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Part 6: Information representation

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Partie 6: Représentation des informations

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 16500 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 16500-6 was prepared by DAVIC (Digital Audio-Visual Council) and was adopted, under the PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

ISO/IEC 16500 consists of the following parts, under the general title *Information technology — Generic digital audio-visual systems*:

— *Part 1: System reference models and scenarios*

— *Part 2: System dynamics, scenarios and protocol requirements*

— *Part 3: Contours: Technology domain*

— *Part 4: Lower-layer protocols and physical interfaces*

— *Part 5: High and mid-layer protocols*

— *Part 6: Information representation*

— *Part 7: Basic security tools*

— *Part 8: Management architecture and protocols*

— *Part 9: Usage information protocols*

Annexes A to G form a normative part of this part of ISO/IEC 16500. Annexes H to P are for information only.

Introduction

ISO/IEC 16500 defines the minimum tools and dynamic behavior required by digital audio-visual systems for end-to-end interoperability across countries, applications and services. To achieve this interoperability, it defines the technologies and information flows to be used within and between the major components of generic digital audio-visual systems. Interoperability between these components and between individual sub-systems is assured through specification of tools and specification of dynamic systems behavior at defined reference points. A reference point can comprise one or more logical (non-physical) information-transfer interfaces, and one or more physical signal-transfer interfaces. A logical interface is defined by a set of information flows and associated protocol stacks. A physical interface is an external interface and is fully defined by its physical and electrical characteristics. Accessible reference points are used to determine and demonstrate compliance of a digital audio-visual subsystem with this international standard.

A summary of each part follows.

ISO/IEC 16500-1 (DAVIC 1.3.1a Part 2) defines the normative digital audio-visual systems technical framework. It provides a vocabulary and a Systems Reference Model, which identifies specific functional blocks and information flows, interfaces and reference points.

ISO/IEC 16500-2 (DAVIC 1.3.1a Part 12) defines system dynamic behavior and physical scenarios. It details the locations of the control functional entities along with the normative protocols needed to support the systems behavior. It is structured as a set of protocol walk-throughs, or "*Application Notes*", that rehearse both the steady state and dynamic operation of the system at relevant reference points using specified protocols. Detailed dynamics are given for the following scenarios: video on demand, switched video broadcast, interactive broadcast, and internet access.

ISO/IEC 16500-3 (DAVIC 1.3.1a Part 14) provides the normative definition of DAVIC Technology Contours. These are strict sets of Applications, Functionalities and Technologies which allow compliance and conformance criteria to be easily specified and assessed. This part of ISO/IEC 16500 contains the full details of two contours. These are the Enhanced Digital Broadcast (EDB) and Interactive Digital Broadcast (IDB). ISO/IEC 16500-3 specifies required technologies and is a mandatory compliance document for contour implementations.

ISO/IEC 16500-4 (DAVIC 1.3.1a Part 8) defines the toolbox of technologies used for lower layer protocols and physical interfaces. The tools specified are those required to digitize signals and information in the Core Network and in the Access Network. Each tool is applicable at one or more of the reference points specified within the Delivery System. In addition a detailed specification is provided of the physical interfaces between the Network Interface Unit and the Set Top Unit and of the physical interfaces used to connect Set Top Boxes to various peripheral devices (digital video recorder, PC, printer). The physical Delivery System mechanisms included are copper pairs, coaxial cable, fiber, HFC, MMDS, LMDS, satellite and terrestrial broadcasting.

ISO/IEC 16500-5 (DAVIC 1.3.1a Part 7) defines the technologies used for high and mid-layer protocols for ISO/IEC 16500 digital audio-visual systems. In particular, this part defines the specific protocol stacks and requirements on protocols at specific interfaces for the content, control and management information flows.

ISO/IEC 16500-6 (DAVIC 1.3.1a Part 9) defines what the user will eventually see and hear and with what quality. It specifies the way in which monomedia and multimedia information types are coded and exchanged. This includes the definition of a virtual machine and a set of APIs to support interoperable exchange of program code. Interoperability of applications is achieved, without specifying the internal design of a set top unit, by a normative Reference Decoder Model which defines specific memory and behavior constraints for content decoding. Separate profiles are defined for different sets of multimedia components.

ISO/IEC 16500-7 (DAVIC 1.3.1a Part 10) defines the interfaces and the security tools required for an ISO/IEC 16500 system implementing security profiles. These tools include security protocols which operate across one or both of the defined conditional access interfaces CA0 and CA1. The interface CA0 is to all security and conditional access functions, including the high speed descrambling functions. The interface CA1 is to a tamper resistant device used for low speed cryptographic processing. This cryptographic processing function is implemented in a smart card.

ISO/IEC 16500-8 (DAVIC 1.3.1a Part 6) specifies the information model used for managing ISO/IEC 16500 systems. In particular, this part defines the managed object classes and their associated characteristics for managing the access network and service-related data in the Delivery System. Where these definitions are taken from existing standards, full reference to the required standards is provided. Otherwise a full description is integrated in the text of this part. Usage-related information model is defined in ISO/IEC 16500-9.

ISO/IEC 16500-9 (DAVIC 1.3.1a Part 11) specifies the interface requirements and defines the formats for the collection of usage data used for billing, and other business-related operations such as customer profile maintenance. It also specifies the protocols for the transfer of Usage Information into and out of the ISO/IEC 16500 digital audio-visual system. In summary, flows of audio, video and audio-visual works are monitored at defined usage data collection elements (e.g., servers, elements of the Delivery System, set-top boxes). Information concerning these flows is then collected, processed and passed to external systems such as billing or a rights administration society via a standardised usage data transfer interface.

Additional Information

ISO/IEC TR 16501 is an accompanying Technical Report. Further architectural and conformance information is provided in other non-normative parts of DAVIC 1.3.1a (1999). A summary of these documents is included here for information.

ISO/IEC TR 16501 (DAVIC 1.3.1a Part 1) provides a detailed listing of the functionalities required by users and providers of digital audio-visual applications and systems. It introduces the concept of a contour and defines the IDB (Interactive Digital Broadcast) and EDB (Enhanced Digital Broadcast) functionality requirements which are used to define the normative contour technology toolsets provided in ISO/IEC 16500-3.

DAVIC 1.3.1a Parts 3, 4 and 5 are DAVIC technical reports. They provide additional architectural and other information for the server, the delivery-system, and the Service Consumer systems respectively. Part 3 defines how to load an application, once created, onto a server and gives information and guidance on the protocols transmitted from the set-top user to the server, and those used to control the set-up and execution of a selected application. Part 4 provides an overview of Delivery Systems and describes instances of specific DAVIC networked service architectures. These include physical and wireless networks. Non-networked delivery (e.g., local storage physical media like discs, tapes and CD-ROMs) are not specified. Part 5 provides a Service Consumer systems architecture and a description of the DAVIC Set Top reference points defined elsewhere in the normative parts of the specification.

DAVIC 1.3.1a Part 13 is a DAVIC technical report, which provides guidelines on how to validate the systems, technology tools and protocols through conformance and / or interoperability testing.

Information technology — Generic digital audio-visual systems — Part 6: Information representation

1. Scope

This part of ISO/IEC 16500 takes a practical approach to the specification of Information Representation. Just the information types that cannot be dispensed with in producing the set of DAVIC applications (viz. broadcast, movies on demand, home shopping, etc.) are specified. The approach taken in this part of ISO/IEC 16500 starts by defining the various monomedia information types. They include character, text, fonts, service information, audio, video, and graphics. Consistent with DAVIC principles, one tool is selected for the encoding of each information type. Multimedia components comprise one or more monomedia components. This part of ISO/IEC 16500 defines the way in which multimedia information is coded and exchanged. This includes the definition of a virtual machine and a set of APIs to support interoperable exchange of program code. Finally, this part of ISO/IEC 16500 defines a Reference Decoder Model for contents decoding which provides constraints on content. The major problem addressed by the model is to ensure interoperability of applications by specifying memory and behaviour constraints for contents decoding by a hypothetical STU, without specifying the internal design of an STU. An application built according to the reference decoder model will be an "ISO/IEC 16500 conforming application" and will successfully execute on a STU that is compliant to ISO/IEC 16500.

For each monomedia and multimedia component the coding format is specified, as well as applicable constraints for coding of the components. Three types of monomedia components are distinguished. Monomedia components which are included within other monomedia components, such as characters within text, are of type implied. Non-implied monomedia components that do not require synchronization with a time base at play back, are of type stand-alone. Finally, non-implied monomedia components of which the presentation may require synchronization with a time base are of type stream. This part of ISO/IEC 16500 defines which type each DAVIC defined monomedia component may take, and specifies that the coded representation of monomedia components of type stream are packetized in PES packets (for definition of PES packets refer to ISO/IEC 13818-1). PES packets permit (1) to include time stamps to support mutual synchronisation of multiple monomedia components in reference to a common time base and (2) to define timing and buffer behaviour in a common reference model for contents decoding. While there are various ways to deliver the monomedia and multimedia components to the STU, This part of ISO/IEC 16500 defines how the components are carried in an MPEG-2 Transport Stream.

DAVIC specifies a number of different profiles. In a specific profile there may be support of a subset of the monomedia components. Each STU that complies to a specific profile of DAVIC shall be capable of decoding and presenting each monomedia and multimedia component permitted within that profile.

This part of ISO/IEC 16500 also specifies methods for packaging of contents and metadata. The way in which content is packaged for delivery is independent of the way in which content data is delivered to the SPS (it may be delivered to a Service Provider either on physical media or over a transmission system). All programming content is represented in the DAVIC system as multimedia components. Multimedia components comprise one or more monomedia components coupled with the logical relationships between the monomedia components. The multimedia components will be created by content providers for input to the servers.

2. Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 16500. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 16500 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau (TSB) maintains a list of currently valid ITU-T Recommendations.

2.1. ISO, ISO/IEC and ITU Normative References

1. ISO 639, *Codes for the representation of names of languages*.
2. ISO 3166, *Codes for the representation of names of countries.*
3. ISO/IEC 8859-1:1987, *Information technology - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1.*
4. ISO/IEC 10646-1, *Information technology - Universal Multiple-Octet Coded Character Set (UCS) - Part 1: Architecture and Basic Multilingual Plane"* (also known as Unicode).
5. ISO/IEC 11172–2:1993, *Information technology—Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s—Part 2: Video* (Note: known as MPEG-1 Video).
6. ISO/IEC 11172–3:1993, *Information technology—Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s—Part 3: Audio* (Note: known as MPEG-1 Audio).
7. ISO/IEC 13522–5:1997, *Information technology—Coding of multimedia and hypermedia information—Part 5: Support for base-level interactive applications* (Note: known as MHEG-5).
8. ISO/IEC 13522-6, *Information technology - Coding of multimedia and hypermedia information - Part 6: Support for enhanced interactive applications*.
9. ISO/IEC 13818-3:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio* (Note: known as MPEG-2 Audio).
10. ISO/IEC 13818–6, *Information technology—Generic coding of moving pictures and associated audio information—Part 6: Extensions for DSM-CC.*
11. ITU-T (CCITT) Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)* | ISO/IEC 8824: 1990, *Information Technology—Open Systems Interconnection—Specification of Abstract Syntax Notation One (ASN.1).*
12. ITU-T (CCITT) Recommendation X.209 (1988) *Specification of Basic Encoding rules for abstract syntax notation one (ASN.1)* | ISO/IEC 8825: 1990, *Information technology—Open Systems Interconnection—ASN.1 encoding rules—Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*
13. ITU-T Recommendation H.222.0 (1995) | ISO/IEC 13818–1: 1996, *Information technology—Generic coding of moving pictures and associated audio information: Systems* (Note: known as MPEG-2 Systems).

    ISO/IEC 13818-1/Amendment 1: 1997, *Registration procedure for "copyright identifier"*.
    ISO/IEC 13818-1/Amendment 2: 1997, *Registration procedure for "format identifier"*.
    ISO/IEC 13818-1/Amendment 3: 1998, *Private data identifier*.
14. ITU-T Recommendation H.262 | ISO/IEC 13818–2, *Information technology—Generic coding of moving pictures and associated audio information: Video* (Note: known as MPEG-2 Video).

    ISO/IEC 13818–2 /Amendment 1: *Registration procedure for "copyright identifier"*.

2.2. Other Normative References

2.2.1 ATSC (Advanced Television Systems Committee)

1. ATSC A/52: *Digital audio compression standard* (AC-3).
   available at ftp://ftp.atsc.org/pub/Standards/A52.
2. ATSC A/53: *Digital television standard for HDTV transmission*.
   available at ftp://ftp.atsc.org/pub/Standards/A53.

2.2.2 ANSI (American National Standards Institute)

1. ANSI SMPTE 274M-1995, *Television - 1920x1080 Scanning and interface*.
2. ANSI SMPTE 296M-1997, *Television - 1280x720 Scanning, analog and digital representation and analog interface.*

2.2.3 Apple Corporation Inc.

1. *AIFF-C Audio Interchange File Format, version C, allowing for Compression.*
2. *Bento Specification, Revision 1.0d5*, July 15, 1993.

2.2.4 ETSI (European Telecommunications Standards Institute)

1. ETR 162 (October 1995): *Digital broadcasting systems for television, sound and data services: Allocation of Service Information (SI) codes for Digital Broadcasting (DVB) systems.*
2. ETR 211: *Digital broadcasting systems for television, sound, and data services; Guidelines for the usage of Service Information (SI) in Digital Video Broadcasting (DVB) systems.*
3. ETS 300 468 (January 1997*): Specification for Service Information (SI) in DVB Systems Informative Annex C: Conversion Between Time and Date Conventions*.
4. ETS 300 472, *Digital broadcasting systems for television, sound, and data services; Specification for conveying ITU-R System B Teletext in Digital Video Broadcasting (DVB) bitstreams*.
5. ETS 300 743, *Digital Video Broadcasting (DVB), DVB subtitling.*
6. ETS 300 777-2, *Use of Digital Storage Media Command and Control (DSM-CC) for basic multimedia applications.*
7. ETSI DI / MTA-01074, *Multimedia Terminals and Applications, Application Programming Interface (API) for DAVIC Service Information.*

2.2.5 SCTE (Society of Cable Telecommunications Engineers, Inc)

1. SCTE DVS/026 - *Digital Video : Subtitling methods for Broadcast Cable.*

2.2.6 SMPTE (Society of Motion Picture and Television Engineers)

See ANSI (American National Standards Institute)

2.2.7 W3C

1. CSS-1, *Cascading Style Sheets, level 1*; by Håkon Wium Lie and Bert Bos, 17-December-96. available at http://www.w3.org/TR/REC-CSS1-961217.
2. HTML 3.2, *HyperText Mark-up Language reference specification*, by Dave Raggett, 14-Jan-1997. available at http://www.w3.org/TR/REC-html32.html.
3. PNG *Portable Network Graphics version 1*, 01-October-1996. available at http://www.w3.org/TR/REC-png.html.

3. Definitions

This clause defines new terms, and the intended meaning of certain common terms, used in this part of ISO/IEC 16500. Annex A of ISO/IEC 16500-1 defines additional terms and, in some cases, alternative interpretations that are appropriate in other contexts. For convenience, the normative definitions below are included in the annex.

3.1. access control: Provides means to access services and protection against the unauthorized interception of the services.

3.2. anchor: one of two ends of a hyperlink

3.3. application: a set of objects that provides an environment for processing Application Service Layer information flows.

3.4. Application Programming Interface (API): set of inter-layer service request and service response messages, message formats, and the rules for message exchange between hierarchical clients and servers. API messages may be executed locally by the server, or the server may rely on remote resources to provide a response to the client.

3.5. assets: Things that a user sees or hears, e.g., bitmap, audio, text.

3.6. character: an atom of textual information, for example a letter or a digit

3.7. conditional access: A means of allowing system users to access only those services that are authorized to them.

3.8. Content Item: A collection of content items / Content Item Elements that will form a complete application or a complete programme.

3.9. Content Item Element: the smallest (and indivisible) content component.

3.10. Content package: A set of content Item Elements and/or content items for transfer across an A10 interface between Content Provider and Service Provider Systems.

3.11. Content Provider: one who owns or is licensed to sell content.

3.12. Control Word: the secret key used for a scrambling algorithm.

3.13. Delivery System (DS): The portion of the DAVIC System that enables the transfer of information between DS-users.

3.14. element: a component of the hierarchical structure defined by a document type definition; it is identified in a document instance by descriptive markup, usually a start-tag and end-tag.

3.15. end-tag: descriptive markup that identifies the end of an element

3.16. encryption: a mathematical technique used to ensure the confidentiality of security management information.

3.17. Entitlement Control Message (ECM): conditional access messages carrying an encrypted form of the control words or a means to recover the control words, together with access parameters, i.e., an identification of the service and of the conditions required for accessing this service.

3.18. Entitlement Management Message (EMM): conditional access messages used to convey entitlements or keys to users, or to invalidate or delete entitlements or keys.

3.19. key management: The generation, storage, distribution archiving, deletion, revocation, registration, and deregistration of cryptographic keys.

3.20. hyperlink: a relationship between two anchors

3.21. joint stereo: a coding option in MPEG-1 audio that exploits the redundancy between the left and right audio channels

3.22. logical interface: an interface where the semantic, syntactic, and symbolic attributes of information flows is defined. Logical interfaces do not define the physical properties of signals used to represent the information. A logical interface can be an internal or external interface. It is defined by a set of information flows and associated protocol stacks.

3.23. monomedia component: a collection of data representing a single type of audiovisual information.

3.24. monospace format: a presentation format of characters in which each character utilizes a character matrix of the same size, independent of the width and height of the character.

3.25. multimedia component: a collection of data comprising one or more multimedia components

3.26. navigation: the process of reaching a service objective by means of making successive choices; the term may be applied to the selection of a service category, a service provider or an offer within a particular service.

3.27. protocol: set of message formats (semantic, syntactic, and symbolic rules) and the rules for message exchange between peer layer entities (which messages are valid when).

3.28. real-time stream: an MPEG-2 transport stream containing monomedia components of which the timing of the decoding and presentation in an STU is controlled by the characteristics of the stream during the delivery of the stream to the STU.

3.29. rendering: the process in the STU to combine one or more monomedia components such as characters, text, and graphical objects into one presentation on a screen.

3.30. scrambling: The process of making a signal unintelligible at the transmission point in order that it can only be received if an appropriate descrambling system is in place at the point of reception. Scrambling can be applied to audio, video or data signals

3.31. server: any service providing system.

3.32. Service Information (SI): Digital data describing the delivery system, content and scheduling/timing of MPEG-2 Transport Streams. It includes MPEG-2 PSI together with independently defined extensions.

3.33. Service Provider: an entity that provides a service to a client.

3.34. session: an interval during which a logical, mutually agreed correspondence between two objects exists for the transfer of related information. A session defines a relationship between the participating users in a service instance.

3.35. Set Top Box (STB): a module that comprises both Set Top Unit (STU) and Network Interface Unit (NIU) functional elements. The STB may be either “integrated” or “modular”. An integrated STB is designed for connection to a single DAVIC A1 or equivalent interface. A modular STB may be equipped with a DAVIC A0 or equivalent interface to enable connection of a range of NIUs.

3.36. Set Top Unit (STU): a module that contains the “network independent” functionalities of a Set Top Box (STB). The following functionalities are contained in a typical STU:- Processing & Memory Functions; MPEG2 Demux & AV Decoders; Graphics Display; Modulator Output for TV; Peripheral Interfaces.

3.37. start-tag: descriptive markup that identifies the start of an element

3.38. tag: markup that delimits an element

3.39. virtual machine (VM): An abstract specification of a micro-processor and its behaviour

NOTE: A VM may be implemented on different hardware processors. A VM therefore implements the mechanism for all these processors to execute the same instruction set. It is also possible for a micro-processor to be designed so that its instruction set is identical to that of a VM. VM code can be used to make software portable. In the context of DAVIC, the VM is used to extend interoperability by allowing program code produced once to be delivered to and executed on any compliant STU.