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TECHNICAL REPORT

Model and framework for standardization in multimedia equipment and systems

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International Electrotechnical Commission

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MODEL AND FRAMEWORK FOR STANDARDIZATION IN MULTIMEDIA EQUIPMENT AND SYSTEMS

FOREWORD

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IEC TR 61998, which is a technical report, has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 1999 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the annexes describing various technologies have been deleted because their roles have ceased over the past two decades;

b) TC 100 frameworks are described in more general form and from the viewpoint of the model of data usage and communication including the possible future technologies of TC 100.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
100/2528/DTR	100/2576/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Multimedia technology covers a wide range of technical areas and involves a number of technical elements. Most of the technical elements for multimedia are now being developed and updated. IEC standardization activities on the multimedia technology, therefore, should be carried out with enough discussions and clarifications on

- position and relationship of the technology to be standardized among the collection of related technologies,
- scope and framework/guideline of the standardization,
- appropriate standardization organisation having the responsibility,
- schedule of the standardization,
- relationship between new work items and the existing standards on multimedia or single medium technology.

These discussions should be based on appropriate multimedia technology models to create a framework for multimedia standardization.

The first edition of this Technical Report was a snapshot of these discussions in IEC/TC 100 with consideration of the draft IEC PACT (President's Advisory Committee on Future Technology) report which was a study and foreseer on future technology. After that, TC 100 had been engaged in standardization of audio, video and multimedia equipment and systems for over ten years.

In 2010, TC 100/AGS (Advisory Group on Strategy) started to study future technology again because some of ten years of progress of technology had reached beyond the IEC PACT foreseer. The study was FT-TG (Future Technology Task Force) that studied the technology forecast in the near future and resulted to raise Study Sessions in AGS to initiate the new technology areas in TC 100. At the same time, the need to revise IEC TR 61998 was recognized.

This new edition of this Technical Report is based on the IEC PACT report and redefines the TC 100 system model to initiate the future TC 100 standardization work. This Technical Report is expected to contribute as a guideline for IEC standardization experts and National Committees interested in multimedia equipment and systems.

MODEL AND FRAMEWORK FOR STANDARDIZATION IN MULTIMEDIA EQUIPMENT AND SYSTEMS

1 Scope

This Technical Report provides models and frameworks for the standardization of multimedia technology, being undertaken or to be undertaken by IEC as the result of the IEC PACT report.

2 Normative references

Void.

3 Terms and definitions

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

3.1
originator
entity, system or device that provides information or service, or container which includes information or service

3.2
recipient
entity, system, operator or device that receives information or service, or container which includes information or service

3.3
multimedia technology
systematic co-ordination of different single medium technologies

4 Generic model

4.1 General

The generic model clarifies AV and IT multimedia technology and its boundaries.

Standardization is in general required to obtain the following:

- physical and logical connectivity;
- usability and accessibility;
- identification;
- quality;
- safety and security;
- easy implementation;
- ecological considerations;
- energy efficiency;
- environmental safeguards.

The major purposes of multimedia standardization are:

- physical and logical connectivity

  Multimedia data interchange and distribution are based on communication media and interchangeable storage media. Protocols, formats, interfaces, and other data structures of the media are required to be standardized. The features of multimedia data, in particular, make those standards more complicated than in the case of a single medium.

- usability and accessibility

  Multimedia systems contain a number of basic single medium parts, each of which requires appropriate interaction with any users or other systems. In order to realise feasible and human-recognisable operation for the multimedia systems, simplified and standardized user-system interfaces are essential.

- safety and security

  Multimedia equipment and systems form or will form a basic and important infrastructure of national and international activity. Some multimedia data are required to be highly secured. Some systems are required to be strongly protected and besides their operation should be comfortable and safe for operators whose sense organs need to access concurrently to their corresponding media; visible, audible, and other sensible media. Safe and secured environments should be implemented by being based on some guideline and standards.

All the subjects to be standardized for this purpose can be modelled by the relationship between an originator and a recipient as shown in Figure 1.

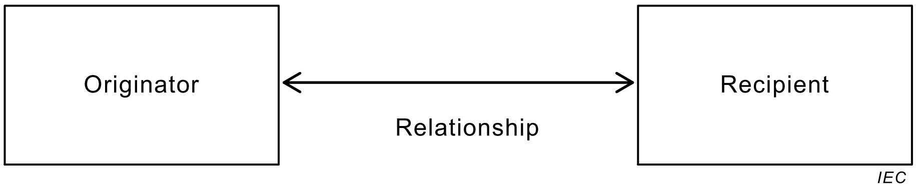

Figure 1 – Generic model

Each multimedia technology for the relationship should be discussed along with appropriate axes defined to describe corresponding features of the relationship.

4.2 Physical and logical connectivity

4.2.1 General

When considering physical and logical connectivity, as presented in Figure 2, an originator is positioned to be an entity, system or device which provides information. A recipient should be an entity, system or device which receives the information. They are reconnected with each other by a relationship: information transfer. The information transfer can be carried out by different types of information transfer media. Another aspect of the information transfer is a structure of data to be transferred by the medium.

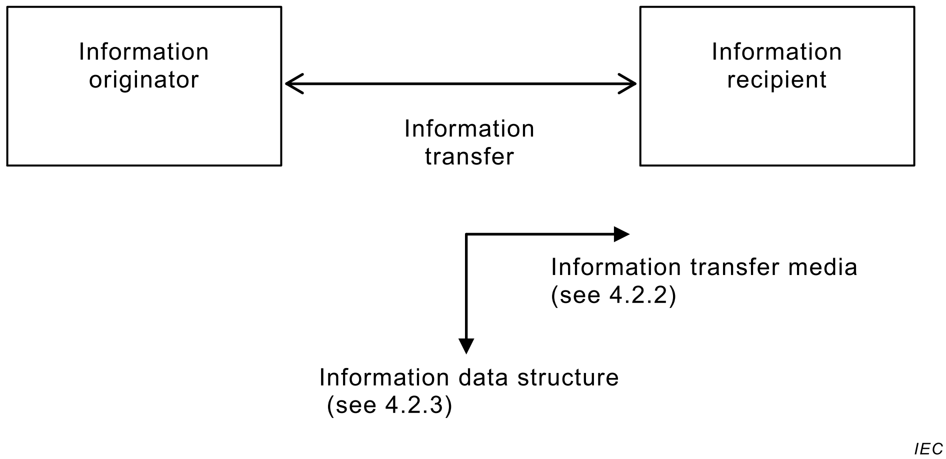

Figure 2 – Model of physical and logical connectivity

4.2.2 Information transfer media

4.2.2.1 Intersystem model

The physical media for information transfer between systems are classified into:

- Broadcasting media

  Broadcasting media support simultaneous information transfer to a number of recipients. Examples of the wireless broadcasting media are BS, CS and terrestrial.

- Intercommunication media

  Intercommunication media support information transfer between two or more systems at a time. Examples of intercommunication media are Internet, WAN, LAN and any area network.

- Interchangeable storage media

  Interchangeable storage media (ISM), e.g., optical disks facilitate data transfer by allowing the physical movement of the ISM from system to system. Large amounts of data transfer can inexpensively and quickly be realised by using interchangeable storage media. Flash memory, hard disk drive are classified as ISM.

They associate open systems as described in Figure 3.

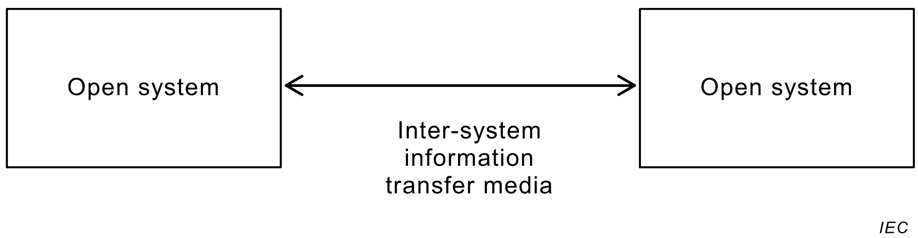

Figure 3 – Intersystem model

4.2.2.2 Inter-device (intra-system) model

Mechanisms for information interchange between devices or subsystems within a larger system are referred to as interfaces. Examples of the interfaces are:

- computer and peripheral interface such as USB and Wi-Fi direct;
- monitor display interface such as DVI, DisplayPort, HDMI;
- consumer equipment interface employed, for instance, IR, Wi-Fi, Bluetooth[1], and NFC.

Devices or subsystems interact as shown in Figure 4.

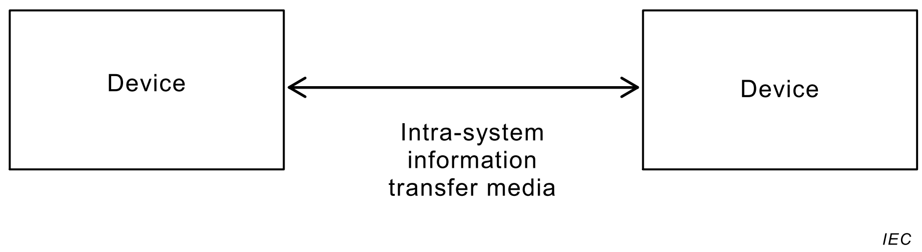

Figure 4 – Inter-device (intra-system) model

4.2.2.3 Boundary model

Some information transfer media can be used both between systems and between devices/subsystems. Examples are:

- IR communication;
- LAN/WAN;
- Internet.

4.2.3 Transferred data structure

4.2.3.1 Data structure in intersystem/intercommunication media

Transferred data structures employed in intersystem/intercommunication environment may be represented by the OSI layered model which was standardized by ISO/IEC 7498-1. The data structure consists of seven layered protocols, semantic and syntactic behaviors of which are defined and treated in corresponding peer-to-peer entities within communicating open systems.

The top layer entities for application protocols provide services to their application itself within an open system. Application data which are outside the scope of the OSI model can be considered from the following points of view:

- Content

  A major feature of multimedia systems is that multiple types of content data are supported by the systems.
- Structure

  Multiple types of content data are integrated into a structure which is appropriate for the application. An instance of multimedia data structure modelling is shown in 5.1.

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[1] Bluetooth is the trade name of Bluetooth SIG.

This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

- Creation

  The structured application data are sometimes created step by step. The data from each step can be transferred between corresponding applications. Instances of modelling of multimedia data creation are shown in 5.2.

Figure 5 shows the data structure in intersystem/intercommunication media.

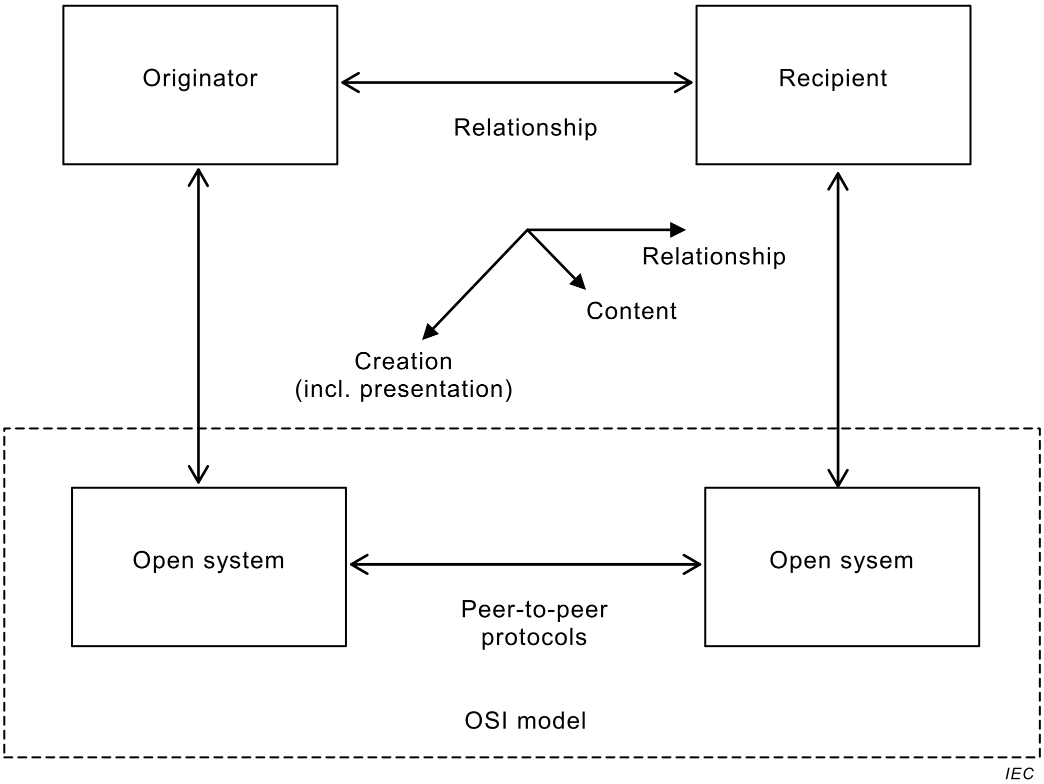

Figure 5 – Data structure in intersystem/intercommunication media

4.2.3.2 Data structure in intersystem/interchangeable storage media

Transferred data structure employed in an intersystem/interchangeable storage media (ISM) environment can be represented similarly to the data in intersystem/intercommunication. ISM are physically moved between systems to transfer the data on the storage media. To allow open data transfer, the data formats and profiles on the media should be standardized as relationships between systems. Logical structures such as volume and file are defined on physical structures such as track and sector to configure a layered structure.

Application data on file structure should be treated in the same manner as those on intersystem/telecommunication media, see Figure 6.

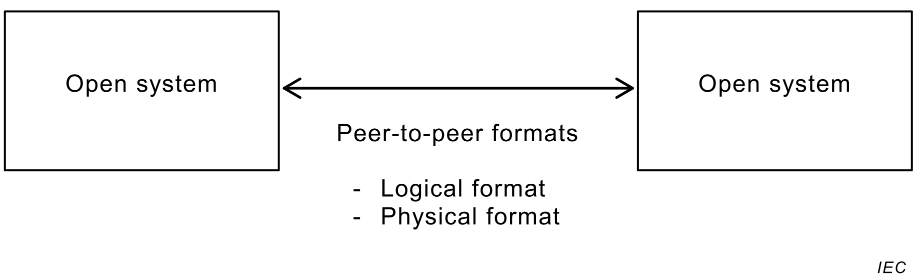

Figure 6 – Data structure in intersystem/interchangeable storage media

Some detailed discussions of data structure modeling for open system interconnection with media are shown in 5.6.

4.2.3.3 Data structure in inter-device model

Data structure in inter-device model is also modeled in a layered manner. As far as a display monitor interface is concerned, for example, the type and dimensions of the connector and cable should be considered in its physical layer.

4.3 Easy operation

Multimedia user-system interfaces are described as a relationship between a multimedia system and an operator. Under this relationship, a system can provide information and services to an operator and vice versa.

The relationship can be implemented with several information types corresponding to sensing organs, such as:

- visual;
- auditory;
- tactile;
- olfactory;
- acceleration-sensing.

The information and services between system and operator can be classified into several layers:

- semantics/ontology;
- state/learning;
- primitive action/gesture.

Considering those aspects of multimedia user-system interfaces, they can be described by the generic model in Figure 7.

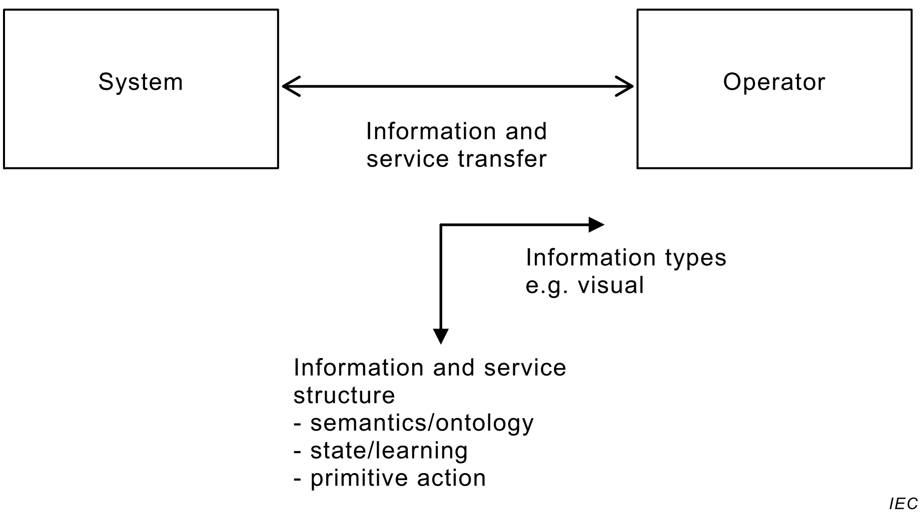

Figure 7 – Generic model for user-system interfaces

4.4 Security

All aspects of security can be treated as protection against some interrupts intervening between originator and recipient, and some intrudes to information originator and information recipient in the generic model.

Interrupt and intrude exist to both physical and logical/cyber aspects of a system and pieces of equipment.

Due to the protection,

- confidentiality,
- integrity, and
- availability

are satisfied in the information transfer between them.

Security mechanisms, e.g., encryption, authentication, access control, should be considered from the point of view of both the media and data structure of the information transfer.

Figure 8 suggests a generic model for security.

NOTE IEC 62045-1 describes the physical aspects of an interrupt and intrude to system and equipment, and guidance for protection. The IEC 62443 series specifies a secure method against cyber attack through the network.

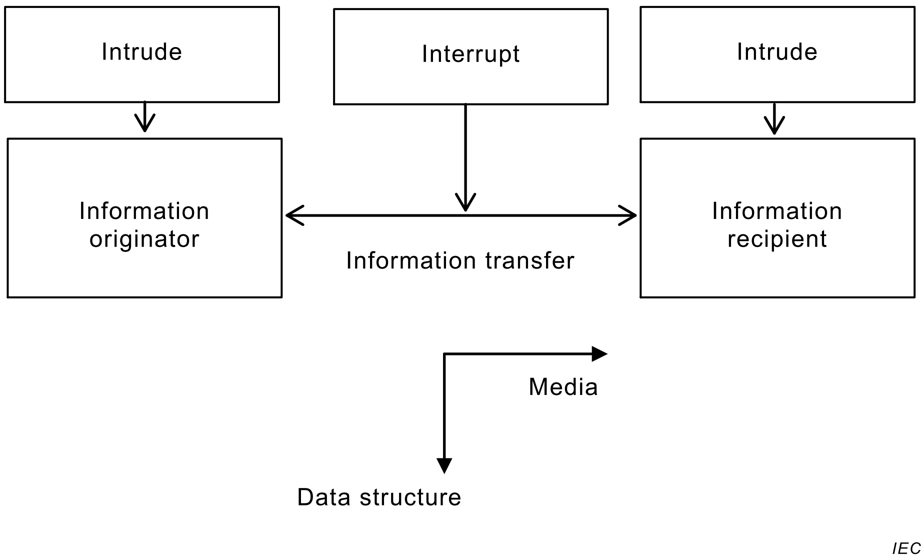

Figure 8 – Generic model for security

5 Specific models

5.1 General

Parts of the generic model discussed in Clause 4 can be described from different points of view to configure different specific models. In this clause, typical specific models are shown to clarify the technology to be standardized.

5.2 Multimedia data

Modeling of the application data structure described in 4.2.3.1 and 4.2.3.2 is discussed in detail.

Multimedia data, content and service structure and format consists of a number of information containers which include several types of content. In addition, multimedia information may include hyperlinks for flexible access to specified objects. These structures are described by structure models.

An example of a structure model is the Dexter model, which consists of three layers, run-time layer, storage layer and within-component layer. The model is shown in Figure 9. Each layer is interfaced with presentation specifications and anchoring.

The within-component layer is the content and its structure. A component means an abstraction of an entity, which is called a node in some hypertext networks. The component is treated as a generic container of contents. Some content types could be character stream, geometric graphics, raster graphics, animation, etc.

The anchoring is a link or URL to the within-component.

The storage layer specifies a structure of components and links associated with each other.

The presentation specifications define how to present components in the storage layer.

The runtime layer is the presentation and user interface.

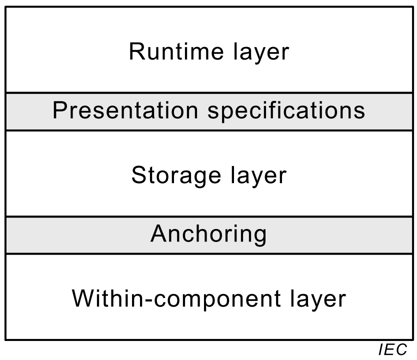

Figure 9 – Dexter model

5.3 Data creation

A modeling of application data creation in 4.2.3.1 and 4.2.3.2 is discussed in detail.

A data creation model describes the creation processes of multimedia/hypermedia data. A data interchange of each processing step is required and therefore standardization has to be performed for the data structure and format employed in each step.

5.4 Equipment structure

The logical and physical structures of multimedia systems or equipment are described using system models, as described in Figure 9 and Figure 10.

Multimedia systems and equipment contain functional blocks and interchange multimedia data through a communication system or an ISM (interchangeable storage medium) distribution system, as shown in Figure 13. They have interfaces which may be subjects for standardisation.

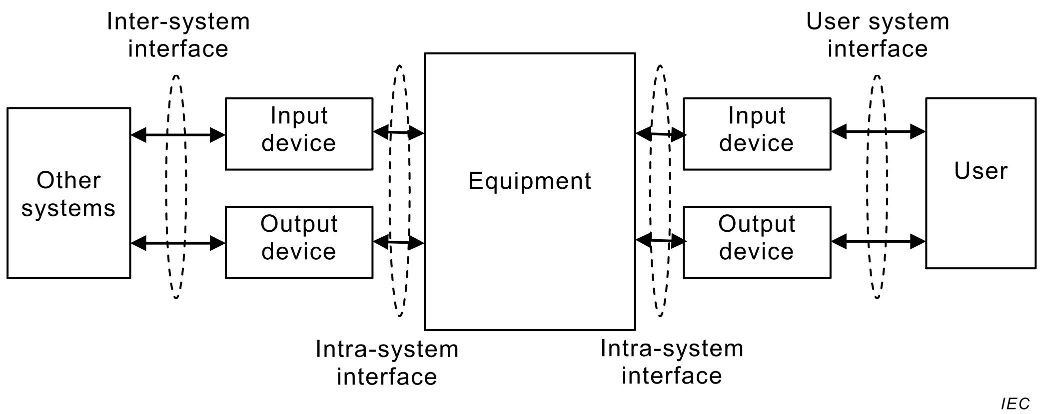

Figure 10 – Systems and equipment model

5.5 User interface

Multimedia systems can provide us with complicated information in easily perceptible forms for our sensing/recognition capabilities, and can possibly be treated with desirable operability. Users of multimedia systems, therefore, expect sophisticated user interfaces and expect them to be easy to use.

User interfaces should be modeled by hierarchical subsystems which include a physical sensing layer up to a logical semantic recognition layer. A user interface has its appropriate system under environments for user and equipment.

5.6 Distribution and management

A multimedia digitized environment has emphasized requirements for appropriate management of data distribution, since the technology makes it possible to

- duplicate the data as it is,
- modify the data to create alternatives,
- account actual use of proprietary data.

The data distribution model should clarify that

- multimedia data in every step of data creation can be interchanged,
- the data or portion of the data should be uniquely identified, and
- interchanged data should be an object for appropriate charging.

Those requirements should be supported by secure technology which consists of

- authentication,
- signature,
- encryption,
- forensic.

5.7 Open system interconnection with media

5.7.1 Specific layers

The general structure of the layered architecture of open system interconnection with media provides architectural concepts, from which the model for information interchange by media has been derived, making specific choices for the layers and their contents, as shown in Figure 11.

The model contains seven layers:

- application layer (layer 7);
- presentation layer (layer 6);
- file layer (layer 5);
- volume layer (layer 4);
- logical storage layer (layer 3);
- physical storage layer (layer 2);
- physical layer (layer 1).

These layers are illustrated in Figure 11.

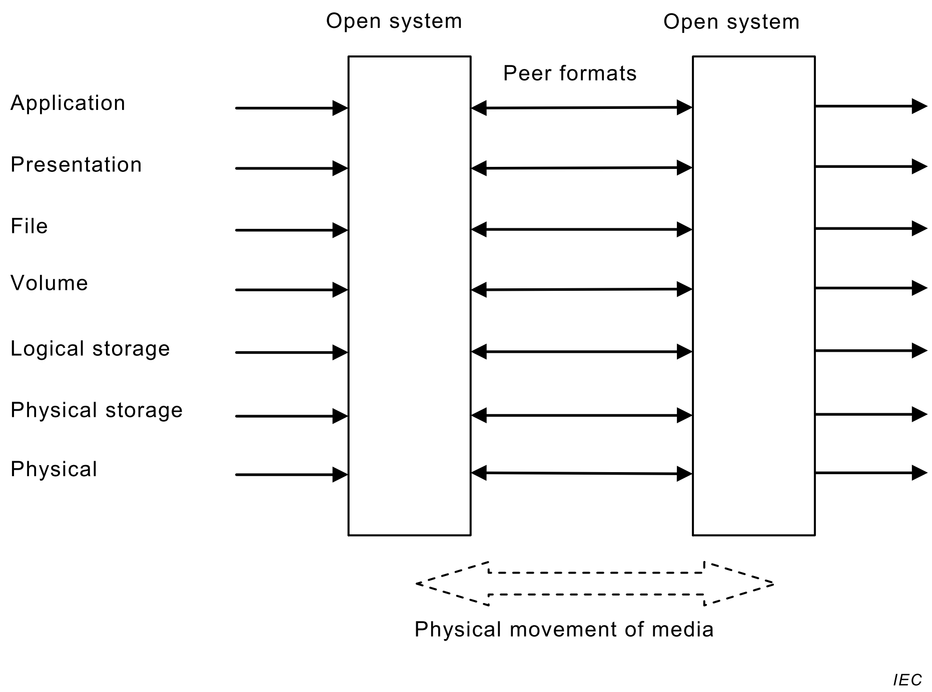

Figure 11 – Seven layer reference model and peer formats

The highest is the application layer and consists of the application-entities that cooperate in the information interchange between open systems. The lower layers provide the services through which the application-entities co-operate.

Layers 1 to 6, together with media, provide a step-by-step enhancement of information interchange services. The boundary between two layers identifies a stage in this enhancement of services at which a service standard is defined, while the functioning of the layers is governed by format standards.

NOTE In most of the existing standards for information interchange by media, services have been specified as requirements for systems.

Not all open systems provide the initial source or final destination of information. When a certain type of media is not distributed among all open systems directly, some open systems act only as open systems for medium conversion, passing upper-layer data to other open systems. The functions and formats which support the forwarding of data are then provided in the lower-layers. This is illustrated in Figure 12.

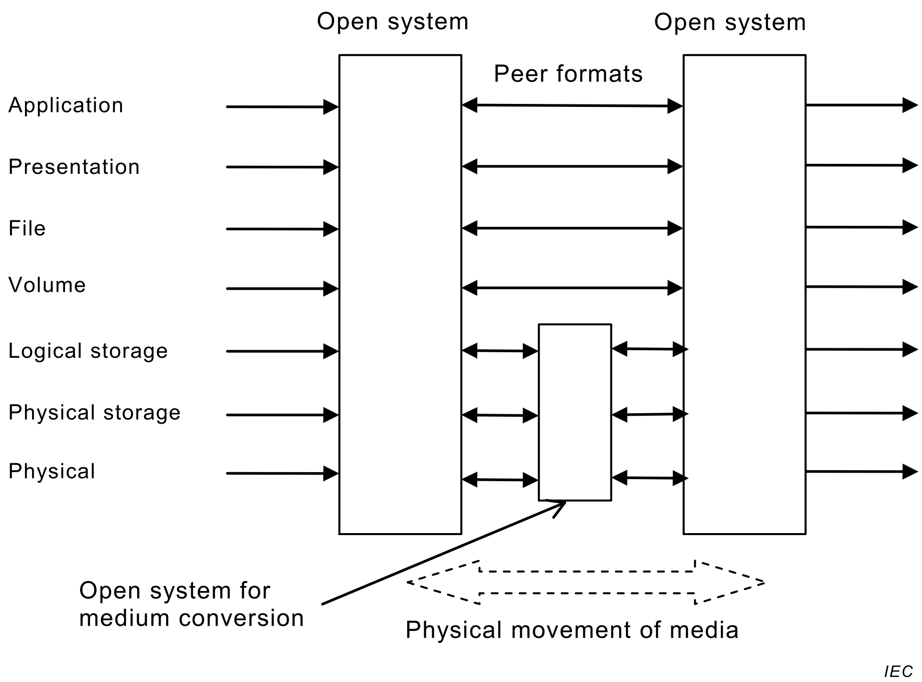

Figure 12 – Information interchange involving open systems for medium conversion

5.7.2 Application layer

The application layer contains all functions which imply information interchange between open systems and are not already performed by the lower layers. These include functions performed by programs as well as functions performed by human beings.

In particular, application-entities maintain, as part of the pre-knowledge necessary for information interchange, (or have access to, via use of a directory facility) information on the use of activity by the peer entities with which they may need to cooperate.

An application-entity can be structured internally into application-layer objects representing groups of functions. Use of one grouping of functions may depend on use of some other functions, and the active functions may vary during the lifetime of the application association.

5.7.3 Presentation layer

The presentation layer performs the following functions to help accomplish the presentation services:

- representation of the abstract syntax chosen by the application-entities in the transfer syntax including format and special purpose transformations (for example, data compression);
- restoration of previous syntaxes on the occurrence of certain events;
- use of file services.

Application-entities agree on the abstract syntaxes to be used for their information interchange. It is necessary that these abstract syntaxes are represented in appropriate transfer syntaxes for communication to take place.

Within a real open system, data defined in terms of an abstract syntax is represented within the local system environment by a local concrete syntax. A transformation may be necessary between the local concrete syntax and the transfer syntax. Thus, in information interchange between real open systems there are three concrete syntax versions of the data: the concrete syntax used by the originating application-entity, the concrete syntax used by the receiving application-entity, and the concrete syntax used between the presentation-entities (the transfer syntax). It is clearly possible that any or all these syntaxes are identical. The local concrete syntaxes are not visible within the open system environment.

The fact that there is or is no actual transformation of concrete syntax has no impact on the presentation-format. There is not a single predetermined transfer syntax.

5.7.4 File layer

The file layer has the following functions:

- area management in the logical volume space;

  The file entity manages unallocated area in the logical volume space provided by volume services.
- read and write of records in a file;

  The file entity reads/writes records in a file. It controls user data by the information of RCW (record control word).
- processing for initialisation;

  The file entity requests the volume layer to provide the logical volume space, where files are configured.

5.7.5 Logical storage layer

The logical storage layer has the following functions:

- logical to physical sector mapping;

  This function maps the logical sector number to the physical sector location where the data contents are actually to be recorded. Contiguous logical sector numbers do not necessarily mean contiguous physical location, they may be mapped to separated physical sectors because of sparing of a defective physical sector.
- physical sector identification/addressing;

  This function identifies the physical sector by its sector ID which is provided by the physical storage layer.
- defect management/sector sparing;

  These functions enable the write/read data integrity services of this layer.
- certification of the sectors;

  This function is utilised when the logical storage layer provides certified sectors to the volume layer in the initial preparation.

5.7.6 Physical storage layer

The physical storage layer has the following functions:

- data encoding / decoding for recording/reading;

  This function encodes the user data to the modulated bits appropriate for each ISM when recording, and decodes it back to the user data when reading. Physical recording/reading is the function of the physical service data unit of physical layer.
- data synchronisation;

  This function adds the data synchronisation marks to the user data when writing, and utilises it for data synchronisation when reading.

5.7.7 Physical layer

The physical layer has the following functions:

- mechanical identification of a volume;

  The physical dimensions and the shape of the storage medium cartridge of a volume are identified by this function.

- recording method identification of a medium;

  This function identifies the recording method for the medium such as:

  – mechanical (punched hole);

  – magnetic;

  – optical (reflectivity change);

  – magneto-optical; and

  – phase change (amorphous/crystal).

- recording/reading of physical service data unit;

  The physical service data units are recorded on or read from the medium according to the identified medium type and recording method.

- write/read circuit management;

  This function deals with the electrical signal of the storage head circuit for recording and reading.

- write/read head positioning control;

  This function deals with storage head seeking to the specified physical location of the medium.

5.8 Application specific modeling

More detailed position and classification of multimedia technology should be considered by using the corresponding application specific modeling.

5.9 TC 100 frameworks

5.9.1 TC 100 model

5.9.1.1 General

TC 100 title and scope is as follows.

- Title: Audio, video and multimedia equipment and systems
- Scope: To prepare international standards in the field of audio, video and multimedia systems and equipment. These standards mainly include specification of the performance, methods of measurement for consumer and professional equipment and their application in systems and their interoperability with other systems or equipment.

  NOTE Multimedia is the integration of any form of audio, video, graphics, data and telecommunication and integration includes the production, storage, processing, transmission, display and reproduction of such information.

TC 100 systems and equipment model from the viewpoint of data usage is described in Figure 13. Data is provided or communicated to equipment and systems with media and network, the equipment and systems are categorized into domains of application such as home, car, mobile and others, for instance wearable, health and robotics.

The functionality of the TC 100 model is realized by physical method and cyber method. The TC 100 cyber model functionality exists in such as computer, network and cloud. It means that physical functionality is a realized cyber method.

Each functionality is a standardization item for specification, format, assessment and measurement method.

The TC 100 model and user communication is described in Figure 14. The communication with a human user implies social factors, the communication and factors are standardisation items for specification, format, assessment and measurement method.

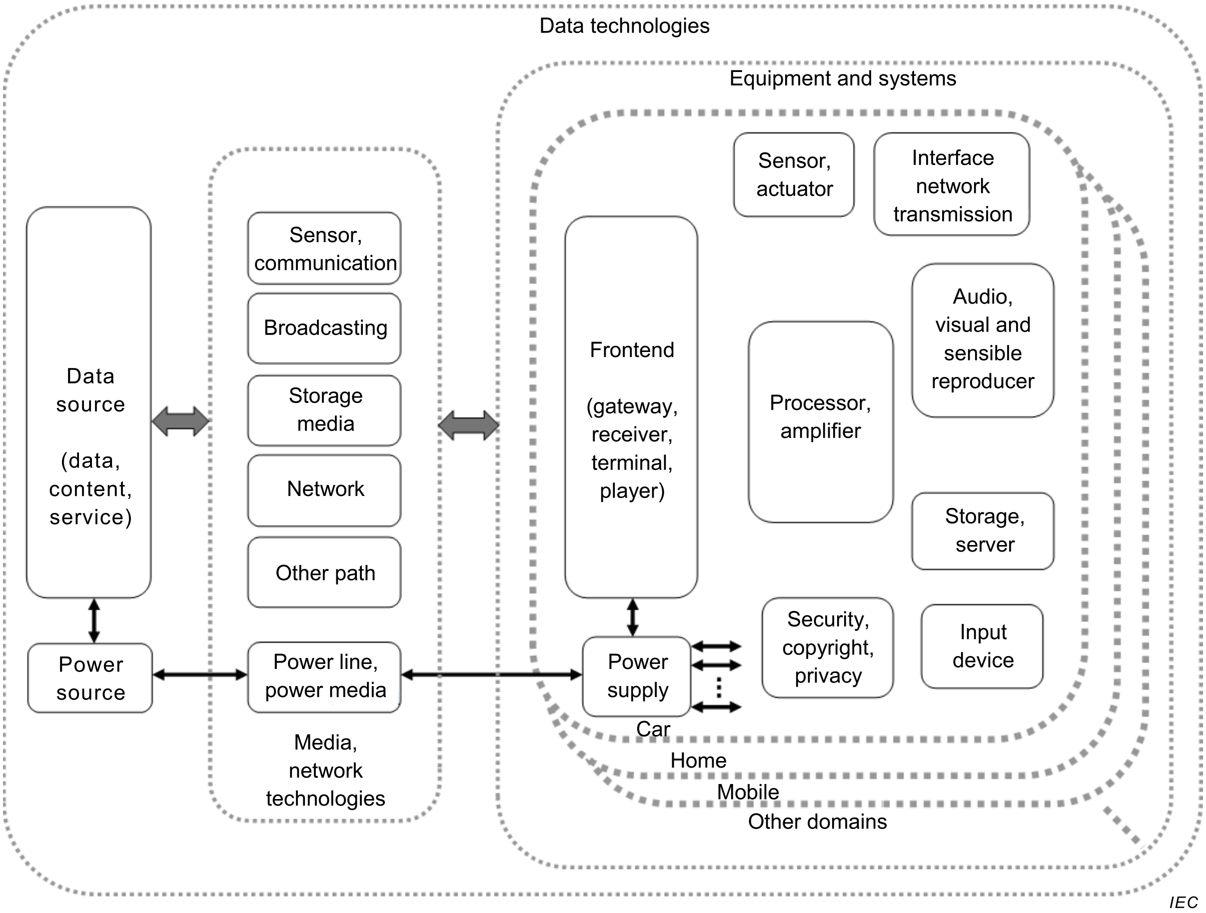

Figure 13 – TC 100 model

5.9.1.2 Equipment and systems

Equipment and systems consist of the functional elements, the functionality is utilisation of the data of the data source, communication with the data source, and reproduction or presentation of the data to user and communication with user. Figure 13 shows the equipment and systems with their elements such as frontend, storage, processor, sensor, network and others. These are basic elements under the scope of TC 100, and any other and new functional elements under the scope of TC 100 can be added. The basic elements are

- frontend: a data receptor functionality,
- processor, amplifier: a data processing and amplification functionality,
- audio, visual and sensible reproducer: a function of data presentation to user,
- storage, server: a data storage and deliver functionality,
- input device: control and data input functionality,
- sensor, actuator: sense and movement functionality to the equipment and systems, and provides user interface elements,
- interface, network, transmission: connection and control functionality inside and outside of the equipment and systems,
- security, copyright, privacy: guarantee functionality of these,
- power supply: power functionality and possibly a path to the data source.

Equipment and systems are categorized into domains. Each domain has its own nature which dominates standardisation items. In a domain, all generic models and specific models are applicable and the standardisation items include all of these aspects from the generic and specific models.

The communication with a user is also a functionality, as described in 5.9.2.

5.9.1.3 Media and network technologies

This is a media or network to provide or communicate data and power to equipment and systems. Media and network technologies are basically out of the scope of TC 100. However, the border area and the portion that affects the TC 100 scope are standardisation items of TC 100.

Figure 13 shows the media and network technologies with their elements such as sensor, broadcasting, storage media, network and others. These are basic elements, and any other and new functional elements can be added. The basic elements are

- sensor, communication: sensing or communicating of data such as RFID, NFC,
- broadcasting: with radio wave and network,
- storage media: physical and cyber storage media,
- network: any area networks and network items of sensor and communication,
- power line, power media: providing power, it can be a path to the data source.

All of their data structure and data control within the scope of TC 100 are standardisation items.

5.9.1.4 Data technologies

Data technologies cover all of the TC 100 model. The data of the data source is provided or communicated to the equipment and systems with media and network technologies. The data technologies such as format, protocol, semantics, ontology, communication and data creation are under the scope of TC 100 and these are standardization items. However, the data technologies under the media and network technologies and the data source may include the standardisation items which are out of scope of TC 100.

5.9.2 TC 100 model and user communication

The communication between the TC 100 model and the user is described in Figure 14. The fundamental communication consists of reproduction of data, use of data and power usage, and control and user interface. This communication affects the individual user, and therefore factors such as accessibility, security of social aspects, quality, identification, and so on, play an important role. These types of communication and the cited factors are standardization items.

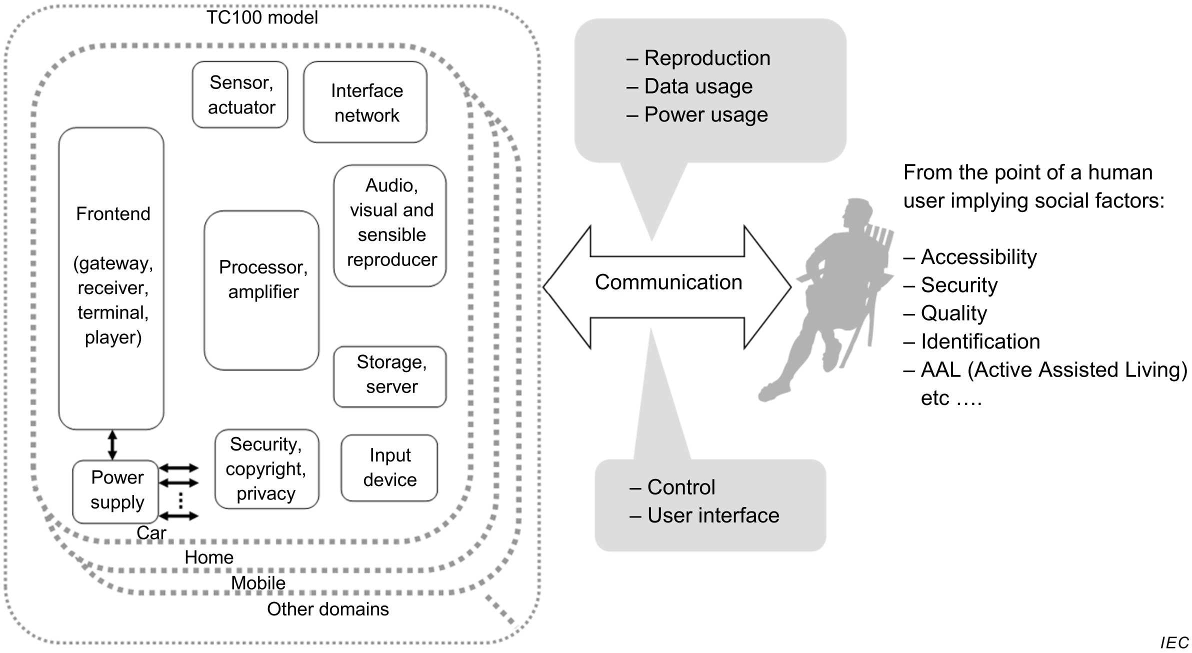

Figure 14 – TC 100 model and user communication

The sensor and actuator add another communication with the user. The sensor recognises user status and the actuator affects the user physically.

In case that the user is not a human being, but, for instance, another TC 100 model, the communication is carried out between the different TC 100 models. In this case, the user is not a human being, however social aspects may still play a role in that TC 100 model.

5.9.3 Networked TC 100 model

Each TC 100 model can be connected via a network with one another, and also to Internet and other network services, as described in Figure 15.

The TC 100 model connects networks physically by means of a gateway and router, and logically by means of protocols of connection, data and control. These items of connection are standardization items.

The cyber TC 100 model can exist in cyber domains such as computers, networks and clouds.

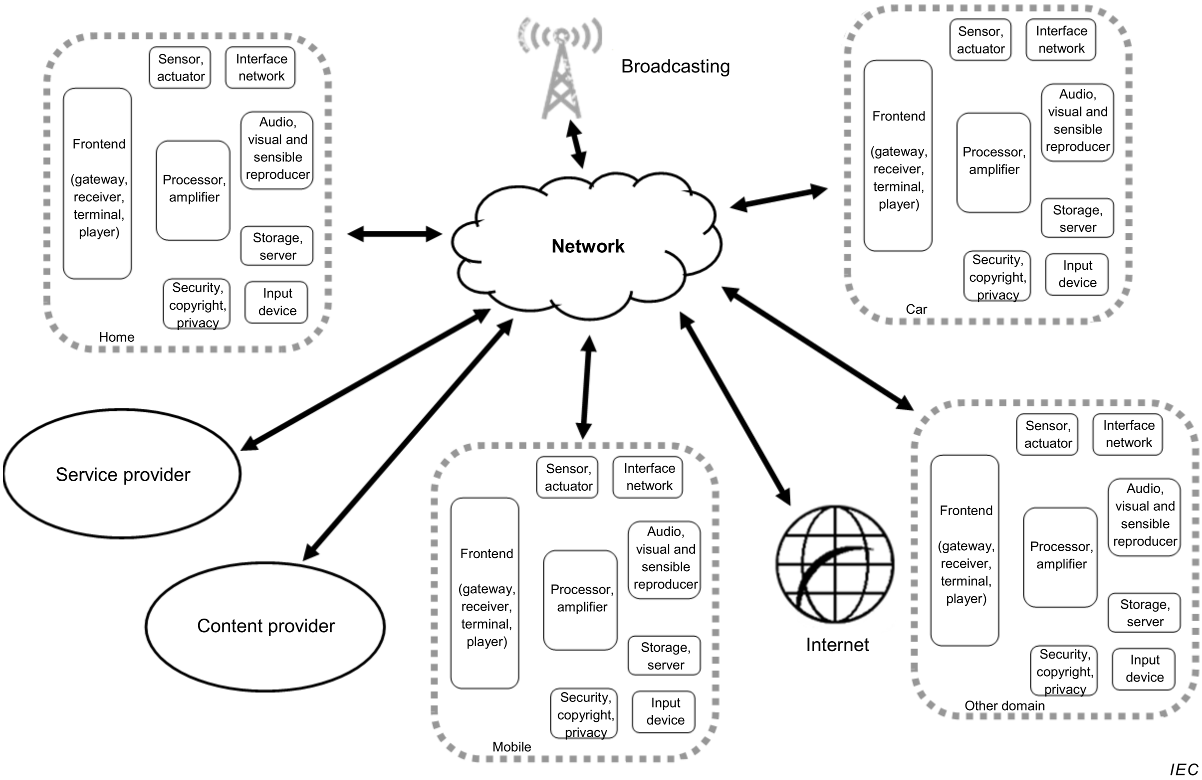

Figure 15 – Networked TC 100 models

5.9.4 Environmental aspect of the TC 100 model

The users of the TC 100 model are human beings, animals and not human beings. This TC 100 model and the user environment influence each other.

With respect to the environment the following factors influence the TC 100 model.

- User environment is from cyber to physical space, at the same time, place or domain is from micro to macro, such as personal space, home, office, shop, town, city, country, earth, and universe. Also, time is from beginning to end, i.e. from infants to old for human beings as users, and the time scale is second, minutes, hour, day, week, month, year for user.
- System environment is from cyber to physical space, at the same time, place or domain is from micro to macro, such as ‘in and around user’, home, office, shop, town, city, country, earth, and universe. Also, time is from beginning to end, i.e. life cycle of products, and the time scale is second, minutes, hour, day, week, month, year for equipment and systems.
- Other physical environmental factors for the user and the TC 100 system are any characteristics such as temperature, pressure, geographical characteristics, and so on.

With respect to the TC 100 model the following factors influence the environment.

- Environmental aspects and influences impact the physical and social world. The former are aspects such as e-waste, energy consumption and the latter are aspects such as privacy, security, copyright and safety.

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