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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).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

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1 Scope

This ETSI Technical Report (ETR) provides an investigation of candidate architectures for Multimedia & Hypermedia Information Retrieval Services (M&HIRS).

The scope of this investigation is clarified by dealing with the related points of importance. These are:

- services;
- multimedia and hypermedia information;
- user-to-host model;
- Narrowband Integrated Services Digital Network (N-ISDN) and Broadband Integrated Services Digital Network (B-ISDN).

"Service" is the level from which the topic is dealt with. According to a communication model standpoint, this leads to the following top-down approach: applications, services, protocols, networks. Applications are related to the user, and concerns that which is offered to the user. Services are related to the network, that means: that which is offered to the applications. Since applications are instances of services which can be varied and services are more generic, a logical basis is the service level.

The type of information of concern is multimedia and hypermedia information.

Retrieval services implicitly refers to a user-to-host model.

The architectures will explicitly take into account a network. At a more detailed level, N-ISDN and B-ISDN are the networks of interest.

Although the focus is on retrieval services and the scope is limited to user-to-host models, this ETR is not limited to retrieval requirements: conversational, messaging and even broadcasting requirements are taken into account. Also, whenever necessary, conversational and messaging services are dealt with.

The basic objective of the ETR is to propose new work items in the field of M&HIRS.

To be able to determine new work items, the following approach has been taken. Firstly, a model is described that deals with the services under consideration. This model leads to requirements on different levels. Secondly, a state of the art investigation clarifies the current standardisation and technology activities related to M&HIRS. Thirdly, an architecture taxonomy is used to make the connection from service to equipment (host, network and terminal). Applications are described by scenarios and appropriate configurations (taking into account interchange protocols, terminals and networks) leading to candidate architectures in the field of M&HIRS. The M&HIRS requirements and the state of the art capabilities are used to justify these candidate architectures. Finally, the yet unfulfilled requirements in the candidate architectures result in new work item proposals in this area.

2 References

For the purposes of this ETR, the following references apply.

[1] CCITT Recommendation Q.9 (1988): "Vocabulary of switching and signalling terms".

[2] ITU-T Draft Recommendation T.170: "Audio-visual interactive (AVI) systems".

[3] CCITT Recommendation I.113 (1991): "Vocabulary of terms for broadband aspects of ISDN".

[4] CCITT Recommendation I.112 (1988): "Vocabulary of terms for ISDNs".

[5] ETS 300 075 (1990): "Terminal Equipment (TE); Videotex processable data".

[6] ISO/IEC 646 (1990): "Information technology - ISO 7-bit coded character set for information interchange".

[7] ISO 8859 (1987): "Information processing - 8-bit single byte coded graphic character sets".

[8] CCITT Recommendation T.50 (1992): "International Alphabet No. 5".

[9] CCITT Recommendation T.51 (1988): "Coded character sets for telematic service".

[10] CCITT Recommendation T.52: "Non-Latin coded character sets for telematic services".

[11] CCITT Recommendation T.61 (1992): "Character repertoire and coded character sets for the international Teletex service".

[12] CCITT Recommendation T.101 (1988): "International interworking for videotex services".

[13] ISO/IEC DIS 10646-1: "Information Technology - Open Systems Interconnection - Systems Management Part I: Object Management Function".

[14] ISO DP 8632 (1987): "Information processing systems - Computer graphics - Metafile for the storage and transfer of picture description information".

[15] ISO 7942 (1985): "Information processing systems - Computer graphics - Graphical Kernel System (GKS) functional description".

[16] ISO/IEC 9637-1: "Information technology - Interface techniques for dialogues with graphical devices - CGI data stream encoding Part 1: object management function".

[17] ISO Committee Draft (CD) 10918 (1989): "Digital compression and coding of continuous-tone images".

[18] ISO/IEC DIS 11544 (1992): "Information technology - Coded representation of picture and audio information - Progressive bi-level image compression".

[19] CCITT Recommendation T.4 (1988): "Standardization of group 3 facsimile apparatus for document transmission".

[20] CCITT Recommendation T.6 (1988): "Facsimile coding schemes and coding control functions for group 4 facsimile apparatus".

[21] ETS 300 177 (1992): "Terminal equipment (TE); Videotex, Photographic syntax".

[22] CCITT Recommendation G.711 (1988): "Pulse code modulation (PCM) of voice frequencies".

[23] CCITT Recommendation G.721 (1988): "32 kbit/s adaptive differential pulse code modulation (ADPCM)".

[24] CCITT Recommendation G.722 (1988): "7 kHz audio-coding within 64 kbit/s".

[25] ETS 300 149 (1992): "Terminal Equipment (TE); Videotex, Audio syntax".

[26] CCITT Recommendation G.723 (1988): "Extensions of Recommendation G.721 adaptive differential pulse code modulation to 24 and 40 kbit/s for digital circuit multiplication equipment application".

[27] ISO/IEC 8613 (1989): "Information processing - Text and office systems - Office Document Architecture (ODA) and interchange format".

[28] CCITT Recommendations T.411 to T.418 (1988): "Open document architecture (ODA) and interchange format".

[29] CCITT Recommendation H.261 (1988): "Codec for audiovisual services at n x 384 kbit/s".

[30] ISO/IEC 8824 (1990): "Information technology - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1)".

[31] ISO 8825 (1990): "Information technology - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)".

[32] ISO 9070 (1990): "Information processing - SGML support facilities - Registration procedures for public text owner identifiers".

[33] ISO/IEC DIS 10744 (1991): "Information technology - Hypermedia/time-based structuring language (Hytime)".

[34] ISO/IEC DIS 11172 (1992): "Information technology - Coding of moving pictures and associated audio for digital storage media up to about 1,5 Mbit/s".

[35] ITU-T Draft Recommendation T.175: "Protocols for browsing, downloading and executing AVI applications".

[36] ITU-T Draft Recommendation T.176: "Protocols for synchronisation of executed AVI applications".

[37] ITU-T Draft Recommendation T.102: "Syntax Based Videotex end-to-end protocols for the circuit mode ISDN".

[38] ITU-T Draft Recommendation T.103: "Syntax Based Videotex end-to-end protocols for the packet mode ISDN".

[39] ITU-T Draft Recommendation T.105: "Syntax Based Videotex application layer protocol".

[40] ETS 300 072 (1990): "Terminal Equipment (TE); Videotex presentation layer protocol, Videotex layer data syntax".

[41] ETS 300 073 (1990): "Videotex presentation layer data syntax, Geometric Display (CEPT Recommendation T/TE 06-02, Edinburgh 1988)".

[42] ETS 300 076 (1992): "Terminal Equipment (TE); Videotex, Terminal Facility Identifier (TFI)".

[43] CCITT Recommendation X.400 (1988): "Message handling system and service overview".

[44] ISO 8859-8 (1988): "Information processing - 8-bit single-byte coded graphic character sets - Part 8: Latin/Hebrew alphabet".

[45] ISO/IEC TR 10000 (1990): "Information technology - Framework and taxonomy of international standardised profiles".

[46] CEC M-IT-01 (1986): "The concept and structure of functional standards for information technology (for interworking in as OSI environment)".

[47] CEC M-IT-02 (1989): "Directory of functional standards (for interworking in an OSI environment)".

[48] CCITT Recommendation T.90 (1992): "Characteristics and protocols for telematic services in ISDN".

[49] ETS 300 080: "Integrated Services Digital Network (ISDN); ISDN lower layer protocols for telematic terminals".

[50] ISO MHEG: "Working Document S: Coded Representation of Multimedia and Hypermedia Information Objects".

[51] ITU-T Draft Recommendation T.171: "Coded representation of Multimedia/Hypermedia information objects".

[52] ETS 300 079 (1991): "Integrated Services Digital Network (ISDN); Syntax-based Videotex, End-to-end protocols, circuit mode DTE-DTE".

[53] ITU-T Draft Recommendation F.740: "Audiovisual Interactive Services".

[54] ETS 300 223: "Integrated Services Digital Network (ISDN); Syntax-based Videotex, Common end-to-end protocols".

[55] CCITT Recommendation H.221 (1988): "Frame structure for a 64 kbit/s channel in audiovisual teleservices".

[56] CCITT Recommendation I.140 (1988): "Attribute technique for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[57] CCITT Recommendation I.121 (1991): "Broadband aspects of ISDN".

3 Definitions and abbreviations

3.1 Definitions

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

Application: a set of a user's requirements (CCITT Recommendation Q.9 [1]).

Hypermedia: the ability to access monomedia and multimedia information by interaction with explicit links (CCITT Draft Recommendation T.170 [2]).

Interactive service: a service which provides the means for bi-directional exchange of information between users, or between users and hosts. Interactive services are subdivided into three classes of services: conversational services, messaging services and retrieval services (CCITT Recommendation I.113 [3]).

Multimedia (representation): the property of handling several types of representation media (CCITT Draft Recommendation T.170 [2]).

Multimedia and hypermedia information retrieval services: a generic set of services which provide users with the capability to access and interchange multimedia and hypermedia information.

Retrieval service: an interactive service which provides the capability of accessing information stored in database centres. The information will be sent to the user on demand only. The information can be retrieved on an individual basis, i.e., the time at which an information sequence is to start is under the control of the user (CCITT Recommendation I.113 [3]).

Service: that which is offered by an Administration to its customers in order to satisfy a specific telecommunication requirement (CCITT Recommendation I.112 [4]).

Scriptware: a mechanism, which allows for the description of an interactive application in a hardware independent way.

User: a person, or machine, delegated by a customer to use the services and/or facilities of a telecommunication network (CCITT Recommendation I.112 [4]).

3.2 Abbreviations

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

A	Application-specific
ACA	Audio Content Architecture
A-RTI	Application-specific Real-Time Interchange
A-T	Application-specific Terminal
ADPCM	Adaptive Differential Pulse Code Modulation
AP	Access Point
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
ASN.1	Abstract Syntax Notation One
ATM	Asynchronous Transfer Mode
AVI	Audio Visual Interactive
B-ISDN	Broadband Integrated Services Digital Network
BRA	Basic Rate Access
C	Communication
CAD	Computer Aided Design
CCITT	Comité Consultatif International Télégraphique et Téléphonique
CD	Content Data or Committee Draft
CDA	Compound Document Architecture
CD-DA	Compact Disc Digital Audio
CD-I	Compact Disc Interactive
CD-ROM	Compact Disc Read Only Memory
CD-ROM XA	Compact Disc Read Only Memory eXtended Architecture
CD-RTI	Content Data Real-Time Interchange
CD-T	Content Data Terminal
CDTV	Commodore Dynamic Total Vision
CGI	Computer Graphics Interface

CGM	Computer Graphics Metafile
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CYM	Cyan, Yellow, Magenta
CYMK	Cyan, Yellow, Magenta, Black
DAB	Digital Audio Broadcasting
DAT	Digital Audio Tape
DBN	Digital Broadcasting Network
DCC	Digital Compact Cassette
DIB	Device Independent Bitmap
DFR	Document Filing and Retrieval
DPCM	Differential Pulse Code Modulation
DQDB	Distributed Queue Dual Bus
DTAM	Document, Transfer, Application Management
DVI	Digital Video Interactive
ECMA	European Computer Manufacturers' Association
ETR	ETSI Technical Report
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
EWOS	European Workshop for Open Systems
FDDI	Fibre Distributed Data Interface
FLOPS	Floating Points Operations Per Second
FT	File Transfer
FTAM	File Transfer, Access and Management
GKS	Graphical Kernel System
H	Host
HD	Hard Disk
HD-MAC	High Definition Multiplexed Analogue Components
HDTV	High Definition TeleVision
HyTime	Hypermedia/Time-based structuring language
I	Interchange

I1	CD-RTI
I2	MHI-RTI
I3	S-RTI
I4	A-RTI
I5	I-NRTI
IDL	Interactive Distributed Learning
IEC	International Electrotechnical Commission
I-NRTI	(All) Information Non Real-Time Interchange
ISDN	Integrated Services Digital Network
ISO	International Standardisation Organisation
JBIG	Joint Bi-level Image Experts Group
JPEG	Joint Photographic Experts Group
JTC	Joint Technical Committee
LAN	Local Area Network
LPC	Linear Predictive Coding
MAC	Multiplexed Analogue Components
MAN	Metropolitan Area Network
MCI	Media Control Interface
MHEG	Multimedia and Hypermedia information coding Experts Group
MHI	Multimedia and Hypermedia Information
M&HIRS	Multimedia & Hypermedia Information Retrieval Services
MHI-RTI	Multimedia and Hypermedia Real-Time Interchange
MHI-T	Multimedia and Hypermedia Terminal
MIDI	Musical Instrument Digital Interface
MIPS	Million Instructions Per Second
MIME	Multipurpose Internet Mail Extension
MMI	Man Machine Interface
MOD	Magneto Optical Disc
MPC	Multimedia Personal Computer
MPEG	Moving Picture Experts Group
N	Network

N-ISDN	Narrowband Integrated Services Digital Network
NRTI	Non Real-Time Interchange
ODA	Open Document Architecture
OSI	Open Systems Interconnection
P	Processing
PCM	Pulse Code Modulation
PLV	Production-Level Video
PRA	Primary Rate Access
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RAM	Random Access Memory
RDA	Remote Database Access
RGB	Red, Green, Blue
RIFF	Resource Interchange File Format
RTI	Real-Time Interchange
RTF	Rich Text Format
RTV	Real-Time Video
S	Script or Storage
SBV	Syntax Based Videotex
SC	Steering Committee
SG	Study Group
SGML	Standard Generalised Markup Language
SQL	Standard Query Language
S-RTI	Script Real-Time Interchange
S-T	Script Terminal
T	Terminal
T1	CD-T
T2	MHI-T
T3	S-T
T4	A-T
WAN	Wide Area Network

WG Working Group

WORM Write Once Read Many

WMF Windows MetaFile

4 Multimedia and Hypermedia Information Retrieval Services (M&HIRS)

This Clause commences by setting up a model which is the basis for M&HIRS throughout this ETR. It then specifies the characteristics of information, the retrieval of which is central to the service. The functional requirements are then analysed from a user point of view.

As the information characteristics lead to requirements on information representation and coding, the service functions lead to requirements on protocols for them to be effective on different networks. In the last subclause, information representation and protocol requirements are studied.

In combination with this Clause, an extensive example of a complex application, using most of the features of this service, can be found in Annex B, "M&HIRS example: interactive distributed learning system". The mapping of the different roles, functions, protocols, information types, etc., is outlined.

4.1 General model of the service

The important aspects in the definition of M&HIRS are the **accessing** and **interchanging** of multimedia and hypermedia **information**. The description of the main roles assumed by the users of the service lead us to a generic, very simple model of the service.

4.1.1 Roles

Three generic roles, or user categories, may be identified:

- the information **producer** is the source of the multimedia and hypermedia information accessed and interchanged within the service;

- the information **manager** is the service operator, responsible for enabling access to the information base as well as administering information interchange between users;

- the information **consumer** is the final user of the service, who retrieves and consults the information for its own purposes.

According to the different applications which use the service, these basic roles may be combined in a wide variety of users. In the example given in Annex B, the roles are mapped to the different kinds of users, some of them undertaking several roles.

4.1.2 Model

Figure 1 shows how the different user categories are connected to a service host.

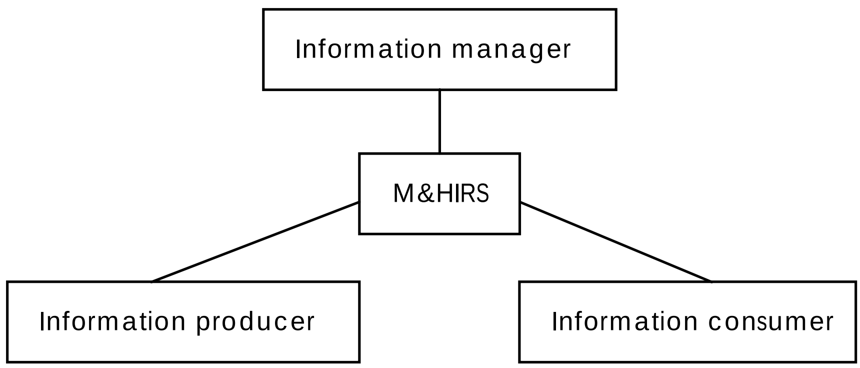

Figure 1: M&HIRS interchange model

4.1.3 Service characteristics

M&HIRS belong to the retrieval services. The services are characterised as follows:

- bi-directional;
- point-to-point;
- real-time and non real-time;
- asymmetric.

Point-to-point refers in the M&HIRS context to user-to-host systems.

Extra characteristics of the services under consideration are:

a) on demand (no permanent connection);
b) user individual presentation control.

Annex A, "Service attributes and examples", contains a more general list of service attributes.

4.2 Information characteristics

As its name suggests, the major specificity of M&HIRS is the kind of information which is handled by the service and retrieved by its users. This subclause is therefore dedicated to the specification of the information accessed by users and interchanged between them.

The M&HIRS provide the users with access to multimedia and hypermedia information. The information handled by the service may belong to four representation levels of increasing complexity:

- Content Data (CD) information;
- Multimedia and Hypermedia Information (MHI);
- Script (S) information;
- Application-specific (A) information, which includes all other kinds of information that users need to interchange within a given application using the service.

The relation with the Open Systems Interconnection (OSI) layers is clarified in subclause 5.2.3. Very roughly, it can be stated that the M&HIRS representation levels are located in the OSI Application layer.

4.2.1 Content data level

The **content data** level refers to basically unstructured data.

In multimedia and hypermedia information retrieval applications, the main information types correspond to (but are not restricted to) monomedia output contents:

- text;
- graphics;
- still picture;
- audio;
- video (i.e. moving pictures with or without associated audio).

Of course, appropriate standards need to exist, especially when these data are intended for real-time interchange and presentation.

4.2.2 Multimedia and Hypermedia Information level

The **Multimedia and Hypermedia Information (MHI)** level refers to structured multimedia and hypermedia presentation objects. The MHI objects may either encompass or refer to information chunks belonging to the data level.

The MHI level should take into account all aspects related to the declaration of presentation entities, no matter how simple or complex they are. Though the semantics of the presentation objects are defined by higher levels (application profiles), the MHI level features should include:

- description of composite objects involving different kinds of spatial and temporal synchronisation;
- description of input request objects;
- description of explicit inter-object relationships, for instance through event-action links;
- description of projection information associated to an object, specifying how it is to be presented to the user;
- mechanisms for either referencing contents or including them inside an MHI object.

4.2.3 Script level

The **script** level refers to structured scenarios specifying semantic relationships within a set of MHI objects, needed to provide the information service required by a using application. The script information may either refer to, or encompass, information objects from the MHI level.

Scripts include procedures capable of defining how MHI objects are to be presented to the final user according to the contents of his successive reactions to input requests.

Functions that scripts are capable to express include (but are not restricted to):

- control structure operations;
- declaration of global control events;
- complex timing operations;
- presentation of an MHI object;
- invocation of external processors;
- call of library functions;
- definition of check-points for navigation and context recovery functions.

NOTE: **Scriptware** may be viewed as a complete package including information from the three levels, the execution of which results in presentation to the final user.

4.2.4 Application-specific level

In the process of accessing, interchanging and using MHI provided by the service, some other information types need to be interchanged. The semantics of these information types depend heavily on the application making use of the MHI service.

An important, quite generic example of these other information types are feedback **traces** resulting from the process of executing scriptware at the final user's station, which are supplied back to the information manager or information producer stations. Different semantics of traces may be involved according to the using application requirements (debugging, execution, learning, charging, statistics, context... traces). Some rough (unprocessed) traces may be processed by a user system and then be interchanged again in elaborate form.

Other generic information typical of the application level is **directory** information. The information base from which the multimedia and hypermedia information is retrieved contains a broad variety of pieces of information (that the application may structure as documents, objects, chunks, files, packages or otherwise) which bear some interrelationships. The purpose of maintaining and giving access to directory information is to allow users to select information before retrieving it.

Further examples of these information types are given in the application example in Annex B. However, any application-specific data, exempt of any particular semantics in the service framework, may be considered as pertaining to this category.

4.3 Functional requirements

This subclause presents an analysis of the functional requirements. The access and interchange requirements of the different roles lead us to a description of the necessary service functions (which should be provided by Administrations) and of the useful service functions (which would provide an added value to the service if they could be provided by Administrations).

4.3.1 Information producer requirements

The basic role of the information producer is to supply the information manager with multimedia and hypermedia information intended for use by information consumers.

The specific requirements of the information producer are:

- uploading multimedia and hypermedia information (basic contents, MHI objects, scripts) and their updates;
- downloading traces.

Within a given application, a user of the service which generally assumes an information producer role may also need to use some of the more manager- or consumer-oriented functions.

4.3.2 Information manager requirements

The basic role of the information manager is to administer the multimedia and hypermedia information supplied by the information producer in order to make them appropriate for final use by the information consumer.

The specific requirements of the information manager are:

- administering multimedia and hypermedia information (basic contents, MHI objects, scripts);
- managing the multimedia and hypermedia information directory;
- administering users (information producers, information consumers);
- uploading elaborate (processed) traces;
- downloading rough (unprocessed) traces;
- charging;
- access control;
- protection;
- system monitoring.

Within a given application, a user of the service which assumes an information manager role may also need to use some of the more producer- or consumer-oriented functions.

4.3.3 Information consumer requirements

The basic role of the information consumer is to use the multimedia and hypermedia information provided by the information producer and administered by the information manager.

The specific requirements of the information consumer are:

- consulting the multimedia and hypermedia information directory, browsing through the available information;
- selecting information within the directory of available multimedia and hypermedia information;
- downloading multimedia and hypermedia information (basic contents, MHI objects, scripts) and their updates;
- remote consultation (real-time downloading) of multimedia and hypermedia information (basic contents, MHI objects, scripts);
- uploading rough (unprocessed) traces.

Within a given application, a user of the service which assumes an information consumer role may also need to use some of the more manager- or producer-oriented functions.

4.4 Technical requirements

4.4.1 Information representation requirements

Information representation requirements regard at least the availability of adequate representation standards for the three lower levels. The upper, application-specific level could be provided at a later stage in some future services for which the demand reveals itself as being considerable and that the

Administrations would wish to provide, but that is, for the time being, regarded as a straight application using the generic M&HIRS.

4.4.1.1 Constraints common to the different information levels

Some constraints, common to the different information levels, should be taken into account in the definition or selection of usable information representation and coding standards. These are related to:

- real-time interchange: the information shall be represented in a way adequate for its downloading and presentation/execution in real-time;
- minimal resources: limited buffering resources of the user system and limited network throughput are constraints that imply a need for specifying internal structuring of the information at a given level.

4.4.1.2 Content data information

Content data should be represented, encoded and decoded according to monomedia recommendations and standards appropriate to their real-time interchange. This includes standards for the representation of text, graphics (2D, 3D), still picture (continuous tone, bi-tonal), audio (speech, music, noise) and video (animation or moving picture, with or without associated audio). Data other than output contents may also need consideration.

4.4.1.3 Multimedia and Hypermedia Information

Multimedia and hypermedia objects should be represented and encoded according to standards appropriate to their real-time interchange. These standards should make use (be client standards) of the content representation standards. They should provide ways to represent information allowing systems to maintain at an acceptable level the quality of service degradation related to the occurrence of interchange resource constraints.

The standards for representing multimedia and hypermedia presentation information should address at least the following features:

- different kinds of temporal synchronisation between presentation objects (serial or parallel elementary, chained, cyclic, conditional);
- spatial composition of presentation objects;
- referencing of external presentation information;
- definition of requests for different kinds of user input;
- definition of links between objects, such as event-action links;
- embedding of output content information from the data level.

4.4.1.4 Script information

Script information should be represented and encoded according to appropriate standards. They should make use (be client standards) of the representation standards for multimedia and hypermedia presentation objects. They should provide ways to express procedural operations as stated in subclause 4.2.3, as well as defining a standardised way of communicating with external processor modules.

One interest in having a standardised representation of script information is to allow its execution in different configurations involving different platforms.

4.4.1.5 Application-specific information

The semantics and coding of these other kinds of information are intrinsically application-specific, at least in a first stage when the corresponding user and service requirements are not yet defined. Indeed, the actual requirements (what information is there to interchange, when and how to interchange it, between whom?) will vary widely from one application to another. Therefore, there does not appear to be an immediate need for the designing of information coding standards for these other kinds of information.

4.4.2 Information interchange requirements

Information interchange requirements are related to different transfer modes (real-time, non real-time) of different kinds and levels of information (data, MHI presentation objects, etc.) structured in different fashions (single stream, multiplexed streams, entire files).

The mapping onto architectures (see Clause 6) takes into account the location where different information kinds are processed within a given telecommunication application. This then leads to a set of protocol requirements.

These protocols shall have to be adapted to different network infrastructures: for instance, N-ISDN and B-ISDN may not use exactly identical protocols for a given interchange function.

Finally, protocols should take into account the management of limited resource situations, according to the capabilities of the different network and terminal configurations (network throughput, storage capacity, processing speed and so on).

4.4.2.1 Real-time interchange

Real-time interchange is a much more complex problem, since the provided methods will have to cope with a lot more constraints.

Real-time interchange issues may be classified according to the type of interchanged information. The main categories are then:

- interchange of data;
- interchange of presentation objects;
- interchange of script information;
- interchange of application-specific information.

The real-time interchange of MHI presentation objects is a critical issue. Such interchange may occur in different scenarios, involving various requirements and constraints. Both directions of interchange need be taken into account: indeed, elaborate as well as rough input responses have to be fed back to the host when script execution is done in a remote fashion. Some major interchange problems are related to the synchronisation needs in limited resource situations, that is when the whole synchronisation of output presentations cannot be done by the terminal. These lead to needs for linearising basically non-linear, simultaneous or "hyper" information.

Concerning the particular respect of multimedia and hypermedia presentation object interchange, the possible issues are indeed so numerous that some reasonable taxonomy shall be made by mapping them to the actual scenarios that can occur in common retrieval services.

The real-time interchange of script information is an open point. The need for it is not obvious. However, for instance, there might be a need for downloaded parts of a script while local script execution is still in progress on the terminal.

The interchange of application-specific information such as traces or directory information need not to be standardised within the service. However, the application may decide to make use of existing available standards.

4.4.2.2 Non real-time interchange

Non real-time interchange may be achieved using either interactive networks or other transmission means, mainly broadcasting networks, telephone or packet-switched digital networks and post delivery using mass storage devices. The information is usually digital but may also be analogue in some cases (e.g. with TV broadcasting networks and storage devices such as laser discs).

The interchange requirements through networks other than interactive digital should be considered as outside the scope of the report, since they are already or will be provided by other studies.

Most of the time, a convenient way of interchanging information in a differed-time fashion through interactive digital networks is to use file transfer. File transfer protocols are already existing (e.g. ETS 300 075 [5]).

However, in some cases involving very large amounts of information, this may prove inappropriate. A good example of this is the differed-time interchange of long video sequences.

File transfer may also raise problems when considering the interchange of a very large number of small objects, such as is the case with Multimedia and Hypermedia information coding Experts Group (MHEG) objects.

5 State of the art

The "state of the art" describes standardisation and technology activities concerning multimedia and hypermedia systems. Those topics are dealt with, taking into account established, emerging and anticipating activities. This Clause shows multimedia and hypermedia work items, which are, on the one hand, already dealt with or will be dealt with by other groups. On the other hand, it will help to determine the "white spots", i.e. those activities which need to be put into standardisation.

In accordance with subclause 4.4, "Technical requirements", a distinction has been made in information representation and information interchange. Subclause 5.3, "Technology", is also included to deal with those technology aspects that are not contained in the information provided in other subclauses.

5.1 Information representation

The distinction into four information levels (data, multimedia and hypermedia, script and application-specific), see Clause 4, is also used here. Each level can be contained in the level directly above. However, the application-specific level can be on top of the script level, but can also contain elements out of all the other levels. The levels are not separated by clear distinction, a more continuous line does exist throughout the different levels.

5.1.1 Content data level

A multimedia document is built on different information types. Different standards already exist for the separate types. The information types that belong to the data level are distinguished into the next categories, see subclause 4.2.1: text, graphics, still-picture, audio and video.

The first three information types (text, graphics and still picture) are time-independent, that is, the time factor is of no concern. This in contrast to the last two information types (audio and video), where the time-dependency is of major influence to the characteristics of the information.

Coding algorithms make it possible to compress the data. In general, a high compression factor results in a lower quality. For each information type, besides the different standards, an idea is given of the amount of uncompressed data.

Content data contains not only the data to be output, but also additional information which are the transfer syntax, such as: algorithm to be used, positioning, additional information necessary to properly decode the received presentation information.

Each information type is described, dealing with the topics: techniques and quantities, international standards and industry formats.

5.1.1.1 Text

5.1.1.1.1 Techniques and quantities

Text consists of strings of symbols, or characters, including, but not restricted to, alphabetic letters, digits and punctuation characters. Three aspects of symbols are of interest to users of text data:

- the symbol itself, as a symbol;
- the font or graphic style in which the symbol is presented;
- the coding used to identify the symbol in data transfer and manipulation.

The repertoire of symbols used in an application depends on the application, and also on the culture in which it is used. The set of symbols used in a document has only an indirect effect on the amount of data required to represent the document. Use of a large set may require use of a coding scheme in which more than one octet is used to represent each character.

Different fonts may be used within an application for aesthetic reasons or for purposes of emphasis. Font specification should generally require only a few characters per font change in a document. The identities of the fonts used and form of references to each font may be agreed in advance by the sender and recipient of the document, or be specified once, at the start of the document.

Each symbol in a text shall be represented individually. Thus the number of symbols in a piece of text has a dominant effect on the number of octets required to represent that piece of text in storage or for transmission.

Characters have in the past generally been encoded in a small number of bits, typically five, seven or eight bits per character. These codes have capacities of 32, 128 and 256 places respectively, although some places have generally been reserved for representation of non-graphic control functions. More recently, requirements for larger sets of symbols have led to the use of eight-bit codes, and to the use of page-switching techniques to permit use of repertoires of more than 200 symbols in the same text.

If single-octet encoding is used, then approximately 2 Kbytes are required to represent a full screen of 25 lines of 80 characters. If a two-octet-per character code is used, then the requirement doubles to approximately 4 Kbytes.

5.1.1.1.2 International Standards

Character coding standards are developed by ISO/IEC JTC1/SC2. The basic International Standard Code for Information Interchange (ISCII) is defined in ISO/IEC 646 [6]. This specifies a 7-bit code, with 32 code positions defined as control characters. The control characters include line termination and spacing functions and an escape mechanism that permits specification of further control functions, including complex graphic rendition specifications. There are also several alphanumeric positions that may be used for characters required for national use, and there are several national variants of ISO/IEC 646 [6] that make use of this facility. The best known variant is 7 bit American Standard Code for Information Interchange (ASCII), so well known and widely used that many people do not realise that it is merely a national variant of an International Standard.

ISO 8859 [7] is a multi-part standard which specifies character codings for several variants of the Latin alphabet, and for combinations of the Latin alphabet with other alphabets. An 8-bit character coding scheme is used. Generally the codes of ISO/IEC 646 [6] are embedded as the first 128 positions, with extensions or other alphabets coded in the second 128 positions.

In the CCITT environment, character sets and repertoires are defined in the T-series of Recommendations. CCITT Recommendation T.50 [8] is equivalent to ISO/IEC 646 [6], CCITT Recommendation T.51 [9] describes the additional character sets for Latin languages while CCITT Recommendation T.52 [10] describes the non-Latin character repertoires (Greek, Chinese, Japanese, Hebrew, ...). Repertoires similar to the Latin-1 repertoire of ISO 8859 [7] are defined in CCITT Recommendation T.61 [11]. Videotex characters are described in Annexes B, C and D of CCITT Recommendation T.101 [12].

A new coding standard, ISO/IEC DIS 10646-1 [13], is being approved that defines a 16-bit encoding scheme. Within this scheme there is sufficient space for the characters and symbols used in almost all current writing systems. The standard defines mechanisms for use of 8-bit coding for applications that need only a small repertoire of characters, and for use of 32-bit coding in those cases, which do exist, that need a larger number of symbols.

5.1.1.1.3 Industry formats

Two base character sets do exist: ISO/IEC 646 [6] (ASCII), with private 8-bit extensions on almost every platform (e.g. IBM, Macintosh) and ISO 8859-1 [7] (e.g. used by Microsoft Windows, X11 workstations, Amiga, Archimedes).

Every word processing package has private formats for formatting and layout. An example is Digital's Compound Document Architecture (CDA), which is similar to Open Document Architecture (ODA).

Most programs can import and convert rival formats. The Microsoft solution for interchange across platforms is Rich Text Format (RTF). Postscript and LaTeX are also used to interchange text documents.

5.1.1.2 Graphics

5.1.1.2.1 Techniques and quantities

Display devices can be characterised by the number of lines of pixels on the screen, the number of pixels per line, and the number of colours that can be displayed at each pixel. A large range of screen capacities is currently available, with 640 pixels on each of 480 lines, just over 300 K pixels in all, being available on most personal computer displays. Higher resolutions are also commonly available. A bi-tone display requires one bit per pixel for a full screen. Multi-level monochrome and colour displays require more bits per pixel. Several different colour coding systems are used. In one class, the colour for each pixel is specified independently, requiring up to 24 bits per pixel, depending on the number of colours that are to be distinguished. Other colour variants, and multi-level monochrome, may use as few as 8 bits per pixel. In another class of colour coding scheme, a large colour palette is available, but only a restricted selection from this palette can be used in any one screen. Typically, 8 bits per pixel are used to index into a table of multi-byte colour specifications.

A raster representation of a picture includes, in principle, coding for every pixel in the display. However, compression is possible by making use of the probability that colours will change slowly, and that there will be blocks of pixels with the same colour. The facsimile codings for still pictures make use of this principle in one or two dimensions. This is discussed further in subclause 5.1.1.3.

An alternative approach to picture coding is to make use of information regarding the objects to be displayed. A special case of this approach is the text coding described in subclause 5.1.1.1 above. A more general variant is to consider the geometric objects that make up the display, such as triangles, squares or other polygons, circles, ellipses and more general curvilinear figures. A relatively brief encoding is then possible for the position, shape, orientation and colour of an object that may span many pixels. This approach also facilitates the manipulation of the picture, as the picture is defined in terms of higher level objects it contains rather than the lowest level of undistinguished pixels. The size of coding for a picture is very dependent on the number of objects represented, and the types of those objects. A triangle can be specified by three pairs of co-ordinates, a line width, and a colour. An ellipse requires four parameters, for example two positions, the eccentricity and a colour. For these closed figures, it may be necessary to provide separate colours for the boundary and for the interior.

Graphics representations such as those described here should generally produce much more compact encodings of screens than the basic, low level, raster representation.

5.1.1.2.2 International Standards

Standards for geometric elements are developed in ISO/IEC JTC1/SC24. ISO DP 8632 [14] (Computer Graphics Metafile) is the leading standard for two-dimensional matrices. One other standard is contained in the CCITT Recommendation T.101 [12] and it's annexes (Graphical Kernel System). The amount of data reduction is dependent on the complexity of each picture. In average, the compressed amount of data is equal to 10 Kbyte per picture.

Standards for computer graphics are developed by ISO/IEC JTC1/SC24.

ISO DP 8632 [14], Computer Graphics Metafile (CGM), defines a representation of two-dimensional geometric graphics pictures for interchange purposes. Current work on this area in ISO IEC/JTC1/SC24 is directed towards extensions for the representation of three-dimensional objects.

ISO 7942 [15], Graphic Kernel System (GKS) (equivalent to CCITT Recommendation T.101 [12]) standardises facilities for creation and manipulation of representations of graphics objects. This is currently being extended to three dimensional objects.

ISO 9637-1 [16], Computer Graphics Interface (CGI), defines an interface, which may be implemented in hardware or software, between a computer and a graphics imaging device. It is a multi-part standard, which defines facilities for the transmission of both geometric and raster-represented objects.

Colour coding for all computer graphics applications is normally in terms of Red, Green, Blue (RGB) intensities, corresponding to the colours used on most self-luminous (e.g. Cathode Ray Tube (CRT)) displays.

5.1.1.2.3 Industry formats

Every drawing package has its own format, some examples are: Windows Meta File (WMF), DXF, Postscript and PICT. WMF records the Windows drawing commands, which can be played back. DXF (AutoCAD) is vector format oriented for Computer Aided Design (CAD) requirements. Postscript (Adobe) is a programming language with all kinds of graphics primitives, directly interpreted by printers and displays. PICT is used on Apple computers.

5.1.1.3 Still picture

5.1.1.3.1 Techniques and quantities

Still pictures are time-independent images, with contents that may be continuously varying in colour, saturation and intensity in two dimensions. The basic considerations of representation of pixels described above in connection with graphics apply here, with the difference that pixel densities and image sizes are likely to be different. A wide range of colour models is also used, including both the RGB model used for self-luminous displays and the CYM and CYMK (cyan, yellow, magenta and black) schemes used in the printing industry for illustrations that are to be viewed under reflected light.

In the case of presentation by three components, each pixel will be presented by three bytes (one for each component). This results in a total amount of uncompressed data, with a screen of 640 by 480 pixel, about equal to 1 Mbyte.

5.1.1.3.2 International Standards

ISO/IEC JTC1/SC29 Joint Photographic Experts Group (JPEG), which originally started in ISO IEC/JTC1/SC2, is developing a standard for coding of colour images (ISO 10918 [17]). The standard allows a compression factor of about 80. Good quality pictures can still be achieved with a compression factor of about 20.

ISO/IEC JTC1/SC2, Joint Bi-level Image Experts Group (JBIG) is working on a new generation of bi-level and limited multi-level technique with the purpose to achieve a very high compression (ISO DIS 11544 [18]).

CCITT Recommendations T.4 [19] and T.6 [20] are used for the coding of documents for facsimile transmission and result into pictures with a reasonable quality (up to 400 * 400 ppi). The type fax could be seen as a different information type. However, the coding techniques for fax are image coding techniques, and is therefore included here.

ETS 300 177 [21] describes a transfer syntax for still pictures (JPEG, T.4, T.6, ...) applicable to Videotex and which may be used by other telematic or professional services.

ISO/IEC JTC1/SC18 is developing colour standards for application to ODA in particular and more generally throughout the areas of JTC1 that deal with images of any kind.

5.1.1.3.3 Industry formats

Possible industry formats that deal with still pictures are: GIF, PCX, Windows Device Independent Bitmap (DIB), TIFF and IFF. GIF (CompuServe) is an interchange format that is PC-oriented, up to 256 colours can be used. PCX uses video formats of PCs, including internal video memory structure, which is run length encoded. DIB deals with arbitrary colour resolutions, does not compress and is supported by Windows primitives. TIFF (Aldus): "tags" defines content chunks, which contain number of colours, dimensions, kind of compression (e.g. LZW, run length). TIFF is available on several platforms. IFF (Commodore) similar to TIFF, but with a different byte order in binary information and which can also contain other media (e.g. sound). JPG is an industry format that describes a JPEG coded image file (outside the scope of ISO 10918 [17]).

5.1.1.4 Audio

5.1.1.4.1 Techniques and quantities

Audio data is principally speech, music or similar noise captured from or generated for reproduction within the range of human hearing. The same techniques may also be applied to representation of other sound. However, most audio recording formats are designed for human-perceptible sound, and may not be suitable for the real-time representation of sound from mechanical or animal sources.

Speech with telephony quality is sampled by 8 KHz, and each sample is coded with 8 bits. The uncompressed data results into 64 kbit/s or 8 Kbyte/s. A stereo sound signal with Compact Disc quality is sampled with 44,1 KHz, and each sample shall now be quantized in 16 bits. This results in a total amount of uncompressed data equal to 172 Kbyte/s.

5.1.1.4.2 International Standards

Standards for coding techniques of speech and sound are mainly developed by ITU. CCITT Recommendation G.711 [22] describes coding with a sample frequency of 8 KHz and 8 bit per sample. A lower data rate, and lower quality of speech, can be achieved with CCITT Recommendation G.721 [23]. A higher speech quality, and higher data rate, can be realised with CCITT Recommendation G.722 [24].

In the reference of work from the Moving Picture Experts Group (MPEG), an audio coding algorithm, known as MPEG AUDIO is developed with Compact Disc quality, the data rate is between 8 and 32 Kbyte/s. This MPEG AUDIO algorithm is also used by Digital Compact Cassette (DCC). The coding technique makes high quality possible at a low data rate (compared to the uncompressed data rate), this technique is adapted from Digital Audio Broadcasting (DAB), using subband decomposition.

ETS 300 149 [25] describes a transfer syntax for audio (CCITT Recommendations G.711 [22], G.721 [23], G.722 [24], G.723 [26] and GSM, MPEG AUDIO, ...) applicable to Videotex and which may be used by other services.

The ODA standard (ISO IEC 8613 [27], CCITT Recommendation T.411 to T.418 series [28]) is being extended by the addition of an Audio Content Architecture (ACA). This is expected to be included in the revised version of the standard that is due to be published in late 1992 or early 1993.

5.1.1.4.3 Industry formats

Most industry formats use Pulse Code Modulation (PCM) or Adaptive Differential PCM (ADPCM). An example of a PCM coded industry format is WAV, an example of an ADPCM coded format is VOC. Amiga platforms use a phoneme encoding format to synthesise (low quality) speech (with American accent).

5.1.1.5 Video

5.1.1.5.1 Techniques and quantities

The amount of data for (moving) video is equal to the amount of data for still picture, with the inclusion of the time-dependent factor. With a rate of 25 pictures per second, the result is about equal to 22 Mbyte/s.

5.1.1.5.2 International standards

In the standardisation work on moving video, there are two important bodies: CCITT SG XV, with CCITT Recommendation H.261 [29], and ISO/IEC JTC1/SC2 MPEG. The coding techniques use redundancy reduction between pixels.

Applications with low demands on quality use CCITT Recommendation H.261 [29]. The data rate is equal to p * 64 kbit/s, with p less or equal to 30, this results in a maximum rate of 1 920 kbit/s.

MPEG-1 focuses on a date rate with a maximum of 1,5 Mbit/s, this is equivalent to the I/O speed of an optical medium like Compact Disc Read Only Memory (CD-ROM). Besides this, MPEG-2 is started with the aim to realise an efficient coding with high quality and a maximum data rate of 40 Mbit/s. MPEG has put up preliminary study on a low data rate algorithm (in the order of 10 kbit/s, but has not been decided yet). The aim of the study is to determine the need for such an algorithm and to decide whether or not MPEG should pick up this topic.

Although JPEG, see subclause 5.1.1.3.2, is essentially an algorithm for still picture coding, it can also be used for coding video.

5.1.1.5.3 Industry formats

An industry format for video is CD-I from Philips and Sony. A well-known proprietary format for special video chips is Digital Video Interactive (DVI) from Intel. DVI uses two coding formats: Real-Time Video (RTV) and Production-Level Video (PLV). Both Philips/Sony and Intel have planned to include the MPEG algorithm in their products.

Macromind and Animator are industry formats for animation.

5.1.2 MHI level

During the last past years, considerable effort has been undertaken in developing standards for representing multimedia and hypermedia information objects.

This subclause presents the international standardisation effort to provide information representation methods for multimedia and hypermedia information, that is for representing and encoding, in a form appropriate for interchange, elements which are related to the structure of the presentation information (of different media) handled by the applications.

A complete presentation would involve an extensive comparison between the functionalities provided by the different standards, which is quite difficult and beyond the scope, especially since the studies have followed different approaches, driven by differing main objectives. For this reason, definitions, architectures, information levels are not easily matched from one approach to another one.

Such standards should provide methods for representing the highly varied aspects involved in the structure of multimedia and hypermedia information, including:

- embedding or referencing of content data or other multimedia objects;
- time synchronisation;
- space synchronisation;
- projection information;
- rendition information;
- aggregation of contents into compound multimedia objects;
- "hyper" links between multimedia objects (inter-object links);
- results of user input.

All standardisation efforts have in common their care for defining interchange units and restricting themselves to the representation of information intended for human perception, that is presentation information. The addressed standards are: MHEG, Hypermedia and Time-based Structuring Language (HyTime), HyperODA and MPEG System. At the end of this subclause, some industry standards are given.

5.1.2.1 MHEG

The responsible organisations are ISO/IEC JTC1/SC29/WG12 and CCITT SGVIII/Q9.

The scope is representation of MHI objects for real-time interchange, with a special focus on the following aspects:

- final form presentation;
- minimal resource constraints;
- re-usability of objects within or between applications;
- enabling representation: the aim is to standardise some facilities (the representation of presentation information) for all of the applications.

Framework and architecture aspects are:

- independency from a particular architecture;
- use of any standard format for monomedia (content) information;
- base representation (syntax & coding) is Abstract Syntax Notation Number One (ASN.1) (ISO 8824 [30], ISO 8825 [31]);
- alternate representation is Standard Generalised Markup Language (SGML).

Context of use and applications are:

- document interchange and manipulation (HyTime/SGML, ODA);
- Audio Visual Interactive (AVI) scriptware;
- Videotex;
- interactive multimedia applications using conversational or distribution services (which is outside the scope);
- etc. (limited only by the types of applications which make use of multimedia information).

Characteristics of the approach are:

- intrinsically multimedia and hypermedia: the approach is to build a new, fully suitable representation rather than to adapt an existing, partial one;
- fully non-linear: the representation is based on autonomous objects related to each other using either (static) recursive composition links or (dynamic) event-action trigger links.

Features are:

- interchange/representation unit is equal to multimedia and hypermedia information object, called "MHEG object";
- objects may be referenced either by embedding or linking; ISO 9070 [32] is used for universal addressing;
- space and time dimensions are dealt with in an isomorphic fashion, including aspects with regard to synchronisation;
- presentation uses the concept of a generic (application-and-platform-independent) spatio temporal space.

Some functionalities standardised within MHEG are:

- requests for user input;
- embedding of monomedia content data;
- space and time synchronisation;
- aggregation: definition of autonomous compound (i.e. synchronised) objects;
- definition of hyper links: the occurrence of one or several presentation events on the source object triggers one or several actions (presentation methods) on the destination object;
- projection information;
- rendition information.

Some functionalities which are not standardised within MHEG:

- script representation;
- Application Programming Interface (API)/methods for activating and positioning MHEG objects;
- representation and coding of content data (achieved by other ISO IEC/JTC1/SC29 or non-ISO IEC/JTC1 standards);
- the semantics of the objects are provided by the using application.

The status of MHEG is:

- in progress, Committee Draft (CD) for early 1993.

Adequateness for M&HIRS requirements is that MHEG is:

- designed especially for multimedia and hypermedia information representation;
- adapted for real-time interchange;
- prepared to taking into account minimal resource constraints;

- convenient for a broad range of services including (but not restricted to) information transfer and retrieval;
- compatible with any monomedia content notation.

MHEG appears to provide a suitable standard basis for the representation of any multimedia and hypermedia information to be interchanged within retrieval services.

However, there are still some white spots, which are not, or not yet, addressed by the standard itself. Some of them are dependent on the using service or underlying network. These are thus open for further studies. One of them is the definition of appropriate sequencing methods for transmitting MHEG objects in real-time with limited throughput conditions.

5.1.2.2 HyTime

The responsible organisation is ISO/IEC JTC1/SC18/WG8.

The scope is representation of multimedia synchronisation and hypermedia links within or between documents, with the following aspects of concern:

- processing-independent information;
- re-usability (links are application-independent);
- enabling infrastructure: the aim is to standardise some facilities (representation of hyper links in multimedia documents) for all of the applications.

Framework and architecture aspects are:

- SGML architecture: HyTime is an application of SGML;
- independent from monomedia or multimedia content notations;
- base representation: SGML;
- possible ASN.1 coding.

Context of use is:

- integrated open hypermedia (document interchange and manipulation in an open environment).

Characteristics of the approach are:

- incremental: text is the information basis, multimedia and hypertext information are two ways of enriching documents, hypermedia is viewed as the mixing of the two. Therefore, multimedia standards should be built on text document concepts;
- linear time-based approach (similar to music notation), introduced within linear space-based information (text documents);
- link structure, represented in a hub document (set of all the webs between all the documents). Nothing can be done in HyTime without the hub document.

Features are:

- processing/interchange unit (unit is equal to document);
- time and space dimensions are dealt with in a similar fashion;
- any kind of object (including scripts, programs, monomedia contents...) may be referenced using a universal notation;
- linking and embedding;
- generic space.

Some functionalities that are already standardised:

- time and space synchronisation of documents elements;
- hyper links within and between documents;
- arithmetic functions for expressing relative synchronisation constraints.

Some functionalities which are not standardised:

- reaction to user interaction;
- representation of multimedia objects;
- representation of scripts;
- the semantics of the links are provided by the using application.

The status of HyTime is:

- Draft International Standard (DIS) (end of voting, initially, scheduled April 1992) ISO 10744 [33].

Adequateness to M&HIRS requirements is that a high number of features provided by HyTime are similar to those provided by MHEG. This includes the representation of spatio-temporal synchronisation hyper links, projection and rendition information, and a whole lot more. However, the overall approaches and contexts of use are highly different.

In some applications, especially those involving document processing and/or interchange, HyTime may be viewed as a client standard to MHEG. In this context, MHEG is a possible notation for the multimedia objects which are referenced (but not standardised) within documents using the HyTime language. However, the overlap is so considerable that for a lot of information, there shall be a choice for it to be represented either within the MHEG objects or within the HyTime document; this choice shall be up to the designer.

HyTime is mainly intended as a pivot format and is not specifically designed with respect to real-time interchange requirements.

5.1.2.3 HyperODA and ODA

The responsible organisations are ISO/IEC JTC1/SC18/WG3 and CCITT SGVIII/Q27.

The objective is to extend the ODA model to support multimedia and hypermedia applications. With respect to this objective, HyperODA is:

- an encompassing architecture (external elements should be standardised according to ODA);
- limited to document interchange within the ODA environment (it is not intended for separate use).

Framework and architecture aspects are:

- ODA;
- OSI-based environment.

Context of use is:

- document manipulation and interchange in an ODA environment.

Characteristics of the approach are:

- incremental: following new requirements, ODA is being extended and adapted so that it is able to cope consistently with multimedia and hypermedia information.

Features are:

- processing unit is equal to (hypermedia) document;
- storage/retrieval/interchange unit is equal to document fragment (may be shared by several documents).

Functionalities standardised within ODA are:

- time synchronisation;
- disaggregation;
- external references;

- non-linear structures;
- space synchronisation and a lot of non-multimedia facilities are already addressed by the ODA standard.

A functionality which is not standardised:

- content data representation (addressed by other standards).

Status of HyperODA is:

- ODA is an International Standard (ISO/IEC 8613 [27]);
- HyperODA is very much at a preliminary stage in trying to integrate requirements into the ODA specifications.

Adequateness to M&HIRS requirements is that HyperODA is appropriate for document manipulation and interchange applications, provided that they work in an ODA/Document, Transfer, Application Management (DTAM)/OSI environment.

With respect to ODA only, although ODA documents are a possible presentation or content type, as viewed from the standpoint of the MHEG standard, ODA can also be considered as supporting at least multimedia concepts, and possibly also as a limited form of hypermedia.

5.1.2.4 Other Standards

MPEG System, which is part of the MPEG-1 (ISO 11172 [34]) standard, addressed by ISO/IEC JTC1/SC29/WG11, defines the representation of the information that expresses the time synchronisation features between the interleaved (video, audio and data) streams of the MPEG multiplex.

Of course, this is essentially linear, and limited to relatively simple kinds of information, basically consisting (though not restricted to) video and associated audio. MPEG System provides reserved streams which could be used, for instance, for the transmission of MHEG objects (possibly including interactive information) associated with the video output.

5.1.2.5 Industry standards

Some industry standards on the level of MHI are: Resource Interchange File Format (RIFF), Media Control Interface (MCI), QuickTime.

RIFF is a "wrapper" around other file formats, where tags specify the type and size of components which often use a file format that is available independently. The predefined Microsoft component formats are: Bundle File Format, DIB RIFF-DIB , RIFF-MIDI, Palette File Format, Rich Text File Format, Waveform Audio File Format. The synchronisation of the component data has to be done by the application programme.

The MCI provides a high-level command interface (API) for playing and recording multimedia devices and resource files. The used coding format is RIFF.

The QuickTime MOVIE format allows the specification of parallel media streams and the synchronisation between them. Quicktime is the related multimedia environment to the format MOVIE. The format permits the serialisation of parallel information into chunks and groups.

The MS Windows help file format is text only, and is based on RTF (some attributes have special meaning so that a link structure that can be defined). There also exist several hypertext and hypermedia products for PCs, all of which use their own private formats, however, there can be no interchange.

5.1.3 Script level

Script representation is under responsibility of:

- ISO/IEC JTC1/SC18 and CCITT SGI/Q17 for functional requirements and model;
- ISO/IEC JTC1/SC29 and CCITT SGVIII/Q9 for representation and coding.

Up to now, Drafts have been discussed at CCITT, but there have been only preliminary discussions at ISO. There is, therefore, a lot of work to be achieved within the four or five next years.

Industry formats that already exist are Hypercard (Apple), Toolbook (Asymetrix) and scriptX. Each uses a general script language, which is a general purpose programming language with the ability to specify hyperstructures. Other authoring systems (e.g. Authorware) use their own script language.

5.2 Information interchange

Information interchange techniques are largely independent of the type of information that is to be transferred. At a general level, the transfer standards operate "blind", ignoring any information that there may exist about the structure or purpose of the information being transferred. Some standards can however operate on components within an information store when that information store, or the objects within that store, have a particular structure.

According to the information interchange requirements in subclause 4.4.2, a distinction can be made into real-time and non real-time as interchange (respectively in subclauses 5.2.1 and 5.2.2). A subclause has been added on the topic of OSI (see subclause 5.2.3), especially with regard to M&HIRS.

The distinction between real-time interchange and non real-time interchange is clarified by looking at the two interchange techniques from a presentation point of view. Real-time interchange refers to interchanged information that is presented to the user progressively, while it continues to be transmitted. In this way, the information may be used before the transfer is completed. In the non real-time interchange mode, the terminal system shall wait for complete units to be transferred (e.g. files, database records) before exploiting them. In this case real-time presentation can not be guaranteed.

5.2.1 Real-time interchange

The ITU-T Recommendations to interchange in real-time are ITU-T Draft Recommendations T.170 [2], T.175 [35], T.176 [36] and the T.411 to T.418 series of CCITT Recommendations [28] and T.43x.

NOTE: The ITU-T Draft Recommendations T.17x are still under study and will not be forwarded to the CCITT plenary assembly.

ITU-T Draft Recommendation T.170 [2] describes some service requirements for AVI services, and defines the interface "I", "II", "III", "A", and "B". ITU-T Draft Recommendation T.175 [35] describes the protocol "I" (information consumer to host). It includes file transfer, selection and browsing, remote execution. The Recommendation is scheduled for 1993. ITU-T Draft Recommendation T.176 [36] describes protocol "B", this covers RTI of MHI and is scheduled for adoption in 1995. The protocol "A" covers RTI of CD. It is provided by ITU-T Recommendations T.102 [37], T.103 [38] and T.105 [39] for ISDN Videotex terminals. The T.411 to T.418 series of CCITT Recommendations [28] cover ODA and T.43x (DTAM).

The ETSI standards that cover, in some contexts, the interchange of output contents through data streams are ETSs 300 072 [40], 300 073 [41], 300 076 [42], etc. (syntax-based Videotex).

An important industry standard is X11, developed by the X11 consortium that includes MIT and industry members. X11 is a local network client-server protocol for graphical and windowing information.

5.2.2 Non real-time interchange

ETS 300 075 [5] is a non real-time interchange standard for file-transfer over ISDN.

Some relevant international standards, which deal with communications-oriented access to data stores are: File Transfer, Access and Management (FTAM), Remote Database Access (RDA), Document Filing and Retrieval (DFR) and DTAM.

FTAM basically operates on or transfers a complete file. For certain types of file, however, it can also operate on objects within the file, and can perform some management of file stores.

RDA provides for the transfer of items from a database. The standard is in multiple parts, the first defining a generic service and protocol, with separate parts defining specialisations for different database architectures or database manipulation languages. Currently, the only specialisations defined, or being developed, are for successive versions of the Standard Query Language (SQL) database language. It is intended that further specialisations will be developed for other database languages and organisations, in particular for text databases where the structure of stored objects is described by the use of SGML.

DFR has some similarities, in a very general way, with both FTAM and RDA, but operates on a document store, where documents are described by their attributes. The attributes used by the DFR standard are closely aligned with the attributes of ODA documents.

DTAM is under development to provide facilities for access to and manipulation of ODA documents. DTAM provides the possibility to put the file into sections, this enables a more real-time interchange.

In the ITU, standardisation activities are under way for recording information such as ODA documents on exchangeable media. The revised ODA standard is expected to contain an annex describing the storage of ODA documents on exchangeable media, as a temporary expedient until the more general standard is published.

Other relevant standards are those produced by ISO IEC/JTC1 (although many of them have originated as European Computer Manufacturers' Association (ECMA) standards) on storage media and file labelling.

The messaging systems (complying with international standards, e.g. CCITT Recommendation X.400 [43], or industry standards, e.g. Multipurpose Internet Mail Extension (MIME)) may also be used for (non real-time) exchange of multimedia information.

5.2.3 Open Systems Interconnection (OSI)

This subclause deals with OSI aspects that are relevant to M&HIRS. Especially, to clarify the levels of concern in the scope of M&HIRS in relation to the OSI layers. Subclause 5.2.3.1 gives an introduction to profiles and subclause 5.2.3.2 deals with the OSI peer-to-peer concept that is of importance to the M&HIRS user-to-host model.

5.2.3.1 OSI reference model and profiles

ISO/IEC TR 10000 [45] defines a taxonomy of OSI Profiles. The taxonomy identifies functions that are to be achieved through use of OSI standards. Each profile defines a way in which multiple standards are to be used in combination to achieve a particular function; the selection to be made of the options permitted by a standard so as to facilitate interworking; or a combination of the two.

The taxonomy separates communications profiles into two main groups, an upper group that is based on the top three layers (Application, Presentation and Session) of the OSI Reference Model, and a lower group that is based on the bottom four layers (Transport, Network, Data Link, and Physical).

The upper group is concerned with functionality that is independent of the communications mechanisms used, whilst the lower group is concerned only with the communications aspects and not directly with application functionality. For a given application functional requirement, it is possible in principle, to combine the upper profile with any lower profile. Thus for an application of, say, File Transfer (FT), the FT profile used should be determined from end system capabilities and application requirements, and should operate identically whether the lower layers use Wide Area Network (WAN) or Local Area Network (LAN) technology, or some other communications technology. Whether a particular technology can in fact be used in a particular case depends on whether that technology can provide the quality of service required by the application.

Integrated Services Digital Network (ISDN) covers the functionality of the three lowest layers of the OSI Reference Model. According to the principles described above, M&HIRS, being a family of applications, can make use of ISDN, but only if ISDN can provide sufficient communications capacity to satisfy the information transfer requirements of the particular M&HIRS configuration and application.

5.2.3.2 Peer-to-peer concept

According to the OSI reference model, entities at a given level in one real system communicate with corresponding entities at the same level in another real system. They do this by making use of the services provided by the immediately underlying layer. Thus an entity in the Application Layer communicates logically only with other Application Layer entities.

In the M&HIRS context, most of the entities of interest, such as script processors and multimedia presenters, are at the Application level. Thus entities in the host and the terminal communicate at the Application level. Both contain, in principle, implementations of other OSI Layers that carry the application information (including script and presentation objects) down to the physical communications layers in one protocol stack and up again through the other stack.

For logical communications between host and terminal, M&HIRS investigations should thus be considering Application Layer services, both those which already exist as standards and those for which there are as yet no standards or expected standards. Further, they should consider the profiles of established standards that have been or are being defined, and again identify any required profiles that do not yet exist.

Each of the profiles (or base standards, if no profiling is needed) should be capable of being used in conjunction with lower layer profiles that can provide the quality of service required by the M&HIRS applications.

Examples of profiles that may be relevant to M&HIRS include File Transfer (identified as AFTxx, where xx represents a string of digits identifying the particular profile within the family of file transfer profiles), Virtual Terminal (AVTxx) and Transaction Processing (ATPxx). The alphabetic strings, and the meaning of each possible string of digits, are defined in ISO/IEC TR 10000 [45], Parts 1 and 2, and in the CEC publications M-IT-01 [46] and M-IT-02 [47].

5.3 Technology

This subclause contains those aspects not yet covered by the previous state of the art subclauses. A distinction has been made in terminal equipment, network structures and hosts.

5.3.1 Terminal equipment

Terminals for a M&HIRS can either be general purpose computers (personal computers or workstations) or special purpose (dedicated) devices (Minitel, X-terminals, Compact Disc Interactive (CD-I), Commodore Dynamic Total Vision (CDTV), ISDN-phones).

5.3.1.1 Personal computers, workstations, special devices

Current general purpose computers that would be usable in a M&HIRS include PCs (IBM compatible personal computers), Apple Macintosh and Commodore Amigas, and every kind of Graphics Workstation (usually based on some Unix variation).

Most of these computers only provide a subset of MHI capabilities and have to be enhanced by special add-on hardware.

Worthwhile to mention is the Multimedia PC (MPC). MPC is a multimedia standard from Microsoft and is supported by the MPC Marketing Council (a consortium of companies: Microsoft, Philips, Olivetti, Tandy and AT&T). The standard defines a PC configuration with a number of minimum requirements on hardware, to be able to provide certain facilities of multimedia presentation on a PC.

5.3.1.2 Computing capabilities

The low end of necessary computing power is in the range of a 10 MHz 80 286 processor. The current high end of relatively widespread processors is defined by a 66 MHz 80 486 or a 50 MHz 68 040 processor. The current top mass market technology is presented perhaps by the 100 MHz Alpha chip from DEC.

The general trend in computing still holds: smaller, faster, cheaper.

In the year 2 000 one can expect 2 000 Million Instructions Per Second (MIPS) workstations with 2 gigabytes of main memory, 20 ns access time. It is not yet clear if there still will be a difference between personal computers and workstations (by a factor between 2 and 10) or if they will merge.

In multimedia devices, the Central Processing Unit (CPU) is often supported by additional special processors (e.g. JPEG/MPEG signal processors, graphics processors, numeric processors). These processors are connected to the internal memory and to external devices through the system bus and attached controllers. The speed of this bus often limits the performance, e.g. the maximum internal system bus speed in PCs (ISA bus) is 5 Mbyte/s, the MicroChannel Architecture (MCA) bus in PS/2s can reach 20 Mbyte/s, the EISA bus 33 Mbyte/s. The current solution for these limits is to use local bus systems (80 Mbyte/s 320 Mbyte/s), that connect the fast components (e.g. CPU and graphics controllers), and a slower bus for external devices. Even the external bus can already reach higher speeds, e.g. Sun's S-Bus 80 Mbyte/s and 160 Mbyte/s.

5.3.1.3 Extendibility

Most personal computers and workstations provide extendibility by provided slots where extension boards can be connected to the system bus (or to the local and external bus). The bus architecture determines the ease of these extensions. Different computer platforms also use different bus systems, so that extension boards are not usable across platforms.

5.3.1.4 Local storage

Uses of local storage are:

- working memory (Random Access Memory (RAM)), strongly connected with the computing capabilities; fast chip memory;
- permanent external memory, from where programs and data are loaded into the working memory and where they are stored again for later reference, typically hard disks;
- backup memory, to have a backup when information on external memory is destroyed, typically tapes;
- removable memory, to take programs or data from one computer to another, or to deliver them from the producer to the consumer (diskettes, CD-ROM). Sometimes this can be identical to the external memory, e.g. removable hard disks.

Main characteristics of storage media are:

- access time/seek time: the time it takes to access a specific information item;
- transfer rate: the rate at which information can been read/written from/to the storage medium;
- storage capacities: the amount of information that can be stored;
- removability: the capability to remove the storage medium from a computer;
- write access: the capability to write on the medium, in contrast to read-only capabilities;
- direct/sequential access: the capability to have random access to specific item;
- access/encoding and file structures: special forms of storage with certain access restrictions (e.g. on CD-ROMs Compact Disc audio information can be stored but not accessed by the computer, whereas on CD-I and CD-ROM eXtended Architecture (CD-ROM XA) they can);
- analogue storage: e.g. laserdiscs store analogue video, magnetic tapes use analogue methods to store digital information.

Today's values when buying new hardware are listed in table 1 and the expectation of change in these characteristics is listed in table 2. The following abbreviations apply to the tables:

- RAM: Random Access Memory;
- HD: Hard Disk;
- CD-ROM: Compact Disc Read Only Memory;
- DAT: Digital Audio Tape;
- WORM: Write Once Read Many;
- MOD: Magneto Optical Disk.

Table 1: Today's storage characteristics

	RAM	HD	CD-ROM	DAT	WORM	MOD
access/seek (ms)	0,07	16	325	-	125	90
transfer (kbyte/s)	-	1 000	150	?	450	200-300
capacity (Mbyte)	1-16	80-170	650	5 000	1 600	128-640
removable	no	no	yes	yes	yes	yes
writeable	yes	yes	no	yes	yes	yes
direct access	yes	yes	yes	no	yes	yes

Table 2: Expected storage characteristics for the next decade

	RAM	HD	CD-ROM	DAT	WORM	MOD
access/seek (ms)	0,02	10	?	-	125	20
transfer (kbyte/s)	-	25 000	?	?	450	?
capacity (Mbyte)	2 000	4 000	?	15 000	4 000	20 000
removable	no	no	yes	yes	yes	yes
writeable	yes	yes	yes	yes	yes	yes
direct access	yes	yes	yes	no	yes	yes

New storage media will also arise (e.g. flash memory, optical cards, IC cards).

5.3.1.5 Multimedia presentation

Multimedia presentation can be distinguished in those terminal equipment hardware that handle the output to the user, and those that handle the input from the user.

The output of multimedia presentation should be matched to the user. Before listing some existing hardware equipment on different presentation media, the limits of a user to perception of different media are described.

The visual resolution of the human eye is better than an angular resolution of 1/120 of a degree, this corresponds to a 380 dpi resolution at normal reading distance. Current and near future display technology can only provide about 1/10 of this resolution on displays that are very small (compared with the field of vision a human possesses).

The eye has a dynamic adjustment to brightness, but within one "brightness environment" it can discern about 240 to 300 shades of grey, but is less sensitive in the blue spectrum and more so in red and green shades. That means that 24 bit colours (256 shades each in red, green and blue) are sufficient to produce all colours the eye can recognise. In most cases the amount of available colours is more important than the resolution.

To produce a smooth motion, at least 25 to 30 frames/s are needed.

Like the eye, the ear has a dynamic range for loudness, the sensitivity in a given range is about 80 decibel (16 bit can represent a dynamic range of 96 decibel), the ear can hear frequencies from approximately 20 Hz to 20 kHz. To produce a pure tone at 20 kHz, a device has to provide samples at more than twice that frequency. To produce "realistic" sounds, 44,1 kHz sampling with a 16 bit range is sufficient. To produce stereo sound, the double bandwidth is required for the two channels.

In the following of this subclause are multimedia presentation output devices described. They may be used for direct presentation, but also for generating external documents.

Typical resolutions of today's special displays for computer output are: 640 x 480, 768 x 512, 800 x 600, 1 024 x 768, 1 240 x 1 024. High-end displays provide 24 bit (RGB 8 bit each) direct colours, which means a storage need of 900, 1 152, 1 406, 2 304 and 3 720 Kbyte respectively. To reduce the storage needs, the number of simultaneously available colours can be cut, e.g. to 256 (out of a palette of either 262 144 or 16,8 million colours), or to 32 768 (direct colours, RGB values of 5 bit each).

Audio is digitally stored by sampling at a certain frequency (which has to be at least twice the maximum output frequency to avoid aliasing) with a certain range of values (in practice either 8 or 16 bits). These samples can be encoded by different methods, some of which also compress (and may lose some) data: PCM, Differential PCM (DPCM), or Linear Predictive Coding (LPC).

Some existing sound cards for PCs are: Multisound Board (Turtle Beach Systems), Pro Audio Spectrum (Media Vision), MPC Audio One (Media Vision), Soundblaster pro (Creative Labs). CD-ROM can contain Compact Disc Digital Audio (CD-DA) information which is directly interpreted by hardware in the drives (so that music-CDs can be played without the computer). Also worthwhile to mention in relation with audio is Musical Instrument Digital Interface (MIDI), a protocol to communicate between music synthesisers and controlling devices.

The techniques to sample and compress as described for audio also apply to video and still picture.

Some still picture encoding and decoding hardware for terminal equipment are:

- JPEG boards (e.g. C-Cube: CL550);
- i750 (Intel DVI);
- Kodak Photo-CD (CD-ROM XA compatible).

Some video encoding and decoding boards are:

- C-Cube (MPEG);
- CD-I based on MPEG-1;
- DVI: Intel i750;
- JPEG decoders (e.g. CL550).

CD-I is a standalone multimedia device developed by Philips based on a CD-drive, a microprocessor and an integrated operating system. The video output goes to a standard television set (PAL, NTSC). The format for storing the information on CDs is an extension of the CD-ROM format. Audio information can be stored in CD-DA and CD-I level A, B, C quality. Support for full screen full motion video based on MPEG-1 is announced.

CD-ROM XA is a general CD-ROM storage format that is compatible with CD-I. It supports audio, text (general data), graphics and video.

Video overlay technology is necessary for analogue overlays onto computer screens. Examples are: Screen Machine, DVI Overlay and DAVID (Microvitec). They are often combined with framegrabbing capabilities.

Some outputs devices with concern to the conversion from digital to analogue are:

- television screens dealing with video signals, e.g. NTSC, PAL, SECAM and pre High Definition TeleVision (HDTV) formats (Multiplexed Analogue Components (MAC): D2-MAC, High Definition MAC (HD-MAC)), capabilities do exist for genlock (synchronisation between digital generated information and video signal);
- videotape, the above point and this are covered by the emerging of "digital video studios" which is an evolving market just now;
- printer: thermo sublimation printers (Kodak, Rasterops; 300 dpi and 16,7 million colours); Canon CLC 10 (colour copier and scanner and printer, 400 dpi);
- audio tape.

Considering multimedia presentation input, equipment can be distinguished into pointing devices, text input, still picture input, audio input and video input.

Some pointing devices are: mouse, light pen and touch screens.

Text input is mostly done by keyboard, future developments are on methods to enable us to input by writing in a scratch board.

Still picture input are common known as scanners (from paper or diapositives).

Audio input is achieved by digitising analogue input (microphone).

Video input is done by digital cameras, frame grabbers or digitising boards.

5.3.1.6 User interface

Multimedia and hypermedia systems interact with their users by audio and visual means. Determined by the human conceptual system the visual presentation is the most important. Today, there are two main metaphors for the visual presentation: the world view and the desktop metaphor.

In the world view, metaphor the screen display substitutes for the standard view through our eyes (like television does). As the limits of technology restrict this view to a very small area, this is not very satisfactory because the angular resolution (of the whole view and of singular elements) is very low. To overcome these limitations two approaches are possible:

- increase the screen size and/or the pixel resolution (e.g. HDTV);
- put the screen(s) nearer to the eyes (one aspect of Virtual Reality).

The desktop metaphor tries only to simulate a very restricted view of our world: the top of a desk, where sheets of paper contain information that is used in the working process. This base metaphor leads to today's windowing systems, where the screen is subdivided into several windows that can be manipulated almost independently. Examples for this kind of system are Microsoft Windows, the Macintosh System and the X Windowing System, Version 11, commonly known as X11. Windowing systems can come with a predetermined "look and feel" (e.g. Macintosh), or can separate the windowing functionality almost completely from the appearance (look and functionality of re-sizing controls etc., "decoration" of windows like title bar and frame) which is the task of a (exchangeable) window manager.

Both single view and windowing multimedia systems use the same base metaphors for user input, which are often simulations of common physical activities: manipulating visual analogueies of tactile controls like buttons or sliders, selecting from indices or menus, positioning of a pointer or pencil, typing text, drawing figures, filling out forms, taking something up and dragging it somewhere. Form and functionality of buttons and other controls are often derived from controls for consumer electronic products (e.g. VCR).

It is a widely spread assumption that the "general" or "average" user cannot cope with the complexities of manipulating a windowing system with a pointing device. Therefore, most public information systems (kiosks) are single window ("world view") systems with touch screens. Or they use a very reduced variant of the desktop metaphor with fixed non-overlapping windows ("split screen").

Another recent development is systems that use the metaphor of a writing (and drawing) pen for input.

5.3.1.7 Networking

The terminal needs hardware equipment for networking to be able to communicate with a host. The network under consideration is ISDN. A numerous number of ISDN communication boards are available for the PC, with among them a great number which give support to OSI-protocol stacks. Most of the boards have a standardised programming interface, for instance the German de facto standard, "Common ISDN API".

A small number of ISDN communications are available for workstations. However, none of them supports OSI-protocol stacks. Most of them only support the TCP/IP protocol.

The above mentioned OSI protocol stacks refer to those stacks, standardised by standardisation groups for ISDN terminals. These are the ISO ISP (ISO/IEC TR 10000 [45]), the CCITT Recommendation T.90 [48] and ETS 300 080 [49] standards for ISDN terminals.

Nowadays, there are mostly national variants of ISDN. There are a few boards available for Euro-(ETSI) ISDN.

ISDN-PCI is the European API for ISDN access.

5.3.2 Network structures

Available or emerging networking technologies able to support M&HIRS could be:

- Fibre Distributed Data Interface (FDDI);
- Metropolitan Area Network (MAN);
- ISDN;
- B-ISDN;
- Public Switched Telephone Network (PSTN);
- Mobile;
- Digital Broadcasting Network (DBN).

The Fibre Distributed Data Interface (FDDI) is a high speed LAN based on a token ring protocol which offers a throughput of 100 Mbit/s over an optical fibre medium. FDDI is an ISO standard. A second phase, FDDI II, is under development which will add the current FDDI voice and video capabilities.

Metropolitan Area Networks (MANs) are intended to fill a gap between LAN and public WAN. They can provide LAN interconnection at high speed. The IEEE standard for this kind of network is Distributed Queue Dual Bus algorithm (DQDB) which interconnects stations by two parallel 150 Mbit/s optical fibre.

ISDN is a public WAN which provides two kinds of access:

- the Basic Rate Access (BRA) offers two B-channels at 64 kbit/s and one D-channel at 16 kbit/s;
- the Primary Rate Access (PRA) offers 30 B-channels at 64 kbit/s and one D-channel at 64 kbit/s.

In addition, B-channels can be joined and synchronised to provide the use of n x 64 kbit/s.

On the other hand, hyperchannels can be used:

- H0 channel : 384 kbit/s;
- H11 channel : 1 536 kbit/s;
- H12 channel : 1 920 kbit/s.

B-ISDN is a development of ISDN which provides the integration of audio, video and data applications on a single network. B-ISDN shall be implemented using Asynchronous Transfer Mode (ATM) according to the CCITT Recommendations and shall make use of fibre optical medium or electronic wires. It will provide up to 155 Mbit/s access.

The Public Switched Telephone Network (PSTN) is generally too slow for M&HIRS, but could be used for semi off-line uses.

The Mobile network can also be considered as an appropriate network for M&HIRS services.

Digital Broadcasting Network (DBN), e.g. cable TV networks, could also be used for delivery of MHI. It is a unidirectional network and, therefore, shall be used in conjunction with an interactive network for M&HIRS applications.

5.3.3 Hosts

The demands on hosts in M&HIRS are potentially very high: high volumes of data have to delivered in real time to many users. Hosts need high capacity storage and the corresponding computing power to manage the traffic and handling of MHI.

High-end supercomputers announced for the next years, will reach Tera Floating Point Operations Per Second (FLOPS) performance.

The hard disk speed of the host should be matched with the network bandwidth**.** B-ISDN and multichannel N-ISDN have a bandwidth of respectively 155 Mbit/s and 1 920 Kbit/s (30×64). The host hard disk speed is currently 8 Mbit/s, it is forecast at 200 Mbit/s before the end of the decade.

6 Architectures

An architecture makes the connection of a service to the equipment. At this point, the requirements of the service will have to fit with the capabilities of the equipment. In the case of a user-to-host model, equipment can be subdivided into host, network and terminal. To be able to identify suitable candidate architectures for M&HIRS, at first scenarios and configurations have to be dealt with, taking into account the characteristics and properties of M&HIRS (see Clause 4). A scenario refers to the actual location (of processing and storage) within a given application and a configuration refers to the capabilities (of interchange protocol, terminal and network).

An architecture is related to a service, and is generic. However, a scenario is related to an application (or a generic set of applications, as identified by the scenario), and is therefore more specific. Different scenarios can be imposed on one architecture, the same as many applications can make use of one service. In subclause 6.1, a taxonomy is given to describe scenarios.

Same aspects of scenarios can be identified as more generic, and therefore can be regarded as a typical service elements. Each aspect will have a limited number of possible configurations. In the case of M&HIRS, the important aspects are: interchange, terminal and network. Subclause 6.2 describes the possible configurations for those aspects.

A candidate architecture can now be identified as a useful connection with respect to M&HIRS between the different possible configurations of the most important aspects (interchange and terminal). This leads in total to six candidate architectures for M&HIRS. They are listed in subclause 6.3.

6.1 Scenarios

The scenario as considered in this context deals explicitly with information access. As has been stated above, a scenario refers to an application, or type of application, whereby a connection has been made between application and equipment. First, the taxonomy of the scenario is dealt with. Secondly, four applications examples are given to clarify the taxonomy.

The first important point of this connection is the location of the processing and storage at host and/or terminal side. The second one is the communication, and can be subdivided in a Real-Time Interchange (RTI) and Non Real-Time Interchange (NRTI), related respectively to the interchange between the host and the terminal of the information to be processed or to be stored. Both location (at host, network and terminal) and function (processing, storage and communication) can be distinguished into the four information levels (see subclause 4.2): application-specific, script, multimedia and hypermedia and content data.

Figure 2 is used to have a proper taxonomy to describe different scenarios, which handle location and function aspects.

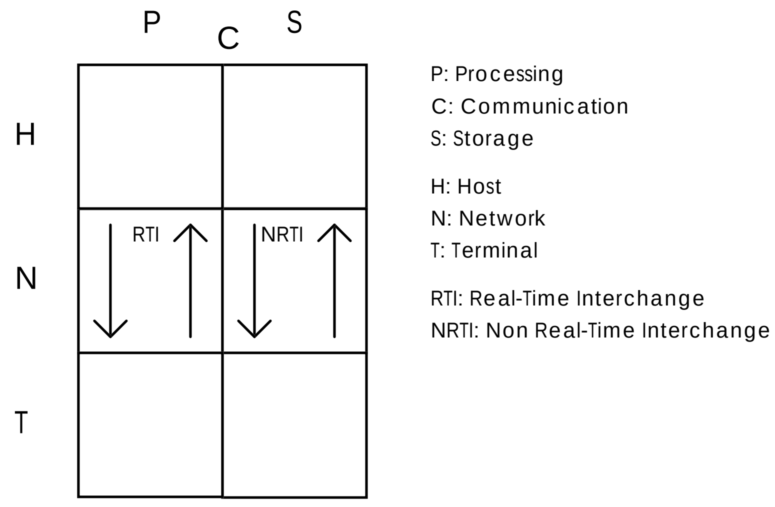

Figure 2: Diagram for a scenario

The different information levels are put in the boxes where they are actually located, not where they could be located. For example, when at the terminal side only, the CD is processed (and no MHI, S or A) is this generally seen as a simple terminal, however this does not mean that a workstation could not fulfil this job (on the contrary), it only refers to the minimal requirements.

The communication is divided into NRTI and RTI. Also, a distinction can be made in the direction of the information on a certain level, e.g. the host shall send to the terminal information on all the levels (A, S, MHI, CD) and the terminal shall only send to the host information on level A. This imposes more specific requirements on the application. The left side of a box indicates the host to terminal information flow, the right side is reserved for the terminal to host information flow. If the information level is spotted in the middle part of the box, than this level has an information flow in both directions.

If the type of network is explicitly mentioned in relation to the scenario, then this implies that the application shall take into account the capabilities and restrictions of that typical network.

Four different examples are given to demonstrate the taxonomy. From a terminal processing point of view, they are put in order of complexity.

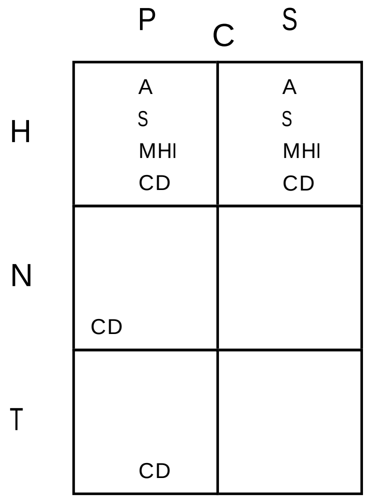

Figure 3: Scenario "Traditional Videotex"

The scenario "Traditional Videotex" deals with Videotex applications which are enhanced with multimedia (e.g. sound, still pictures and video). The CD is transferred from host to terminal and processed at the terminal side. There is no local storage.

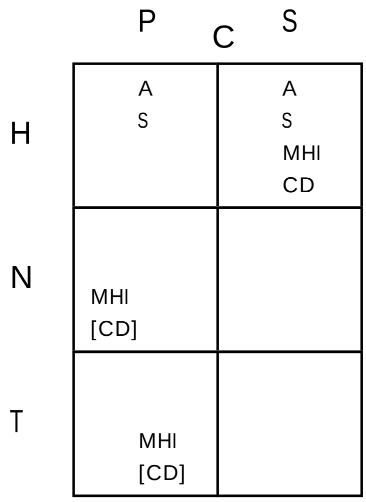

Figure 4: Scenario "Remote consultation"

The remote consultation scenario also interchanges multimedia and hypermedia information. This is a more elaborate scenario. However, the information flow is still the same: from host to terminal. As shown in figure 4, the CD is embedded in the MHI, this is expressed in figure 4 by putting the CD in square brackets.

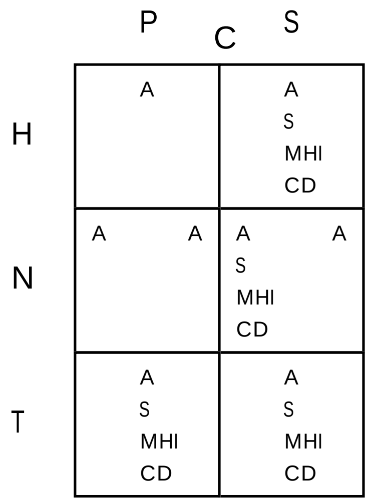

Figure 5: Scenario "Kiosk"

"Kiosk" is a more complex scenario, having both RTI and NRTI. Also, the NRTI information flows do not contain the same information levels. With regard to the previous two scenarios, this scenario uses local storage.

The applications are in the range of information booths. For example, booths can be installed in public areas for the delivery of advertising from different producers through the use of MHI. These booths may interwork with transactional services (e.g. with a reservation service).

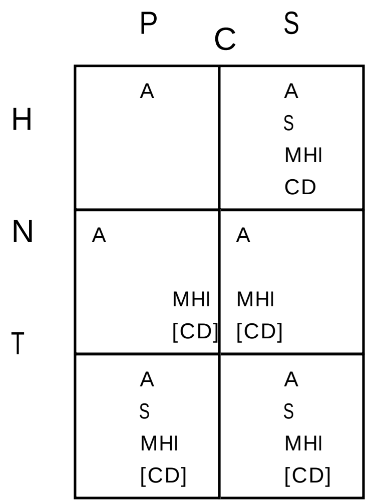

Figure 6: Scenario "Points of sales"

The scenario "Points of sales" is the most complex example with regard to the terminal: all information levels (A, S, MHI and CD) are processed. There is both storage on the terminal side as on the remote side. By exchanging information on several levels, the user can view both databases as a single (distributed) hypermedia database. The applications shall involve real-time and non real-time interchange on the levels A, MHI and CD.

Possible applications, that belong to this class of applications, are Travel Agency and Interactive Distributed Learning (IDL). The IDL application is described in Annex B.

6.2 Configurations

The generic aspects of the scenarios, which are of relevance to M&HIRS, are dealt with. Each of them can be put into a number of possible configurations. The configurations of each of the three aspects (interchange, terminal and network) are described in different subclauses. The configurations are of great influence to the determination of suitable candidate architectures.

Three relevant aspects of importance, which come from the M&HIRS scenarios, are:

- interchange;
- terminal;
- network.

The interchange aspect is a very obvious aspect of importance, since the main concern of the service is to interchange information between host and terminal. The interchange aspect is the discriminating one with regard to configurations and architectures. The scenario examples in the previous subclause clarify this point: the characterisation of the service is the nature of the transmitted information, and not the actual capabilities of the terminal.

The terminal aspect is, secondly, of importance since the capabilities of the terminal determine the possibilities and restrictions, which should be handled by the service, and that also implies the type of applications that can be offered to the user. Although the host could be of influence too, it will normally exhibit the necessary capabilities, required by the service.

Finally, the network is of importance for the same reasons as the terminal: its special characteristics should be taken into account by the service. However, the influence of the network on the service is not as strong as the influence of the terminal is.

6.2.1 Interchange configurations

The interchange configurations deal with the interchange aspect of the scenarios. All the other aspects are not important. This narrowed view leads to possible interchange configurations. The classification into different configurations will be made first. Then the different configurations are described in detail, listing the protocol requirements, the possible base standards and the enhancements to be made to fit the base standard to the requirements.

The distinction into real-time and non real-time interchange is the first step of classification to be made. The real-time interchange leads to four different configurations, where each configuration deals with up to one of the four levels (CD, MHI, S, A). This distinction is not useful for the non real-time interchange part, the downloading itself does not make this distinction. Therefore, only one configuration is relevant to the non real-time interchange part.

So, five different configurations are relevant, those are described as:

- I1: Content Data Real Time Interchange (CD-RTI);
- I2: Multimedia and Hypermedia Information Real Time Interchange (MHI-RTI);
- I3: Script Data Real Time Interchange (S-RTI);
- I4: Application-specific Data Real Time Interchange (A-RTI);
- I5: (All) Information Non Real-Time Interchange (I-NRTI);

The different configurations are numbered for convenience in the candidate architectures part of this Clause.

The RTI configurations (I1, I2, I3 and I4) are all possible in combination with the NRTI configuration (I5). However, the NRTI configuration (I5) should be regarded as not to be in combination with any RTI configuration.

In the diagrams of the different configurations, the interchanged information levels are put in the middle of the box, referring to bi-directional interchange (from user-to-host and host-to-user). Normally, the interchange should be mostly asymmetric, i.e. no information interchange of Multimedia and Hypermedia Information and Script in the up link (from user-to-host).

6.2.1.1 Content Data Real Time Interchange (CD-RTI)

The CD-RTI configuration interchanges only CD information between terminal and enhancements host. The related diagram of the scenario is given in figure 7.

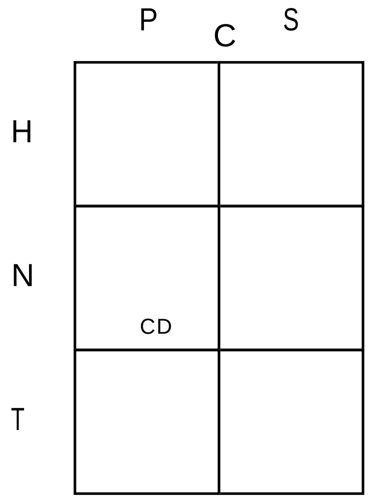

Figure 7: I1: Content Data Real-Time Interchange configuration

The general protocol requirement of this configuration is that the presentation media (text, graphics, still picture, audio, video) should be carried from host to terminal in an appropriate standard representation.

A base standard could be the ISDN Syntax-Based Videotex (SBV).

Some enhancements aspects, that should be noticed to make the base standard appropriate to M&HIRS architectures, are:

- video;
- windowing;
- composite input;
- mapping to high-speed networks.

Video refers to moving pictures, not necessarily with a frame rate of 25 frame/s.

Windowing and composite input provide an enhanced Man Machine Interface (MMI), including for example: moveable, sizeable and scrollable windows, menu bars, dialogue boxes, scroll bars, buttons, list boxes.

High speed networks shall enable more bandwidth, which could provide, for example, the necessary means to incorporate full motion full screen video into Videotex.

6.2.1.2 Multimedia and Hypermedia Information Real Time Interchange (MHI-RTI)

The MHI-RTI configuration interchanges information up to the MHI level between terminal and host. The related diagram of the scenario is given in figure 8.

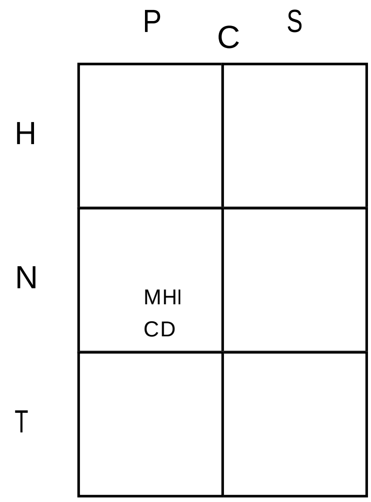

Figure 8: I2: Multimedia and Hypermedia Information Real-Time Interchange configuration

From this configuration comes a list of protocol requirements:

- MHI objects (embedding monomedia objects) should be carried from host to terminal in an appropriate standard representation;
- MHI objects should be sequenced optimally, taking into account minimal resource constraints (e.g. limited throughput) and still preserving the best Quality of Service (QoS);
- MHI objects, that are locally stored or earlier transmitted, can be re-used, provisions should be made to handle this appropriate;
- synchronisation aspects should be dealt with, since this is achieved at the terminal side;
- commands for activating and representing MHI objects should be carried from host to terminal in an appropriate way (including windowing) ;
- requests for MHI objects should be carried from terminal to host;
- input results should be carried from terminal to host.

A possible base standard is dependent on the target network. SBV is perhaps possible, but this should be evaluated especially with regard to the upper limit on network speed. Another possible base is "protocol B", CCITT Draft Recommendation T.176 [36]. This will be a specifically designed protocol to be able to cope with higher bandwidth requirements.

The enhancements to the base will depend on the available base.

6.2.1.3 Script Real Time Interchange (S-RTI)

The configuration S-RTI is capable of interchanging information up to the level of script. This is expressed in figure 9.

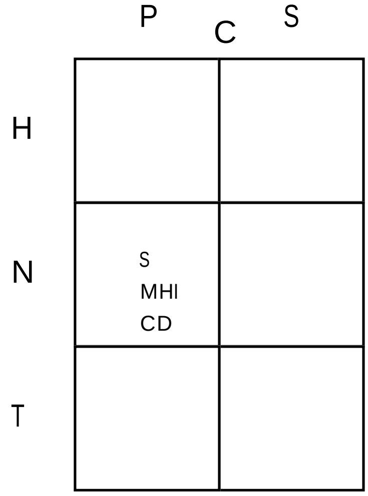

Figure 9: I3: Script Real-Time Interchange configuration

Script is not yet standardised, there are only some basic ideas. So, it is very difficult to make up protocol requirements. The amount of script data is comparatively very low and, in the case of no special time constraints, existing protocols could do (e.g. FTAM).

However, new services could force rigorous transfer time requirements, and protocols for interactive script transfer or remote script execution will have to be developed. The functionality and form of script languages will have major influence on the protocols requirements.

6.2.1.4 Application-specific Real Time Interchange (A-RTI)

The A-RTI configuration can interchange all kinds of information (S, A, MHI, CD) in a real-time way between terminal and host. The scenario diagram is shown in figure 10.

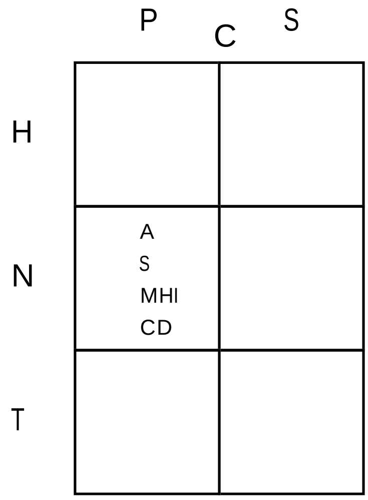

Figure 10: I4: Application-specific Real-Time Interchange configuration

The protocol requirements, that are of importance to this configuration, are:

- real-time updating;
- selection/browsing.

6.2.1.5 All Information Non Real Time Interchange (I-NRTI)

This configuration (I-NRTI) only concerns the non real-time interchange, that is the interchange of information between the storage of the host and the storage of the terminal. The level of information in the downloading is of no importance.

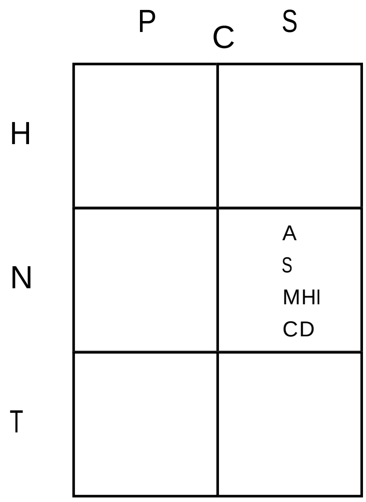

Figure 11: I5: All Information Real Time Interchange configuration

The downloading leads to the following protocol requirements:

- file transfer;
- updating.

Base standards that can be used to fulfil the required downloading are:

- ETS 300 075 [5];
- FTAM.

Enhancements which should be made to base standards are:

- updating;
- high speed networks.

6.2.2 Terminal configurations

As in subclause 6.2.1, a classification of possible configurations is given first. Then each configuration is described, listing which capabilities the terminal should have in order to handle this configuration (the minimum requirements of the terminal).

An appropriate distinction of the terminal aspect into relevant configurations is done with the criterion that a terminal can handle all the information levels, from a processing point of view, up to the highest one. This leads to four different terminal configurations:

- T1: Content Data Terminal (CD-T);
- T2: Multimedia and Hypermedia Information Terminal (MHI-T);
- T3: Script Terminal (S-T);
- T4: Application-specific Terminal (A-T).

Also, here the configurations are numbered for convenience in the candidate architectures part of this Clause.

6.2.2.1 Content Data Terminal (CD-T)

The CD-T configuration is only capable to process CD at the terminal side, and is generally known as the "simple terminal". The scenario diagram is given in figure 12.

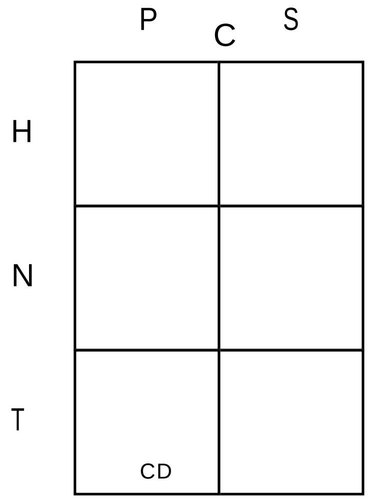

Figure 12: T1: Content Data Terminal configuration

The processing capabilities should be equivalent to that of a 80286 processor, to be able to process the decompression algorithms on the incoming, compressed, information types.

The communication capabilities should at least include the network interface, but also software modules should be present to take care of the CD-protocol or the NRTI-protocol.

The terminal should have to include presentation devices (hardware or software) dealing with the interchange representations of CD (e.g. JPEG, G.721, MPEG).

The storage capabilities can be restricted to RAM, there is no need for mandatory local mass storage.

6.2.2.2 Multimedia and Hypermedia Information Terminal (MHI-T)

The MHI-T configuration is capable of processing information on the level of MHI. Figure 13 contains the related scenario diagram.

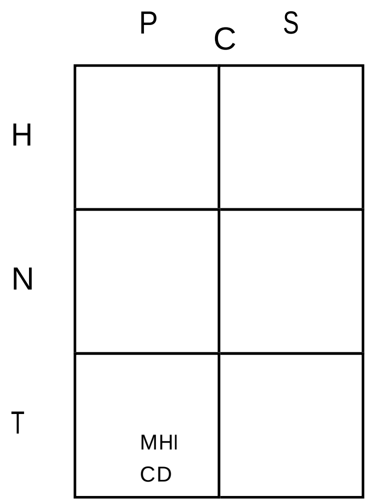

Figure 13: T2: Multimedia and Hypermedia Information Terminal configuration

Due to the fact that also MHI shall be processed, a 80286 equivalent processor is not sufficient, and the minimal requirements on the processing capabilities of the terminal are that it should have at least have an equivalent 80386 processor.

The communication capabilities should also have to include at least a network interface and also software modules that can handle the MH-protocol or the NRTI-protocol.

The presentation capabilities listed in subclause 6.2.2.1, to be able to represent the CD, should be included by this terminal configuration. But also, a MHI objects processor should be present for dealing with the interchange representation of MHI objects (e.g. MHEG).

The storage capabilities are the same as for the previous configuration. However, although the terminal configurations are mainly of concern to the processing properties and not to the storage properties, local mass storage would enhance performances (but is not mandatory).

The MPC (see subclause 5.3.1.1) is an example computer that could fit most of the required capabilities.

6.2.2.3 Script Terminal (S-T)

This S-T configuration can process all the information levels up to script (S, MHI, CD). The diagram is given in figure 14.

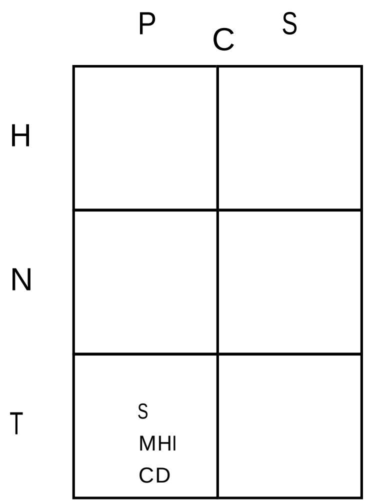

Figure 14: T3: Script Terminal configuration

Processing capabilities should be on the level of an equivalent 80386 processor with the addition of a script processor dealing with the interchange representation of script.

The communication capabilities are equivalent with the previous ones: besides of a network interface, there is a need for software modules which can handle the S-protocol or the NRTI-protocol.

The presentation and storage capabilities do not differ from the previous configuration (see subclause 6.2.2.3).

6.2.2.4 Application-specific Terminal (A-T)

This configuration can process all the different information levels (A, S, MHI, CD), and is the most complex terminal with respect to the previous ones. The diagram is given in figure 15.

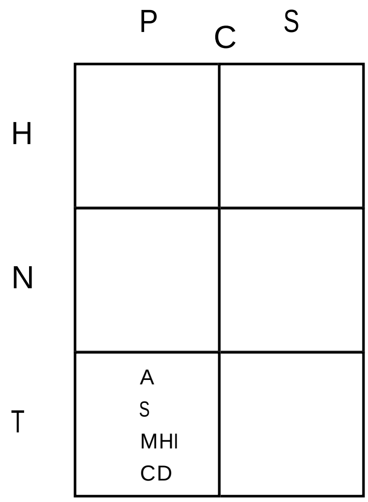

Figure 15: T4: Application-specific Terminal configuration

To be able to process all the different information levels the minimum requirement is a 80386 equivalent processor.

The communication capabilities should not be restricted to a network interface and a software module on the level of the A-protocol, but also include a software module to be able to handle the S-protocol. In case of only non real-time interchange, a software module implementing the NRTI-protocol is sufficient (besides the network interface).

The presentation and storage capabilities do not differ from the previous two configurations. However, a software module should be included to deal with the representation of the application-specific data.

6.2.3 Network configurations

The last aspect of importance to the M&HIRS architectures is the network. The network aspect is very general to the architectures. Each configuration has its own typical characteristics and can, taking into account the capabilities of the network, be used in almost any architecture. Due to this, and the fact that the service is of primary concern to the architecture (not the network), the candidate architectures (see subclause 6.3) does not deal explicitly with the network aspect. Therefore, it is not useful at this stage to give a thorough overview of the different requirements of the different network configurations. However, the network configurations to be distinguished are presented in this subclause.

A distinction has been made in two network configuration aspects: type of connection and type of network.

6.2.3.1 Type of connection

The first network configuration aspect is the type of connection. Since the scope is on user-to-host model, this refers to the type of connection between terminal and host. Three different terminal to host connections can be distinguished. Each one is illustrated in figures 16 to 18 respectively.

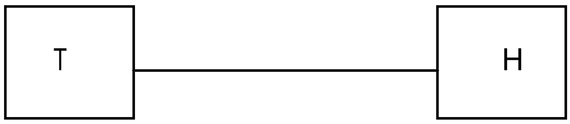

Figure 16: Connection to one host

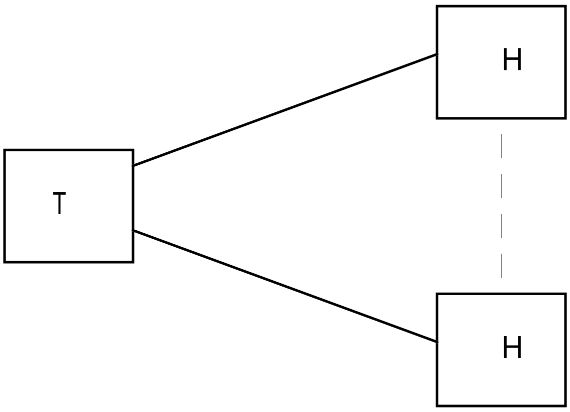

Figure 17: Connection to several hosts

The connection to several hosts shall have no implication on the protocol.

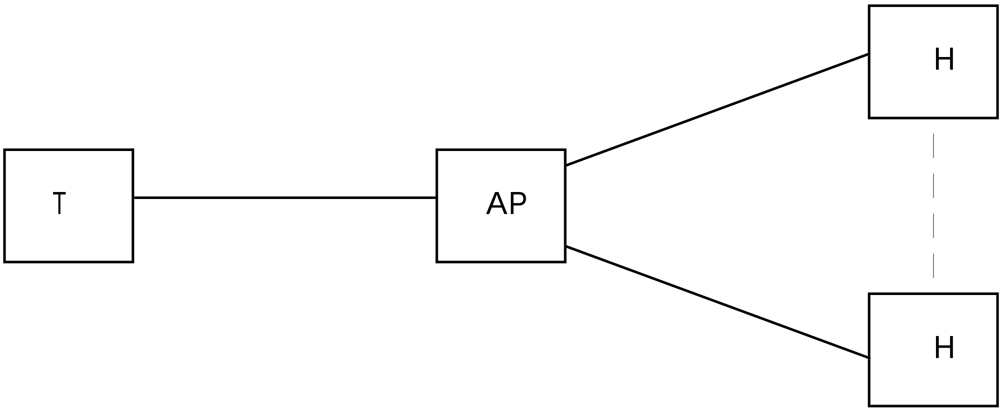

Figure 18: Connection to several hosts via an access point

The terminal is connected to several hosts by means of an Access Point (AP). The protocol shall be able to handle multi sessions.

6.2.3.2 Type of network

The second network configuration aspect is the type of network, that is the actual network (or networks) that shall be used. Since the scope is mainly on ISDN, the different ISDNs are the basis for this subclause. Characteristics of the networks are described in subclause 5.3.2.

The given type of networks can be (part) of the terminal to host connections, as given in the previous subclause.

The different network configurations can of course be combined, e.g. the backbone network between host and access point is a B-ISDN and the distribution between terminal and access point uses an ISDN for interactive communication and a DBN for "high volume" transmission.

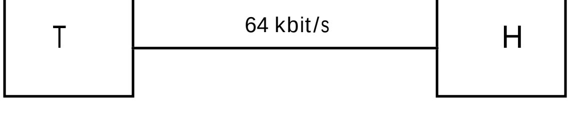

Figure 19: N-ISDN (1B)

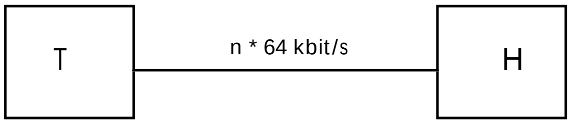

Figure 20: N-ISDN (nB)

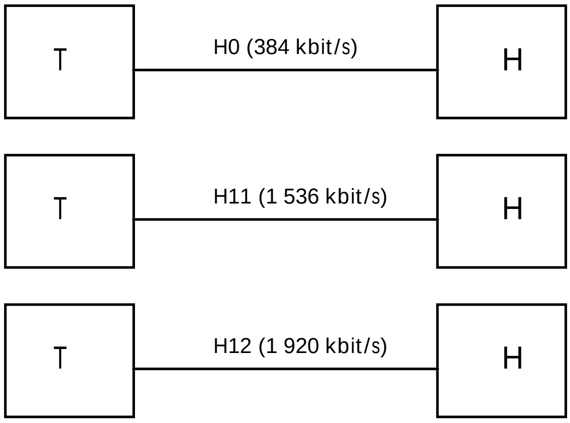

Figure 21: N-ISDN (Hyperchannel)

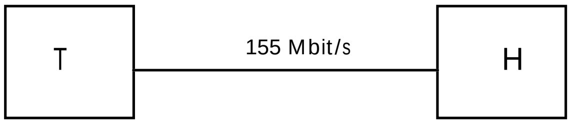

Figure 22: B-ISDN

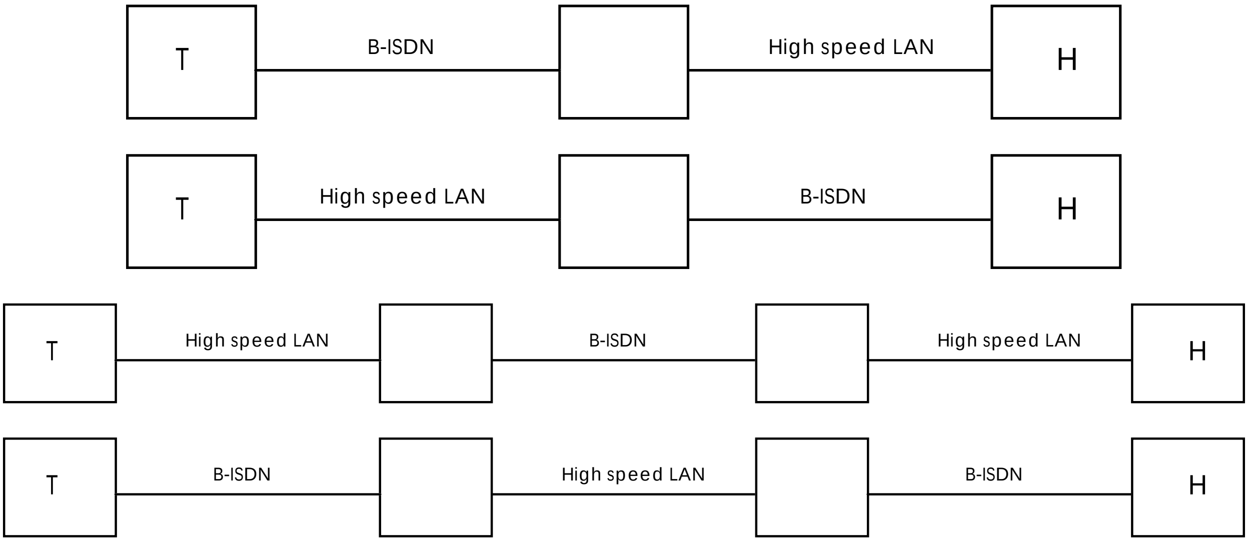

Figure 23: B-ISDN + High speed LAN

The interconnection of high speed LANs by B-ISDN will be the most common one of the last two interconnection configurations shown in figure 23.

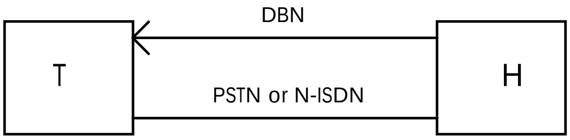

Figure 24: Hybrid network

The hybrid network uses both a one way connection (DBN) and an interactive connection (PSTN or ISDN).

6.3 Candidate architectures

As is already mentioned at the beginning of this Clause, a candidate architecture is an architecture where the configurations of the interchange and terminal aspect lead to useful connections with respect to M&HIRS. The network configurations shall not be taken into account because each architecture can include the different network configurations and also because the network aspect is not of main concern to the service level (see subclause 6.2).

Before the identified candidate architectures are described, the procedure on how they were identified is given.

All possible architectures which can be built by the interchange and terminal configurations lead to a matrix of (I1..I5) * (T1..T4). This matrix is given in figure 25. The notation IxTy, with x and y referring to a number, stands for the combination of the interchange configuration Ix and the terminal configuration Ty.

	T1 (CD-T)	T2 (MHI-T)	T3 (S-T)	T4 (A-T)
I1 (CD-RTI)	I1T1	I1T2	I1T3	I1T4
I2 (MHI-RTI)	I2T1	I2T2	I2T3	I2T4
I3 (S-RTI)	I3T1	I3T2	I3T3	I3T4
I4 (A-RTI)	I4T1	I4T2	I4T3	I4T4
I5 (I-NRTI)	I5T1	I5T2	I5T3	I5T4

Figure 25: Matrix of possible architectures

Due to the fact that I3 and I4 do not (yet) differ very much, the I3 row (S-RTI configuration) can be deleted. Configuration I4 (A-RTI) will also represent the I3 configuration.

With respect to M&HIRS, the terminals T3 and T4, referring to respectively the S-T and the A-T configuration, also do not differ very much. Whether the terminal can process up to application-specific or up to script level is of no importance to the service. This is taken into account in the matrix by deleting the T3 column. Those two points reduce the matrix, see figure 26.

	T1 (CD-T)	T2 (MHI-T)	T4 (A-T)
I1 (CD-RTI)	I1T1	I1T2	I1T4
I2 (MHI-RTI)	I2T1	I2T2	I2T4
I4 (A-RTI)	I4T1	I4T2	I4T4
I5 (I-NRTI)	I5T1	I5T2	I5T4

Figure 26: Matrix of all possible M&HIRS architectures

To be able to find the candidate architectures from this matrix (figure 26), another step shall be taken: the deletion of non-interesting and useless configurations connections:

- I1T2 is not an interesting combination with respect to M&HIRS, the MHI that is processed at the terminal cannot be transferred by the protocol, and therefore, this architecture is covered by I1T1;
- I2T1 is a useless combination, the transferred MHI from the host to the terminal is not processed locally;
- I4T1 and I4T2 are useless combinations, the transferred script information from the host to the terminal is not processed locally;
- I5T1 and I5T2 are useless combinations, the application shall be processed locally (the interchange is non real-time).

Finally, this leads to six candidate architectures, these are marked in the matrix shown in figure 27.

	T1 (CD-T)	T2 (MHI-T)	T4 (A-T)
I1 (CD-RTI)	I1T1		I1T4
I2 (MHI-RTI)		I2T2	I2T4
I4 (A-RTI)			I4T4
I5 (I-NRTI)			I5T4

Figure 27: Matrix of candidate architectures

The most important and distinguished candidate architectures are I1T1, I2T2 and I4T4. They are all RTI configurations, with the ability to locally process up to the interchanged information level.

In the following subclauses, each candidate architecture is described, together with the scenario diagram and possible applications. The possible applications come from the list of applications examples given in Annex A.

6.3.1 Candidate architecture I1T1

Candidate architecture I1T1 is capable to interchange CD in real-time between terminal and host, and to process CD at the terminal side.

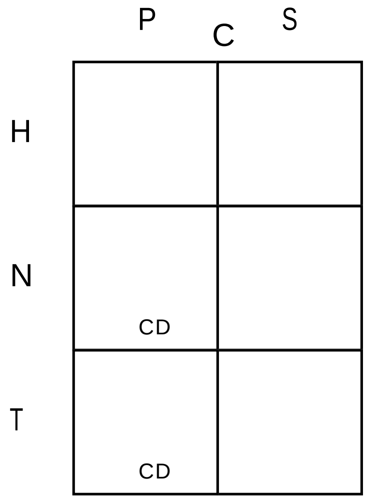

Figure 28: Candidate architecture I1T1

Application examples are: tele-presence, tele-shopping, advertising, entertainment and games, electronic library and electronic books, medical applications, music on demand, video on demand, home automation and security systems, news on demand. See also the example of "Traditional Videotex" in subclause 6.1.

6.3.2 Candidate architecture I1T4

Candidate architecture I1T4 can only interchange CD in real-time between terminal and host, however has the facilities to process all levels of information (A, S, MHI and CD) at the terminal side.

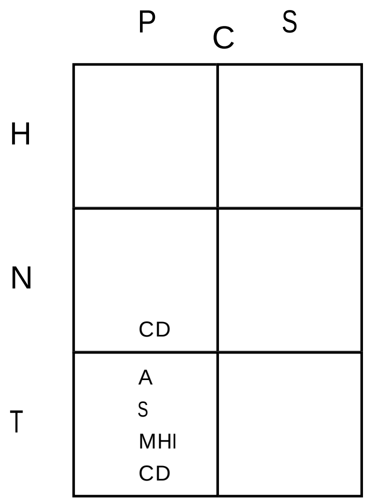

Figure 29: Candidate architecture I1T4

An application example could be, for instance, a local application running on a PC which needs from time-to-time to get additional (updated) information from a Videotex host (e.g. stock exchange information, plane or time table).

6.3.3 Candidate architecture I2T2

Candidate architecture I2T2 can interchange both the MHI level and the CD level in real-time. These levels can also be processed at the terminal side.

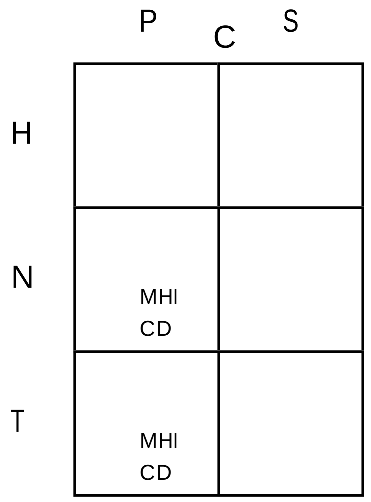

Figure 30: Candidate architecture I2T2

Application examples are: entertainment and games, electronic library and electronic books, medical applications, news on demand, encyclopaedic devices. See also the example of "Remote consultation" in subclause 6.1.

6.3.4 Candidate architecture I2T4

Candidate architecture I2T4 can interchange, in real-time, the same levels as the previous candidate (MHI and CD). The terminal is a more elaborate one and can process all kinds of information (A, S, MHI and CD).

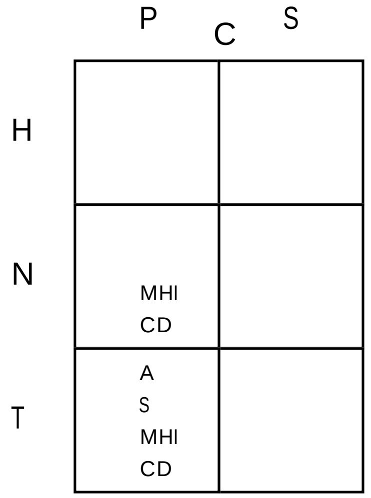

Figure 31: Candidate architecture I2T4

Application examples are: remote processing (upload), remote publishing, training and education, office information systems, points of information, computer supported co-operative work.

6.3.5 Candidate architecture I4T4

Candidate architecture I4T4 is the most elaborate real-time interchange architecture. Interchange can be done up to the application-specific level. The terminal can also handle all four different levels.

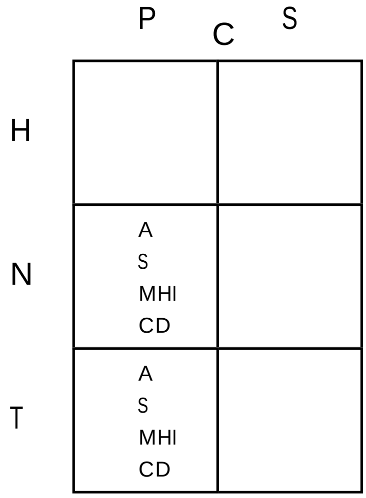

Figure 32: Candidate architecture I4T4

Application examples are: remote expertising, tele-shopping, advertising, training and education, entertainment and games, electronic library and electronic books, home automation and security systems. See also the examples of "Kiosk" and "Points of sales" in subclause 6.1.

6.3.6 Candidate architecture I5T4

Candidate architecture I5T4 is the only candidate architecture with non real-time interchange. It can interchange all different levels (in non real-time). Also, the terminal can process up to the application-specific level.

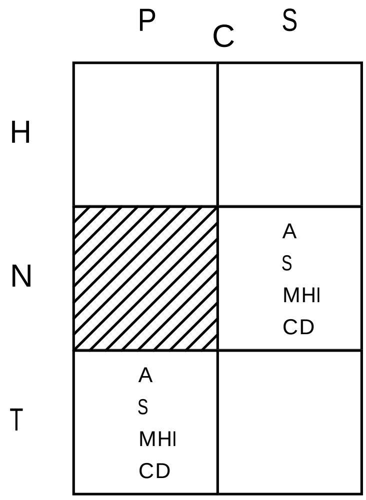

Figure 33: Candidate architecture I5T4

To stress the NRTI character without allowing RTI, the P-N box has been dashed.

Application examples are: remote processing (download), training and education, remote expertising, office information systems, point of information, music on demand, video on demand, discussion corners, news on demand, encyclopaedic service.

7 New work items

Eleven new work items in the field of M&HIRS are presented in this Clause. These items come from the candidate architectures (see subclause 6.3). After the relation is shown between the items and the architectures, each new work item is described in a subclause.

From the previous Clause, it is clear that a candidate architecture is mainly a choice of components on the level of:

- interchange configuration;
- terminal configuration;
- network configuration.

Those aspects are all appropriate for access and interchange of information at different levels (Application-specific (A), Script (S), Multimedia and Hypermedia Information (MHI) and Content Data (CD)).

From the candidate architectures, one can take different approaches to come to new work items:

- requirements;
- enhancements;
- general.

The requirements approach is top-down and generally follows a three stage approach. First, one starts with the evaluation of the requirements. Second, one investigates the liaison with relevant standardisation activities to ensure the co-ordination of results with those activities. Third, one will put up the specification itself.

The enhancements approach is bottom-up. It starts with existing standards and evolves, or migrates, those to satisfy new requirements.

The general approach refers to those approaches not covered by the two previous ones.

All the approaches are related to the candidate architectures: the implementation of candidate architectures leads to the new work items. The first two approaches focus on the separate candidate architectures. But logically, a new work item is not restricted to one candidate architecture, but several candidate architectures may lead to the same new work item(s). The last approach is appropriate for all candidate architectures together.

From the requirements on information interchange and representation come the following identified work items:

1 **API for manipulation of MHI objects;**
2 **real-time interchange of MHI in retrieval services;**
3 **representation of scripts for AVI applications;**
4 **protocols for AVI scriptware services.**

From the enhancement of existing retrieval services come the following identified work items:

1 **Videotex protocols and syntaxes for an enhanced man-machine interface;**
2 **Videotex protocols and syntaxes for real-time transmission of video;**
3 **interworking of retrieval services with audiovisual services;**
4 **real-time transmission of video on high-speed interactive networks.**

NOTE: The work item "Videotex protocols and syntaxes for an enhanced man-machine interface" is to be covered by the ETSI PT48 "Man Machine Iinterface (MMI)". Therefore, this item is not addressed further in this ETR.

General identified work items are:

1 **interchange representation of access restrictions to information within M&HIRS;**
2 **recommendation for a common user interface for M&HIRS;**
3 **profiles of ODA and HyperODA for use in M&HIRS.**

The new work items are described in one of the following subclauses. and are arranged according to the originating approach: requirements on information interchange and representation (see subclause 7.1), enhancements of Videotex protocols and architectures (see subclause 7.2) and general requirements and enhancements (see subclause 7.3).

The addressed topics are: description of the new work item, the rationale to which aspects the new work items are appropriate, approaches which make it able to set up a structure for the new work item and an aspect for the schedule of the new work item: pre-requisites.

7.1 Requirements on information interchange and representation

The described new work items are:

- API for manipulation of MHI objects;
- real-time interchange of MHI in retrieval services;
- representation of scripts for AVI applications;
- protocols for AVI scriptware services.

7.1.1 API for manipulation of MHI objects

7.1.1.1 General description

Title:

API for manipulation of MHI objects.

Context:

Development of new interactive services.

Reasons:

See requirements.

Scope:

Specify an API above the MHI objects (e.g. between script and MHI level). The API allows:

- activation/de-activation of MHI object presentation (including windowing, rendition);
- requesting/getting back user interaction;
- uniform access to (locally stored or remote) MHI objects.

7.1.1.2 Rationale

Relevant service architectures:

- candidate architecture I1T4 on any network;
- candidate architecture I2T2 on any network;
- candidate architecture I2T4 on any network;
- candidate architecture I4T4 on any network;
- candidate architecture I5T2 on any network;
- candidate architecture I5T4 on any network;
- any other (API on host side).

Applications:

Categories:

- all: AVI scriptware, document interchange, Videotex, applications using retrieval and conversational services, applications using retrieval and distribution services.

Context:

- any M&HIRS context.

<u>Identification of requirements:</u>

Technical requirements:

- see subclause 5.1.2.1, MHEG;
- see subclause 5.1.3, script;
- see subclause 7.1, work item RTI of MHI.

There is a need to define the commands that maybe issued for **accessing** and **presenting** MHI on the terminal. This is useful for:

- scriptware development;
- application portability;
- real-time interchange protocols for MHI.

7.1.1.3 Approaches

<u>Related standardisation activities:</u>

- ISO/IEC SC18/WG8: script functionalities;
- ISO/IEC SC29/WG12: script/MHI representation and coding.

<u>List of study items:</u>

- overview of requirements within different scenarios context;
- liaison with/study of script standardisation, MHI standardisation, MHI interchange work item;
- specification of the API.

<u>Reference documents:</u>

- ISO/MHEG [50] S.7.

7.1.1.4 Schedule

<u>Pre-requisites:</u>

MHEG Committee Draft scheduled Spring 1993.

7.1.2 Real-time interchange of MHI in retrieval services

7.1.2.1 General description

<u>Title:</u>

Real-time interchange of MHI in retrieval services.

<u>Context:</u>

Development of new interactive services.

<u>Reasons:</u>

RTI of MHI is central to M&HIRS.

<u>Scope:</u>

- evaluate detailed representation and protocol requirements for RTI of MHI objects in the context of M&HIRS;
- specify the appropriate protocol(s) and profiles.

NOTE: If the MHEG CD document defines profiles, this item should be limited to protocols. Otherwise, both protocols and profiles should be incorporated into the scope.

7.1.2.2 Rationale

Relevant service architectures:

- candidate architecture I2T2 on any network;
- candidate architecture I2T4 on any network;
- candidate architecture I4T4 on any network.

Applications:

Categories:

- AVI scriptware;
- document interchange/manipulation;
- syntax-based Videotex;
- applications using retrieval plus conversational services;
- applications using retrieval plus distribution services.

Context:

- sales and advertising;
- education and training;
- entertainment;
- news and information.

Identification of requirements:

Technical requirements:

- see subclause 6.2.1.2, configuration MHI-RTI;
- see subclause 5.1.2.1, MHEG "white spots";
- see subclause 4.4, M&HIRS technical requirements;
- see Annex B, M&HIRS application example.

The RTI of structured MHI appears to be central in M&HIRS. It involves a more efficient and intelligent way of exchanging information than the classical transmission of content data: re-usability of objects, adaptability to various terminals, object-oriented rather than stream-oriented.

7.1.2.3 Approaches

Related standardisation activities:

- ISO/IEC JTC1/SC29/WG12: elaboration of MHEG standard;
- ITU-TS SGVIII/Q9 (Draft ITU-T Recommendation T.171 [51] and Draft ITU-T Recommendation T.175 [35]): protocol for AVI systems.

List of study items:

- evaluate requirements associated with the real-time interchange of structured MHI objects:
    - sequencing of objects for appropriate synchronisation;
    - presentation/activation commands;
- evaluate requirements associated with interworking with conversational/distribution services;
- liaison with other WGs working on:
    - MHI object representation for interchange;
    - MHI presentation API;

  link with other work items MHI API and script representation;
- specify appropriate protocols/profiles.

Reference documents:

- ISO/MHEG [50] S.7;
- ITU-T Draft Recommendation T.175 [35];

- ITU-T Draft Recommendation T.170 [2];
- ISO/IEC 8613 [27] HyperODA "Extensions for temporal relationships";
- existing real-time interchange standards (e.g. ETS 300 079 [52]).

7.1.2.4 Schedule

Pre-requisites:

- MHEG Committee Draft scheduled Spring 1993.

The specification of an API for manipulation of MHI objects, see previous work item, shall be a pre-requisite to this item.

7.1.3 Representation of scripts for AVI applications

7.1.3.1 General description

Title:

Representation of scripts for AVI applications.

Context:

Development of new interactive services.

Reasons:

Standardisation work at ISO and CCITT (ITU) is only at a very preliminary stage: waiting for them might lead to undesired delays in the development of scriptware application-oriented applications over ISDN.

Scope:

Specify a representation allowing the description of access and processing of MHI used in interactive applications in an hardware-independent way.

7.1.3.2 Rationale

Relevant service architectures:

Any candidate architecture on any network.

Applications:

Categories:

- AVI scriptware.

Context:

- information services;
- education and training;
- entertainment and games;
- commercial presentations.

Identification of requirements:

Technical requirements:

- see subclauses 6.2.1.3 and 6.2.1.5, interchange configurations S-RTI and I-NRTI;
- see subclause 4.4, M&HIRS technical requirements;
- see subclause 5.1.3, script standardisation;
- see Annex B, M&HIRS application example.

The availability of a uniform script representation would allow for the interchange of scripts between different actors/platforms and their execution in a platform-independent way.

7.1.3.3 Approaches

Related standardisation activities:

- ISO/IEC SC22: scripting language;
- ISO/IEC JTC/SC18/WG8 and SC29/WG12: script representation;
- ITU-TS SGI/Q17: representation and coding of scripts and SGVIII/Q9: functional requirements of scripts.

List of study items:

- study of/liaison with scriptware standardisation activities;
- evaluate functional requirements associated with the interchange of scripts (navigation, windowing, external process invocation, logical structure, processing of interaction response, activation of MHI presentation, etc.);
- evaluate technical requirements associated with the interchange of scripts.

Reference documents:

- ITU-T Draft Recommendation F.740 [53];
- ITU-T Draft Recommendation T.170 [2];
- ISO/MHEG [50] S.7;
- existing contributions to ISO/IEC JTC1/SC18 and SC29 work on scripts.

7.1.3.4 Schedule

As soon as possible.

Pre-requisites:

Not applicable.

7.1.4 Protocols for AVI scriptware services

7.1.4.1 General description

Title:

Protocols for AVI scriptware services.

Context:

Development of new interactive services.

Reasons:

See requirements.

Scope:

Define protocols between terminals and AVI systems for the access to AVI scriptware services. One possible objective is to input an ETS to ITU undergoing studies (Draft ITU-T Recommendation T.17x series).

7.1.4.2 Rationale

Relevant service architectures:

- candidate architecture I1T4 on an ISDN-based network;
- candidate architecture I2T4 on an ISDN-based network;
- candidate architecture I4T4 on an ISDN-based network;
- candidate architecture I5T4 on an ISDN-based network.

Applications:

Categories:

- AVI scriptware.

Identification of requirements:

Technical requirements:

Different interchange functions, especially real-time ones, have been identified for the use of AVI services. Some are already provided by existing protocols (non real-time interchange), others are under study (see work item RTI of MHI), some are still needed (more closely related to the AVI service). A more complete description of the requirements may be found in Draft ITU-T Recommendation T.175 [35].

An urgent need is the definition of a protocol for non real-time interchange of AVI scriptware.

7.1.4.3 Approaches

Related standardisation activities:

ITU-TS SGVIII/Q9 Draft ITU-T Recommendation T.17x series.

List of study items:

- study documents ITU-T Draft Recommendation T.175 [35] and Draft ITU-T Recommendation T.170 [2] and evaluate detailed requirements;
- choose among the candidate protocol architectures;
- specify the "Interchange" protocol for NRTI;
- specify the "Interchange" protocol for RTI;
- specify the interworking of the NRTI and the RTI protocol;
- liaison with other working groups:
  - work item RTI of MHI;
  - ITU-TS SGVIII/Q9.

Reference documents:

ITU-T Draft Recommendations T.170 [2], T.175 [35], T.176 [36].

7.1.4.4 Schedule

Pre-requisites:

Not applicable.

7.2 Enhancements of Videotex protocols and architectures

The described new work items are:

- Videotex protocols and syntaxes for real-time transmission of video;
- interworking of retrieval services with audiovisual services;
- real-time transmission of video on high-speed interactive networks.

7.2.1 Videotex protocols and syntaxes for real-time transmission of video

7.2.1.1 General description

Title:

Videotex protocols and syntaxes for real-time transmission of moving video (at a range of 64 kbit/s to 150 kbits/s).

Context:

Enhancement of Videotex services and/or development of new interactive services.

Reasons:

The current emergence of several moving video coding standards, together with the strong attractiveness of this user interface feature, now makes it possible and desirable to envisage the incorporation of moving video, with or without associated audio, in retrieval services. This may be considered as an early move towards the migration of existing services to M&HIRS.

Scope:

Upgrade the existing Videotex protocols and syntaxes so as to allow the real-time transmission of moving video on medium-speed networks (at a range of 64 kbit/s to 150 kbit/s).

7.2.1.2 Rationale

Relevant service architectures:

- candidate architecture I1T1 on N-ISDN;
- candidate architecture I1T4 on N-ISDN.

Applications:

As Videotex, with enhanced QoS.

Identification of requirements:

Technical and market-oriented requirements.

The current evolution of multimedia information coding (digital video) puts into the light the need for adopting the existing SBV protocol, in order to provide a higher QoS.

7.2.1.3 Approaches

Related standardisation activities:

- ETSI STC-TE1 activities on SBV.

List of study items:

- identify requirements for adapting SBV to digital video (e.g. CCITT Recommendation H.261 [29]);
- undertake appropriate specifications concerning data syntaxes and protocol elements.

Reference documents:

- CCITT Recommendation H.261 [29];
- ETS 300 079 [52], ETS 300 080 [49], ETS 300 223 [54].

7.2.1.4 Schedule

Pre-requisites:

Not applicable.

7.2.2 Interworking of retrieval services with audiovisual services

7.2.2.1 General description

Title:

Interworking of retrieval services with audiovisual services.

Context:

Enhancement of Videotex services and/or development of new interactive services.

Reasons:

See requirements.

Scope:

To study the interworking between retrieval (Videotex, possibly including moving video) and audiovisual services (videophony, videoconference).

7.2.2.2 Rationale

Relevant service architectures:

- candidate architecture I1T1 on N-ISDN or any ISDN;
- candidate architecture I1T4 on N-ISDN or any ISDN.

Applications:

Simultaneous or non-simultaneous access to retrieval and conversational services, most likely involving moving video, via a single terminal.

Identification of requirements:

Technical and market-oriented requirements:

- the development of conversational services such as videophony and videoconference is likely to give rise to applications involving both kinds of services;
- the results of this study are likely to impact on the choices made for incorporating moving video in Videotex services.

7.2.2.3 Approaches

Related standardisation activities:

- ETSI STC-TE1 activities on SBV.

List of study items:

- study characteristics of retrieval and audiovisual services, taking into account different information access scenarios;
- evaluate functional requirements associated with the interworking of retrieval services and audiovisual services;
- evaluate the technical requirements associated with the interworking of retrieval services and audiovisual services.

Reference documents:

- CCITT Recommendation H.221 [55];
- ETS 300 079 [52], ETS 300 080 [49], ETS 300 223 [54].

7.2.2.4 Schedule

Pre-requisites:

Not applicable.

7.2.3 Real-time transmission of video on high speed interactive networks

7.2.3.1 General description

Title:

Real-time transmission of moving video on high-speed interactive networks (around 1 Mbit/s).

Context:

Enhancement of videotex services and/or development of new interactive services.

Reasons:

See requirements.

Scope:

Study the applicability and upgrading of ISDN SBV over high-speed networks (e.g. hyperchannel, B-ISDN).

7.2.3.2 Rationale

Relevant service architectures:

- candidate architecture I1T1 on N-ISDN or any ISDN;
- candidate architecture I1T4 on N-ISDN or any ISDN.

Applications:

As videotex, with enhanced QoS. Interactive video programs in games and entertainment, education and training, sales and advertising.

Identification of requirements:

Technical and market-oriented requirements.

The current evolution of multimedia information coding (digital video), together with the upcoming availability of higher speed networks, allows to envisage the adoption of the existing SBV protocols to high-speed networks in order to provide a higher QoS and allow the emergence of new interactive applications.

However, several questions remain pending, among which:

- the applicability of SBV protocols to broadband applications;
- the target network(s) for M&HIRS;
- the target architecture for such services: following the ongoing development of multimedia terminal capabilities, I2- or I4- based architectures might be more appropriate since they allow to delegate more "intelligence" (storage and processing) from the host to the terminal.

7.2.3.3 Approaches

Related standardisation activities:

- ETSI STC-TE1 activities on SBV;
- MPEG-1, MPEG-2.

List of study items:

- incorporate results from related work items;
- identify requirements for adapting SBV protocols to high speed networks;
- undertake appropriate specifications.

Reference documents:

- ISO/IEC DIS 11172 [34];
- ETS 300 079 [52], ETS 300 080 [49], ETS 300 223 [54].

7.2.3.4 Schedule

Pre-requisites:

The results of work items "Real-time interchange of MHI in retrieval services" and "Videotex syntaxes and protocols for real-time transmission of video" are to be incorporated.

7.3 General requirements and enhancements

The described new work items are:

- interchange representation of access restrictions to information within M&HIRS;
- recommendation for a common user interface for M&HIRS;
- profiles of ODA and HyperODA for use in M&HIRS.

7.3.1 Interchange representation of access restrictions to information within M&HIRS

7.3.1.1 General description

Title:

Interchange representation of access restrictions to information within M&HIRS.

Context:

Development of new interactive services.

Reasons:

A number of potential MHI producers are reluctant to the use of interactive networks because of copyright, access right payments, security, confidentiality and dissemination factors. Especially, the copyright and access right payment are the most important items. Security and confidentially problems may be solved in the multimedia and hypermedia domain, like in any other one (e.g. fax, document transfer). However, the multimedia content types may not become commercially available if the copyright and access rights problem is not properly solved. This problem is extended using a network oriented architecture.

Scope:

Define appropriate mechanisms to handle copyright and access right payments. In general, define representations for restricting access and use of the information interchanged within M&HIRS, so as to satisfy different protection requirements.

7.3.1.2 Rationale

Relevant service architectures:

any architecture but T1I1, on any network.

Applications:

Categories:

any.

Context:

any context involving the use of restricted (not public) information, e.g.:

- education and training;
- entertainment;
- news agency;
- document interchange.

Identification of requirements:

Market-related requirements:

see reasons.

7.3.1.3 Approaches

Related standardisation activities:

- EWOS EG-SEC is studying security aspects of profiles;
- JTC1/SC21: OSI security and access control;
- ETSI TC NA Security Techniques Advisory Group (STAG).

List of study items:

- study of relevant activities;
- investigate possible technical requirements;
- evaluate the different categories of protection information (copyright, protection against dissemination, protection against inappropriate use, confidentiality, charging, modification);
- study the available alternatives for representing and interchanging these information kinds (where and how);
- specify according to a selection among candidate approaches.

Reference documents:

-

7.3.1.4 Schedule

Pre-requisites:

-

7.3.2 Recommendation for a common user interface for M&HIRS

7.3.2.1 General description

Title:

Recommendation for a common user interface for M&HIRS.

<u>Context:</u>

Development of new interactive services.

<u>Reasons:</u>

See requirements.

<u>Scope:</u>

Define a set of guidelines/recommendations to be fulfilled by terminal applications of M&HIRS. The concentration should be on service definition.

7.3.2.2 Rationale

<u>Relevant service architectures:</u>

- candidate architecture I1T4 on any network;
- candidate architecture I2T2 on any network;
- candidate architecture I2T4 on any network;
- candidate architecture I4T4 on any network;
- candidate architecture I5T4 on any network.

<u>Applications:</u>

Any.

<u>Identification of requirements:</u>

Market-oriented requirements:

the sharing of common interaction features by the user interfaces located on M&HIRS terminals will help to encourage the broader acceptability of such services by their final users on a large public basis.

7.3.2.3 Approaches

<u>Related standardisation activities:</u>

- ETSI PT48 MMI;
- ETSI TC-HF;
- EWOS EG-DBE;
- ISO/IEC JTC1/SC18/WG9.

<u>List of study items:</u>

- identify user interface requirements of M&HIRS;
- specify characteristics of M&HIRS user interface.

<u>Reference documents:</u>

ETSI TC-HF documents.

7.3.2.4 Schedule

<u>Pre-requisites:</u>

-

7.3.3 Profiles of ODA and Hyper-ODA for use in M&HIRS

7.3.3.1 General Description

Title:

Profiles of ODA and Hyper-ODA for use in M&HIRS.

Context:

Development of new interactive services.

Reasons:

The ODA standard and its projected extension to HyperODA satisfy the technical and market-oriented requirements of M&HIRS for open multimedia and hypermedia interchange. The ODA standard offers a very rich set of facilities and selection of one or more profiles is necessary in order to balance functional capabilities against program storage and processing capabilities of particular classes of terminal devices.

Scope:

Specify profiles of ODA and Hyper-ODA standards that define document content types and structuring capabilities needed for M&HIRS applications and appropriate to particular types of M&HIRS terminal devices.

7.3.3.2 Rationale

Relevant service architectures:

Any candidate architecture on any network.

Applications:

Categories:

- document interchange/manipulation;
- applications using retrieval.

Context:

- sales and advertising;
- commercial presentations;
- entertainment;
- news and information services;
- education and training.

Identification of requirements:

Technical requirements:

the ability to interchange hyper-documents that contain elements coded according to the provisions of any number of information representation standards and also contain information describing spatial and temporal requirements for presentation of those hyper-documents.

Market-oriented requirements:

ODA/ODIF provides an open architecture for documents and similar information objects that permits interchange without requiring explicit prior agreement between the parties to the interchange on the meaning of elements in the interchanged data stream that describe its structure and content-types.

7.3.3.3 Approaches

Related standardisation activities:

- ISO/IEC JTC1/SC18/WG3 - Open Document Architecture and Interchange Format: Development of the ODA standard, ISO/IEC 8613 (identical to CCITT T.410 series of Recommendations, developed by CCITT SG VIII Q27);
- ISO/IEC JTC1/SC18/WG3 and CCITT SG VIII Q.27 - Definition of "Abstract interface for the manipulation of ODA documents";
- ISO/IEC JTC1/SC18/WG5 - Development of a Generic Data Interchange/Interface for Documents (New Work Item proposal, June 1992);
- ISO/IEC JTC1/SC29 - Coded Representation of Picture, Audio and Multimedia and Hypermedia Information;
- EWOS/EG ODA: Development of ODA profile taxonomy and profiles.

List of study items:

- evaluate the applicability to M&HIRS of the profiles of the ODA standard that are currently identified;
- identify any further profiles of the ODA standard that are required for M&HIRS;
- evaluate Hyper-ODA specifications, standards committee working documents, and standards to determine the Hyper-ODA facilities that are relevant to M&HIRS;
- identify profiles of Hyper-ODA standards that are required for M&HIRS;
- develop any necessary profiles of ODA or Hyper-ODA;
- consider requirements for protocols for navigation within and retrieval of objects from ODA and HyperODA documents, and make recommendations for development, either under this work item or as a separate work item, of such protocols or profiles of protocols as may be needed.

Reference documents:

- ISO/IEC 8613 [27] - Open Document Architecture (ODA) and Interchange Format (a multi-part standard identical to the CCITT T.410-series of Recommendations);
- ISO/IEC 8613 - Open Document Architecture (ODA) and Interchange Format: proposed Amendment 7: HyperODA - Extensions for Temporal Relationships;
- ISO/IEC 8613 - Open Document Architecture (ODA) and Interchange Format: proposed Amendment 8: HyperODA - Extensions for non-linear structures.

7.3.3.4 Schedule

Pre-requisites:

Work can start immediately on evaluation of the existing taxonomy of ODA profiles and of the profiles that have already been developed.

Preliminary evaluation of HyperODA specifications can also begin, but completion must wait on the development of final versions of documents that are currently at Committee Draft stage within ISO/IEC and at the corresponding stage within ITU.

Annex A (informative): Service attributes and examples

This annex contains a list of service attributes and service examples. Also some application examples are given. The attributes are of importance to the Clauses **Multimedia and hypermedia information retrieval services** and **Information access scenarios**. The examples are illustrative.

A.1 Service attributes

First, the basic attributes are listed. Next, some additional service attributes/characteristics are given.

The next points refer to the basic attributes relevant to M&HIRS (CCITT Recommendation I.140 [56]). The boldfaced attribute values are the ones to be focused on in this TC-TR:

- information transfer rate;
- information transfer capability;
- establishment of communication (**demand**, reserved, permanent);
- communication configuration (**point-to-point**, multi-point, broadcast);
- symmetry (unidirectional, bi-directional symmetric, **bi-directional asymmetric**).

Information transfer rate is related to the network (N-ISDN and B-ISDN are the networks of concern). Considering the information transfer capability, only digital transfer is considered.

Additional service attributes/characteristics that occur in the context of M&HIRS:

- charging;
- security, privacy, identification, authentication, access control/authorisation;
- distribution of storage, processing and presentation capabilities;
- establishment of local and remote resources (fixed, on demand);
- session state information (none, simple/complex (trace), recoverable (within session, over sessions);
- freedom of choice for the user (predetermined sequences, arbitrary choices);
- user modifications (none, local, private, public) that may concern the contents and/or the structure and sequencing of objects;
- resource sharing (none, exclusion, update policies);
- distribution of application activities (browse - download - execution);
- quality of media (e.g. no lossy compression in medical images);
- protocol layers involved.

A.2 Service and application examples

For illustration, a list of service examples and application examples is given. Although the distinction between services and applications might not always be that clear, each topic is separately dealt with.

A.2.1 Service examples

Although the focus is on retrieval interactive services, also some examples are given belonging to the classes "conversational" and "messaging". More generally, all the services may use MHI.

An extensive list of service examples can be found in CCITT Recommendation I.121 [57].

Retrieval services examples:

- multimedia Videotex;
- hypermedia retrieval;
- document retrieval;
- data (file) retrieval;
- multimedia bulletin boards, which originates in computer conferencing services (like CompuServe, BIX (Byte Magazine's Information Exchange) or Usenet.

Conversational services examples:

- multimedia tele-meeting, which is an extension of videoconferencing;
- shared working space.

Messaging services example:

- multimedia mail.

A.2.2 Application examples

Before some examples are listed, a more comprehensive definition is given of both "multimedia applications" and "hypermedia applications".

Multimedia applications use a mixture of the following information types: text, data, graphics, sound, (still) images, video (moving pictures), animated (dynamic) graphics.

Hypermedia applications then would allow the user to follow **links** between **points** in these streams (the applications need addressing techniques for different media).

One way to view multimedia applications is that they use "**streams**" of these media elements which may be synchronised. Another point of view is that multimedia applications manipulate objects that are organised in monomedia (basic) objects and complex objects that consists of monomedia objects and structural information about the relation between these objects (including synchronisation, presentation, ...). Hypermedia applications use more complex structures that define **hyperlinks**.

Some additional new aspects of MHI applications:

- **multilingual** applications change only one or some stream (text, narration) but keep the others unchanged;
- some applications may include **filters** that reduce the amount of information a user can receive (e.g. a news service where a user can specify his/her interests).

Applications using MHI services:

- **remote processing** of hypermedia information: user sends special data (e.g. 3-D wire frame model with rendering information and a description of an animation sequence) to a special service centre with high capacity computation facilities and gets back a MPEG encoding video sequence;
- **remote publishing**: user sends HM document to a service centre that produces an enhanced document (e.g. typographic and graphic layout) for some output medium (electronic, paper, video tape, CD-ROM, ...);
- **remote expertising**: human or artificial expert demonstrates solutions for certain problems by "showing and explaining" using MHI objects. The expert adds objects and links to a database, parts of which can be downloaded or consulted by the user;
- **tele-presence**: remote action using robot interfaces with feedback through virtual reality devices;
- t**ele-shopping, advertising**: remote-transactions and electronic publishing;
- **training and education**: user consults prepared MHI lessons, interacts with simulations, asks a tutor for an explanation of some demonstrated process and gets it through some additional Hyper links in the lessons, makes personal annotations about lessons, gives remarks about some aspects of lessons to the lesson preparer or author, works together with other students to solve a problem,...;
- **entertainment and games**: games in a virtual "world" with potential (asynchronous) interaction between the users, including usage of virtual reality systems in entertainment centres;
- **office information systems**, engineering: consulting project documentation;
- **electronic library** and electronic books: yellow pages, tourist guides using electronic publishing of MHI material;
- **point of information**, information kiosk: information booths with a city guide including street maps and orientation help, regular remote update of information (traffic situation, cinema and restaurant programs, special events, ...), may be combined with advertising, tele-transactions (ticket and other reservations) and tele-shopping;
- **computer supported co-operative work**: joint editing or viewing, replacement for a white board;

- **medical applications**: exchange of diagnostic pictures, videos, sounds and data-based simulations;
- **music on demand**: user selects a "mood", some preferences (American folk music without vocals) and a duration, service delivers corresponding music to the personal hi-fi centre;
- **video on demand**: user orders a video which is delivered to the home HDTV centre;
- **home automation** and security systems: a MHI PC is the control centre which can be checked and programmed from outside;
- **discussion corners**, MHI bulletin boards: similar to current systems (CompuServe, BIX, Usenet) with the inclusion of MHI objects;
- **news on demand**: personalised electronic newspaper with "tell-me-more" feature, can be similar to current electronic news or current television news;
- **encyclopaedic service**: core encyclopaedia on CD-ROM, updates (subscription) through regular downloads, hot topics available on-line.

Applications based on personal computers or workstations may need following communication and manipulation functions for MHI objects:

- storage, manipulation, retrieval and broadcasting of MHI objects;
- integration of such objects locally in documents (MHI presentations);
- local editing of MHI objects and update of the central database.

Annex B (informative): M&HIRS example: interactive distributed learning system

This annex describes an example of a complete application making use of multimedia and hypermedia information retrieval. The structure of the annex matches the structure of the Clause that presents the M&HIRS model and requirements. In this way, the features of the application - different kinds of users, general service architecture, different types of information, functional requirements, information representation and interchange requirements - are mapped to the generic requirements expressed in that Clause.

B.1 General description

The interactive distributed learning application is a general application that makes use of M&HIRS over ISDN. It aims at providing people involved in distance training in a corporate context with a set of functions for accessing and interchanging multimedia and hypermedia training material.

B.2 Roles

The actors involved in the interactive distributed learning process are:

- authors;
- course producers;
- course managers;
- tutors;
- learners.

The **author** creates, modifies and tests training material. These activities are not directly related to the IDL system in the sense that they do not involve any telecommunications requirements. It is likely that all of these activities are performed in a local fashion.

The **course producer** supplies and installs training material onto the IDL system. This role may be fulfilled either by the tutor of training material or by the author himself.

The **course manager** administers the IDL system and its users. He is responsible for the operational behaviour of the IDL system and the technical management of the training process. He also deals with the relationships between the IDL actors. For instance, he organises the learners into classes, assigns the tutors to courses and/or classes, etc.

The **tutor** manages the training material contents in order to prepare and follow up the learners' sessions. The basic idea is to use (public) material provided by the course producers and mix it together with (private) material of its own in order to build appropriate, consistent courseware. For instance, he may consult and refine public material, edit instructions sheets for use of material by learners, analyse and correct results from learners' work, define new exercises tailored to one or several learners' status of knowledge. He then structures the material into courseware packages to be delivered to classes of learners.

The **learner** makes use of the packages prepared by his tutor(s) and delivered by the IDL system. This involves reading instructions sheets, studying tutorials (consulting documents), doing exercises (executing scriptware), etc.

The mapping of the IDL actors to the M&HIRS roles is as follows:

- information producer: the course producers (they provide the basic training material to the system), but also the tutors (they provide additional information for use by the learners);
- information manager: the course manager;
- information consumer: the learners (they are the final users of the MHI), but also the tutors (since they make use of the available training material in order to provide new, more elaborate training material to the IDL system).

B.3 Model

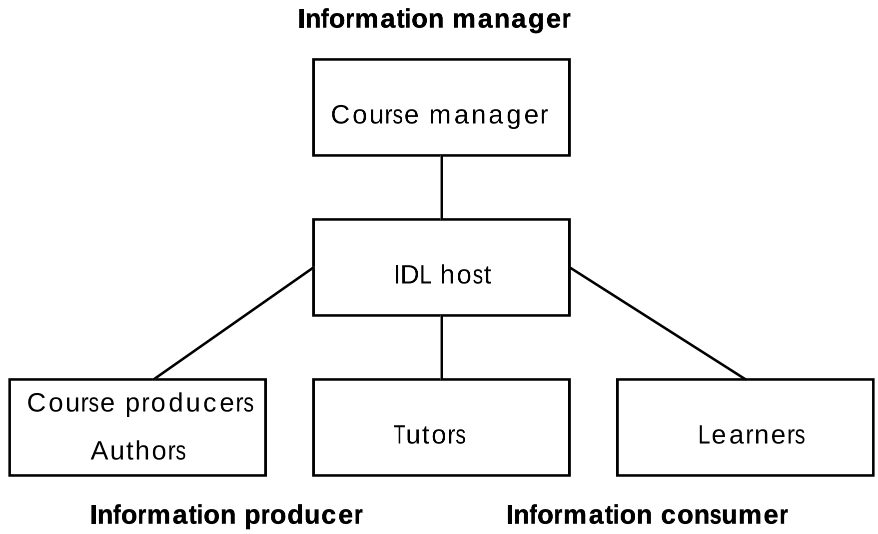

Figure B.1: Interactive distributed learning model

B.4 Characteristics of information

The information supplied by the course producers consists of "public" training material. The "public" training material consists in basic information which may be of very different nature according to its semantics. This ranges from unstructured monomedia material such as video sequences, audio recordings or even text files, up to complete CBT packages encompassing all the information useful to a particular session. Intermediate types include multimedia or hypermedia documents and scriptware. As a rule, possible semantics are reference documents, tutorials, exercises, tests, etc.

The tutors will supply additional information, referred to as "private" training material, relevant to a particular training context (session, course, class, etc.). This information may belong to any of the types that the course producers may supply. Moreover, frequent semantics will be related to instructions for appropriate use of training materials by the learners as well as additional work expected. These instructions will often be text files or voice messages.

This list makes it clear that the information may belong to at least the three different levels defined by the M&HIRS model: script, multimedia and hypermedia, content data. This information is likely to be supplied by different users. There is, therefore, a strong need for a common representation for each of the three levels.

Depending on the pedagogical approach that the tutor wants to follow, courseware packages may be build in different ways. Two are especially of interest:

- the hyperdocument paradigm is based on a declarative approach. The MHI presentation objects are referred to in a document structure, which encodes all of the useful information. The document basis mainly consists of text together with multimedia annotations. The interactivity is provided through the capacity to navigate across the hyper links of the document structure. This approach may be an appropriate one for tutorials or lessons;

- the scriptware paradigm is based on a more procedural approach. The MHI presentation objects are referred to by a script. The interactivity is provided through the user responses to input requests, the results of which are then computed by the script procedures so as to determine the next objects to be presented. The presentation is then commanded by the script together with its projection/rendition characteristics. This approach may be an appropriate one for exercises and tests.

To be complete, one should notice that there is no restriction to the fact that hyperdocument packages might refer scriptware packages and vice versa.

Application-specific information (likely to be interchanged) include everything which is related to the management of the training process. This includes:

- pedagogical information about learners: status of knowledge, traces collected from learners stations such as test results;
- administrative information about learners, tutors and course producers, including aspects such as copyright, charging, etc.;
- delivery information such as package delivery lists, updating information, etc.;
- directory information concerning the availability of additional training material on the host for learner consultation.

B.5 Functional requirements

The functional requirements from the different actors are the following:

- course producer: upload/update public training material;
- course manager: enquire the information base to enter or consult application-specific information;
- tutor: download (non real-time) or consult (real-time) public training material, upload private training material, enquire application-specific information (pedagogical, learning traces);
- learner: download (non real-time) training material packages or updates (an option is that they are delivered at the host's initiative on demand by the tutor), upload learning traces (an option is that they are collected at the host's initiative on demand by the tutor), consult (real-time) and select additional available training material.

B.6 Technical requirements

The technical requirements expressed through the study of this example application include information representation and protocol requirements.

B.6.1 Information representation requirements

Information representation requirements include the need of a common representation for each of the different levels of information: content data, multimedia and hypermedia information, scriptware, hyperdocuments.

For some of these information types, there already are existing or upcoming standards, e.g. JPEG, MPEG-x, G.72x, MHEG, HyTime. For others (script representation), standards are yet to be defined, though some preliminary studies have been undertaken in this direction.

Other common representations might be of interest concerning application-specific data including updates, traces, directory information.

B.6.2 Information interchange requirements

Protocol requirements include appropriate protocols and functions for:

- file transfer (downloading and uploading);
- real-time consultation of scriptware, of hyperdocument;
- (possibly) partial updating of script or of MHI.

History

Document history	
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