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**Information technology — Generic digital  
audio-visual systems —**

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

*Technologies de l'information — Systèmes audiovisuels numériques  
génériques —*

*Partie 5: Protocoles de la couche haute et moyenne*

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Reference number  
ISO/IEC 16500-5:1999(E)



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Printed in Switzerland

| Contents                                              | Page        |
|-------------------------------------------------------|-------------|
| <b>Foreword .....</b>                                 | <b>vii</b>  |
| <b>Introduction .....</b>                             | <b>viii</b> |
| <b>1. Scope .....</b>                                 | <b>1</b>    |
| <b>2. Normative references .....</b>                  | <b>1</b>    |
| <b>3. Definitions.....</b>                            | <b>4</b>    |
| <b>4. Acronyms and abbreviations.....</b>             | <b>7</b>    |
| <b>5. Conventions.....</b>                            | <b>8</b>    |
| <b>6. S1 flow: high and mid layer protocols .....</b> | <b>8</b>    |
| 6.1 S1 flow description.....                          | 8           |
| 6.2 Overview of protocol stacks.....                  | 8           |
| 6.3 Description of specific protocols.....            | 10          |
| 6.3.1 MPEG-2 Packetized Elementary Stream (PES).....  | 10          |
| 6.3.2 MPEG-2 Private Section .....                    | 10          |
| 6.3.3 DSM-CC Private Section .....                    | 10          |
| 6.3.4 MPEG Elementary Streams.....                    | 10          |
| 6.3.5 Real time uncompressed graphics streams .....   | 10          |
| 6.3.6 Real time compressed graphics streams .....     | 10          |
| 6.3.7 Stored monomedia streams .....                  | 10          |
| 6.3.8 Stand-alone monomedia components.....           | 11          |
| 6.3.9 Other data .....                                | 11          |
| 6.3.10 MPEG-2 Program Specific Information.....       | 11          |
| 6.3.11 MPEG-2 Transport Stream (TS) .....             | 11          |
| 6.3.12 ATM Adaptation Layer 5 (AAL5).....             | 14          |
| <b>7. S2 flow: high and mid layer protocols .....</b> | <b>15</b>   |
| 7.1 S2 flow description.....                          | 15          |
| 7.2 Overview of protocol stacks.....                  | 15          |
| 7.2.1 Download control.....                           | 15          |
| 7.2.2 User-User interaction .....                     | 16          |
| 7.3 Description of specific protocols.....            | 17          |
| 7.3.1 DSM-CC option choices summary.....              | 17          |
| 7.3.2 Remote Procedure Call.....                      | 18          |
| 7.3.3 Download .....                                  | 18          |
| 7.3.4 User-User interaction .....                     | 18          |
| 7.3.5 Service Gateway functions.....                  | 19          |
| 7.3.6 Application service functions.....              | 21          |
| 7.3.7 Access control .....                            | 21          |
| 7.3.8 Stream service functions .....                  | 21          |
| 7.3.9 File service functions .....                    | 22          |
| 7.3.10 Data base service functions .....              | 22          |

|            |                                                                                       |           |
|------------|---------------------------------------------------------------------------------------|-----------|
| 7.3.11     | Use of the DSM-CC User-to-User interface in the DAVIC distribution profile.....       | 22        |
| 7.3.12     | Application note: Use of ISO/IEC 16500 for karaoke (high-layer protocol aspects)..... | 22        |
| 7.3.13     | Application note: network congestion control for enhanced broadcast .....             | 23        |
| 7.3.14     | A10 content transfer interface .....                                                  | 24        |
| 7.4        | Distributed Server API.....                                                           | 25        |
| 7.4.1      | Member interface .....                                                                | 25        |
| 7.4.2      | Group interface.....                                                                  | 26        |
| 7.4.3      | Domain Interface.....                                                                 | 27        |
| <b>8.</b>  | <b>S3 flow: high and mid-layer protocols.....</b>                                     | <b>28</b> |
| 8.1        | S3 flow description .....                                                             | 28        |
| 8.2        | Session control .....                                                                 | 28        |
| 8.2.1      | Overview of protocol stacks.....                                                      | 29        |
| 8.2.2      | Description of specific protocols.....                                                | 29        |
| 8.2.3      | DSM-CC U-N resource descriptor usage .....                                            | 34        |
| 8.2.4      | DAVIC-defined resource descriptors.....                                               | 36        |
| 8.2.5      | Operations to cope with rainy day scenarios .....                                     | 36        |
| 8.3        | STU configuration.....                                                                | 37        |
| 8.3.1      | Overview of protocol stacks.....                                                      | 37        |
| 8.3.2      | Description of specific protocols.....                                                | 37        |
| 8.4        | Interface initialization (DIIP).....                                                  | 38        |
| 8.4.1      | Overview of protocol stacks.....                                                      | 38        |
| 8.4.2      | Description of specific protocols.....                                                | 38        |
| 8.4.3      | DIIP transaction state machine .....                                                  | 42        |
| 8.5        | Network state machine .....                                                           | 43        |
| 8.6        | Switched video broadcasting channel change.....                                       | 43        |
| 8.6.1      | Overview of protocol stacks.....                                                      | 44        |
| 8.6.2      | CCP message sequence .....                                                            | 44        |
| 8.6.3      | CCP message structure .....                                                           | 44        |
| 8.6.4      | The usage of ProgramSelect message parameters .....                                   | 46        |
| 8.6.5      | DavicSvbNetworkResourceDescriptor definition .....                                    | 47        |
| 8.7        | Network-initiated channel changing .....                                              | 48        |
| 8.7.1      | Message header .....                                                                  | 48        |
| 8.7.2      | Message body Syntax.....                                                              | 48        |
| 8.7.3      | Parameters .....                                                                      | 49        |
| <b>9.</b>  | <b>S4 flow: high and mid layer protocols .....</b>                                    | <b>49</b> |
| 9.1        | S4 flow description .....                                                             | 49        |
| 9.2        | Overview of protocol stacks.....                                                      | 49        |
| 9.3        | Description of specific protocols .....                                               | 50        |
| 9.3.1      | Call/connection control protocol .....                                                | 50        |
| 9.3.2      | S-AAL protocol.....                                                                   | 56        |
| <b>10.</b> | <b>S5 flow: high and mid layer protocols .....</b>                                    | <b>56</b> |
| 10.1       | S5 flow description .....                                                             | 56        |

|            |                                                                               |           |
|------------|-------------------------------------------------------------------------------|-----------|
| 10.2       | Overview of protocols stacks .....                                            | 57        |
| 10.2.1     | Upper layer protocol stacks for management interface .....                    | 57        |
| 10.2.2     | Lower layer protocol for management interface .....                           | 57        |
| 10.3       | Management information flow .....                                             | 58        |
| 10.4       | Transport layer and network layer protocols .....                             | 59        |
| 10.4.1     | Transport layer protocols .....                                               | 59        |
| 10.4.2     | Network layer protocols .....                                                 | 60        |
| 10.5       | Management Information Bases .....                                            | 60        |
| 10.5.1     | STU MIB .....                                                                 | 60        |
| 10.5.2     | Server MIB .....                                                              | 61        |
| 10.5.3     | Delivery system elements .....                                                | 61        |
| 10.6       | Element capability profiles .....                                             | 61        |
| 10.6.1     | STU Profile .....                                                             | 61        |
| <b>11.</b> | <b>Common protocols .....</b>                                                 | <b>61</b> |
| 11.1       | TCP .....                                                                     | 61        |
| 11.2       | UDP .....                                                                     | 61        |
| 11.3       | IP .....                                                                      | 61        |
| 11.3.1     | IP over ATM .....                                                             | 62        |
| 11.4       | ATM Adaptation Layer Type 5 .....                                             | 62        |
| 11.5       | ATM layer specifications .....                                                | 62        |
| 11.5.1     | Reserved VPI/VCI values for uni-format cells .....                            | 62        |
| 11.5.2     | Reserved VPI/VCI values for NNI-format cells .....                            | 62        |
| 11.5.3     | Reserved VPI/VCI values for intra-network cells .....                         | 62        |
| 11.5.4     | ATM Layer OAM .....                                                           | 64        |
| 11.5.5     | Connection management functions for the non-ATM end-to-end case .....         | 64        |
| <b>12.</b> | <b>Connection Block Descriptors and initialization protocols for A0 .....</b> | <b>64</b> |
| 12.1       | Connection Block Descriptors .....                                            | 64        |
| 12.2       | A0 protocol stacks .....                                                      | 65        |
| 12.2.1     | MPEG-2 TS downstream bus .....                                                | 65        |
| 12.2.2     | Bi-directional cell bus .....                                                 | 66        |
| 12.2.3     | Local control bus .....                                                       | 67        |
| 12.2.4     | Optional analog pass-through bus (internal A0 only) .....                     | 68        |
| 12.3       | STU/NIU initialization messages .....                                         | 68        |
| 12.3.1     | Initialization functions .....                                                | 68        |
| 12.3.2     | STU initialization messages .....                                             | 70        |
| 12.4       | A0 Local CBD management .....                                                 | 74        |
| 12.4.1     | Connection set-up .....                                                       | 74        |
| 12.4.2     | Connection release .....                                                      | 75        |
| 12.4.3     | Local CBD messages .....                                                      | 75        |
| 12.5       | Status and diagnostic functions .....                                         | 78        |
| 12.5.1     | Diagnostic primitives .....                                                   | 78        |

|                     |                                                                            |            |
|---------------------|----------------------------------------------------------------------------|------------|
| 12.5.2              | NIU table formats .....                                                    | 78         |
| 12.5.3              | STU table formats .....                                                    | 80         |
| 12.5.4              | STU to NIU messages .....                                                  | 81         |
| 12.5.5              | NIU-to-STU messages .....                                                  | 84         |
| 12.6                | Logical parameter definitions .....                                        | 87         |
| <b>13.</b>          | <b>STU dataport.....</b>                                                   | <b>87</b>  |
| 13.1                | Protocol stacks for STU dataport .....                                     | 87         |
| 13.1.1              | Protocol stacks for the STU multimedia dataport – MPEG based services..... | 88         |
| 13.1.2              | Protocol stacks for the STU multimedia dataport – IP based services .....  | 88         |
| 13.2                | Support of IP services over the STU multimedia dataport .....              | 88         |
| 13.2.1              | MTU size .....                                                             | 88         |
| 13.2.2              | Encapsulation .....                                                        | 88         |
| 13.2.3              | Address Resolution Protocol (ARP).....                                     | 90         |
| 13.2.4              | Link-fragmentation.....                                                    | 91         |
| 13.2.5              | IP unicast messages .....                                                  | 92         |
| 13.2.6              | IP multicast and broadcast.....                                            | 92         |
| <b>Annex A</b>      | <b>(normative) STU Management Information Base.....</b>                    | <b>93</b>  |
| <b>Annex B</b>      | <b>(normative) Server Management Information Base.....</b>                 | <b>110</b> |
| <b>Annex C</b>      | <b>(informative) A1-A0 Inter-working.....</b>                              | <b>142</b> |
| <b>Bibliography</b> | <b>.....</b>                                                               | <b>147</b> |

## 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 16500-5 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 and B form a normative part of this part ISO/IEC 16500. Annex C is 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 5: High and mid-layer protocols

## 1. Scope

This part of ISO/IEC 16500 covers the high and mid layer protocols for DAVIC systems. It defines a set of protocol components (“tools”) which are referenced by ISO/IEC 16500-2 (“System Dynamics, Scenarios, and Protocol Requirements”).

In particular this part of ISO/IEC 16500 describes the protocol stacks required for the support of the DAVIC flows, i.e., S1 through S5. The specific DAVIC options for each of the protocols are specified as well as the different optional protocols stacks applicable. Requirements on protocols at specific interfaces are also considered and included in the specification.

## 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 Identical Recommendations | International Standards

- ITU-T Recommendation H.220.0 (1996) | ISO/IEC 13818-1:1996, *Information technology – Generic coding of moving pictures and associated audio information – Part 1: Systems* (Note: known as MPEG-2).  
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*.
- ITU-T Recommendation H.262 (1996) | ISO/IEC 13818-2:1996, *Information technology – Generic coding of moving pictures and associated audio information: Video* (Note: known as MPEG-2).
- ITU-T Recommendation X.215 (1995) | ISO/IEC 8326:1996, *Information technology — Open Systems Interconnection — Session service definition*.
- ITU-T Recommendation X.216 (1994) | ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition*.
- ITU-T Recommendation X.217 (1995) | ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the Association Control Service Element*.
- ITU-T Recommendation X.225 (1995) | ISO/IEC 8327-1:1996, *Information Technology – Open Systems Interconnection – Connection-oriented session protocol: Protocol specification*.
- ITU-T Recommendation X.226 (1994) | ISO/IEC 8823-1:1994, *Information Technology – Open Systems Interconnection – Connection-oriented protocol: Protocol specification*.
- ITU-T Recommendation X.233 (1993) | ISO/IEC 8473-1:1994, *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification*.

### 2.2 Paired Recommendations | International Standards equivalent in technical content

- 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)*.

- 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) for Abstract Syntax Notation One (ASN.1)*.
- ITU-T Recommendation X.218 (1995), *Reliable transfer: model and service definition*.  
ISO/IEC 9066-1:1989, *Information processing systems – Text communication – Reliable transfer: Model and service definition*.
- ITU-T (CCITT) Recommendation X.219 (1988), *Remote operations: Model, notation and service definition*.  
ISO/IEC 9072-1:1989, *Information processing systems – Text communication – Remote Operations: Model, notation and service definition*.
- ITU-T Recommendation X.224 (1993), *Protocol for providing the OSI connection-mode transport service*.  
ISO/IEC 8073:1992, *Information technology – Telecommunications and information exchange between systems – Open Systems Interconnection – Protocol for providing the connection-mode transport service*.
- ITU-T (CCITT) Recommendation X.229 (1988), *Remote operations: Protocol specification*.  
ISO/IEC 9072-2:1989, *Information processing systems – Text communication – Remote Operations: Protocol specification*.

## 2.3 IEC, ISO, and ISO/IEC Standards

- IEC 61883-1:1997, *Consumer audio/video equipment – Digital Interface. – Part 1: General*.
- IEC 61883-4:1997, *Consumer audio/video equipment – Digital Interface – Part 4: MPEG-2 TS data transmission*.
- ISO/IEC 11172-2:1993, *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbits/s – Part 2: Video*. (Note: also known as MPEG-1).
- ISO/IEC 11172-3:1993, *Information technology Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbits/s – Part 3: Audio*. (Note: also known as MPEG-1).
- ISO/IEC 13818-3:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*. (MPEG-2).
- ISO/IEC 13818-6:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 6: Extensions for DSM-CC*.
- ISO/IEC 14750, *Information technology – Open distributed processing - Interface Definition Language*.
- ISO/IEC 7776:1995, *Information technology – Telecommunications and information exchange between systems – High-level data link control procedures – Description of the X.25 LAPB-compatible DTE data link procedures*.
- ISO/IEC 8802-2:1994, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*.
- ISO/IEC 8802-3:1993, *Information technology – Local and metropolitan area networks – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*.

## 2.4 ITU-T Recommendations

- ITU-T Recommendation E.164 (R/1996) *Numbering plan for the ISDN era*
- ITU-T Recommendation G.774 (1992), *Synchronous digital hierarchy management information model*
- ITU-T I.150 (R/1995), *B-ISDN asynchronous transfer mode functional characteristics*
- ITU-T Recommendation I.361 (R/1996), *B-ISDN ATM layer specification*
- ITU-T Recommendation I.363 (R/1994), *B-ISDN ATM adaptation layer (AAL) specification*

- ITU-T Recommendation I.363.5 (1996), *B-ISDN ATM Adaptation Layer Type 5 (AAL5) specification*
- ITU-T Recommendation I.610 (R/1995), *B-ISDN operation and maintenance principles and functions*
- ITU-T Recommendation M.3100 (1995), *Generic network information model*
- ITU-T Recommendation Q.822 (1994), *Stage 1, Stage 2, Stage 3 description for the Q3 interface - Performance management*
- ITU-T Recommendation Q.2110 (1994), *B-ISDN ATM Adaptation Layer – Service Specific Connection Oriented Protocol (SSCOP)*
- ITU-T Recommendation Q.2120 (1995), *B-ISDN meta-signaling protocol (SAAL)*
- ITU-T Recommendation Q.2130 (1994), *B-ISDN ATM Adaptation Layer- Service Specific Coordination Function for Support of Signaling at the User Network Interface (SSCF at UNI)*
- ITU-T Recommendation Q.2931 (1995), *Broadband integrated services digital network (B-ISDN). Digital Subscriber Signaling System No.2 (DSS 2): User-network interface (UNI) layer 3 specification for basic call/connection control*
- CCITT Recommendation V.35, *Data transmission at 48 Kilobits per second using 60-108 kHz Group Band Circuits*
- ITU-T Recommendation X.25 (1993), *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*
- ITU-T Recommendation X.710 (1991), *Common management information service definition for CCITT applications*
- ITU-T Recommendation X.711 (1991), *Common Management Information Protocol, Specification for CCITT applications*
- ITU-T Recommendation X.721 (R/1994), *Information Technology – Open Systems Interconnection – Structure of Management Information: Definition of Management Information*

## 2.5 Other normative references

### 2.5.1 ANSI

- ANSI EIA/TIA-232-E-91, *Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, July 1991

### 2.5.2 The ATM Forum

- AF-SAA-0049.001, The ATM Forum, *Audiovisual Multimedia Services: Video on Demand Specification 1.1*, 1997

### 2.5.3 Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA)

- RS-232-C, *see* ANSI/EIA/TIA-232-E-91

### 2.5.4 European Telecommunications Standards Institute (ETSI)

- ETSI 300 468, *Digital Video Broadcasting, Specification for Service Information in DVB Systems*, January 1997  
(Note: includes normative reference to the *Informative Annex C: Conversion Between Time and Date Conventions*.)

### 2.5.5 Institute for Electrical and Electronic Engineers (IEEE)

- IEEE 802.2, *see* ISO/IEC 8802-2
- IEEE 802.3, *see* ISO/IEC 8802-3

- IEEE 1394-1995, *Standard for a High Performance Serial Bus*, August 1996

## 2.5.6 Internet Society

- RFC 768, J. Postel, *User Datagram Protocol (UDP)*, 08/28/1980
- RFC 791, J. Postel, *Internet Protocol (IP Addressing)*, 09/01/1981
- RFC 793, J. Postel, *Transmission Control Protocol (TCP)*, 09/01/1981
- RFC 826, D. Plummer, *Ethernet Address Resolution Protocol: Or converting network protocol addresses to 48.bit Ethernet address for transmission on Ethernet hardware*, 11/01/1982
- RFC 1006, D. Cass, M. Rose, *ISO transport services on top of the TCP: Version 3*, 05/01/1987
- RFC 1155, K. McCloghrie, M. Rose, *Structure and Identification of Management Information for TCP/IP-based Internets*, 05/10/1990
- RFC 1157, M. Schoffstall, M. Fedor, J. Davin, J. Case, *A Simple Network Management Protocol (SNMP)*, 05/10/1990
- RFC 1212, K. McCloghrie, M. Rose, *Concise MIB Definitions*, 03/26/1991
- RFC 1213, K. McCloghrie, M. Rose, *Management Information Base for Network Management of TCP/IP-based internets: MIB-II*, 03/26/1991
- RFC 1662, W. Simpson, *PPP in HDLC-like Framing*, 07/21/1994
- RFC 1700, J. Reynolds, J. Postel, *Assigned Numbers*, 10/20/1994  
(Note: this supersedes RFC 1060 and 1340. The IETF regularly updates “Assigned Numbers” so this reference may be obsolete in the future)

## 2.5.7 Object Management Group (OMG)

- *Common Object Request Broker: Architecture and Specification*, Version 2.1, August 1997  
(Note: known as OMG CORBA 2.1. Includes definition of the Common Data Representation and the Remote Procedure Call mechanism and encoding rules for General Inter-ORB Protocol, and Internet Inter-ORB Protocol).

## 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 Network (AN):** a part of the Delivery System consisting of a collection of equipment and infrastructures, that link a number of Service Consumer Systems to the rest of the Delivery System through a single (or a limited number of) common port(s).
- 3.2. Access Node:** the element of the Access Network containing centralized functions responsible for processing information flows in preparation for transport through the selected distribution network.
- 3.3. 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.
- 3.4. Control Plane:** a classification for objects that interact to establish, maintain, and release resources and provide session, transport, and connection control functions that facilitate transparent information transfers between ISP clients.
- 3.5. call:** (in signaling) An association between two or more users, or between a user and a network entity, that is established by use of network capabilities. This association may have zero or multiple information exchange mechanisms established within this call, for example in connection-oriented or in connectionless modes. (ITU-T Rec. Q.9)

- 3.6. channel:** a connection conveying signals between two blocks (the conveyed signals represent information). Channels also convey signals between a block and the environment. Channels may be unidirectional or bi-directional.
- 3.7. client:** a service consuming object or system (block); ( a synonym for user).
- 3.8. conditional access:** a means of allowing system users to access only those services that are authorized to them.
- 3.9. connection:** an association of transmission channels or circuits, switching and other functional units set up to provide a means for a transfer of user, control and management information between two or more end points (blocks) in a telecommunications network. (ITU-P.10).
- 3.10. connection service:** provides basic functions to create, maintain, and tear down connections.
- 3.11. content-information:** information that does not alter the state of the object intercepting the information flow, e.g., audio, video, or data in a television program that is processed transparently by a television receiver (the control state of the receiver will not change as a result of such information).
- 3.12. control-information:** information that may change the state of the object intercepting the information flow, e.g., a remote control channel up command input. (In some cases an object may interpret a message but reject a request and remain in its current state.)
- 3.13. Core Network:** a portion of the Delivery System composed of networks, systems, equipment and infrastructures, connecting the Service Providers to the Access Networks.  
NOTE: The term Core Network, in the DAVIC use, is wide sense as it includes the notion of the access networks that are needed to link the Service Providers Systems to the core network in strict sense (i.e., exclusive of any access network). This kind of access networks are not under consideration within DAVIC.
- 3.14. Delivery System (DS):** The portion of the DAVIC System that enables the transfer of information between DS-users.
- 3.15. domain:** a scope that delimits (makes clear what is included and what is not) the extent of influence of one object on another. Domain boundaries may represent regulatory, ownership, span-of-control and other influence factors.
- 3.16. downstream:** information flow direction is from an End Service Provider System to an End Service Consumer System.
- 3.17. End-Service Consumer (ESC):** a user, either human or machine, whose primary interaction with the system is through the STU.
- 3.18. End-Service Consumer System (ESCS):** a system that (predominantly) consumes information. ESCSs are ISPS and ESPS clients. The ESCS includes the STU and the ESC.
- 3.19. End-Service Provider (ESP):** an entity with jurisdiction over a domain that contains a system that (predominantly) provides information to clients.
- 3.20. End-Service Provider System (ESPS):** a system that (predominantly) provides information to clients. ESPSs are ISPS clients and may also be clients of other ESPSs. ESPSs consist of hardware and software sub-systems that use ISP services to provide video and multimedia services to ESCSs.
- 3.21. layer:** a collection of objects of the same hierarchical rank.
- 3.22. layer service:** functions provided by a layer to a layer above through a Service Access Point.
- 3.23. Intermediate-Service Provider (ISP):** ISPs provide adjunct services and convey information among ESPs and ESCs.
- 3.24. Management Entity:** The Management Entity is responsible for the operation and maintenance functions of a network. Several instances of information flow S5 exist for the Management entity.
- 3.25. Management Plane (MP):** a plane that contains those interfaces and functions which support interactions which may be typified as being temporally disjoint from an off-hook interaction. Interactions among Management Plane objects may also occur concurrently with an off-hook interaction.
- 3.26. management-information:** information exchanged by Management Plane objects; may be content-information or control-information.

- 3.27. 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.
- 3.28. network:** a collection of interconnected elements that provides connection services to users.
- 3.29. Network Interface Unit (NIU):** the NIU accepts network specific content-information flows from the Delivery System and provides a non-network specific interface to the Connectivity Entity in the STU. (Additional definitions of the NIU may exist).
- 3.30. Network Termination (NT):** the element of the Access Network performing the connection between the infrastructure owned by the Access Network operator and the Service Consumer System (ownership decoupling). The NT may be passive or active, transparent or not.
- 3.31. physical interface:** an interface where the physical characteristics of signals used to represent information and the physical characteristics of channels used to carry the signals are defined. A physical interface is an external interface. It is fully defined by its physical and electrical characteristics. Logical information flows map to signal flows that pass through physical interfaces.
- 3.32. plane:** a category that identifies a collection of related objects, e.g., objects that execute similar or complementary functions; or peer objects that interact to use or to provide services in a class that reflects authority, capability, or time period. Management-plane service objects, for example, may authorize ISP-clients' access to certain control-plane service objects that in turn may allow the clients to use services provided by certain user-plane objects.
- 3.33. port:** an abstraction used by transport protocols to distinguish among multiple destinations associated with particular applications running on a host computer: and application may specify the ports it wants to use; some ports are reserved for standard applications/ services such as e-mail (also known as well-known ports).
- 3.34. procedure:** an encapsulation of the behavior of part of a process. A procedure is defined in one place but may be referred to several times within a process.
- 3.35. process:** a communicating extended finite state machine. Communication may take place via signals or shared variables. The behavior of a process depends on the order of arrival of signals in its input port.
- 3.36. 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)
- 3.37. reference point:** a set of interfaces between any two related blocks through which information flows from one block to the other. A reference point comprises one or more logical (non-physical) information-transfer interfaces, and one or more physical signal-transfer interfaces.
- 3.38. S1:** content-information flow, from a source to a destination object on the User Plane of any service layer.
- 3.39. S2:** control-information flow from a source to a destination object on the Control Plane of the Application Service Layer (SL1).
- 3.40. S3:** control-information flow from a source to a destination object on the Control Plane of the Session and Transport Service Layer (SL2).
- 3.41. S4:** control-information flow from a source to a destination object on the Control Plane of the Network Service Layer (SL3).
- 3.42. S5:** management-information flow from a source to a destination object on the Management Plane of the container object: the objects may be peers (service layer is known), or the service layer may be unspecified.
- 3.43. server:** any service providing system.
- 3.44. Service Gateway (SGW):** an element of the service domain through which a client may browse available services; also a mechanism for a client to obtain an object reference (message connection) to an instance of a service.
- 3.45. Service Provider System (SPS):** a general reference to ESP or ISP systems.
- 3.46. session services:** provide basic functions to create, modify, maintain, and tear down sessions (negotiate and allocate network resources).

**3.47. 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.

**3.48. Stream Service Element:** this Service Provider System entity allows for the processing of the content-information flows at the stream level. The content stream is a sub-set of the actual content-information flow and processing at the stream level allow the ability to uniquely align a service offering.

**3.49. User Plane (UP):** a classification for objects whose principal function is to provide transfer of (end) user information: user information may be user-to-user content (e.g., a movie), or private user-to-user data.

**3.50. Value-Added Service Provider (VASP):** This provider offers, for example, a Video-on-Demand Service to the end-user. Within the Systems Reference Model this is the ESP.

## 4. Acronyms and abbreviations

This clause defines the acronyms and abbreviations used in this part of ISO/IEC 16500. Annex B of ISO/IEC 16500-1 defines acronyms and abbreviations used within ISO/IEC 16500.

|            |                                                                   |
|------------|-------------------------------------------------------------------|
| AAL        | ATM Adaptation Layer                                              |
| ACSE       | Application Control Service Element                               |
| AFI        | Authority and Format Identifier                                   |
| ANSI       | American National Standards Institute                             |
| API        | Application Programming Interface                                 |
| ATM        | Asynchronous Transfer Mode                                        |
| B-ISDN     | Broadband Integrated Services Digital Network                     |
| CBD        | Connection Block Descriptor                                       |
| CLNP       | ConnectionLess Network Protocol                                   |
| CLP        | Cell Loss Priority                                                |
| CMIP       | Common Management Information Protocol                            |
| CMISE      | Common Management Information Service Element                     |
| CORBA      | Common Object Request Broker Architecture                         |
| CPCS       | Common Part Convergence Sub-layer                                 |
| DLL        | Data Link Layer                                                   |
| DSM-CC     | Digital Storage Media - Command and Control                       |
| DSM-CC U-N | Digital Storage Media - Command and Control User-to-Network       |
| DSM-CC U-U | Digital Storage Media - Command and Control User-to-User          |
| DVB        | Digital Video Broadcasting                                        |
| GIOP       | Generic Inter-ORB Protocol                                        |
| HFC        | Hybrid Fiber Coax                                                 |
| HO-DST     | High Order - Domain Specific Part                                 |
| IBC        | Inter-Integrated Circuit                                          |
| IDLE       | Interface Definition Language                                     |
| IEC        | International Electrotechnical Commission                         |
| IIOP       | Internet Inter-ORB Protocol                                       |
| ILMI       | Integrated Local Management Interface                             |
| IP         | Internet Protocol                                                 |
| ISDN       | Integrated Services Digital Network                               |
| ISO        | International Organization for Standardization                    |
| ITU-T      | International Telecommunication Union - Telecommunications sector |
| L1GW       | Level 1 Gateway                                                   |
| LAPB       | Link Access Procedure Balanced                                    |
| LAPD       | Link Access Procedure D-channel                                   |
| MAC        | Medium Access control                                             |
| MIB        | Management Information Base                                       |
| MPEG       | Moving Pictures Experts Group                                     |
| MPEG-TS    | MPEG-2 Transport Stream                                           |
| N-ISDN     | Narrowband Integrated Services Digital Network                    |
| NIU        | Network Interface Unit                                            |

|          |                                                      |
|----------|------------------------------------------------------|
| NMS      | Network Management System                            |
| NSAP     | Network Service Access Point                         |
| OAM      | Operation and Maintenance                            |
| OMG-CDR  | Object Management Group - Common Data Representation |
| OMG-GIOP | Object Management Group - Generic Inter-ORB Protocol |
| PDU      | Protocol Data Unit                                   |
| PES      | Packetized Elementary Stream                         |
| PID      | Packet Identifier                                    |
| PSI      | Program Specific Information                         |
| PSTN     | Public Switched Telephone Network                    |
| PVC      | Permanent Virtual Connection                         |
| RF       | Radio Frequency                                      |
| ROSE     | Remote Operation Service Element                     |
| RPC      | Remote Procedure Call                                |
| SAAL     | Signaling ATM Adaptation Layer                       |
| SAR      | Segmentation and Re-assembly                         |
| SDU      | Service Data Unit                                    |
| SNMP     | Simple Network Management Protocol                   |
| SSCOP    | Service Specific Connection Oriented Protocol        |
| STU      | Set Top Unit                                         |
| TCP      | Transmission Control Protocol                        |
| UDP      | User Datagram Protocol                               |
| UNI      | User Network Interface                               |
| VASP     | Value Added Service Provider                         |
| VCi      | Virtual Channel Identifier                           |
| VP       | Virtual Path                                         |
| VPCI     | Virtual Path Connection Identifier                   |
| VPI      | Virtual Path Identifier                              |

## 5. Conventions

The style of this Specification follows the *Guide for ITU-T and ISO/IEC JTC1 co-operation, Appendix H: Rules for presentation of ITU-T | ISO/IEC Common text* (March, 1993).

## 6. S1 flow: high and mid layer protocols

### 6.1 S1 flow description

As defined in ISO/IEC 16500-1 clause 7, the S1 information flow is for content-information flow from a source object to a destination object. For ISO/IEC 16500, S1 is defined to be a uni-directional flow from the server to the STU carrying encoded video/audio content and associated data, binary objects to be used by the STU, and other content-information types. ISO/IEC 16500 has selected ISO/IEC 11172-2,-3 (MPEG-1 video and audio) and ISO/IEC 13818-1,-2,-3 (MPEG-2 systems, video, and audio) for the coding of the video/audio content information and the Transport Stream systems layer for the multiplexing of video, audio and other data types; and ISO/IEC 13818-6 (MPEG-2 digital storage media command and control) for the binary object (and other data types) download protocol. Refer to ISO/IEC 16500-6 for information on other content-information types.

### 6.2 Overview of protocol stacks

The allowable protocol stacks for carrying S1 information flows are defined in the following figures. When S1 consists of an MPEG program (a single video stream, associated audio streams and data), the MPEG-2 Transport Stream format shall be used as indicated in the diagrams below. In all cases where ATM is used in the access network (in particular, for ATM across the A1 interface), the Transport Stream shall contain one and only program (referred to as a single-program Transport Stream or SPTS). See Figure 6.1. In all other cases – e.g., ATM layer which does not cross A1 (also Figure 6.1) or for a non-ATM HFC access network (Figure 6.2) – the Transport Stream may contain more than one program (referred to as a multi-program Transport Stream or MPTS). See ISO/IEC 16500-4 for information on the lower layer protocols.

When S1 consists of “download” data or other content information, the information shall be carried within a “high bandwidth” Transport Stream (per either Figure 6.1 or Figure 6.2). In addition, S1 download data may be carried in a separate ATM Virtual Channel as shown in Figure 6.3. The selection of the option shall be done during service activation time using DSM-CC resource descriptors and binding lists (see ISO/IEC 16500-2).

S1 information shall be carried transparently through the Delivery System, except in the case where MPEG Transport Stream re-multiplexing is performed in cascaded SPS networks (see DAVIC 1.3.1a Part 3). This exception occurs because the originating SPS may deliver MPEG programs in SPTS format which are subsequently multiplexed into MPTS prior to delivery to the STU. In all cases, the data/elementary stream information and PES/private\_section information shall be passed transparently through the Delivery System. For all MPEG-2 Transport Streams, the PSI tables shall be included. Other data – e.g., DVB Service Information, ATSC Program and System Information, or conditional access information – is optional.

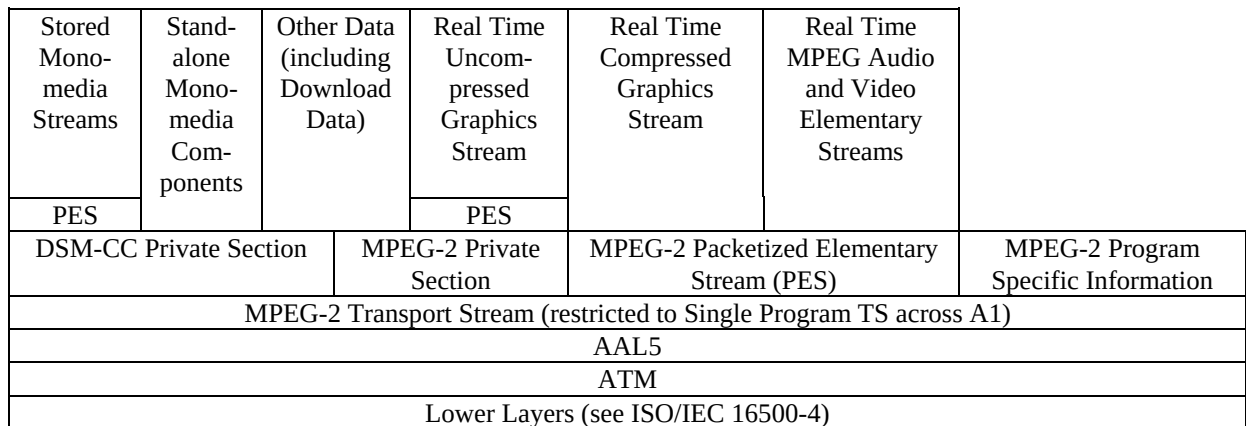


**Figure 6.1 — MPEG TS protocol stack for an ATM-based transmission system**

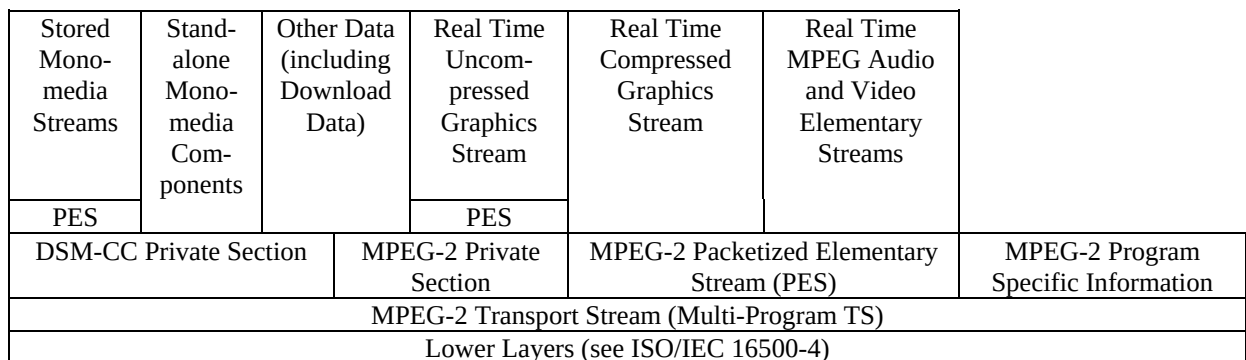


**Figure 6.2 — MPEG TS protocol stack for the non-ATM based transmission system**

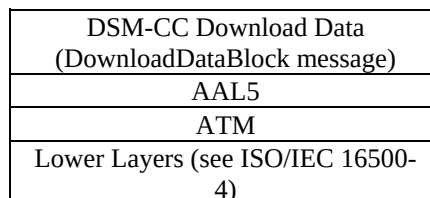


**Figure 6.3 — Separate ATM VC protocol stack for S1 Download Data**

## 6.3 Description of specific protocols

This section describes the specific protocols used in the protocol stacks identified in the section above. Wherever required the protocols layers are grouped by pairs in order to explicitly focus on the mapping issues between different protocols. Only the protocols which are specific to the S1 flow are described in detail, while the protocols which are common to other flows are described in a separate section.

### 6.3.1 MPEG-2 Packetized Elementary Stream (PES)

Defined in ISO/IEC 13818-1.

### 6.3.2 MPEG-2 Private Section

Defined in ISO/IEC 13818-1.

The choice of using the CRC form (private\_section\_syntax\_indicator field set to 1, the “long form”) or “no CRC” for (private\_section\_syntax\_indicator field set to 0, the “short form”) is not specified.

### 6.3.3 DSM-CC Private Section

The DSM-CC Private Section, DSMCC\_section, is defined in ISO/IEC 13818-6, clause 9 “Transport”.

The choice of using the CRC, Checksum, or “no coverage” form has not been specified.

### 6.3.4 MPEG Elementary Streams

MPEG Video ES and MPEG Audio ES are content information specified in Parts 9 and 12 of this Specification. This includes Real Time Streams (but excludes Real Time Stream Graphics), as defined in ISO/IEC 16500-6. The syntax is also defined in ISO/IEC 11172 MPEG-1 Parts 2 and 3 and ISO/IEC 13818 MPEG-2 Parts 2 and 3.

### 6.3.5 Real time uncompressed graphics streams

Defined in ISO/IEC 16500-6. According to ISO/IEC 16500-6 and shown in Figure 6.2 and Figure 6.3, this data type is first encapsulated into MPEG-2 PES packets and then encapsulated into MPEG-2 Private Sections.

### 6.3.6 Real time compressed graphics streams

A format for graphics that may be used for subtitling; the format complies to ETS 300 743. This data type is encapsulated into MPEG-2 private PES packets as defined in ETS 300 743.

### 6.3.7 Stored monomedia streams

Stored Monomedia Streams are content types defined in ISO/IEC 16500-6 and may include MPEG Audio, Linear Audio (AIFF-C), MPEG Video, Uncompressed Graphics and Compressed Graphics. Stored Monomedia Streams are encapsulated into MPEG-2 PES packets.

The content type may be DSM-CC User-User Objects or pointers to these objects. DSM-CC User-User Objects may be carried in DSM-CC User-User Object Carousels (defined in ISO/IEC 13818-6, clause 8), which in turn are transmitted using the DSM-CC Data Carousel scenario for DSM-CC Download (defined in ISO/IEC 13818-6, clause 7). Alternatively, User-User Objects may be carried within an RPC reply (in which case, it is an S2 flow; see Section 7). When carried within an MPEG TS, this information shall first be encapsulated in DSMCC\_sections per ISO/IEC 13818-6, clause 9.

The content type may be DSM-CC Download Modules (defined in ISO/IEC 13818-6, clause 7) or Images (Download Images are logically sub-divided into one or more Download Modules). Download Modules are delivered using one of the three DSM-CC download scenarios – Data Carousel, Flow Control, or Non-Flow Control. Note that Modules are actually divided into data blocks and transported as DownloadDataBlocks. When carried within an MPEG TS, this information shall first be encapsulated in DSMCC\_sections per ISO/IEC 13818-6, clause 9.

### 6.3.8 Stand-alone monomedia components

Stand-alone Monomedia Components may be a still picture bitmap or a graphics bitmap or text, as specified in ISO/IEC 16500-4.

Stand-alone Monomedia Components may be carried by DSM-CC using the same mechanisms as for Stored Monomedia Streams; see subclause 6.3.7.

### 6.3.9 Other data

Other Data includes any type of information not defined elsewhere in subclause 6.3. Some examples are:

- Tunneled IP data over MPEG (see Section 7.2.3 of this specification).
- Application code; for the Application Format and the mapping to DSM-CC, see ISO/IEC 16500-6 subclause 9.
- Download Data. For carriage by DSM-CC the same mechanisms may be used as for Stored Monomedia Streams; see subclause 6.3.7.
- DVB Service Information, as defined in ETS 300 468. Service Information data is encapsulated into MPEG-2 private sections.
- ATSC Program and System Information, as defined in ATSC Standard A/65.

### 6.3.10 MPEG-2 Program Specific Information

Defined in ISO/IEC 13818-1. Examples of MPEG-2 PSI (Program Specific Information) are the Program Association Table, Program Map Table, Conditional Access Table, and Network Information Table.

### 6.3.11 MPEG-2 Transport Stream (TS)

Defined in ISO/IEC 13818-1. This is one of the two systems layers defined for MPEG-2.

#### 6.3.11.1 Tunneling IP over MPEG

This section specifies how IP datagrams are carried over MPEG in the downstream direction to support the Internet Access with a delivery with a broadband broadcast network and a narrowband return channel.

##### 6.3.11.1.1 *Broadband MPEG TS encapsulation format and filtering*

Datagrams are encapsulated in datagram\_sections which are compliant to the DSMCC\_section format for private data as defined in ISO/IEC 13818-6. The mapping of the section into MPEG-2 Transport Stream packets is defined in ISO/IEC 13818-1 MPEG-2 Systems.

The syntax of the datagram is fully aligned with the DVB specification for Data Broadcasting.

The syntax and semantics of the datagram\_section are defined below.

Table 6.1 — Syntax of datagram\_section

| Syntax                                       | No. of bits | Mnemonic |
|----------------------------------------------|-------------|----------|
| datagram_section() {                         |             |          |
| table_id                                     | 8           | uimsbf   |
| section_syntax_indicator                     | 1           | bslbf    |
| private_indicator                            | 1           | bslbf    |
| reserved                                     | 2           | bslbf    |
| section_length                               | 12          | uimsbf   |
| MAC_address_6                                | 8           | uimsbf   |
| MAC_address_5                                | 8           | uimsbf   |
| reserved                                     | 2           | bslbf    |
| payload_scrambling_control                   | 2           | bslbf    |
| address_scrambling_control                   | 2           | bslbf    |
| LLC_SNAP_flag                                | 1           | bslbf    |
| current_next_indicator                       | 1           | bslbf    |
| section_number                               | 8           | uimsbf   |
| last_section_number                          | 8           | uimsbf   |
| MAC_address_4                                | 8           | uimsbf   |
| MAC_address_3                                | 8           | uimsbf   |
| MAC_address_2                                | 8           | uimsbf   |
| MAC_address_1                                | 8           | uimsbf   |
| if (LLC_SNAP_flag == '1') {                  |             |          |
| LLC_SNAP()                                   |             |          |
| } else {                                     |             |          |
| for (j=0;j<N1;j++) {                         |             |          |
| IP_datagram_data_byte                        | 8           | bslbf    |
| }                                            |             |          |
| }                                            |             |          |
| if (section_number == last_section_number) { |             |          |
| for (j=0;j<N2;j++) {                         |             |          |
| stuffing_byte                                | 8           | bslbf    |
| }                                            |             |          |
| }                                            |             |          |
| if (section_syntax_indicator == '0') {       |             |          |
| checksum                                     | 32          | uimsbf   |
| } else {                                     |             |          |
| CRC_32                                       | 32          | rpchof   |
| }                                            |             |          |
| }                                            |             |          |

The semantics of the datagram\_section are as follows:

**table\_id:** this is an 8-bit field which shall be set to 0x3E (DSM-CC sections with private data [5]).

**section\_syntax\_indicator:** this field shall be set as defined by ISO/IEC 13818-6 [5].

**private\_indicator:** this field shall be set as defined by ISO/IEC 13818-6 [5].

**reserved:** this is a 2-bit field that shall be set to '11'.

**section\_length:** this field shall be set as defined by ISO/IEC 13818-6 [5].

**MAC\_address\_[1..6]:** this 48-bit field contains the MAC address of the destination. The MAC address is fragmented in 6 fields of 8-bits, labeled MAC\_address\_1 to MAC\_address\_6. The MAC\_address\_1 field contains

the most significant byte of the MAC address, while MAC\_address\_6 contains the least significant byte. Figure 6.4 illustrates the mapping of the MAC address bytes in the section fields. Note that the order of the bits in the bytes is not reversed and that the most significant bit of each byte is still transmitted first.

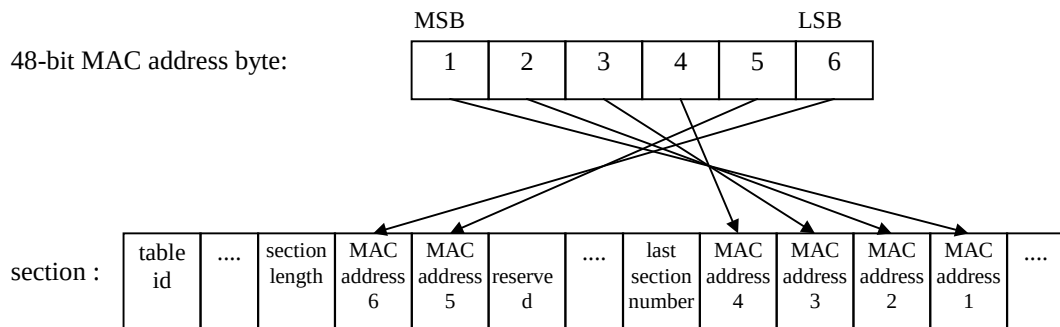


**Figure 6.4 — Mapping of MAC address bytes to section fields.**

The MAC\_address fields contain either a clear or a scrambled MAC address as indicated by the address\_scrambling\_control field.

**payload\_scrambling\_control:** this 2-bit field defines the scrambling mode of the payload of the section. This includes the payload starting after the MAC\_address\_byte\_1 but excludes the checksum or CRC32 field. See Table 6.2. The scrambling method applied is user private.

**Table 6.2 — Coding of the payload\_scrambling\_control field.**

| value | payload scrambling control |
|-------|----------------------------|
| 00    | unscrambled                |
| 01    | defined by service         |
| 10    | defined by service         |
| 11    | defined by service         |

**address\_scrambling\_control:** this 2-bit field defines the scrambling mode of MAC address in this section. See Table 6.3. This field enables a dynamic change of MAC addresses. The scrambling method applied is user private.

**Table 6.3 — Coding of the address\_scrambling\_control field.**

| value | address scrambling control |
|-------|----------------------------|
| 00    | unscrambled                |
| 01    | defined by service         |
| 10    | defined by service         |
| 11    | defined by service         |

**LLC\_SNAP\_flag:** this is a 1-bit flag. If this flag is set to '1' the payload carries an LLC/SNAP encapsulated datagram following the MAC\_address\_1 field. The LLC/SNAP structure shall indicate the type of the datagram conveyed. If this flag is set to '0', the section shall contain an IP datagram without LLC/SNAP encapsulation.

**current\_next\_indicator:** this is a 1-bit field. It shall be set to a value of '1'.

**section\_number:** this is an 8-bit field. If the datagram is carried in multiple sections, then this field indicates the position of the section within the fragmentation process. Otherwise it shall be set to zero. When carrying IP datagrams, each datagram shall be encapsulated to exactly one section and the value of the section\_number shall be set to zero always (i.e., the MTU for IP is 4080 bytes).

**last\_section\_number:** this 8-bit field shall indicate the number of the last section that is used to carry the datagram, i.e., the number of the last section of the fragmentation process.

**LLC\_SNAP:** this structure shall contain the datagram according to the ISO/IEC 8802-2 [11] Logical Link Control (LLC) and ISO/IEC 8802-1a SubNetwork Attachment Point (SNAP) specifications. If the payload of the section is scrambled (see `payload_scrambling_mode`), these bytes are scrambled.

**IP\_datagram\_data\_byte:** these bytes contain the data of the datagram. If the payload of the section is scrambled (see `payload_scrambling_mode`), these bytes are scrambled.

**stuffing\_byte:** this is an optional 8-bit field whose value is not specified. If the payload of the section is scrambled (see `payload_scrambling_mode`), these bytes are scrambled. They are to assist with block encryption and data processing in wide bus environments. The number of stuffing\_bytes used should meet the data alignment requirements defined in the `data_broadcast_descriptor`.

**checksum** - This field shall be set as defined by ISO/IEC 13818-6 [5]. It is calculated over the entire `datagram_section`.

**CRC\_32** - This field shall be set as defined by ISO/IEC 13818-6 [5]. It is calculated over the entire `datagram_section`.

### 6.3.12 ATM Adaptation Layer 5 (AAL5)

Defined in ITU-T Rec. I.363.5.

#### 6.3.12.1 Encapsulation of MPEG-2 Transport Streams for distribution to the STU

The mapping of Transport Streams into AAL5 which are intended to cross the A1 reference point is defined in af-saa-0049.001, The ATM Forum, "Audiovisual Multimedia Services: Video on Demand Specification 1.1". The default mapping case of "N=2" shall be used: Two MPEG-2 TS packets shall be mapped onto an AAL5 CPCS-SDU (common part convergence sub-layer – service data unit), which gives a 376 octet size for the AAL5 CPCS-SDU. In the case where the MPEG program contains an odd number of TS packets (such as at the end of a MPEG program where only one TS packet remains), the last AAL5 PDU (protocol data unit) shall contain only one MPEG-2 TS packet.

The AAL5 CPCS-SDU, together with the AAL5 CPCS-PDU trailer of 8 octets requires 384 octets and maps into exactly 8 ATM cells with zero CPCS padding octets.

In the case where the AAL5 PDU contains only one MPEG-2 TS packet, the AAL5 CPCS PDU will include the AAL5 CPCS-SDU, the 8 octets trailer and 44 CPCS padding octets.

A "Null" Service Specific Convergence Sub-layer shall be required.

#### 6.3.12.2 Encapsulation of MPEG-2 Transport Stream for contribution or broadcast distribution not intended to be delivered to the STU

In order to meet the higher quality of service requirements for the delivery of Transport Streams as contribution to SPS entities or distribution to the access network (excluding ATM across A1 to the STU), AAL5 encapsulation shall be "PCR aware" at the A11, A9\*, and A9 reference points. "PCR aware" is defined as guaranteeing that if a TS packet contains an Program Clock Reference, it shall only be in the second of the two TS packets within the AAL5 PDU (see the previous sub-clause). Otherwise, the AAL5 PDU shall be truncated to 5 cells and only contain one TS packet (plus the 8 octet trailer and 44 CPCS padding octets).

For high-quality broadcast services (defined in DAVIC 1.3.1a Part 4) over ATM networks, "PCR aware" encapsulation shall be used, except as follows:

- Constant bit rate MPTS, where all programs are CBR-encoded MPEG, "PCR aware" ATM encapsulation is optional.
- Constant bit rate MPTS, where at least one of the programs is VBR-encoded MPEG, shall not use "PCR aware" ATM encapsulation.

Variable bit rate MPTS shall not be supported by ISO/IEC 16500.

## 7. S2 flow: high and mid layer protocols

### 7.1 S2 flow description

As defined in ISO/IEC 16500-1 subclause 7, the S2 information flow is for control information flow from an application service layer source object to a peer destination object. ISO/IEC 16500 has chosen the International Standard MPEG-2 Digital Storage Media Command & Control (DSM-CC) for the high level S2 interface between the STU and Server (ISO/IEC 13818-6 clause 5, User-to-User Interface), the control of binary object and other data type information download (ISO/IEC 13818-6 clause 7, User-Network Download Protocol), and the carriage of IP-encapsulated S2 information over an MPEG Transport Stream (ISO/IEC 13818-6 clause 9, Transport).

The description of the service domain interfaces organizes the service domain around the objects which are visible to the set-top device. The text which follows then lists the interfaces which these objects export. The interfaces are those of ISO/IEC 13818-6 MPEG-2 DSM-CC specification, clause 5 User-to-User Interface, and clause 8 Normal Play Time, Stream Mode and Stream Events.

Transport of Normal Play Time, Stream Mode and Stream Events is specified in Section 9.2.8 “NPT Time Stamps and DSM-CC Descriptors” of ISO/IEC 13818-6.

### 7.2 Overview of protocol stacks

#### 7.2.1 Download control

When S2 consists of “download” control information, the information shall be carried either within a separate channel as shown in Figure 7.1 (separate ATM Virtual Channel) and in Figure 7.2 (separate channel over, e.g., ISDN or PSTN), or in a “high bandwidth” SPTS or MPTS (where applicable) as shown in Figure 7.3 and Figure 7.4 (the latter is for the Data Carousel scenario). In the cases where an SPTS or MPTS downstream is used, the associated (i.e., in the same domain) upstream channel shall be as shown in Figure 7.1.

The selection of the option is done during service activation time using DSM-CC resource descriptors and binding lists (see ISO/IEC 16500-2).

|                         |
|-------------------------|
| DSM-CC Download Control |
| TCP                     |
| IP                      |
| AAL5                    |
| ATM                     |
| Lower layer protocols   |

**Figure 7.1 — Separate ATM VC protocol stack for Download Control**

In the case of enhanced broadcast, data via the broadcast channel shall be transported according to the protocol stack in Figure 7.2.

|                         |
|-------------------------|
| DSM-CC Download Control |
| TCP                     |
| IP                      |
| PPP(MP)                 |
| Lower layer protocols   |

**Figure 7.2. — Download Control across the interaction channel for Enhanced Broadcast services**

|                                                          |
|----------------------------------------------------------|
| DSM-CC Download Control                                  |
| TCP                                                      |
| IP                                                       |
| DSM-CC Private Section                                   |
| Lower layer protocols<br>(see Figure 6-1 and Figure 6-2) |

**Figure 7.3 — MPEG-2 TS protocol stack for Download Control, for cases other than the Data Carousel Scenario<sup>1</sup>**

|                                                                             |
|-----------------------------------------------------------------------------|
| DSM-CC Download Control<br>(DownloadInfoIndication message)                 |
| DSMCC Private Section                                                       |
| Lower layer protocols (see protocol stacks in<br>Figure 6-1 and Figure 6-2) |

**Figure 7.4 — MPEG-2 TS protocol stack for Download Control, for the Data Carousel Scenario case**

## 7.2.2 User-User interaction

The protocols to support user-to-user interaction for ATM networks are defined in Figure 7.5 and for MPEG Transport Stream networks in Figure 7.6. In the case where an MPEG TS downstream is used, the associated (i.e., in the same domain) upstream channel shall be as shown in Figure 7.5.

|                                                                   |
|-------------------------------------------------------------------|
| DSM-CC User-User Interface                                        |
| Object Management Group - Common Data Representation<br>(OMG-CDR) |
| Object Management Group – GIOP/IOP<br>(OMG-GIOP/IOP)              |
| TCP                                                               |
| IP                                                                |
| AAL5                                                              |
| ATM                                                               |
| Lower layer protocols (see ISO/IEC 16500-4)                       |

**Figure 7.5 — ATM protocol stack for User to User Interaction**

IP shall be carried over ATM according to subclause 11.3 (IP).

For compression of the IP Address and Control Fields (RFC 1332), the following protocols shall be supported in the PPP data link layer (RFC 1700):

|      |                                  |
|------|----------------------------------|
| 0021 | Internet Protocol                |
| 002d | Van Jacobson Compressed TCP/IP   |
| 002f | Van Jacobson Uncompressed TCP/IP |

For the PPP link, the following configuration shall be supported as recommended for PSTN type links (Appendix A to RFC 1662):

|                                       |
|---------------------------------------|
| Async Control Character Map           |
| Magic Number                          |
| Address and Control Field Compression |
| Protocol Field Compression            |

<sup>1</sup>DSM-CC Download Control messages are DownloadInfoRequest, DownloadInfoResponse, and DownloadCancel

|                                                                |
|----------------------------------------------------------------|
| DSM-CC User-User Interface                                     |
| Object Management Group - Common Data Representation (OMG-CDR) |
| Object Management Group – GIOP/IOP (OMG-GIOP/IOP)              |
| TCP                                                            |
| IP                                                             |
| DSM-CC Private Section                                         |
| Lower layer protocols (see Figure 6-2)                         |

**Figure 7.6 — MPEG TS downstream protocol stack for User to User Interaction**

For enhanced broadcast services, DSM-CC User to User interaction is supported over the broadcast channel as depicted in Figure 7.7 and over the interaction channel as specified in Figure 7.8.

|                               |
|-------------------------------|
| DSM-CC U-U Primitives         |
| DSM-CC Object Carousels       |
| MPEG-2 DSM-CC Private Section |
| MPEG-2 TS                     |

**Figure 7.7 — U-U Primitives across the broadcast channel (ii)**

Note that DSM-CC sections are a category of MPEG Private sections and are defined in DSM-CC ISO/IEC 13818-6 DSMCC.

|                           |
|---------------------------|
| DSM-CC U-U                |
| OMG-CDR                   |
| OMG-GIOP/IOP <sup>2</sup> |
| TCP                       |
| IP                        |
| PPP(MP)                   |
| Lower layer protocols     |

**Figure 7.8 — User-User Interaction (including Data transfer) across the interaction channel**

PPP (MP) - Multilink Point-to-point protocol. Multilink PPP allows the use of multiple PPP links to be aggregated to provide a single transmission link for use by the IP layer. It is an extension to PPP and is inter-operable with PPP. (IETF RFC1717).

## 7.3 Description of specific protocols

The description does not attempt to re-define the DSM-CC interfaces. The readership should refer to the DSM-CC specification for the exact functions. Rather, the description classifies each interface with respect to its adoption in this specification. If there are comments on an interface, the following identification will be used:

- **Pragmatics:** The interface and the semantics are clear. The comment relates to implementation concerns outside the scope of DSM-CC but within the scope of DAVIC. The comment is the implementation agreement.

In each case, reliance is made on standard protocols, and these are indicated. Where additional details on how these standards are to be applied, these are indicated.

### 7.3.1 DSM-CC option choices summary

In some instances, DSM-CC allows a choice of options. DAVIC has selected the following DSM-CC options:

<sup>2</sup> See clauses 7.3.1 and 7.3.2 of part 7 for an exact specification of the options needed in a DAVIC compliant system.

1. Universal networked objects (i.e., GIOP/IIOP) as the Remote Procedure Call (RPC).
2. Common Data Representation (CDR) as the data encoding for User-to-User messages.
3. Inter-operable Object Reference as the encoding of inter-operable addressing and identification of objects.
4. IIOP Protocol Profile as a required object reference encoding. In the case of enhanced broadcast services, BIOP is a required object encoding reference for object carousels. BIOP is specified in DSM-CC ISO/IEC 13818-6 DSMCC.
1. IOP Inter-operable Object Reference as a required object reference encoding.
2. NPT Descriptors Must be Placed in the MPEG-2 Delivery Stream at intervals of no greater than 1 second.
3. DAVIC will use the interface definition module name *DAV*.
4. The DAVIC Stream Service (DAV::Stream) is composed of the DSM::Stream, DSM::Event, and DSM::Service interfaces.
5. DAVIC will implement a mini- Interface Repository Application Service which is composed of DSM::Interfaces and DSM::Directory. This service will be used to verify interface definitions and serve as a mechanism for making application service interfaces available.

### 7.3.2 Remote Procedure Call

DAVIC compliant systems require an inter-operable protocol stack for the presentation and session layer that will transport User-User primitives between STU and Server, or Server and Server. The definition of DAVIC upper layer protocols is identical to the OMG-GIOP/IIOP specification in CORBA 2.1. This solution comprises:

- a) a framework which allows nodes to select a protocol stack, or interpose an object which translates protocol stacks,
- b) conventions to encode the message payload at the presentation level (the Common Data Representation),
- c) a message set for request/response at the session level,
- d) a pervasive protocol solution at the transport level and network level.

### 7.3.3 Download

The DSM-CC Download protocol (ISO/IEC 13818-6 clause 7) is used to satisfy the needs listed above. The protocol may be thought of as two flows. The first flow is control which negotiates download parameters. The second flow is the download data, which the download service transmits to the set top, and the acknowledgments which set top returns to the download service. The distinction between the flows anticipates the allocation of different flows to different network resources. As described further in ISO/IEC 16500-2, the architecture allows the download control to be bound to a connection of modest bandwidth, while the download data is bound to another connection with serious bandwidth. The connection which supports the media stream, for example, may embed the download data as private data. The discussion of the structure which binds interfaces to network resources describes the technique further.

The service decides what to download from the set top profile. The set top provides the profile first session protocol message. The discussion on the set top profile describes the contents of the set top profile further.

### 7.3.4 User-User interaction

User-user interaction, where an element of the Service Provider System represents one user and an element of the Set-Top Unit another, is governed by the protocols specified in ISO/IEC 13818-6 MPEG-2 Digital Storage Media Command and Control (DSM-CC). The interactions are listed below as particular functions, grouped according to the Service Provider System element to which they pertain. Each function is accompanied by a citation of the clause of the DSM-CC standard that dictates its operation, and by any constraints on the use of that standard in the DAVIC context. Unless otherwise noted, the standard operation and the constraints are normative.

## 7.3.5 Service Gateway functions

### 7.3.5.1 Service configuration phase

The service configuration phase is the exchange between the Session Gateway, which resides in the Service Domain, and the Session & Resource Manager, which resides in the network. Note that this specification refers to the element which terminates the session protocol on the service side as the ses(s) and the element which terminates the session protocol on the network side as the ses(n).

The DSM-CC Configuration Protocol (see ISO/IEC 13818-6 clause 3) is used to implement the service configuration phase. These subclauses assume that the element which implements the configuration protocol and the element which implements the session protocol are distinct elements. An interface outside the scope of this specification may exist between the configuration element and the session element on the service side, as well as between the configuration element and the session element on the network side. In both cases, the session element forwards values to the configuration element before the configuration phase, and the configuration element returns values to the session element after the configuration phase. The specification of the interactions, however, is not defined by this specification.

The configuration element on the service side understands the network address to associate with the configuration element on the network side through convention. The configuration element on the service side initiates the exchange. The data which it provides in the first message is:

- **Configuration Network Address:** This is the network address to which the DSM-CC network shall send DSM-CC U-N configuration messages.
- **Session Network Address:** This is the network address to which the DSM-CC network shall send DSM-CC U-N session messages.
- **Session Profile:** The session profile shall indicate the subset of DSM-CC U-N session primitives supported by the server.
- **Resource Profile:** The resource profile shall indicate the subset of DSM-CC U-N resources that the server expects the network to provision for a service.
- **Default Service:** The default service is defined as the service to be selected if the set-top does not indicate the desired service during the DSM-CC U-N session establishment.
- **When the set top establishes a DSM-CC U-N session** (see ISO/IEC 13818-6 for the definition of DSM-CC U-N session), it provides a client profile through the session protocol. The client profile articulates features of the device which relate to inter-operation, or which clarify what data to download. DSM-CC User Compatibility (ISO/IEC 13818-6 clause 6) describes a structure which allows the set top to describe itself. The set top shall at least define its system hardware and its system software. In both cases, it shall provide the specifier field which identifies the organization which defines the semantics. The schema for the specifier is IEEE OUI. The system hardware shall be the first declaration in the profile and the system software shall be the second declaration. The client may provide other declarations. The structure provides the vocabulary to articulate application profiles.

The configuration code on the network side returns the data shown below. It initializes the context of the ses(s) element (also known as the Session Gateway) in the service domain.

- **Session & Resource Manager Network Address:** The configuration phase initializes the network address to which the service side will send session protocol.
- **Session Profile:** The profile identifies the subset of the session protocol which the Session & Resource Manager supports.
- **Resource Profile:** The profile identifies the resources which the Session & Resource Manager may allocate for a service. The data includes the type field of the resource descriptor.
- **Resource Allocation Option:** There are two options. The service may provision network resources and inform the network, or the service may request that the network establish network resources on its behalf.

- SessionId Option: The SessionId is a unique value which identifies a session. The Session & Resource Manager instructs the ses(s) element as to whether it is to assign the value.
- Maximum Session Forward Count: The protocol which relates to session forward includes a count which increments with each attempt to forward the session. This is the maximum count.
- Maximum Message Retry Count: The session elements re-send a message up to this count (see ISO/IEC 13818-6 for the state machine definition).
- Message Time-out. The session protocol elements re-send a message if the response does not arrive before the time-out.

### 7.3.5.2 Browse and select services

Function: The DSM::ServiceGatewayUU and DSM::Directory interfaces provide functions, e.g., list(), which allow a client to browse the available services and select a service with its name.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

### 7.3.5.3 Install and de-install services

Function: The DSM::ServiceGatewayUU and DSM::Directory interfaces provide functions which allow a service to install itself. The service provides its name with bind() function. The companion unbind() function removes the service from the Service Gateway.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5

### 7.3.5.4 Mandatory User-Network Session Gateway functions

Function: The session protocol includes messages which establish the session. The request to establish a session includes fields to select a service to launch for the session. The discussion below specifies interface, semantics, and pragmatics which integrate the session protocol with the life cycle of the services found in the service domain.

Citation of normative standard: ISO/IEC IS 13818-6 IS, clause 4.

Constraints: Pragmatics: The DSM-CC specification does not specify whether a specific service supports the session protocol (see below for further description of the session protocol). Since the Service Gateway is, in practice, the first service which the set-top device encounters in a service domain. The convention is that the Service Gateway must support the session protocol. It also exports the above resource interface to support other services in the service domain.

Constraints: Pragmatics: The configuration phase shall install into the set-top device the ServiceId of the default Service Gateway for the default service domain. The set-top device uses the default value in its first session establishment attempt.

### 7.3.5.5 Client profile (User-Network related)

Function: The client profile articulates the device features which a service must understand in order for the service to determine if it may inter-operate with the client.

Citation of normative standard: ISO/IEC 13818-6 IS clause 6

Constraints: Pragmatic: It is necessary to adopt a convention about how to forward the profile from the client to the service. The convention is that the client is to place the profile data in the user data field during the session establishment phase. The session protocol of DSM-CC provides the mechanism. If a service launches another service (as is true for the Service Gateway) the service shall provide the client profile during the launch phase.

### 7.3.5.6 Life cycle of users' instances of Service Gateway

Function: The DSM::Base interface relates to object life cycle. The destroy() function allows a client to delete a single object instance. The close() function allows a client to indicate that it will no longer need to communicate with an object.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

## 7.3.6 Application service functions

### 7.3.6.1 Life cycle of service instance

Function: The DSM::Base interface, which all service objects inherit, provides functions to control the life cycle of multiple services.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

### 7.3.7 Access control

Function: The DSM::Access interface provides attributes for Access control, such as access permissions.

Pragmatics: It is used in conjunction with the DAVIC Domain, Group and Member interfaces.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

## 7.3.8 Stream service functions

### 7.3.8.1 Individual stream control (Pause, Resume)

Function: The DSM::Stream interface, which the DAVIC Stream object inherits, provides functions, such as pause() and resume(), to control the advance of the media stream.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

### 7.3.8.2 Stream event

Function: The DSM::Event interface, which the DAV::Stream object inherits, provides functions to express interest in certain events, which the Stream object later places in the media stream.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: Pragmatics: The DAVIC design mandates that a Stream object provide the Event interface.

### 7.3.8.3 Cascading streams

Function: The DSM::QStream interface enables cascading of stream control to the next stream object to transport a media stream. The interface is expected to be used to implement play lists.

Citation of informative standard: ISO/IEC 13818-6 IS, Informative Annex K, Stream Playlist.

### 7.3.8.4 Scale control

See subclause 7.3.12, Karaoke.

Function: The resume() function of the stream interface allows the client to select the stream scale value, that is the rate at which to transport the stream. This operation may be invoked while the state machine is in Transport mode.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

### **7.3.9 File service functions**

#### **7.3.9.1 File access**

Function: The DSM::File interface provides read() and write() functions, subject to access control.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: None

### **7.3.10 Data base service functions**

#### **7.3.10.1 Data base access**

Function: The DSM::View interface provides basic data base functions.

Citation of normative standard: ISO/IEC 13818-6 IS, clause 5.

Constraints: Scope: The interface is out of scope for STU to Server interface, but may be used for server to server communication.

### **7.3.11 Use of the DSM-CC User-to-User interface in the DAVIC distribution profile**

The ISO/IEC 16500 Distribution profile does not mandate the use of a back-channel. Nevertheless, it is desirable in order to achieve maximum inter-profile interoperability to provide the DSM-CC User-to-User interfaces also to applications that run under the Distribution profile. DSM-CC provides a mechanism to do so in clause 11 “User-to-User Object Carousels”.

Function: The provision of (constrained versions of) the DSM-CC Base, Access, Directory, Service, File, Stream, and Event interfaces in a pure-broadcast environment.

Citation of normative standard: ISO/IEC 13818-6, clause 11 and Annex F.

Constraints: None

### **7.3.12 Application note: Use of ISO/IEC 16500 for karaoke (high-layer protocol aspects)**

DAVIC tools may be used to support Karaoke, at least at a basic level. An MPEG may carry the video, audio, and subtitle streams of a selection chosen from a menu in any of the normal ways. This section pertains to the additional functions of pitch and tempo control.

#### **7.3.12.1 Pitch control**

Pitch control shall be provided solely by the Set-Top Unit. No support by the Service Provider System is mandated.

#### **7.3.12.2 Tempo control**

Tempo control relies on the DSM-CC Scale facility, whereby the playback speed is scaled by the scaling factor.

Citation of normative standard:

Constraints:

1. The scaling factor shall be represented by the fraction A/B where A and B are positive integers.

2. The tempo shall be changed seamlessly with no loss or duplication of content.
3. Bounds on the amount of scaling may be conveyed by either party at session establishment via private data.
4. Changes in tempo shall be conveyed to the Set-Top Unit in the data stream so that it may play the stream back at the proper rate.

Note: Increases in tempo may affect the amount of network bandwidth required to transmit the stream. Actions dealing with the consequences of tempo increase are beyond the scope of ISO/IEC 16500.

### 7.3.12.3 Language selection

Selection of different languages for either the audio or subtitle stream may be desired. At present this is possible by downloading a menu of choices, each of which would constitute an elementary stream in the MPEG Transport Stream.

Citation of normative standard: MPEG TS; Download protocol

### 7.3.13 Application note: network congestion control for enhanced broadcast

Because of the potentially large numbers of (nearly) simultaneous transactions that may occur during a popular broadcast, actions are necessary to ensure the network may cope with the demands placed upon it at that time.

Two methods may be used to avoid network congestion. The network operator may wish to implement call distribution management, using intelligent network control for example. A second possibility is to provide data to terminals to reduce the burstiness of interaction channel use. A data set (in the form of an application control object) may be downloaded into the STU in order to provide a randomizing element which may reduce the number of simultaneous interaction channel activations.

To allow for the second kind of traffic shaping described above, an object implementing two mechanisms is defined:

- reduce the number of callers if necessary (the threshold randomizer)
- spread the responses in time (the time randomizer)

The first point is achieved by signaling a threshold to the receiving set-top box. If the user wants to participate in an interactive program, the set-top generates a random 16 bit number. Only if this number is higher than the threshold, the box will place a call to the service provider. The second point is implemented by giving start and stop times in between which a set-top box may place its call. This should happen at a random moment in this interval. If the service provider is unreachable, the set-top may try again after a specified time. Again a random time in the resulting interval should be chosen. This minimum waiting time after a try is introduced to prohibit traffic explosions when there's very little response time left.

The `giveNextDialTime` function of the `trafficShaping` object implements the above mentioned mechanisms. If the `giveNextDialTime` returns true then the time when the set-top may dial out is given in the variable `dialTime`. Otherwise false is returned and the set-top is not allowed to call out. A description of the semantics of the variables involved is also given.

```
typedef short date;
typedef char[3] time;
struct dateTime
{
    date aDate;
    time aTime;
}
interface trafficShaping
{
    attribute short numResponseThreshold;
    attribute dateTime responseStartTime;
    attribute dateTime responseEndTime;
    attribute time retryWaitTime;
    attribute short responseAttemptLimit;
```

```
// next time: result false -> not allowed any more
boolean giveNextDialTime (out dateTime dialTime);
};
```

**numResponsesThreshold:** this 16-bit field signals the threshold above which a set-top unit may initiate a call to a service provider. The set-top unit should compare this value with an internally generated 16-bit unsigned integer random number.

**responseStartTime:** this 40-bit field contains the start time of the responses in Universal Time, Coordinated (UTC) and Modified Julian Date (MJD). This field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in 4-bit Binary Coded Decimal (BCD) (see also Annex C of ETS 300 468).

EXAMPLE 1: 93/10/13 12:45:00 is coded as '0xC079124500'

**responseEndTime:** this 40-bit field contains the end time of the responses in UTC and MJD. This field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in 4-bit BCD.

**retryWaitTime:** a 40-bit field containing the date and time after which a set-top box is allowed to retry. It has the same coding as the response\_end\_time

**responseAttemptLimit:** this 8-bit field signals how many times a set-top box may try to call to a service provider. A value of zero (0) means unrestricted calling.

### 7.3.14 A10 content transfer interface

Function: The interface provides functions to copy(), modify(), move() content objects between nodes indicated by pathnames. DSM::Directory operations get() and bind() are invoked as sub-routines of the Content Interface operations.

Citation of normative standards: ISO/IEC 13818-6 clause 5, Directory interface

Constraints: None

#### 7.3.14.1 IDL syntax

```
Module DAV {
    enum NotFoundReason { missing_node, not_context, not_object };
    exception NotFound {
        NotFoundReason why;
        CosNaming::Name rest_of_name;
    };
    exception AlreadyBound {};
    exception CannotProceed {
        CosNaming::NamingContext cxt;
        CosNaming::Name rest_of_name;
    };
    exception InvalidName{};
    exception NoAuth{
        unsigned long minor;
        unsigned long completed;
        sequence<octet> authData;
    };
    interface Content : DSM::Directory {
        const DSM::AccessRole copy_ACR = DSM::WRITER;
        const DSM::AccessRole modify_ACR = DSM::WRITER;
        const DSM::AccessRole move_ACR = DSM::WRITER;
        const DSM::AccessRole load_ACR = DSM::WRITER;
        void copy (in CosNaming::Name dest, in CosNaming::Name source)
            raises(NotFound, AlreadyBound,
                CannotProceed, InvalidName,
                NoAuth);
    };
};
```

```

void modify (in CosNaming::Name dest, in CosNaming::Name source)
    raises(NotFound, CannotProceed,
           InvalidName, NoAuth);
void move (in CosNaming::Name dest, in CosNaming::Name source)
    raises(NotFound, AlreadyBound,
           CannotProceed, InvalidName,
           NoAuth);
void load (in CosNaming::Name package)
    raises(NotFound, CannotProceed,
           InvalidName, NoAuth);
};
};

```

#### 7.3.14.2 Semantics

The Content Interface extends the DSM-CC Directory Interface to provide common application level content manipulation operations. The arguments to the Content Interface operations are CORBA CosNaming::Names. This enables implementations the freedom to choose location and instances of content. The operations are sent to a content object which is in the hierarchy of the **dest** parameter. The path Name of this parameter shall extend from the target object of this invocation. The path Name of the other parameter (**source**) will extend from the client's local Service Gateway. The transfer may occur within one Service Provider or across Service Provider Domains.

**copy()** is used to copy a content object from one Directory to another. A copy of the **source** object will be created, and the bound at the **dest** location.

**modify()** is used to replace existing content with a new source. A copy of the **source** object will be created, and the rebound at the **dest** location.

**move()** is used to transfer content from one location to another. The **source** is unbound from the source parent directory, and bound to the **dest** location.

**load()** is used to unpack a Content Package. The load() is sent to a Content Service, which has in its name graph a content package. The **package** argument is a path name the extends from the Content Service to the content package to load. The Content Package encoding is specified by ISO/IEC 16500-6. The ISO/IEC 16500 Information Representations shall be represented as objects with a path Name, load instructions (with operation identifier as specifier by GIOP/IIOP), and the content data itself. These shall be extracted, and the load instruction(s) shall be performed on them. Unrecognized Information Representations will not be processed.

### 7.4 Distributed Server API

The following IDL specifies the Domain-related interfaces enabling the encapsulation of the Distributed Server. It represents generic classes for membership in domains and groups, which may be used by Service Providers, Content Providers and Applications Services for enrolling end-users and controlling access and invocation rights.

#### 7.4.1 Member interface

The Member interface provides an object that represents capabilities information about a Principal member of a Domain. The attribute Privs uses the DSM-CC Permissions structure to hold the privileges of the member, e.g., which READER groups the member is in, which WRITER groups, etc. This format enables an efficient match with the Perms attribute of DSM-CC objects that inherit DSM::Access interface. The match shall determine whether a member has privileges to invoke an operation on an object. The PrincipalId is the unique identifier of the member within the Domain, and is used in the RPC header for messages sent to objects in the Domain. A member with MANAGER privileges may invoke grant() or revoke(), to set the Access Role of the Member to a valid DSM-CC Access Role.

##### 7.4.1.1 IDL syntax

```

Module DAV {
    exception INV_ACCESS_ROLE{};
    interface Member : DSM::Base, DSM::Access {

```

```

attribute DSM::Access::Perms_T Privs;
readonly attribute DSM::Principal PrincipalId;
typedef sequence<DSM::AccessRole> AccessRolesList;
readonly attribute AccessRolesList AccessRoles;
//
const DSM::AccessRole Privs_get_ACR = DSM::MANAGER;
const DSM::AccessRole Privs_put_ACR = DSM::MANAGER;
const DSM::AccessRole PrincipalId_get_ACR = DSM::MANAGER;
const DSM::AccessRole AccessRoles_get_ACR = DSM::MANAGER;
const DSM::AccessRole grant_ACR = DSM::MANAGER;
const DSM::AccessRole revoke_ACR = DSM::MANAGER;
void grant (in DSM::AccessRole acr)
    raises(INV_ACCESS_ROLE);
void revoke (in DSM:: AccessRole acr)
    raises(INV_ACCESS_ROLE);
};
};

```

#### 7.4.1.2 Semantics

The DSM::AccessRole progresses from lowest privilege to highest privilege as follows: READER, WRITER, BROKER, MANAGER, OWNER. A WRITER has both READER and WRITER privileges. A BROKER has BROKER, WRITER and READER privileges. An OWNER has OWNER, BROKER, WRITER and READER privileges. The creator of an object has OWNER privileges for that object. A MANAGER has all privileges on an object. In order to invoke an operation on an object, the Member must have the required Access Role (as specified by the operation), and must also be a member of one of the corresponding Access Role groups of that object. DSM::Base is inherited and used to destroy() the Member.

**grant()** is used to promote a Member to a higher Access Role.

**revoke()** is used to demote a Member to a lower Access Role.

### 7.4.2 Group interface

The Group interface provides the ability to establish multiple groups in a Domain, with Members in each group.

#### 7.4.2.1 IDL syntax

```

module DAV {
    interface Group : DSM::Base, DSM::Access {
        typedef sequence<Member> MemberList;
        const DSM::AccessRole Role_get_ACR = DSM::MANAGER;
        const DSM::AccessRole addMember_ACR = DSM::MANAGER;
        const DSM::AccessRole addMemberList_ACR = DSM::MANAGER;
        const DSM::AccessRole removeMember_ACR = DSM::MANAGER;
        readonly attribute DSM::AccessRole Role;
        void addMember (in Member aMember);
        void addMemberList (in MemberList members);
        void removeMember (in Member aMember);
    };
};

```

#### 7.4.2.2 Semantics

The Group interface is used to enable a Domain to have multiple Groups with Members in each. DSM::Base is inherited and used to destroy() the Group.

**addMember()** adds a Member to a Group.

**addMemberList()** adds multiple Members at one time to a Group.

**removeMember()** removes a Member from a Group.

### 7.4.3 Domain Interface

The Domain Interface enables the establishment of a boundary around a set of objects that share a common set of attributes. The Domain may be an administrative domain, a security domain, a conference, or other. The domain may be a combination of types. The DAVIC Service Provider Domain is both an Administrative and Security Domain. When inherited with a DSM::Directory, the Domain Interface establishes a containment for the complete Directory graph. A client with MANAGER privileges may establish Groups for and enroll Members to the Domain. Members with READER privileges may gain access to other Members or Groups in the Domain.

Note that MANAGER privileges means that the client has MANAGER or higher Access Role and is a member of one of the MANAGER groups of the Domain object. Also note that READER privileges means that the client has READER or higher Access Role and is a member of one of the READER groups of the Domain object.

#### 7.4.3.1 IDL syntax

```
Module DAV {
    typedef sequence<string> Roster;
    interface RosterIterator {
        const DSM::AccessRole next_n_ACR = DSM::READER;
        const DSM::AccessRole destroy_ACR = DSM::READER;
        void next_n (in unsigned long count, out Roster members);
        void destroy();
    };
    exception NAME_TAKEN{};
    exception INV_NAME{};
    exception NAME_NO_EXIST{};
    exception NOT_A_PEER{};
    // Domain will be typically be inherited with Directory, which inherits Access
    interface Domain {
        typedef DSM::opaque GroupToken;
        typedef unsigned short type;
        typedef sequence<type> CategoryList;
        typedef sequence<string> GroupList;
        const type security = 1;
        const type admin = 2;
        const type conference = 3;
        readonly attribute CategoryList Category;
        //
        const DSM::AccessRole Category_get_ACR = DSM::MANAGER;
        const DSM::AccessRole newMember_ACR = DSM::MANAGER;
        const DSM::AccessRole newGroup_ACR = DSM::MANAGER;
        const DSM::AccessRole findMember_ACR = DSM::BROKER;
        const DSM::AccessRole findGroup_ACR = DSM::BROKER;
        const DSM::AccessRole listMembers_ACR = DSM::READER;
        const DSM::AccessRole listGroups_ACR = DSM::READER;
        const DSM::AccessRole resolveMembers_ACR = DSM::READER;
        const DSM::AccessRole resolveGroups_ACR = DSM::READER;
        void newMember (in string nameId,
                        out DSM::Principal aPrincipal,
                        out Member aMember)
                        raises(INV_NAME, NAME_TAKEN);
        void newGroup (in string nameId, in DSM::AccessRole acr,
                       out GroupToken aToken, out Group aGroup)
                       raises(INV_NAME, NAME_TAKEN);
        void findMember (in string nameId, out Member aMember)
                       raises(NAME_NO_EXIST);
        void findGroup (in string nameId, out Group aGroup)
                       raises(NAME_NO_EXIST);
        void listMembers (in DSM::u_long count, //READER
                          out Roster members, out RosterIterator it);
    };
};
```

```

        void listGroups (out GroupList groups);    //READER
        Object resolveMember(in string nameId)    //READER
            raises(NAME_NO_EXIST, NOT_A_PEER);
        Object resolveGroup(in string nameId)    //READER
            raises(NAME_NO_EXIST);
    };
};

```

### 7.4.3.2 Domain Interface semantics

Exceptions: INV\_NAME indicates the characters or length of the NameId is not valid. NAME\_TAKEN indicates the proposed nameId already exists in this Domain. NAME\_NO\_EXIST indicates the nameId is not present in this Domain. NOT\_A\_PEER indicates the Member is not capable of responding to requests.

**Domain newMember()** creates a new Member object with a unique nameId and PrincipalId in the given Domain.

**Domain newGroup()** creates a new Group with a unique nameId and AccessRole.

**Domain findMember()** will return a Member given a nameId.

**Domain findGroup()** will return a Group given a nameId.

**Domain listMembers()** will list the NameIds of Members in this Domain. The RosterIterator interface is used to iterate through very long lists.

**Domain listGroups()** will list the NameIds of Groups in this Domain.

**Domain resolveMember()** will return an addressable peer object. The exception NOT\_A\_PEER indicates the Member cannot receive messages ( The Member is likely a Client only)

**Domain resolveGroup()** will return an addressable multi-point object for sending messages to a Group of peers.

### 7.4.3.3 RosterIterator Semantics

The RosterIterator is used as a follow-up to Domain listMembers(). It provides a mechanism similar to CosNaming BindingIterator to iterate through very long Member lists

**RosterIterator next\_n** returns the next portion of a Member list

**RosterIterator destroy()** destroys the RosterIterator.

## 8. S3 flow: high and mid-layer protocols

### 8.1 S3 flow description

The S3 flow is a bi-directional flow used for the exchange of control information related to the service to be provided. Server, STU, and delivery system (specific entity in the delivery system, depending on the specific service) may all be involved in the exchange of information. The S3 flow is not transparent to the delivery system at any layer. A number of procedures, required for different services, are classified as requiring an exchange of control information of S3 type. In ISO/IEC 16500 the following control protocols are classified as S3:

- Session Control;
- STU Configuration;
- Interface Initialization;
- Switched Video Broadcasting Channel Change.

### 8.2 Session control

ISO/IEC 16500 will use the DSM-CC User-Network Session Protocol (ISO/IEC 13918-6 clause 4) for session control.

## 8.2.1 Overview of protocol stacks

ISO/IEC 16500-2 defines several scenarios in which the S3 flow for session control must be supported. The diagrams below summarize the protocol stacks used for these scenarios.

|                       |
|-----------------------|
| DSM-CC U-N            |
| TCP/UDP               |
| IP                    |
| AAL5                  |
| ATM                   |
| Lower layer protocols |

**Figure 8.1 — Protocol Stack for Session Control for ATM based transmission**

TCP will be used at the Server side, while UDP will be used at the STU side.

IP shall be carried over ATM according to subclause 11.3.1a “IP”.

The Enhanced Broadcast Scenario defines the physical tools for using the PSTN/ISDN/PLMN channel as a return channel with PPP link.

The difference between the PPP link and the normal DAVIC return channel scenarios is that the PPP link provides a connection to an IP network instead of ATM as all other DAVIC scenarios. When the S3 flow shall be carried over the PPP link, the IP address of the SES<sub>n</sub> entity shall be well known to the STU. DSM-CC U-N messages shall be sent using normal UDP/IP over the PPP link instead of the dedicated ATM virtual circuit used in other DAVIC scenarios.

In this case the protocol stack is as follows:

|            |
|------------|
| DSM-CC U-N |
| UDP        |
| IP         |
| PPP        |
| Phy        |

**Figure 8.2 — Protocol Stack for Session Control for Internet Access for Enhanced Broadcast Scenario.**

It should be noted that in this case the STU needs an IP address for itself in addition to the possible other IP address given to the PC. This IP address will be assigned to the STU using IPCP during the PPP link setup. The IP address for the STU does not need to be a real Internet address; it may be taken from a address space which is defined to be private address space in RFC1597 (i.e., packets from those addresses will not be routed to the Internet, but they may be used for internal communication in the sub-net.)

## 8.2.2 Description of specific protocols

This section describes the specific protocols used in the protocol stacks identified in the section above. Wherever required the protocols layers are grouped by pairs in order to explicitly focus on the mapping issues between different protocols. Only the protocols which are specific to the S3 flow are described in detail, while the protocols which are common to other flows are described in a separate section.

### 8.2.2.1 DSM-CC User-Network

The session control protocol for ISO/IEC 16500 is DSM-CC (ISO/IEC 13818-6) User-Network signaling.

### 8.2.2.2 DSM-CC U-N messages related to session control supported by ISO/IEC 16500

Only some command sequences of the DSM-CC U-N specification for session control are supported in ISO/IEC 16500. These are Client Session Set-Up, Server Add and Release Resource, Server Client and Network Session Tear-Down. In addition the related DSM-CC U-U messages that appear in the command sequences are supported.

Table 8.1 shows the message required for each of the command sequences listed above. The Table also lists the messages required for Session Transfer.

Table 8.1 — DSM-CC U-N messages supported in ISO/IEC 16500

|                   | ISO/IEC 16500 messages                                                                                                                                                                                                                                                                                                     |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Session set-up    | Client Session SetUp Request<br>Server Session SetUp Indication<br>Client Session Proceeding Indication<br>Server Session SetUp Response<br>Client Session SetUp Confirm<br>DSM ServiceGateway attach (Note 1)                                                                                                             |
| Session tear-down | Client Session Release Request<br>Server Session Release Indication<br>Server Session Release Response<br>Client Session Release Confirm<br>Server Session Release Request<br>Client Session Release Indication<br>Client Session Release Response<br>Client Session Release Confirm<br>DSM ServiceGateway detach (Note 1) |
| Service transfer  | DSM ServiceGateway suspend (Note 1)<br>DSM ServiceGateway resume (Note 1)                                                                                                                                                                                                                                                  |
| Add resources     | Server Add Resource Request<br>Client Add Resource Indication<br>Client Add Resource Response<br>Server Add Resource Confirm                                                                                                                                                                                               |
| Release resources | Server Delete Resource Request<br>Client Delete Resource Indication<br>Client Delete Resource Response<br>Server Delete Resource Confirm                                                                                                                                                                                   |
| Miscellaneous     | Server Status Request<br>Server Status Confirm<br>Server Status Indication<br>Server Status Response<br>Client Status Request<br>Client Status Confirm<br>Client Status Indication<br>Client Status Response                                                                                                               |

Note 1: These messages are DSM-CC U-U messages closely associated with the DSM-CC U-N messages in the command sequence.

ISO/IEC 16500 supports only client initiated session set-up. Session tear-down may be initiated by either client, or server, or network (SRM). Session transfer is always initiated by the server. Addition and release of resources is always initiated by the server.

In ISO/IEC 16500-2 other information flows, related to other procedures, are illustrated such as, e.g., Client initiated add resources; however these procedures are to be considered of informative nature only and are not required to be supported by ISO/IEC 16500 compliant systems.

All messages are structured according to the DSM-CC U-N specification defined in ISO/IEC 13818-6. All the procedures are according to ISO/IEC 13818-6. The following section shows the use of the message information elements and parameters for ISO/IEC 16500.

The following DSM-CC User-to-Network command sequences shall be supported for ISO/IEC 16500.

- Client-initiated session set-up
- Server-initiated resource addition
- Server-initiated resource deletion
- Client-initiated session tear-down
- Server-initiated session tear-down
- Network-initiated session tear-down

- Service Transfer

The following tables describe the DSM-CC U-N command sequences and the relevant messages together with notes on the implementation and selected options for DAVIC compliant systems.

### 8.2.2.3 Client-initiated session set-up

This is the basic command sequence used to set-up a session. It follows the DSM-CC specification, with the following options: ClientSessionProceedingIndication is sent after the session proceeding timer 'Sid.tProceed' expired no Connect messages are used.

**Table 8.2 — Client Session Set-Up messages**

| <i>DSM-CC U-N Session Message</i> | <i>Note for the usage</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ClientSessionSetup Request        | <ul style="list-style-type: none"> <li>• The session ID shall be assigned by the STU.</li> <li>• The client ID shall be the E.164 NSAP address of the STU. The E.164 NSAP address HO-DST contains the IP address used in setting the TCP connection for the S2 information flow.</li> <li>• UserData shall be limited to 0x400 bytes.</li> <li>• The UserData field shall contain the input parameters of DSM ServiceGateway Attach which are rClientRef, rClientProfile, aEndUser, aSuspendContext and rPathSpec.</li> </ul>                                                     |
| ClientSession Proceeding          | Sent from the network to the client only when the timer value Sid.tProceed expires before ClientSessionSetupConfirm is sent to the STU.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ServerSessionSetup Indication     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ServerAddResource Request         | <ul style="list-style-type: none"> <li>• No uuData is allowed</li> <li>• The Server shall assign resourceNum to all resources included in the Server Add Resource Request.</li> <li>• The message shall contain resource descriptors for a group of resources providing the S2 connection. If a S1 flow is set-up at session start (e.g., for download purposes), a second set of resource descriptors for the S1 connection will be included in the message. See Note 1 below.</li> <li>• Table 8.9 gives the resource descriptors supported by <i>ISO/IEC 16500</i>.</li> </ul> |
| ServerAddResource Confirm         | <ul style="list-style-type: none"> <li>• In the case of PVC, the AtmConnection resource descriptors shall contain the VPI/VCI selected for the requested ATM channel(s). See Note 1 below.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                             |
| ServerSessionSetup Response       | <ul style="list-style-type: none"> <li>• The uuData field shall contain the output parameters of DSM ServiceGateway Attach which are aResumeContext, rPathRef and rDateTime.</li> </ul> <p>Note 1: When all resources are to be allocated by the server (and not by SRM), as is the case of end-to-end ATM SVC then parameters (i.e., resource descriptors) in ServerAddResourceRequest are carried in ServerSessionSetupResponse, and ServerAddResourceRequest/Confirm are not used.</p>                                                                                         |
| ClientSessionSetup Confirm        | <ul style="list-style-type: none"> <li>• Table 8.9 gives the resource descriptors supported by <i>ISO/IEC 16500</i>.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

#### 8.2.2.3.1 Server-initiated resource addition

This command sequence is used to add in-session resources

**Table 8.3 — Server Add Resource messages**

|                              |                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ServerAddResource Request    | <ul style="list-style-type: none"> <li>In this command sequence, uuData is allowed.</li> <li>The Server shall assign resourceNum to all resources included in this message.</li> <li>Table 8.9 gives the resource descriptors supported by <i>ISO/IEC 16500</i>.</li> </ul>                                                                                 |
| ClientAddResource Indication | <ul style="list-style-type: none"> <li>For the physical instances #3 and #4 of the ATM access network case, the message shall contain the AtmSvcConnection or AtmConnection resource descriptors that indicate VPI and VCI for the added ATM connection(s).</li> <li>Table 8.9 gives the resource descriptors supported by <i>ISO/IEC 16500</i>.</li> </ul> |
| ClientAddResource Response   | This basically is a check that the STU can support the resources agreed upon                                                                                                                                                                                                                                                                                |
| ServerAddResource Confirm    | <ul style="list-style-type: none"> <li>For the physical instance #4, the message shall contain the AtmConnection resource descriptors which indicate VPI and VCI for the added ATM connection(s).</li> </ul>                                                                                                                                                |

**8.2.2.3.2 Server-initiated resource deletion****Table 8.4 — Server Delete Resource messages**

|                                 |                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| ServerDeleteResource Request    | <ul style="list-style-type: none"> <li>The S2 resources are only allowed to be deleted if other S2 resources have been successfully added.</li> </ul> |
| ClientDeleteResource Indication |                                                                                                                                                       |
| ClientDeleteResource Response   |                                                                                                                                                       |
| ServerDeleteResource Confirm    |                                                                                                                                                       |

**8.2.2.3.3 Server-initiated session tear-down****Table 8.5 — Server Session Tear-Down messages**

|                                |  |
|--------------------------------|--|
| ServerSessionReleaseRequest    |  |
| ClientSessionReleaseIndication |  |
| ClientSessionReleaseResponse   |  |
| ServerSessionReleaseConfirm    |  |

**8.2.2.3.4 Client-initiated session tear-down****Table 8.6 — Client-Initiated Session Tear-Down messages**

|                                |                                                                                                                                                  |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| ClientSessionReleaseRequest    | <ul style="list-style-type: none"> <li>The uuData field shall contain the input parameters of DSM ServiceGateway detach<sub>g</sub>.</li> </ul>  |
| ServerSessionReleaseIndication |                                                                                                                                                  |
| ServerSessionReleaseResponse   | <ul style="list-style-type: none"> <li>The uuData field shall contain the output parameters of DSM ServiceGateway detach<sub>g</sub>.</li> </ul> |
| ClientSessionReleaseConfirm    |                                                                                                                                                  |

**8.2.2.3.5 Network-initiated session tear-down****Table 8.7 — Network-Initiated Session Tear-Down messages**

|                                |  |
|--------------------------------|--|
| ClientSessionReleaseIndication |  |
| ServerSessionReleaseIndication |  |
| ClientSessionReleaseResponse   |  |
| ServerSessionReleaseResponse   |  |

## 8.2.2.3.6 Service Transfer

Table 8.8 — Service Transfer

| DSM-CC                           |                                                                                                                                                       | Note for the usage                                                                                                                                                                         |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| U-U msg                          | U-N msg                                                                                                                                               |                                                                                                                                                                                            |
| Scenario I & Scenario II SUSPEND | -                                                                                                                                                     | e-e control passed as an S2 information flow<br>SUSPEND “in” parameters = aReason SUSPEND<br>“out” parameters = aResumeContext<br>Ref: DSM-CC subclause 5.5.6.6 DSM ServiceGateway suspend |
|                                  | Scenario I<br>Client-initiated session tear-down U-N messages                                                                                         | as in Table 8.6 Client initiated session tear-down                                                                                                                                         |
|                                  | Scenario II<br>Server-initiated resource deletion U-N messages                                                                                        | as in Table 8.4 Server delete resource messages                                                                                                                                            |
| ATTACH “in”                      | e-e control carried in the uuData of ClientSessionSetUpRequest and ServerSessionSetUpIndication in Client-initiated session set-up below              | contains parameters<br>(= in ServiceContextList, aPrincipal, downloadInfoReq, aSuspendContext, rPathSpec)                                                                                  |
| ATTACH “out”                     | e-e control carried in the uuData of ServerSessionSetUpResponse and ClientSessionSetUpConfirm in Client-initiated session set-up below                | contains parameters<br>(= out ServiceContextList, downloadInfoResp, aResumeContext, rPathRefs, resolved IORs)                                                                              |
|                                  | Client-initiated session set-up U-N messages                                                                                                          | as in Table 8.2 Client session set-up                                                                                                                                                      |
| DETACH “in”                      | e-e control carried in the uuData of ClientSessionRequest and ServerSessionReleaseIndication in Client-initiated session tear-down U-N messages below | uuData of ClientSessionReleaseRequest contains detach “in” parameters (=aSuspend)<br>Ref: DSM-CC subclause 5.5.6.5 DSM ServiceGateway detach                                               |
|                                  | Client-initiated session tear-down U-N messages                                                                                                       | as in Table 8.6 client initiated session tear-down                                                                                                                                         |
| Scenario II RESUME               | -                                                                                                                                                     | e-e control passed as an S2 information flow<br>RESUME “in” parameters = aSuspendContext,<br>RESUME “out” no parameters<br>Ref: DSM-CC subclause 5.5.6.7 DSM ServiceGateway resume         |
|                                  | Scenario II<br>Server-initiated resource addition                                                                                                     | as in Table 8.3                                                                                                                                                                            |

Scenario I = Server A Session is released

Scenario II = Server A Session resources are minimized

Scenario III = Server A Session kept in full

The Table below illustrates the DSM-CC Resource Types required for *ISO/IEC 16500*. the Resource Types are defined for the two cases of ATM based Access Network (indicated as A) and MPEG TS based Access Network (HFC non-ATM, indicated as B).

**Table 8.9 — DSM-CC Resource Types required by ISO/IEC 16500**

| <i>Physical Instance Scenario</i> | <i>Server-side resources (exist in ServerAddResourceRequest or ServerSessionSetupResponse)</i> | <i>Client-side resources (exist in ClientAddResourceIndication or ClientSessionSetupConfirm)</i>                                                                                                        |
|-----------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                 | AtmSvcConnection<br>SharedResource<br>SharedRequestId<br>MpegProgram<br>Ip                     | A:<br>AtmSvcConnection<br>SharedResource<br>SharedRequestId<br>MpegProgram<br>Ip<br>B:<br>Physical Channel<br>TS Downstream<br>MpegProgram<br>ATM Connection<br>SharedResource<br>SharedRequestId<br>Ip |
| 2                                 | same as 1                                                                                      | same as 1A                                                                                                                                                                                              |
| 3                                 | same as 1                                                                                      | same as 1A                                                                                                                                                                                              |
| 4                                 | same as 1 except AtmConnection replaces AtmSvcConnection                                       | A: same as 1A except AtmConnection replaces AtmSvcConnection<br>B: same as 1 B                                                                                                                          |

### 8.2.3 DSM-CC U-N resource descriptor usage

#### 8.2.3.1 Inclusion of resource descriptors in DSM-CC U-N messages

When a resource (resource A, ex AtmConnection) is used at the underlying layer of another resource (resource B, TsDownStream), resource A is regarded as the ‘parent resource’ of the resource B. The following rule shall be satisfied when resource descriptors are included DSM-CC U-N messages:

Every resource must not be defined in the resource list ahead of its parent resource.

#### 8.2.3.2 Usage of fields

Table 8.10 shows the usage of resource descriptor field. The usage is specified for each resource descriptor field in each message.

Table 8.10 — Resource Descriptor Field Usage

| Descriptor Type   | Field Name             | Usage (Notes 1 and 2) |                      |          |                 |
|-------------------|------------------------|-----------------------|----------------------|----------|-----------------|
|                   |                        | Request               | Indication           | Response | Confirm         |
| Atm Connection    | atmAddress             | I(S)                  | I(S)                 | Ind      | Req             |
|                   | atmVci                 | I(S)                  | I(S)                 | Ind      | Req             |
|                   | atmVpi                 | I(S)                  | I(S)                 | Ind      | Req             |
| AtmSvc Connection | CalledPartyNumber      | I(S)                  | N / I(S)<br>(Note 3) | Ind      | Req             |
|                   | CalledPartySubaddress  | I(S)                  | N / I(S)<br>(Note 3) | Ind      | Req             |
|                   | CallingPartyNumber     | I(S)                  | N / I(S)<br>(Note 3) | Ind      | Req             |
|                   | CallingPartySubaddress | I(S)                  | N / I(S)<br>(Note 3) | Ind      | Req             |
|                   | TrafficDescriptor      | I(S)                  | N / I(S)<br>(Note 3) | Ind      | Req             |
|                   | ConnectionIdentifier   | N                     | N / I(S)<br>(Note 3) | Ind      | N               |
| TsDown Stream     | downstreamBandwidth    | I(S)                  | I(S)                 | Ind      | Req             |
|                   | downstreamTransportId  | I(S)                  | I(S)                 | Ind      | Req             |
| Mpeg Program      | mpegProgramNum         | I(S)                  | I(S)                 | Ind      | Req             |
|                   | mpegPmtPid             | I(S)                  | I(S)                 | Ind      | Req             |
|                   | mpegCaPid              | I(S)                  | I(S)                 | Ind      | Req             |
|                   | mpegPidCount           | I(S)                  | I(S)                 | Ind      | Req             |
|                   | mpegPid                | I(S)                  | I(S)                 | Ind      | Req<br>(Note 4) |
|                   | stream_type            | I(S)                  | I(S)                 | Ind      | Req             |
|                   | associationTag         | I(S)                  | I(S)                 | Ind      | Req             |
| Ip<br>(Note 5)    | sourceIPAddress        | I(S)                  | I(S)                 | Ind      | Req             |
|                   | sourceIPPort           | I(S)                  | I(S)                 | Ind      | Req             |
|                   | destinationIPAddress   | I(S)                  | Req                  | Req      | Req             |
|                   | destinationIPPort      | N                     | N                    | I(S)     | N/I(S)          |
|                   | ipProtocol             | I(S)                  | I(S)                 | Ind      | Req             |
| Physical Channel  | channelId              | (Note 6)              | I(S)                 | Ind      | (Note 6)        |
|                   | direction              | (Note 6)              | I(S)                 | Ind      | (Note 6)        |
| Shared Resource   | sharedResourceNum      | I(S)                  | I(S)                 | Ind      | Req             |

Note 1: The columns “in Req”, “in Ind”, “in Resp” and “in Conf” indicate the usage in ServerAddResourceRequest, ClientAddResourceIndication, ClientAddResourceResponse and ServerAddResourceConfirm messages, respectively. When resource descriptors are included in a ServerSessionSetupResponse message, the usage of fields should follow the usage in ServerAddResourceRequest. When resource descriptors are included in a ClientSessionSetupConfirm message, the usage of fields should follow the usage in ClientAddResourceIndication message.

Note 2: The following notations are defined for the usage of fields:

N: The field shall be null in the message

I(S): The field shall be indicated in the single form.

I(R): The field shall be indicated in the range form.

I(L): The field shall be indicated in the list form.

Ind: The field shall be identical to the one in the associated indication message.

Req: The field shall be identical to the one in the associated request message.

Note 3: The field should be indicated in the Physical Instance #3, and should be null in other instances.

Note 4: The implication is that the network should perform PID re-mapping when the server side PIDs and client side PIDs are different.

Note 5: For Ip resource descriptors, the term ‘source’ is used for the server, and the term ‘destination’ is used for the client. See 1.1.3 for additional constraints on the usage of Ip resources.

Note 6: The descriptor is used only in the client side.

## 8.2.4 DAVIC-defined resource descriptors

### 8.2.4.1 EnhancedBroadcast descriptor

The EnhancedBroadcast descriptor covers the following modes:

- 1 = with MPEG TS and PSTN/NISDN/PLMN Downstream and PSTN/NISDN/PLMN Upstream
- 2 = with MPEG TS Downstream and PSTN/NISDN/PLMN Upstream
- 3 = PSTN/NISDN/PLMN Downstream and Upstream

### 8.2.4.2 DhcpOffer descriptor

The DhcpOffer descriptor covers the following parameters (RFC 1541 RFC 1533):

|         |                                                                                                                                                                                                                                                                                                                                                |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| htype   | Hardware address type = 1 for 10mb Ethernet                                                                                                                                                                                                                                                                                                    |
| hlen    | = 6 for 10mb Ethernet                                                                                                                                                                                                                                                                                                                          |
| hops    | = 0                                                                                                                                                                                                                                                                                                                                            |
| xid     | Transaction ID, a random number chosen by the client, used by the client and server to associate messages and responses between a client and a server                                                                                                                                                                                          |
| secs    | = 0                                                                                                                                                                                                                                                                                                                                            |
| ciaddr  | = 0                                                                                                                                                                                                                                                                                                                                            |
| yiaddr  | IP address offered to client                                                                                                                                                                                                                                                                                                                   |
| siaddr  | IP address of next bootstrap server                                                                                                                                                                                                                                                                                                            |
| flags   | if 'giaddr' is not 0 then 'flags' from client message else 0                                                                                                                                                                                                                                                                                   |
| chaddr  | identical to 4=1                                                                                                                                                                                                                                                                                                                               |
| giaddr  | identical to 4                                                                                                                                                                                                                                                                                                                                 |
| sname   | Server host name or options                                                                                                                                                                                                                                                                                                                    |
| file    | Client boot file name or options                                                                                                                                                                                                                                                                                                               |
| options | Requested IP address - MUST NOT<br>IP address lease time - MUST<br>Use 'file'/'sname' fields - MAY<br>DHCP message type - DHCPOFFER<br>Parameter request list - MUST NOT<br>Message - SHOULD<br>Client identifier - MUST NOT<br>Class identifier - MUST NOT<br>Server identifier - MUST<br>Maximum message size - MUST NOT<br>All others - MAY |

## 8.2.5 Operations to cope with rainy day scenarios

### 8.2.5.1 Status check procedure

The following usage of DSM-CC U-N Status operation shall be supported for the SRM to detect unexpected terminal down.

- If the network did not receive any DSM-CC U-N message from a terminal (STB or Server) for some pre-determined period of time, the network (SESn) may send a ClientStatusIndication or ServerStatusIndication message to the terminal. The statusType field of the messages shall be set to 0x0001, which indicates request of a list of the active sessions. Upon the receipt of the request message, the terminal shall send a ClientStatusResponse or ServerStatusResponse message to the network.

- If the terminal did not respond to the status request message, the network shall release the sessions associated with the terminal. To release the sessions, the network shall send a ClientSessionReleaseIndication or ServerSessionReleaseIndication message to the counterpart terminal of each session. The reason code to be included in ClientSessionReleaseIndication shall be set to 0x0004 (RsnSeProcError) which indicates that procedure error has been detected at the Server. The reason code to be included in ServerSessionReleaseIndication shall be set to 0x0002 (RsnClProcError).

### 8.2.5.2 Reset procedure

DSM-CC U-N Reset operation shall be supported for the terminal to request the SRM to release all active sessions in case of terminal failure.

## 8.3 STU configuration

ISO/IEC 16500 will use the DSM-CC U-N Configuration protocol (ISO/IEC 13818-6 clause 3) for the configuration of the STU. The STU configuration operation allows the STU to get necessary information to start session set-up (e.g., IP address). In the following, the STU configuration server is defined as the network-side peer entity of the STU configuration.

### 8.3.1 Overview of protocol stacks

|                          |
|--------------------------|
| DSM-CC U-N configuration |
| UDP                      |
| IP                       |
| LLC/SNAP                 |
| AAL5                     |
| ATM                      |
| Physical Layer           |

Figure 8.3 — Protocol stack for STU configuration

### 8.3.2 Description of specific protocols

Step 1: The STB sends a DSM-CC U-N configuration request message with a UDP/IP datagram. If the STB knows the IP address of the STU configuration server, the STB shall fill this address in the IP header field of the message as the destination address. Otherwise the STB shall set the destination address to 255.255.255.255 (all 1). The destination port number shall be the well-known value assigned to DSM-CC U-N. If the STB knows its own IP address for STU configuration, the STB shall set this address in the IP header field of the message as the source address. Otherwise the source IP address shall be set to 0.0.0.0 (all 0).

Step 2: Upon the reception of a DSM-CC U-N configuration request, the STU configuration server formulates a DSM-CC U-N configuration confirm message and sends it to the STB with a UDP/IP datagram. If the source IP address of the configuration request message is 0.0.0.0, the destination IP address of the configuration confirm message shall be set to 255.255.255.255. Otherwise, the destination IP address of the configuration confirm message shall be the source IP address of the configuration request message.

#### 8.3.2.1 Usage of DSM-CC U-N configuration messages

The usage of networkParameter field in networkConfigurationParameters() of DSM-CC U-N configuration confirm is specified in the below table.

| parameters                    | # of octets |
|-------------------------------|-------------|
| networkNumberingPlanIndicator | 1           |
| sessionControlChannelFlag     | 1           |
| srmIpAddress                  | 4           |
| stbIpAddress                  | 4           |

**Parameters:**

networkNumberingPlanIndicator: as specified in ISO/IEC 16500-2 clause 10 (Note: this parameter is only useful when the VC for STU configuration is a PVC).

sessionControlChannelFlag: This parameter indicates whether the STB needs to establish a separate ATM VC for DSM-CC session control. If the value is 0x00, the STB may use the same ATM VC for STB configuration and DSM-CC session control. If the value is 0x01, the STB shall obtain necessary information through DIIP and avail a separate VC for DSM-CC session control.

srmIpAddress: This parameter indicates the SRM's IP address.

stbIpAddress: This parameter indicates the STB's IP address for DSM-CC session control.

## 8.4 Interface initialization (DIIP)

This section specifies the method of assigning to the STB the initial parameters that allow connections (channels) from the STB to different network entities (e.g., SESn, BCU-Broadcast Control Unit) to be used. The protocol specified in this section is called DIIP (DAVIC Interface Initialization Protocol 1.0).

The specification is based on the following principles:

1. Each protocol message is transported using one ATM-cell.
2. The protocol runs on the 'one transaction for one channel basis, which means that if more than one channel is needed, then multiple transactions are required.
3. The protocol is defined for a point to point configuration. The usage for point to multi-point configurations is for further study.
4. The protocol is defined to be used independent of the physical architecture on which it is transported. This implies that the user side termination point of the protocol resides inside the STU.
5. The protocol operates over a specific predefined VPI/VCI value.
6. The protocol supports both provisioned VC (PVC) allocated by the network or switched VC (SVC) to be established. In the case of PVC, the VPI/VCI of the channel is notified to the STB. In the case of SVC, the DIIP protocol returns the network address of the entity to which a connection shall established.

### 8.4.1 Overview of protocol stacks

|          |
|----------|
| DIIP 1.0 |
| AAL5-CP  |
| ATM      |
| PHY      |

Figure 8.4 — Protocol stack for interface initialization

The messages are carried with a fixed VPI,VCI value. Another value than VPI,VCI=0,1 should be used to allow co-existence with meta-signaling as defined in ITU-T Q.2120.

### 8.4.2 Description of specific protocols

The DIIP 1.0 utilizes the following three messages:

- ASSIGN\_REQUEST
- ASSIGNED
- DENIED

according to the following procedure: