provisions of that service (such as special tariffs, directories...). Expressing this requirement differently, it need not to be mandatory that a PNO provide the means to look at HLCs within the network, nor in this latter case will the terminals be forbidden to transmit HLCs.

c) A PNO or Regulator will be able to impose restrictions on the I.E. values sent or accepted, but these need not be part of the international standardization rules.

d) It should be possible to make connections from terminals on ISDN to those on PSTN and vice versa, whenever the two ends are able to deal with the same medium, through a simple gateway in which there is no transcoding [complication: transcoding needed between A-law and μ-law]. Other more complex gateways are not precluded, but require special addressing arrangements. It is recognised that it may be necessary to make 2 call attempts from ISDN to PSTN gateway (e.g. Fax 3/4 trying first BC='UDI', then BC='3,1kHz audio'). "Medium" here refers both to information medium in the terminals and communication medium.

e) Table 9 contains a list of terminal types - not an exhaustive list but carefully chosen as examples of the variety which might be encountered. Each of these will be able to put through calls to the destination types listed in table 10, at least when common media are invoked (or intended to be invoked); likewise the destinations shall accept call requests of appropriate parameters, unless barred therefrom by specific action resulting from Ud wishes or regulatory imposition.

f) The existing HLC definitions in ITU Recommendation Q.931 [211][6] need to be respected.

g) It should be possible to change protocol during a call, from conversational (ITU-T Recommendation H.221 [48] framed or just CCITT Recommendation G.711 [133] encoded) to telematic (ITU-T Recommendation T.90 [43] negotiated) and vice versa, if the terminals are known/expected to have suitable capabilities, and if the type of physical connection also supports this change. For example, if a BC="Speech" call had been made, this might have been routed through low-rate encoding DCME, and thus not (perhaps) then carry a modem signal. It does not seem to be necessary to change to messaging, as the end-point of the call is also likely to be on a different terminal.

h) It will be possible for a conversational terminal to communicate with a Database, provided that they have at least one medium in common (could be speech, or pictures, or another medium); the same applies to accessing a message mailbox (e.g. "Voicebank").

i) Tones and announcements will be transmitted by the networks when a PSTN connection has been requested, or an ISDN conversational service (BC="Speech" or BC="UDI-TA").

Table 9: Terminal types

ISDN Terminals		
Tp	Telephone	conversational only, no video; G.711
Fx	Facsimile Gp 3(?)	non-conversational; fax only
Mm1	PC with ISDN card (1B)	non-conv; fax, still-TV, file transfer and Videotex
Mm2	Workstation with ISDN card (2B)	non-conv; still-TV, file transfer and graphics/pointer....
Vp1	PC Videophone (1B)	conversational with video; file transfer; H.320
Vp2	PC Videophone (2B)	conversational with video; file transfer and fax; H.320
DB1	Multimedia database (1B)	Videotex (excl. audio), fax, still-TV, non-H.320
DB2	Multimedia database (2B)	Videotex (incl. audio), fax, still-TV, also H.320 interface
PSTN terminals		
P-Tp	Telephone	conversational only, no video
P-Fx	Facsimile Gp 3(?)	non-conversational; fax only
P-Vp	PSTN videophone	conversational with video; V.32/V.34 + V.8
P-Mm	PC with comms	non-conv; fax, still-TV, file transfer and Videotex
P-Vp1	PC Videophone	conversational with video, file transfer; V.32/V.34+V.8

6 The ETSI equivalemt to ITU-T Recommendation Q.931 is ETS 300 102-1 [25].

Table 10: Intercommunication or interworking between terminal types

Originating terminal	Destination terminals accepting (unless barred)
Tp	All conversational, DB2?
P-Tp	All conversational, DB2?
P-Vp	All conversational, DB2
Vp1	All conversational, Mm1, Mm2, P-Mm, DB2
Vp2	All conversational, Mm1, Mm2, P-Mm, Fx, P-Fx, DB2
P-Vp1	All conversational, Mm1, Mm2, P-Mm, DB2
Fx	Fx, Mm1, Vp2, P-Fx, P-Mm, DB1, DB2
P-Fx	Fx, Mm1, Vp2, P-Fx, P-Mm
Mm1	Mm1, Mm2, Vp1, Vp2, P-Mm, P-Vp1,Fx, P-Fx, DB1, DB2
Mm2	Mm2, Mm1, Vp1, Vp2, P-Mm, P-Vp1, DB1, DB2
P-Mm	Mm1, Mm2, Vp1, Vp2, P-Mm, P-Vp1, Fx, P-Fx,DB1

9.1.2 Mobile networks

Most of the mobile networks (e.g. GSM, DECT) introduce transmission capacity restrictions as well as signalling procedures that are different compared with the ISDN/PSTN case. In the future mobile networks that offer higher bandwidth may be offered. Both the connectivity requirements and interworking with other networks need further analysis.

9.1.3 Broadband networks

B-ISDN offers both connection-oriented and connectionless services as described in subclause 7.3. There is ongoing work on services classification. To secure interworking with N-ISDN the principles described in subclause 9.1.1 should be used. Terminal types similar to the types defined in table 9 need to be defined.

One important requirement that has to be defined is the relationship between aggregated B-channels in the N-ISDN and corresponding network and terminal functionalities in the B-ISDN. This is for further study in ITU-T.

9.2 Brief analysis of the present schemes

9.2.1 ISDN aspects

The MoU on ISDN describe a set of bearer services to be supported by the networks offered by the signatories of the MoU. The bearer service UDI-TA which is an essential element in the description of audiovisual services in the ISDN, is not covered by the MoU, and it is not clear if and when this bearer service will be implemented in the European ISDNs.

Some of the requirements that are described in subclause 9.1.1 require that this bearer service, and the functionalities that are associated with it, is implemented in the network. It can therefore be concluded that some requirements are not met on a short term.

9.2.2 Broadband aspects

There is a need for analysis on several network and user-network interface aspects on broadband communication. These are related both to B-ISDN communication and to interworking between B-ISDN and N-ISDN.

9.2.3 Service aspects

There are incompatibilities between the protocols of the audiovisual services, the Videotex service and the facsimile service. Further on, MHS and Internet aspects need to be analysed.

One important aspect that should be analysed is the possibility to use the ITU-T T.120 Recommendations as a platform for multimedia services. An important activity is the ITU-T SG8 work on Q.15/8.

10 Conclusions

This ETR presents the results of a survey of communication protocols related to multimedia services and applications.

There is a lot of ongoing work that is relevant for the content of this ETR. The ETR therefore reflects the status of December 1994. It might be useful to prepare a new edition within 1 to 2 years to include the results of ongoing and new activities.

For the information presented in this ETR, the following conclusions can be made:

- the present inband signalling schemes for telematic and audiovisual services are incompatible;

- the T.120 series of Recommendations may form a protocol platform for multimedia services and applications. The ITU-T SG8/Q15 work is interesting and should be carefully analysed;

- interworking between networks (e.g. ISDN and B-ISDN) and the requirements of multimedia applications and services to network interworking require further analysis;

- service interworking requirements require further analysis;

- the out-of-band signalling principles for multimedia applications and services in the B-ISDN should be analysed;

- a strategy for interworking between Internet and teleservices/applications should be developed.

Annex A (normative): ISDN supplementary services

Supplementary service	ETSI Standards	
	Stage one	**Stage three**
Advice of charge during the call (AOC-D)	ETS 300 179	ETS 300 182-1
Advice of charge at the end of the call (AOC-E)	ETS 300 180	ETS 300 182-1
Advice of charge at call set-up time (AOC-S)	ETS 300 178	ETS 300 182-1
Completion of call to busy subscriber (CCBS)	ETS 300 357	ETS 300 359-1
Call forwarding busy (CFB)	ETS 300 199	ETS 300 207-1
Call forwarding unconditional (CFU)	ETS 300 200	ETS 300 207-1
Call forwarding no reply (CFNR)	ETS 300 201	ETS 300 207-1
Call deflection (CD)	ETS 300 202	ETS 300 207-1
Calling line identification presentation (CLIP)	ETS 300 089	ETS 300 092-1
Calling line identification restriction (CLIR)	ETS 300 090	ETS 300 093-1
Connected line identification presentation (COLP)	ETS 300 094	ETS 300 097-1
Connected line identification restriction (COLR)	ETS 300 095	ETS 300 098-1
Conference call, add-on (CONF)	ETS 300 183	ETS 300 185-1
Explicit Call Transfer (ECT)	ETS 300 367	ETS 300 369-1
Closed user group (CUG)	ETS 300 136	ETS 300 138-1
Call waiting (CW)	ETS 300 056	ETS 300 058-1
Direct dialling in (DDI)	ETS 300 062	ETS 300 064
Freephone (FPH)	ETS 300 208	ETS 300 210-1
Call Hold (HOLD)	ETS 300 139	ETS 300 141-1
Malicious call identification (MCID)	ETS 300 128	ETS 300 130-1
Multiple subscriber number (MSN)	ETS 300 050	ETS 300 052-1
Subaddressing (SUB)	ETS 300 059	ETS 300 061-1
Terminal portability (TP)	ETS 300 053	ETS 300 055-1
User-to-user signalling	ETS 300 284	ETS 300 286-1
Three-party	ETS 300 186	ETS 300 188-1

History

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