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Information technology — Coding of audio-visual objects —

Part 6: Delivery Multimedia Integration Framework (DMIF)

Technologies de l'information — Codage des objets audiovisuels —

Partie 6: Charpente d'intégration de livraison multimédia (DMIF)

Reference number
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Contents

Page

1 Scope 1

2 Conformance 1
2.1 Requirements for conformance 1
2.2 DMIF-Application Interface 1
2.3 DMIF signalling messages 2

3 Normative references 2

4 Terms and definitions 2

5 Abbreviations 3

6 Organization of this part of ISO/IEC 14496 3

7 Compliance terms 5

8 DMIF overview 5
8.1 ISO/IEC 14496 terminal architecture 5
8.2 The objectives of DMIF 6
8.3 The DMIF communications architecture 6
8.4 DMIF computational model 8
8.5 DMIF QoS model 9
8.6 The User Plane in the Delivery Layer 9

9 Remote interactive scenario 10
9.1 Additional requirements 10
9.1.1 Introduction 10
9.1.2 Billing policies 11
9.1.3 Possible evolution to Heterogeneous Networks 11
9.2 DMIF within the context of the ISO/OSI layers 11

10 The DMIF-Application Interface 12
10.1 The DMIF-Application Interface key concepts 12
10.2 Common semantic elements 13
10.2.1 channelDescriptor 13
10.3 DMIF-Application Interface primitives 15
10.4 DMIF-Application Interface semantics 17
10.4.1 DA_ServiceAttach () 17
10.4.2 DA_ServiceAttachCallback () 18
10.4.3 DA_ServiceDetach () 18
10.4.4 DA_ServiceDetachCallback () 18
10.4.5 DA_ChannelAdd () 18
10.4.6 DA_ChannelAddCallback () 19
10.4.7 DA_ChannelDelete () 19
10.4.8 DA_ChannelDeleteCallback () 19
10.4.9 DA_UserCommand () 19
10.4.10 DA_UserCommandCallback () 19
10.4.11 DA_Data () 19
10.4.12 DA_DataCallback () 20
10.4.13 DA_UserCommandAck() 20
10.4.14 DA_UserCommandAckCallback() 20
10.4.15 DA_ChannelMonitor() 20
10.4.16 DA_ChannelEvent() 20
10.5 QoS Monitoring 21
10.5.1 Monitoring events 21

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10.5.2 qosMode 21
10.5.3 qosReport 23

11 The DMIF-Network Interface 23
11.1 The DMIF-Network Interface key concepts 23
11.2 Common syntax elements 24
11.2.1 DMIF Descriptors 24
11.2.2 DMIF to DMIF data 26
11.2.3 Resource Descriptors 26
11.2.4 Direction parameter 28
11.2.5 Reason parameter 28
11.2.6 Response parameter 28
11.2.7 channelDescriptor and qosDescriptors 29
11.3 DMIF-Network Interface primitives 34
11.4 DMIF-Network Interface semantics 36
11.4.1 DN_SessionSetup () 36
11.4.2 DN_SessionRelease () 36
11.4.3 DN_ServiceAttach () 36
11.4.4 DN_ServiceDetach () 37
11.4.5 DN_TransMuxSetup () 37
11.4.6 DN_TransMuxRelease () 37
11.4.7 DN_ChannelAdd() 37
11.4.8 DN_ChannelAdded() 38
11.4.9 DN_ChannelDelete () 38
11.4.10 DN_TransMuxConfig () 39
11.4.11 DN_UserCommand () 39
11.4.12 DN_UserCommandAck () 39

12 Control Plane mappings 40
12.1 Default syntax 40
12.1.1 Syntax elements 40
12.1.2 DNI mapping to DMIF signalling messages 46
12.2 Syntax for IP networks with (or without) RSVP signalling, using TCP for DMIF signalling 56
12.2.1 Approach overview 56
12.2.2 DSM-CC Resource Descriptors used 56
12.2.3 Usage of networkSessionIds 56
12.2.4 Usage of transactionIds 57
12.2.5 DNI mapping to socket actions and RSVP signalling 57
12.3 Syntax for IP networks with (or without) RSVP Signalling, using UDP for DMIF signalling 59
12.3.1 Approach overview 60
12.3.2 DSM-CC Resource Descriptors used 60
12.3.3 Usage of networkSessionIds 60
12.3.4 Usage of transactionIds 60
12.3.5 DNI mapping to socket actions and RSVP signalling 60
12.4 Syntax for ATM networks with Q.2931 signalling 61
12.4.1 Approach overview 61
12.4.2 DSM-CC Resource Descriptors used 61
12.4.3 Usage of networkSessionIds 61
12.4.4 Usage of transactionIds 61
12.4.5 DNI mapping to Q.2931 signalling messages 62
12.5 Syntax for Networks with ITU-T H.245 Signaling 66
12.5.1 Approach overview 66
12.5.2 DSM-CC Resource Descriptors used 66
12.5.3 Usage of networkSessionIds 66
12.5.4 Usage of transactionIds 67
12.5.5 DNI mapping to H.245 Signaling messages 67
12.5.6 Data transmission procedures 68

13 Terminal Capability Matching 68
13.1 DMIF Default signalling with Compatibility Descriptors 68

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Annex A (informative) **Overview of DAI and DNI parameters** 69
A.1 Sessions and services 69
A.2 Channels 69

Annex B (informative) **Information flows for DMIF** 71
B.1 Information flows for Remote Interactive DMIF 71
B.1.1 Initiation of a service in a Remote Interactive DMIF 72
B.1.2 Addition of Channels in a Remote Interactive DMIF 74
B.1.3 Deletion of Channels in a Remote Interactive DMIF 80
B.1.4 Termination of a Service in a Remote Interactive DMIF 82
B.2 Information Flows for Broadcast DMIF 83
B.2.1 Initiation of a service in a Broadcast DMIF 84
B.2.2 Addition of Channels in a Broadcast DMIF 85
B.2.3 Deletion of Channels in a Broadcast DMIF 86
B.2.4 Termination of a service in a Broadcast DMIF 87
B.3 Information Flows for Local Storage DMIF 87
B.3.1 Initiation of a service in a Local Storage DMIF 88
B.3.2 Addition of Channels in a Local Storage DMIF 89
B.3.3 Deletion of Channels in a Local Storage DMIF 90
B.3.4 Termination of a service in a Local Storage DMIF 91

Annex C (informative) **Use of URLs in DMIF** 92
C.1 Introduction 92
C.2 Generic concepts 92
C.3 URL schemes allowed in DMIF 92
C.4 New URL schemes 92
C.4.1 URL scheme for DMIF signalling over UDP/IP 93
C.4.2 URL scheme for DMIF signalling over TCP/IP 93
C.4.3 URL scheme for DMIF signalling over networks using NSAP addresses format 93

Annex D (informative) **Protocol error recovery** 94
D.1 Timouts and retransmission 94
D.2 Transaction state variables 94
D.2.1 Transaction identifier: Tid 94
D.2.2 Transaction state: Tid.state 94
D.2.3 Associated session: Tid.Sid 94
D.2.4 Transaction message timeout: Tid.tMessage 94
D.2.5 Expired transactionId holding timer: Tid.tHold 95
D.2.6 Transaction message: Tid.message 95
D.2.7 Tid.retransBound 95
D.2.8 Tid.numRetrans 95
D.3 Transaction Identifier State Machine 95
D.4 Transaction Identifier State table 96

Annex E (informative) **Subset of DSM-CC resource descriptors from DSM-CC ISO/IEC 13818-6** 98
E.1 ResourceDescriptor format 98
E.1.1 ResourceDescriptorDataField 98
E.1.2 Specifying ranges and lists of values in resource descriptors 99
E.2 Resource descriptor types useful to this part of ISO/IEC 14496 101
E.3 Resource descriptor definitions 102
E.3.1 AtmSvcConnection resource descriptor definition 102
E.3.2 IP resource descriptor definition 102
E.3.3 AtmVcConnection resource descriptor definition 103

Annex F (informative) **ISO/IEC 14496 content carried over an ETS 300 401 system** 104
F.1 Introduction 104
F.2 ISO/IEC 14496 content embedded in an ETS 300 401 multiplex 104
F.2.1 Overview of ETS 300 401 payload transmission 104
F.2.2 Object descriptor encapsulation 105
F.2.3 Scene description stream encapsulation 109
F.2.3.1 BIFSCommandDataField 110

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F.2.4 ClockReferenceStream encapsulation **111**
F.2.5 Audiovisual stream encapsulation **111**
F.2.6 ISO/IEC 14496 stream indication in ETS 300 401 Service Information **112**
F.3 Walkthrough of a typical MPEG-4 session carried in an ETS 300 401 system **112**
F.3.1 General **112**
F.3.2 Start of a session **113**
F.3.3 Retrieval of the InitialOD **113**
F.3.4 Retrieval of the subsequent BIFS and Object Descriptor streams **113**
F.3.5 Retrieval of the clock reference and the audio-visual streams **113**
F.3.6 Dynamic changes to the scene **113**
F.4 Mapping of DAI procedures to ETS 300 401 procedures **113**
F.4.1 Initiation of an MPEG-4 service in a DAB system **114**
F.4.2 Addition of channels in an MPEG-4 service in a DAB system **114**
F.4.3 Deletion of Channels in an MPEG-4 service in a DAB system **115**
F.4.4 Termination of a service in an MPEG-4 service in a DAB system **115**

Annex G (informative) **Patent statement** **116**
G.1 Patent statement **116**

Annex H (informative) **ISO/IEC 14496 content carried over an H.324 system** **118**
H.1 Introduction **118**
H.2 Walkthrough of a typical MPEG-4 session carried in an H.324 system **118**
H.2.1 General **118**
H.2.2 Start of a session **118**
H.2.3 Retrieval of the InitialOD **118**
H.3 Mapping of DAI procedures to H.245 procedures **118**
H.3.1 Initiation of a service in a Remote Interactive DMIF **119**
H.3.2 Addition of Channels in a Remote Interactive DMIF **119**
H.3.3 Deletion of Channels in a Remote Interactive DMIF **121**
H.3.4 Termination of a Service in a Remote Interactive DMIF **122**

Annex I (informative) **DMIF Application Programming Interface – Syntax definition** **123**
I.1 Objectives of this Annex **123**
I.2 DAI protocol flow **123**
I.3 Application Programming Interface **124**
I.3.1 DMIF primitives **124**
I.4 DMIF Application Programming Interface – ANSI C/C++ **126**
I.4.1 Reference Implementation **126**

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Foreword

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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 14496 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 14496-6 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 14496-6:1999), which has been technically revised.

ISO/IEC 14496 consists of the following parts, under the general title *Information technology — Coding of audio-visual objects*:

— *Part 1: Systems*

— *Part 2: Visual*

— *Part 3: Audio*

— *Part 4: Conformance testing*

— *Part 5: Reference software*

— *Part 6: Delivery Multimedia Integration Framework (DMIF)*

Annexes A to I of this part of ISO/IEC 14496 are for information only.

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Introduction

The digital technology has transformed the generation, storage and communication of information. With this, the information age was borne allowing humankind to generate multimedia contents, communicate them and store them in meaningful ways. Digitization has also meant a rich variety of delivery and storage technologies, each bringing its own unique characteristics, over which multimedia material is communicated, broadcast or stored. The MPEG Delivery Multimedia Integration Framework (DMIF) allows each delivery technology to be used for its unique characteristics in a way transparent to application developers. DMIF specifies the semantics for the DMIF-Application Interface (DAI) in a way that it satisfies the requirements for both broadcast, local storage and remote interactive scenarios while maintaining uniformity across all cases. By including the ability to bundle connections into sessions DMIF enables network operators to apply appropriate billing policies in the provision of multimedia services. By adopting QoS metrics which relate to the media and not to the transport mechanism, DMIF hides the delivery technology details to applications. These unique features of DMIF give multimedia application developers what they need in terms of permanence and richness beyond what is possible with each individual delivery technology. With DMIF, application developers can begin to invest in commercial multimedia applications with the assurance that their investment will not be made obsolete by new delivery technologies. In order to fully reach its goal, DMIF needs "real" instantiation of its DMIF-Application Interface, and well defined, specific mappings of DMIF concepts and parameters into existing signalling infrastructures.

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Information technology — Coding of audio-visual objects —

Part 6:
Delivery Multimedia Integration Framework (DMIF)

1 Scope

This part of ISO/IEC 14496 specifies the Delivery Layer of ISO/IEC 14496, which allows applications to transparently access and view multimedia streams whether the source of the streams is located on an interactive remote end-system, the streams are available on broadcast media or they are on storage media.

In this part of ISO/IEC 14496, the following aspects are covered:

DMIF communication architecture

DMIF-Application Interface (DAI) definition

URL semantic to locate and make available the multimedia streams

DMIF Default Signalling Protocol (DDSP) for remote interactive scenarios, and its related variations using existing native network signaling protocols

Information flows for player access to streams on remote interactive end-systems, from broadcast media or from storage media

2 Conformance

2.1 Requirements for conformance

DMIF conformance is only requested at the boundary of the equipment implementing a DMIF Instance. This includes the syntax and semantics of the particular Control protocol selected for a particular network (e.g., DMIF signalling messages), as well as the compliance to the mappings defined for broadcast and local storage systems.

DMIF conformance specifications is provided in ISO/IEC 14496-4.

2.2 DMIF-Application Interface

The DAI is a reference point. The exact syntax of the DAI is not defined by this part of ISO/IEC 14496, and does not represent a conformance point.

The DAI does not impose any programming language, nor syntax (e.g., the exact format for specifying a particular parameter -within the bounds of its semantic definition- or the definition of reserved values). Moreover the DAI provides only the minimal semantics for defining the behaviour of DMIF.

A real interface needs more than what is specified in the DAI (e.g.; methods to initialise, reset, reconfigure, destroy, query the status or register services). Most of these aspects, as well as the detailed syntax, deeply depend on the implementation and language bindings. Moreover such details have no impact on the DMIF model and on the conformance issues, and therefore they are out of the scope of DMIF.

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2.3 DMIF signalling messages

This part of ISO/IEC 14496 specifies the syntax and semantics of a few instances of protocols for DMIF peer to DMIF peer interactivity, designed for specific network environments. A DMIF Instance making use of one of the specified protocols shall fully comply to it. A DMIF Instance implementing a protocol not specified in this International Standard cannot be tested for conformance, but may still be evaluated at the DAI Reference Point.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14496. 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 14496 are encouraged to investigate the possibility of applying the most recent editions of the normative documents 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.

ETS 300 401:1997, *Radio broadcasting systems: Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers*.

IEEE 802:1990, *IEEE Organization Unique Identifier*.

ISO/IEC 13818-6:1998, *Information technology — Generic coding of moving pictures and associated audio information — Part 6: Extension for DSM-CC*.

ISO/IEC 14496-1:—[1)], *Information technology — Coding of audio-visual objects — Part 1: Systems*.

ITU-T Recommendation Q.2931:1995, *Broadband Integrated Services Digital Network (B-ISDN) — Digital Subscriber Signalling System No. 2 (DSS 2) — User-Network Interface (UNI) — Layer 3 specification for basic call/connection control*.

ITU-T Recommendation E.164:1997, *The international public telecommunication numbering plan*.

RFC1738:1994, *Uniform Resource Locators (URL)*.

4 Terms and definitions

For the purposes of this part of ISO/IEC 14496, the following terms and definitions apply.

4.1 Association Tag: In the context of this specification an Association Tag is used to identify elements within a Network Session with unique end-to-end significant values.

4.2 Channel: Is the entity over which a DMIF User sends or receives data.

4.3 Delivery layer: The layer of an ISO/IEC 14496 terminal that abstracts the delivery mechanism used to store or transmit streaming data and associated control information.

4.4 DMIF-Application Interface: Is the interface between an application (DMIF User) and the Delivery layer.

4.5 DMIF Default Signalling Protocol (DDSP): A session level protocol for the management of multimedia streaming over generic delivery technologies defined in this part of ISO/IEC 14496. The protocol comprises primitives to setup and tear down sessions as well as individual data channels.

4.6 DMIF Instance: Is an implementation of the Delivery layer for a specific delivery technology.

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1) To be published. (Revision of ISO/IEC 14496-1:1999)

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4.7 DMIF-Network Interface: Is a semantic API that abstracts the signalling between DMIF peers irrespectively of the delivery support.

4.8 DMIF peer: a shorthand for "peer DMIF Instance".

4.9 DMIF User: Is the application that exploits the functions offered by the Delivery Layer through the DAI.

4.10 Heterogeneous Network: A Network composed of different transport technologies which are connected in tandem through InterWorking Units.

4.11 Homogeneous Network: A Network composed of one transport technology only.

4.12 Network Session: An association between two DMIF peers providing the capability to group together the resources needed for an instance of a service. The Network Session is identified by a network-wide unique ID. A Network Session could group one or more Service Sessions.

4.13 Service: Is an entity identified by a Service Name (opaque to DMIF) which responds to DAI primitives.

4.14 Service Session: A local association between the local DMIF Instance and a particular service.

4.15 Transmux Channel: A native network transport channel: it includes the transport protocol stack that is directly supported by the signalling means of the network. It provides the basic transport stack element that DMIF may complement with additional multiplexing or protection tools.

5 Abbreviations

CAT: Channel Association Tag

DAI: DMIF-Application Interface

DDSP: DMIF Default Signalling Protocol

DS: DMIF Signaling

DNI: DMIF-Network Interface

QoS: Quality of Service

TAT: Transmux Association Tag

URL: Universal Resource Locator

6 Organization of this part of ISO/IEC 14496

This part of ISO/IEC 14496 contains the following technical clauses:

Clause	Definition
8	DMIF Overview - This clause explains how DMIF reaches its two-fold goal of hiding the delivery technology details from the DMIF User, and ensuring interoperability between end-systems. It describes the DMIF communications architecture and explains how this architecture can support current and future delivery technologies, preserving application from continuous updates to follow evolving technologies.
9	The remote interactive scenario - In this clause the additional requirements due to a remote

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interactive scenario are considered.

10 The DMIF-Application Interface - This clause defines a (semantic) API, called the DAI, that allows for the development of applications involving media content delivery, irrespective of delivery technology. The DAI provides primitives for contacting remote services, for establishing data communication channels with these services, and also exchanging data over these channels. It should be noted that the DAI provides a minimum semantics, which means that a DMIF User would have to turn to a specific implementation of the DAI for a syntax; moreover this implementation would probably provide additional functionality. The only elements whose syntax is specified at the DAI are the URL, for locating services.

11 The DMIF-Network Interface (informative) - The DMIF-Network Interface (DNI) is a semantic API that abstracts the signalling between DMIF peers irrespectively of the delivery support. The DNI is informative, and is introduced in support to the description of the DMIF Signalling Protocol.

12 Control Plane mappings - This clause describes the mappings of the DNI primitives into DMIF Signalling Protocol messages. A Default DMIF Signalling Protocol is specified as well as a set of mappings into native network signalling protocols (extended through additional DMIF signalling messages, usually carried opaque to native signalling in a dedicated channel). These specifications ensure that different implementations of a DMIF Instance interoperate.

13 Terminal Capability Matching – Specifies how DMIF determines compatibility between DMIF terminals.

Annex A Overview of DAI and DNI parameters (informative) - This Annex provides the glue to link concepts and parameters as defined in DAI and DNI.

Annex B Information Flows for DMIF (informative) - This Annex defines the scenarios for remote interactive end-system, broadcast and local storage DMIF implementations.

Annex C Use of URLs in DMIF (informative) - This Annex defines the URL schemes currently supported.

Annex D Protocol error recovery (informative) – This Annex specifies the state machine for the transactions in the DMIF Signalling Protocol.

Annex E Subset of DSM-CC resource descriptors from DSM-CC ISO/IEC 13818-6 (informative) – This Annex reports selected dsm-cc resource descriptors from ISO/IEC 13818-6 that are used by this part of ISO/IEC 14496.

Annex F ISO/IEC 14496 content carried over an ETS 300 401 System (informative) – This Annex defines how ISO/IEC 14496 content can be carried over an ETS 300 401 System (DAB), and describes how to access it through the DMIF-Application Interface.

Annex G Patent statement (informative)

Annex H ISO/IEC 14496 content carried over an H.324 system (informative)

Annex I DMIF Application Programming Interface – Syntax definition (informative)

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7 Compliance terms

The following table defines the meaning of terms used in this part of ISO/IEC 14496:

Table 7—1 — Definition of terms used in this part of ISO/IEC 14496

Term	Definition
shall	Means that an item is required. For example, the phrase “The widget shall be blue.” means that no color other than blue is acceptable for the widget.
shall not	Means that an item is not allowed. For example, the phrase “The widget shall not be blue.” means that the color blue is not acceptable for the widget.
must	Not used. Use “shall” instead.
must not	Not used. Use “shall not” instead.
should	Means that, if possible, an item shall be used. For example, the phrase “The widget should be blue.” Means that blue is the preferred color for the widget but, if blue is not possible, other colors are acceptable.
should not	Means that, if possible, an item shall not be used. For example, the phrase “The widget should not be blue.” Means that it is preferred that the color of the widget not be blue, however it is allowable to use that color if necessary.
may	Means that an item is optional. For example, the phrase “The widget may be blue.” Means that it is allowable to use blue as the widget color.
may not	Not used. Use “shall not” instead.

8 DMIF overview

8.1 ISO/IEC 14496 terminal architecture

The generic ISO/IEC 14496 terminal architecture is depicted in Figure 1. It comprises three layers: the Compression Layer, the Sync Layer and the Delivery Layer. The Compression Layer is media aware and delivery unaware; the Sync Layer is media unaware and delivery unaware; the Delivery Layer is media unaware and delivery aware.

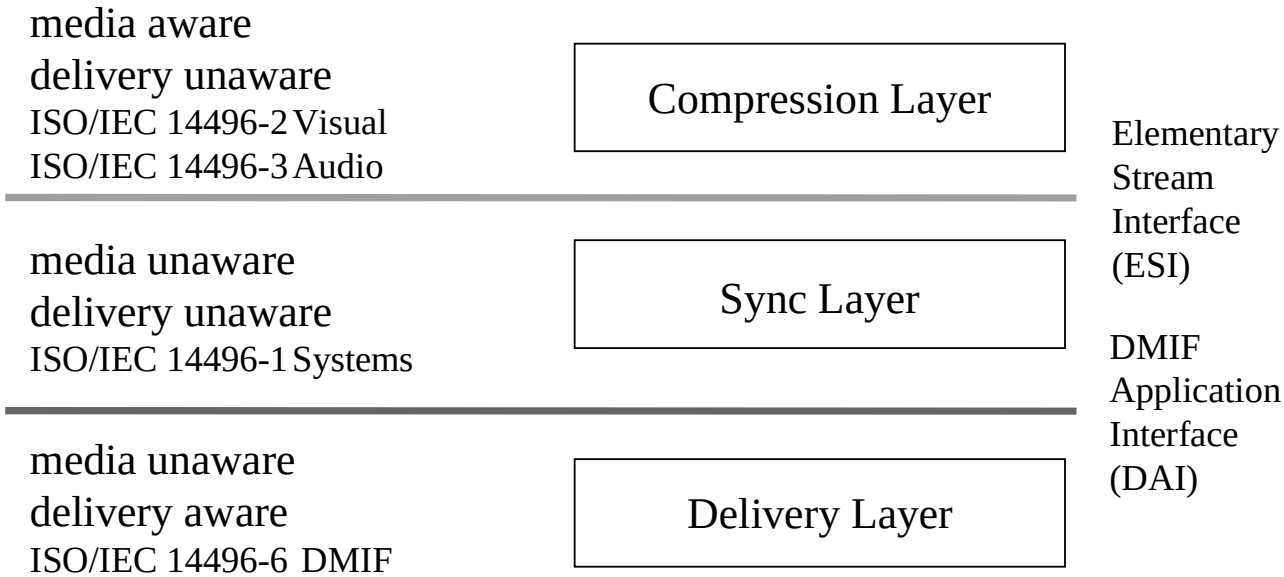

Figure 1 — ISO/IEC 14496 terminal architecture

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The Compression Layer performs media encoding and decoding of Elementary Streams and is specified in ISO/IEC 14496-2:1999 and ISO/IEC 14496-3:1999; the Sync Layer manages Elementary Streams and their synchronisation and hierarchical relations and is specified in ISO/IEC 14496-1:2001; the Delivery Layer ensures transparent access to content irrespective of delivery technology and is specified in this part of ISO/IEC 14496.

The boundary between the Compression Layer and the Sync Layer is named Elementary Stream Interface (ESI) and its minimum semantic is specified in ISO/IEC 14496-1:2001.

The boundary between the Sync Layer and the Delivery Layer is named DMIF-Application Interface (DAI) and its minimum semantic is specified in this part of ISO/IEC 14496.

8.2 The objectives of DMIF

The Delivery Multimedia Integration Framework has a number of objectives:

to hide the delivery technology details from the DMIF User

to manage real time, QoS sensitive channels

to allow service providers to log resources per session for usage accounting

to ensure interoperability between end-systems

DMIF defines a communication architecture that hides the details of the delivery technologies below an interface that is exposed to the application, called the DMIF-Application Interface (DAI). Delivery technologies include transport network technologies (e.g., the Internet, or an ATM infrastructure), as well as broadcast technologies and local storage technologies.

The DAI separates the delivery aware and delivery unaware layers of the ISO/IEC 14496 terminal architecture. In the case of transport network technologies the DAI fulfils the specific needs of ISO/IEC 14496 based applications, however, its design is generic enough to allow the exploitation of DMIF in contexts other than ISO/IEC 14496 based applications.

The DAI is a semantic API that allows the development of applications irrespectively of the delivery support. No syntax is specified for this Interface, since this would be programming language and operating system dependent; moreover only the minimum functionality is specified.

DMIF takes into account the QoS management aspects and the requirement of allowing service providers to log resources per session for usage accounting, in order to facilitate the implementation of appropriate billing policies. In the case of interactive networks it derives a generic protocol to fulfil the requirements (the DMIF Default Signalling Protocol – DDSP).

By adapting the generic protocol to the native network signalling mechanisms, DMIF fully specifies the behaviour of the DMIF Instances operating on particular network environments, thus ensuring interoperability for those cases. Other network environments and protocol implementations are not prevented, as far as the DAI functionality is preserved, but are out of the scope of this specification.

8.3 The DMIF communications architecture

The integration framework of DMIF covers three major technologies, interactive network technology, broadcast technology and the storage technology; this is shown in Figure 2.

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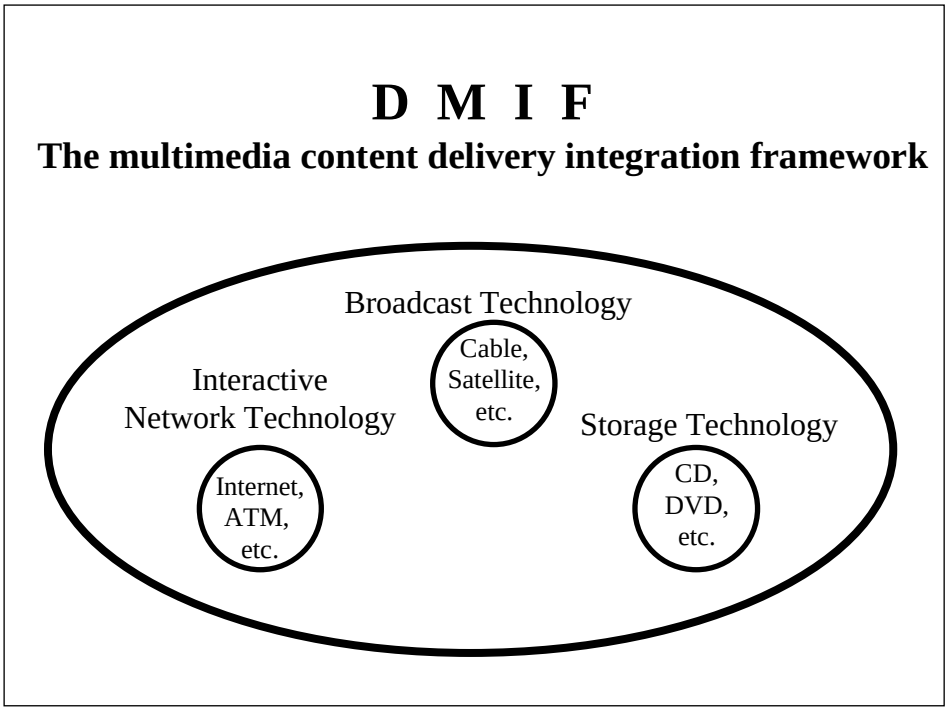

Figure 2 — DMIF addresses the delivery integration of three major technologies

Figure 3 represents the DMIF communication architecture. The shaded boxes clarify what are the boundaries of a DMIF implementation: this part of ISO/IEC 14496 normatively specifies the behaviour of a DMIF implementation at those boundaries, while the additional modelling and definitions which apply to elements internal to the shaded boxes have only informative value.

The DMIF architecture is such that applications that rely on DMIF for communications do not have to be concerned with the underlying communications method. The implementation of DMIF takes care of the delivery technology details presenting a common interface to the application.

Figure 3 depicts the above concept. An application accesses data through the DMIF-Application Interface, irrespective whether such data comes from a broadcast source, from local storage or from a remote server. A Delivery layer implementation allows the concurrent presence of more than one DMIF Instance. When requesting a specific service the Application supplies a URL that allows the Delivery layer to determine the appropriate DMIF Instance to activate. The DMIF Instances will then translate the Originating Application requests into specific actions to be taken with respect to the broadcast network or the local file system, or translate it into messages to be delivered to the Target Application, taking care of the peculiarities of the involved delivery technology. Similarly, data entering the terminal (from remote servers, broadcast networks or local files) is uniformly delivered to the Originating Application through the DAI. The DAI allows the DMIF User to group elementary streams into services and to specify the QoS requirements for the desired elementary streams.

DMIF separates the common features that should be implemented in each DMIF Instance from the details of the delivery technology. In the case of interactive networks DMIF specifies a logical interface (the DMIF-Network Interface – DNI) between a hypothetical module implementing this common features and the network specific modules. The DNI specifies the information flow that should occur between peers of such hypothetical module; the network specific modules specify the exact mapping of the DNI primitives into signalling messages.

DNI primitives need to be adapted to the native network signalling mechanisms in order to provide access to the network resources. DNI primitives represent one of the possible solutions to ensure the DAI functionality when interacting with a remote peer. A straightforward mapping of DNI primitives into signalling messages is defined, and named DMIF Default Signalling Protocol (DDSP). The DMIF Default Signalling Protocol is a session level protocol for the management of multimedia streaming over generic delivery technologies. The protocol comprises primitives to set-up and tear down sessions as well as individual data channels.

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DNI primitives can be mapped into different protocols (e.g., in a LAN, or in the domain of a particular telecom operator) to provide the DAI functionality in the presence of different requirements imposed by a particular network environment (e.g., for admission control, billing policies …).

In the case of the Broadcast and Local Storage scenarios the model is simpler, and no internal interface has been identified. Conceptually, such a DMIF Instance includes the features of a Target DMIF peer, as well as those of the Target Application. This implies that such a DMIF Instance is not agnostic of the application making use of it. Specifically, broadcast or local storage DMIF Instances have to be ISO/IEC 14496 aware if they are used in an ISO/IEC 14496 terminal. All the control messages that are exchanged between peer applications in an interactive scenario are in this case terminated in the DMIF Instance. Stream control commands like PLAY/PAUSE/MUTE are an example.

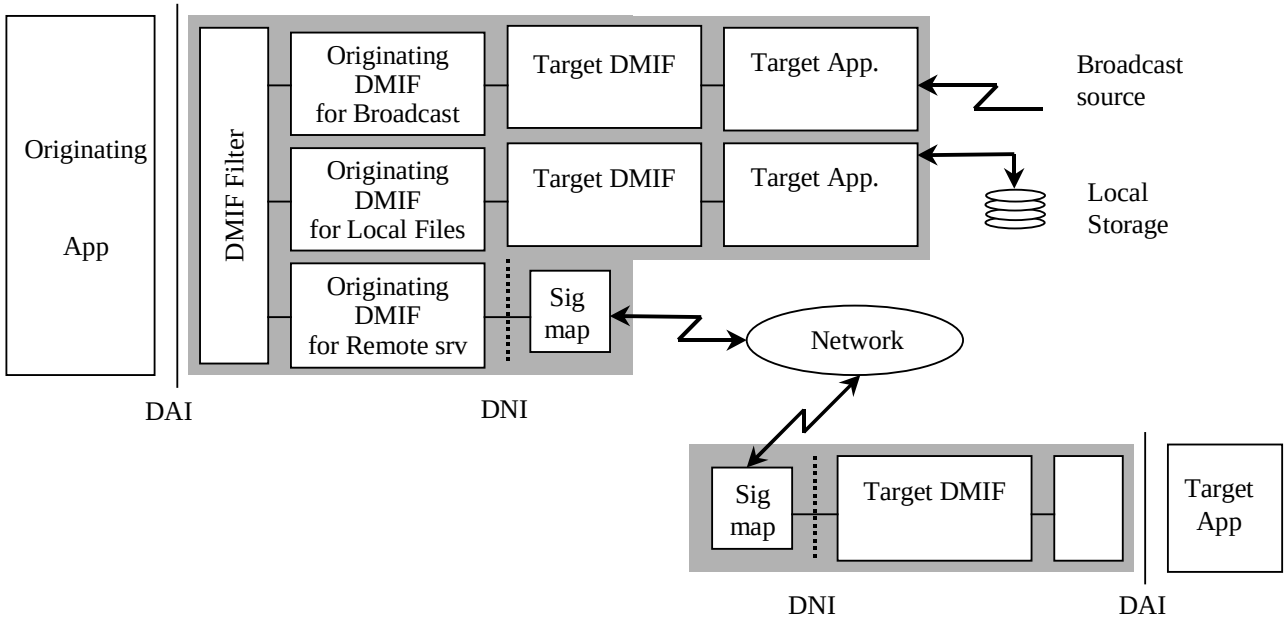

Figure 3 — DMIF communication architecture

DMIF allows the concurrent presence of one or more DMIF Instances, each one targeted for a particular delivery technology, in order to support in the same terminal multiple delivery technologies and even multiple scenarios (broadcast, local storage, remote interactive). Multiple delivery technologies may be activated by the same application, which could therefore seamlessly manage data sent by broadcast networks, local file systems and remote interactive peers.

8.4 DMIF computational model

When an application requests the activation of a service, it uses the Service primitives of the DAI (see clause 10), and creates a Service Session. In the case of a local storage or broadcast scenario, the DMIF Instance locates the content which is part of the indicated service; in case of interactive scenarios the DMIF Instance contacts its corresponding peer and creates a Network Sessionwith it. The peer DMIF Instance in turn identifies the peer Application that runs the service, and establishes a Service Session with it. Network Sessions have network-wide significance, Service Sessions have instead local meaning. The Delivery layer maintains the association between them. Each DMIF Instance uses the native signalling mechanism for the respective network to create and then manage the Network Session (e.g.; DMIF Default Signalling Protocol integrated with ATM signalling). The application peers then use this session to create connections that are used to transport application data (e.g., ISO/IEC 14496 Elementary Streams).

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When an application needs a Channel, it uses the Channel primitives of the DAI (see clause 10), indicating the Service they belong to. In the case of a local storage or broadcast scenario, the DMIF Instance locates the requested content, which is scoped by the indicated service, and prepares itself to read it and pass it in a channel to the application; in case of interactive scenarios the DMIF Instance contacts its corresponding peer to get access to the content, reserves the network resources (e.g.; connections) to stream the content, and prepares itself to read it and pass it in a channel to the application; in addition, the remote application locates the requested content, which is scoped by the indicated service. DMIF uses the native signalling mechanism for the respective network to reserve the network resources. The remote application then uses these resources to deliver the content.

Figure 4 provides a high level view of a service activation and of the beginning of data exchange in the case of interactive scenarios; the high level walk-through consists of the following steps:

The Originating Application requests the activation of a service to its local DMIF Instance: a communication path between the Originating Application and its local DMIF peer is established in the control plane (1)

The Originating DMIF peer establishes a Network Session with the Target DMIF peer: a communication path between the Originating DMIF peer and the Target DMIF Peer is established in the control plane (2)

The Target DMIF peer identifies the Target Application and forwards the service activation request: a communication path between the Target DMIF peer and the Target Application is established in the control plane (3)

The peer Applications create channels (requests flowing through communication paths 1, 2 and 3). The resulting channels in the user plane (4) will carry the actual data exchanged by the Applications.

DMIF is involved in all four steps above.

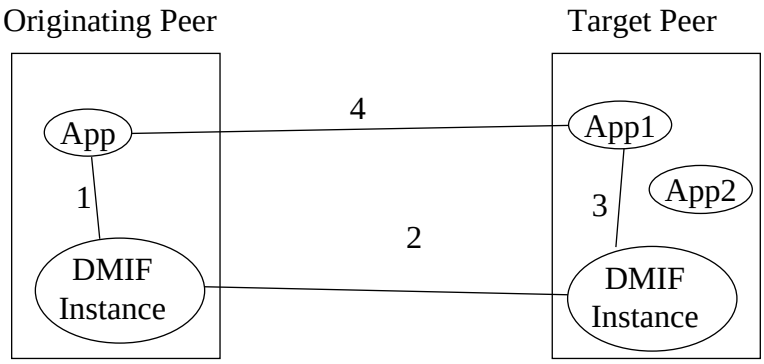

Figure 4 — DMIF computational model

8.5 DMIF QoS model

This part of ISO/IEC 14496 while it specifies the QoS traffic parameters for a given stream at the DAI (e.g., bitrate, maximum access unit size, …), it does not specify its QoS performance requirements (e.g., delay, loss probability, …). As a result, the QoS performance should be based only on the transport network and the administrative policy imposed by a given implementation, e.g., choose best-effort for all channels, or guaranteed service for all channels.

8.6 The User Plane in the Delivery Layer

Figure 5 illustrates the User Plane in an ISO/IEC 14496 terminal, and specifically in the Delivery Layer: Elementary Streams cross the DAI in individual channels, and are multiplexed/demultiplexed in the Delivery Layer. The Delivery Layer makes use of the available multiplexing facilities of the native protocol stacks (e.g., IP port numbers, ATM VCs, MPEG-2 PIDs, file names in a file system), which are referred as Transmuxes in this specification. Where

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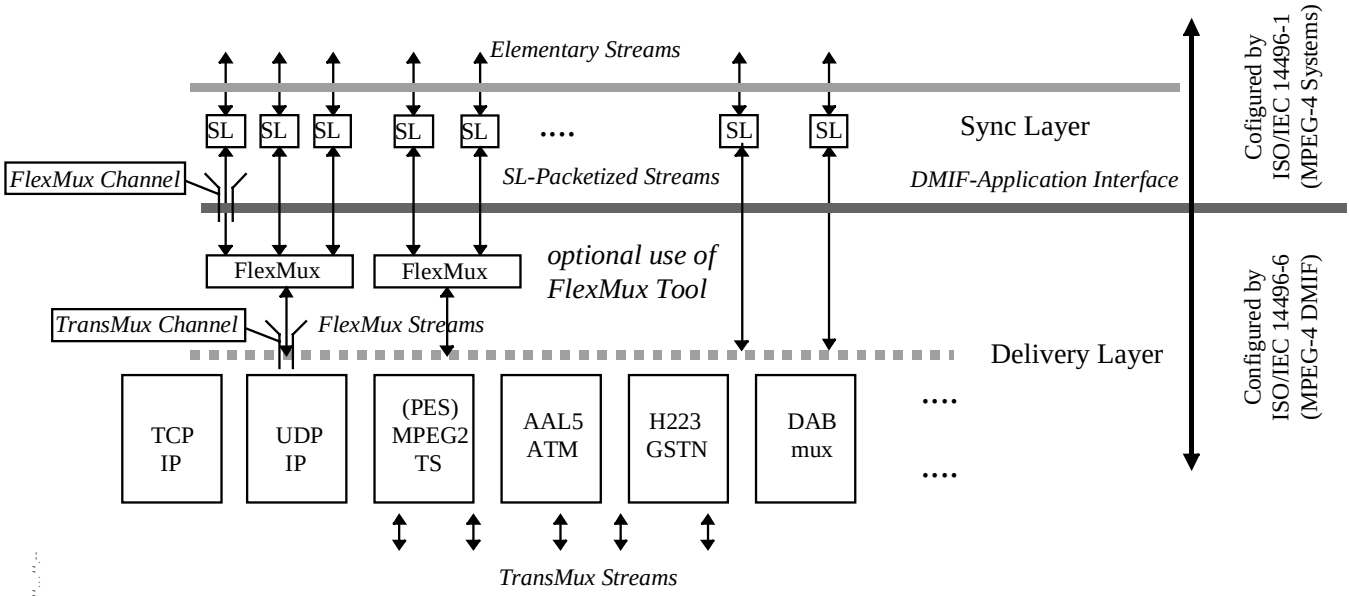
necessary it makes use of additional multiplexing or protection tools, and uses DMIF descriptors to appropriately configure the stacks at both ends.

Currently the FlexMux multiplexing tool specified in ISO/IEC 14496-1:2001 is supported.

The Delivery layer is responsible for the configuration of the transport protocol stacks. Each DMIF Instance is in charge of configuring the exact protocol stack for each channel, and of keeping track of the associations of channels and transport resources. The configuration of the Transmux portion of the protocol stack is achieved through the usage of DMIF signalling with Resource Descriptors and/or their execution using native signalling; the configuration of the remaining portion of the protocol stack is achieved through the usage of DMIF signalling with DMIF Descriptors.

Figure 5 provides a sample of the choice of native transport protocol stacks. It outlines the fact that either an Elementary Stream or a group of streams multiplexed together (e.g., with the FlexMux tool) can be carried over a native transport.



NOTE The figure shows a number of relevant protocol stacks, that are, however, not all fully specified in this part of ISO/IEC 14496.

Figure 5 — The User Plane in a ISO/IEC 14496 terminal

9 Remote interactive scenario

9.1 Additional requirements

9.1.1 Introduction

This subclause only focuses on the Remote Interactive scenario, and defines the common features that each DMIF Instance for such a scenario should implement. These common features take care of the requirement of facilitating the possible evolution to Heterogeneous Networks and of allowing service providers to log resources per session for usage accounting, in order to facilitate the implementation of appropriate billing policies. Valid DMIF Instances may however ignore these requirements.

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9.1.2 Billing policies

In order to facilitate the implementation of appropriate billing policies, DMIF allows to group in Network Sessions the resources consumed for the delivery of a certain service. This way network service providers may log and then charge the resources consumed in the course of a Network Session as a whole, instead of just summing the cost for each individual resource. Network Sessions may include multiple Service Sessions, as far as they relate to the same DMIF peers. These Service Sessions may relate to different application instances on one or both sides. This case is depicted in Figure 6. Valid DMIF Instances may however prefer to maintain a one-to-one relation between the services as requested by the DMIF User and the Network Sessions. In this case if extra capacity is available on one connection belonging to one Service Session it cannot be used by the other Service Session and as a result the end user will pay more.

Billing policies are out of the scope of this specification.

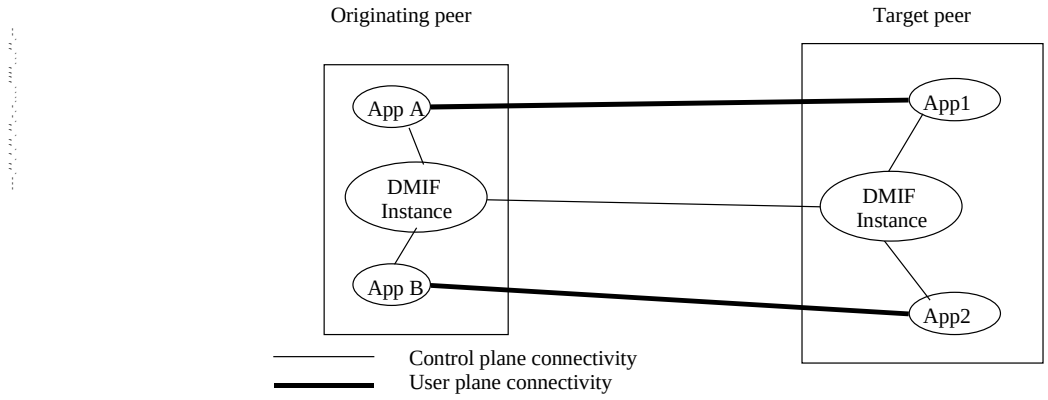

Figure 6 — A Network Session shared by multiple Service Sessions

9.1.3 Possible evolution to Heterogeneous Networks

This specification only targets homogeneous networks; however, possible evolution to Heterogeneous Networks has been considered. In order to facilitate this evolution, parts of a solution framework that was developed in ISO/IEC 13818-6 (Digital Storage Media Command & Control, User to Network – DSMCC-UN) have been adopted. In particular, the DMIF Default Signalling Protocol defined in this specification makes use of a generic descriptor architecture derived from ISO/IEC 13818-6 for describing and tagging the network resources being used.

9.2 DMIF within the context of the ISO/OSI layers

Figure 7 positions the DMIF-Application Interface in the DMIF architecture shown in Figure 3 and its networked component shown in Figure 4, and highlights the role of Delivery Layer with respect to the ISO/OSI layers: a DMIF Instance performs Session Layer functions, and the DMIF-Application Interface corresponds to a Session Service Access Point. The DMIF control primitives at the DMIF-Application Interface capture parameters that are maintained for the duration of the contract. Any other parameter that varies during the life of the contract is carried on the User Plane and is out of the scope of this specification. In the case of ISO/IEC 14496 refer to ISO/IEC 14496-1:2001. One such example of the first kind is the QoS of the media stream that is fixed during the contract and therefore carried in the DMIF control primitives. In the case of ISO/IEC 14496 an example of the second kind is the SL packet header length which could vary during the life of the media stream and is therefore carried on the User Plane as specified in ISO/IEC 14496-1:2001. Also while the DMIF control primitives are specified both at the receive and transmit ends, the User Plane is only specified at the receive end.

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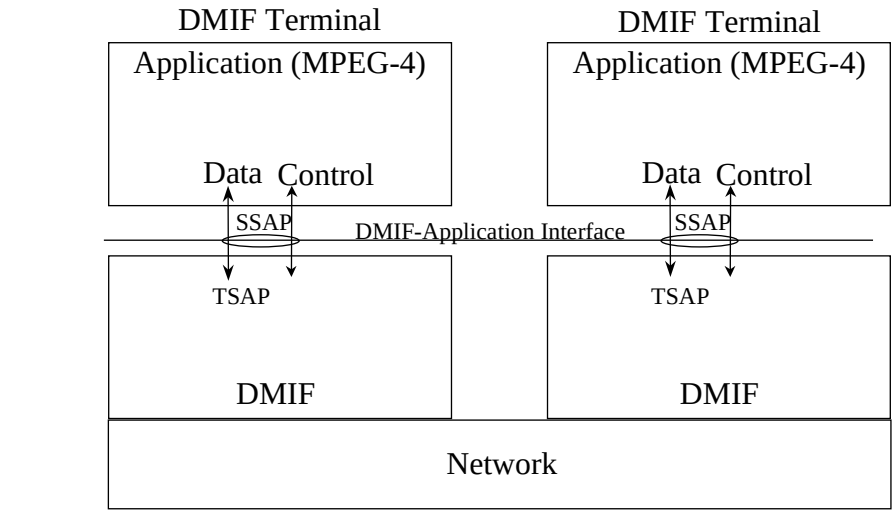

Figure 7 — Position of the DMIF-Application Interface in the DMIF architecture

10 The DMIF-Application Interface

10.1 The DMIF-Application Interface key concepts

The DMIF-Application Interface (DAI) is a semantic API that allows the development of applications transparent to the supported delivery technologies. By using the DAI, an application could seamlessly access content from broadcast networks, from local storage devices and from remote end-systems.

The DAI semantics is normative.

DAI does not impose any programming language, nor syntax (e.g., the exact format for specifying a particular parameter -within the bounds of its semantic definition- or the definition of reserved values), except for the URL defined in Annex C.. Moreover the DAI provides only the minimal semantics for defining the behaviour of DMIF.

A real implementation of the DAI needs more than what is specified here (e.g.; methods to initialise, reset, reconfigure, destroy, query the status, register services …). Most of these aspects, as well as the detailed syntax, deeply depend on the language binding and on the implementation (part of an operating system, or a separate library, or a set of separate libraries, or a combination of the above, or …; and for the syntax: synchronous or asynchronous implementation, callback functions or events or a polling technique, …). Moreover such details have no impact on the DMIF model, and are therefore out of the scope of DMIF.

It is worth mentioning that this interface is available to any application, not just ISO/IEC 14496-1:2001 (MPEG-4 System) applications, i.e., the DMIF-Application Interface is designed for generic use.

The DMIF-Application Interface defines the functions offered by the Delivery layer. The entity that uses this interface is named the DMIF User.

Through the DMIF-Application Interface DMIF Users are hidden from the delivery technology details (for both Data and Control Planes), and just manipulate Service Sessions and channels.

The DMIF-Application Interface is comprised of the following classes of primitives:

Service primitives, which deal with the Control Plane, and allow the management of Service Sessions (attach and detach);

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Channel primitives, which deal with the Control Plane, and allow the management of channels (add and delete);

Data primitives, which deal with the User Plane, and serve the purpose of transferring data through channels.

Note that since only the minimum DAI semantics is specified, additional primitives and parameters may be required in actual implementations, e.g., to initialize the DMIF Instance, to register callbacks, to resolve service names, to apply sophisticated statistical multiplexing at the FlexMux Layer on the sender side (including the usage of unequal protection schemes), etc.

10.2 Common semantic elements

10.2.1 channelDescriptor

DMIF defines a ChannelDescriptor at the DMIF-Application Interface to carry all informations which relate to the channel configuration. This includes in particular Quality of Service parameters for both profile (e.g, loss, delay, priority, etc.) and bandwidth requirements (e.g., peak bit rate, average bit rate, etc.) for an individual Elementary Stream. The ChannelDescriptor may also include information specific to a particular application. Two of these application dependent descriptors are defined in this document. These descriptors are intended to fully support MPEG-4 Systems based applications on any kind of delivery technology (e.g., MPEG-2 Transport Stream, RTP/RTCP orRTSP in the control plane). The information carried through the DAI in the ChannelDescriptor can be further delivered across the DNI and be mapped in the DMIF Default Signaling Protocol (DDSP).

Only the semantics of the ChannelDescriptor used at the DAI is specified in this clause.

The exact syntax of the ChannelDescriptor used at the DNI and in the DMIF Default Signaling Protocol (DDSP) is specified in subclause 11.2.4.

DMIF enables the aggregation of multiple Elementary Streams, which share the same QoS profile, into a single TransMux, and computes the aggregate bandwidth. DMIF then maps the QoS requirements (i.e., QoS profile and aggregated bandwidth requirements) for a particular TransMux into specific network QoS (e.g, traffic contract). This is shown in Figure 8.

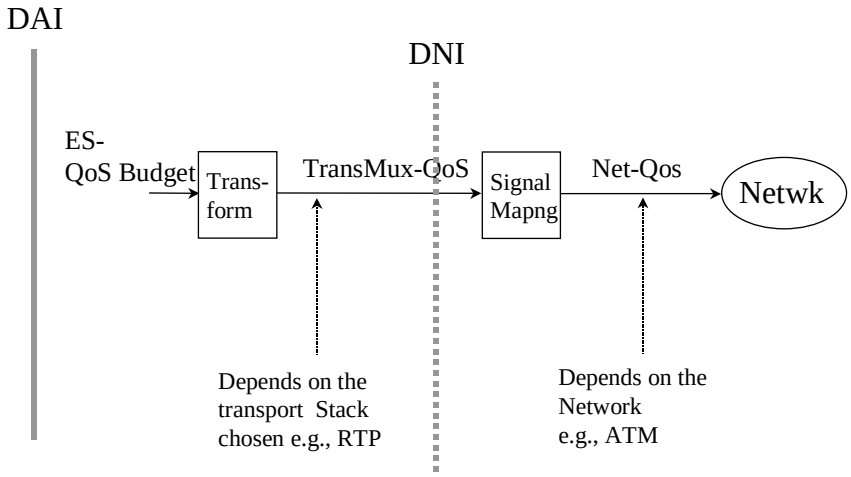

Figure 8 — Transformations of the Media QoS

In MPEG-4 the QoS parameters for an individual Elementary Stream are transmitted as part of the ES_Descriptor as defined in MPEG-4 Systems ISO/IEC 14496-1:2001. These QoS parameters represent the total media QoS budget (total-QoS). The total-QoS differs from the QoS exposed at the DAI (DAI-QoS) in that the application is expected to compute the DAI-QoS taking into account the QoS requirements and the performance of the receiver itself (decoder-QoS). This is shown in Figure 9 and Figure 10 below.

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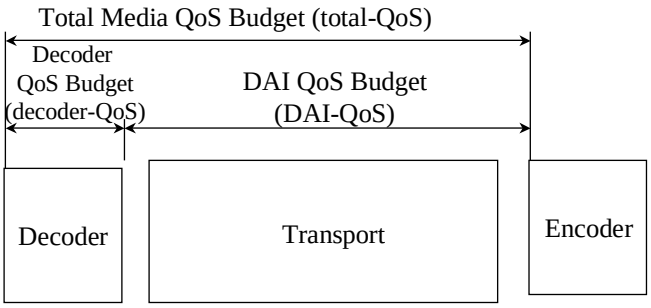

Figure 9 — Apportionment of the total end-to-end QoS Budget

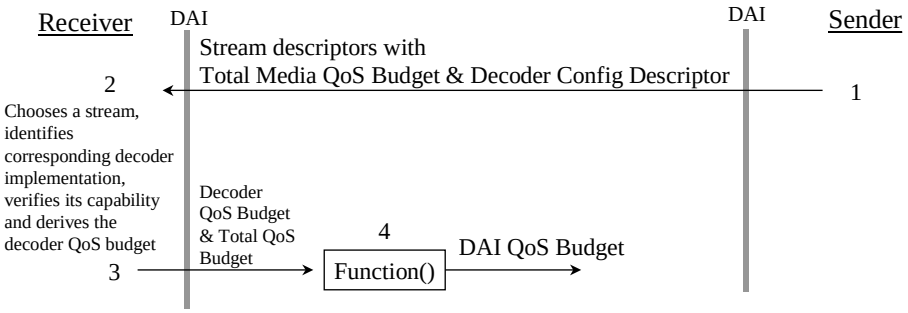

Figure 10 — The Life cycle of the Media QoS

The channel Descriptor shall be able to carry a number of QoS metrics. The set of metrics currently defined and their semantic is summarized in Table 10—1.

Table 10—1 — ISO/IEC 14496-6 defined channelDescriptor parameters.

channelDescriptor Parameter	Semantic Description
PRIORITY	Priority for the stream
MAX_AU_SIZE	Maximum size of a PDU, as delivered through the DAI
AVG_BITRATE	Average bit rate measured over an observation time window
MAX_BITRATE	Maximum bit rate measured over an observation time window
MAX_DELAY	Maximum delay experienced by any PDU of an Elementary Stream measured over an observation time window
AVG_DELAY	Average delay experienced by the PDUs of an Elementary Stream measured over an observation time window
LOSS_PROBABILITY	Allowable probability of loss of any single PDU of an Elementary stream measured over an observation time window
JITTER_TOLERANCE	Maximum delay variation experienced by any PDU of an Elementary Stream measured over an observation time
SYNC_GROUP	Identifies the timeline associated to a channel
SL_CONFIG_HEADER	Describes the MPEG-4 Sync Layer Packet Header format

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The semantic meaning of the channel qualifiers tags are as follows :

PRIORITY : this qualifier defines a relative measure for the priority of an elementary stream. An elementary stream with a higher priority is more important than one with a lower priority.

MAX_PDU_SIZE : this qualifier defines the maximum size of any PDU that can be delivered through the DAI.

AVG_BITRATE : this qualifier defines the average bitrate of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

MAX_BITRATE : this qualifier defines the maximum bitrate of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

MAX_DELAY : this qualifier defines the maximum delay experienced by any PDU of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

AVG_DELAY : this qualifier defines the Average delay experienced by the PDUs of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

LOSS_PROBABILITY: this qualifier defines the allowable probability of loss of any single PDU of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

JITTER_TOLERANCE: this qualifier defines the maximum delay variation experienced by any PDU of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

SYNC_GROUP : this channel qualifier provides an identifier for the timeline associated to a channel. It allows to expose to a dmif instance the knowledge that a group of streams is sharing the same timeline.

SL_CONFIG_HEADER : this channel qualifier describes the MPEG-4 Sync Layer Packet Header format. This qualifier is comprised by a binary sequence of bytes called slConfig, whose syntax corresponds to SLConfigDescriptor defined in ISO/IEC 14496-1:2001. The length of the slConfig is specified y slConfigLen. This qualifier is therefore comprised of two semantic elements. It allows to expose to a dmif instance the knowledge that a certain channel carries content which is packetized according to the semantic rules of the MPEG-4 SL.

10.3 DMIF-Application Interface primitives

This subclause lists the primitives specified for the DMIF-Application Interface, and describes the parameters used. The only parameter with fixed syntax is the URL defined in Annex C. The C++ like formalism used to describe the primitives only aims at capturing their semantic meaning. IN and OUT keywords allow to clearly distinguish the parameters provided to the other side of the interface from those returned from it; by no means they are meant to force a synchronous implementation. The loop() construct allows to concisely represent an array of elements.

The primitives are:

— DA_ServiceAttach (IN: parentServiceSessionId, URL, uuDataInBuffer, uuDataInLen; OUT: response, serviceSessionId, uuDataOutBuffer, uuDataOutLen)

— DA_ServiceAttachCallback (IN: serviceSessionId, serviceName, uuDataInBuffer, uuDataInLen; OUT: response, uuDataOutBuffer, uuDataOutLen)

— DA_ServiceDetach (IN: serviceSessionId, reason; OUT: response)

— DA_ServiceDetachCallback (IN: serviceSessionId, reason; OUT: response)

— DA_ChannelAdd (IN: serviceSessionId, loop(channelDescriptor, direction, uuDataInBuffer, uuDataInLen); OUT: loop(response, channelHandle, uuDataOutBuffer, uuDataOutLen))

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— DA_ChannelAddCallback (IN: serviceSessionId, loop(channelHandle, channelDescriptor, direction, uuDataInBuffer, uuDataInLen); OUT: loop(response, uuDataOutBuffer, uuDataOutLen))

— DA_ChannelDelete (IN: loop(channelHandle, reason); OUT: loop(response))

— DA_ChannelDeleteCallback (IN: loop(channelHandle, reason); OUT: loop(response))

— DA_UserCommand (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle))

— DA_UserCommandCallback (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle))

— DA_UserCommandAck (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle) ; OUT : response, uuDataOutBuffer, uuDataOutLen)

— DA_UserCommandAckCallback (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle) ; OUT : response uuDataOutBuffer, uuDataOutLen)

— DA_ChannelMonitor (IN: channelHandle, qosMode; OUT: response)

— DA_ChannelEvent (IN: channelHandle, mode, qosReport)

— DA_Data (IN: channelHandle, streamDataBuffer, streamDataLen)

— DA_Data (IN: channelHandle, streamDataBuffer, streamDataLen, appDataBuffer, appDataLen)

— DA_DataCallback (IN: channelHandle, streamDataBuffer, streamDataLen, errorFlag)

— DA_DataCallback (IN: channelHandle, streamDataBuffer, streamDataLen, appDataBuffer, appDataLen, errorFlag)

The parameters have the following semantics:

appDataBuffer:is the data conveying application information. In the case of MPEG-4 this data shall be used to convey SYNC layer information.

appDataLen: is the length of the appDataBuffer field.

channelDescriptor: is a parameter set by the DMIF User containing the complete description of the Quality of Service requested for a particular channel as well as possibly application specific descriptors. Its semantic definition is given in subclause 10.2.1.

channelHandle: is a local identifier that uniquely identifies a channel in the application space, no matter how many services the application attaches to, or how many DMIF Instances it is using. In this interface specification the channelHandle parameter is set by the DMIF Instance, however it would be also acceptable if it were set by the DMIF User. The algorithm used by the DMIF Instance (User) to set the channelHandle is a matter that does not affect this interface.

direction: Indicates the direction of the channel, either UPSTREAM i.e., from the receiver to the sender or DOWNSTREAM i.e., from the sender to the receiver.

errorFlag: is a flag that indicates whether an error has been detected (but not corrected) on the streamDataBuffer.

mode: this parameter, also contained in the **qosMode** structure, indicates the type of QoS mode. The set of modes is summarized in subclause 10.5.2.

parentServiceSessionId: is a local identifier that uniquely identifies the Service Session whose URL is to be possibly used to expand the relative URL of a newly requested Service Session.

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qosMode: this is a parameter set by the DMIF User containing the requested QoS Monitoring mode for a particular stream (i.e., channelHandle), as well as, associated commands with the monitoring process (i.e., start, stop, single report).

qosReport: is a parameter set by the DMIF Layer containing the QoS report for a particular stream (i.e., channelHandle). This parameter shall contain the QoS profile parameters contained in the **qosDescriptor** parameter sent in the addition of the channel (i.e., delay and loss), as well as, additional statistical parameters to be defined in the future.

reason: a code identifying the reason.

response: a code identifying the response.

serviceName: at the target DMIF peer it identifies the actual service.

serviceSessionId: is a local identifier that uniquely identifies a Service Session in the application space, no matter how many services the application attaches to, or how many DMIF Instances it is using. In this interface specification the serviceSessionId parameter is set by the DMIF Instance, however it would be also acceptable if it were set by the DMIF User. The algorithm used by the DMIF Instance (User) to set the serviceSessionId is a matter that does not affect this interface.

streamDataBuffer: is the actual Data Unit generated by the DMIF User.

streamDataLen: is the length of the streamDataBuffer field.

URL: within DMIF is a string that identifies a Service. Refer to Annex C for more information on the usage of URLs in DMIF, including the list of allowed URL schemes.

uuDataInBuffer: is an opaque structure providing upper layer information; it is transparently transported through DMIF from the local peer to the remote peer.

uuDataInLen: is the length of the uuDataInBuffer field.

uuDataOutBuffer: is an opaque structure providing upper layer information; it is transparently transported through DMIF from the remote Peer to the local Peer.

uuDataOutLen: is the length of the uuDataOutBuffer field.

10.4 DMIF-Application Interface semantics

10.4.1 DA_ServiceAttach ()

DA_ServiceAttach (IN: parentServiceSessionId, URL, uuDataInBuffer, uuDataInLen; OUT: response, serviceSessionId, uuDataOutBuffer, uuDataOutLen)

This primitive is issued by a DMIF User to request the initialization of a Service Session: the service is unambiguously identified by its **URL** which conveys information for identifying both the delivery technology being used (i.e. protocol), the address of the target DMIF peer (this may have different meanings in the different scenarios) and the name of the service inside the domain managed by the target DMIF peer -which is then referred to as **serviceName**. The **URL**, if relative, is expanded using as base URL the URL associated to the **parentServiceSessionId**.

The DMIF User might provide additional information such as client credentials in **uuDataIn**: this additional information is opaque to the Delivery layer and is only consumed by the target DMIF User (which is locally emulated in Broadcast and Local Storage scenarios).

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The target DMIF User might in turn provide additional information in **uuDataOut**: this additional information is opaque to the Delivery layer and is only consumed by the local DMIF User. In an ISO/IEC 14496 application the **uuDataOut** shall return a single Object Descriptor or Initial Object Descriptor if required by the context of this call.

In case of a positive **response**, the **serviceSessionId** parameter contains the Service Session identifier that the DMIF User should refer to in subsequent interaction through the DAI regarding this Service Session.

10.4.2 DA_ServiceAttachCallback ()

DA_ServiceAttachCallback (IN: serviceSessionId, serviceName, uuDataInBuffer, uuDataInLen; OUT: response, uuDataOutBuffer, uuDataOutLen)

This primitive is issued by the target DMIF Instance to the appropriate target DMIF User as identified through the **serviceName** field. The steps involved in identifying the appropriate DMIF User and delivering the primitives to it are out of the scope of this specification.

The target DMIF Instance also provides the **serviceSessionId** parameter, that contains the Service Session identifier that the target DMIF User should refer to in subsequent interaction through the DAI regarding this Service Session.

The target DMIF User (the Application Executive running the service) might also receive additional information (e.g.; client credentials) through the **uuDataIn** field.

The target DMIF User might in turn provide additional information in **uuDataOut**: this additional information is opaque to the Delivery layer and is only consumed by the local DMIF User. In an ISO/IEC 14496 application the **uuDataOut** shall return a single Object Descriptor or Initial Object Descriptor if required by the context of this call.

In case of a negative **response**, the **serviceSessionId** becomes invalid at the target DMIF Instance.

Real implementations of this primitive are likely to support an additional parameter identifying the calling peer.

10.4.3 DA_ServiceDetach ()

DA_ServiceDetach (IN: serviceSessionId, reason; OUT: response)

This primitive is issued by a DMIF User to request the termination of the service identified by **serviceSessionId**; a **reason** should be specified. The DMIF Instance returns a **response**.

10.4.4 DA_ServiceDetachCallback ()

DA_ServiceDetachCallback (IN: serviceSessionId, reason; OUT: response)

This primitive is issued by the target DMIF Instance to inform the target DMIF User that the service identified by **serviceSessionId** has been terminated due to the reason **reason**. The target DMIF User returns a **response**.

10.4.5 DA_ChannelAdd ()

DA_ChannelAdd (IN: serviceSessionId, loop(channelDescriptor, direction, uuDataInBuffer, uuDataInLen); OUT: loop(response, channelHandle, uuDataOutBuffer, uuDataOutLen))

This primitive is issued by a DMIF User to request the addition of one or more end-to-end channels in the context of a particular Service Session identified by **serviceSessionId**.

Each channel is requested by providing an (optional) **channelDescriptor** and a **direction**

The local DMIF User might provide additional information for each requested channel in **uuDataIn**. This additional information is opaque to the Delivery layer and is only consumed by the target DMIF User. In the case of an ISO/IEC 14496 application the **uuDataIn** shall always be present.

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For each requested channel, in case of a positive **response**, the **channelHandle** parameter contains the channel identifier that the DMIF User should refer to in subsequent interaction through the DAI involving this channel.

10.4.6 DA_ChannelAddCallback ()

DA_ChannelAddCallback (IN: serviceSessionId, loop(channelHandle, channelDescriptor, direction, uuDataInBuffer, uuDataInLen); OUT: loop(response, uuDataOutBuffer, uuDataOutLen))

This primitive is issued by the target DMIF Instance to the appropriate target DMIF User as identified through the **serviceSessionId** field, to inform the target DMIF User that the addition of channels is requested.

For each requested channel, the target DMIF Instance provides the **direction** to the target DMIF User. It also provides the **channelHandle** parameter, that contains the channel identifier that the target DMIF User should refer to in subsequent interaction through the DAI involving this Channel.

The target DMIF User (the Application Executive running the service) might also receive additional information through the **uuDataIn** field. In the case of an ISO/IEC 14496-1:2001 based application the **uuDataIn** shall always be present and may contain the Elementary Stream Identifier -ES_ID-.

For each requested channel, the target DMIF User returns a **response**. In case of a negative **response**, the **channelHandle** becomes invalid at the target DMIF Instance.

10.4.7 DA_ChannelDelete ()

DA_ChannelDelete (IN: loop(channelHandle, reason); OUT: loop(response))

This primitive is issued by a DMIF User to delete one or more channels as identified by **channelHandle**; a **reason** should be specified. The channels need not be all part of a single Service Session. The DMIF Instance returns a **response**.

10.4.8 DA_ChannelDeleteCallback ()

DA_ChannelDeleteCallback (IN: loop(channelHandle, reason); OUT: loop(response))

This primitive is issued by the target DMIF Instance to inform the target DMIF User that the channels identified by **channelHandle** have been closed due to the reason **reason**. The target DMIF User returns a **response**.

10.4.9 DA_UserCommand ()

DA_UserCommand (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle))

This primitive is issued by a DMIF User to send **uuData** that refers to channelsidentified by **channelHandle**. This primitive is intended to support the delivery of control information in the upstream direction.

10.4.10 DA_UserCommandCallback ()

DA_UserCommandCallback (IN: uuDataInBuffer, uuDataInLen loop(channelHandle))

This primitive is issued by the target DMIF Instance to inform the target DMIF User that there is **uuData** relative to channels identified by **channelHandle**.

10.4.11 DA_Data ()

DA_Data (IN: channelHandle, streamDataBuffer, streamDataLen)

DA_Data (IN: channelHandle, streamDataBuffer, streamDataLen, appDataBuffer, appDataLen)

This primitive is issued by a DMIF User to send **streamData** in the channel identified by **channelHandle**.

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The second form of this primitive is issued by a DMIF User to send **streamData** in the channel identified by **channelHandle** along with application specific **appData** describing the **streamData**. In the case of ISO/IEC 14496-1:2001 based applications **appData** would carry sync layer information associated to the **streamData**.

10.4.12 DA_DataCallback ()

DA_DataCallback (IN: channelHandle, streamDataBuffer, streamDataLen, errorFlag)

DA_DataCallback (IN: channelHandle, streamDataBuffer, streamDataLen, appDataBuffer, appDataLen, errorFlag)

This primitive is issued by the DMIF Instance to the appropriate DMIF User (identified through the **channelHandle**) and provides the **streamData** along with an **errorFlag** for that channel.

The second form of this primitive is issued by the DMIF Instance to send **streamData** in the channel identified by **channelHandle** along with application specific **appData** describing the **streamData**. In the case of ISO/IEC 14496-1:2001 based applications **appData** would carry sync layer information associated to the **streamData**.

10.4.13 DA_UserCommandAck()

DA_UserCommandAck (IN: uuDataInBuffer, uuDataInLen, loop(channelHandle) ; OUT : response, uuDataOutBuffer, uuDataOutLen)

This primitive is issued by a DMIF User to send **uuDataIn** that refers to channels identified by **channelHandle**. This primitive is intended to support the delivery of control information with acknowledgement (and possibly additional information in **uuDataOut**).

10.4.14 DA_UserCommandAckCallback()

DA_UserCommandAckCallback (IN: uuDataInBuffer, uuDataInLen loop(channelHandle) ; OUT : response, uuDataOutBuffer, uuDataOutLen)

This primitive is issued by the target DMIF Instance to inform the target DMIF User that there is **uuDataIn** relative to channels identified by **channelHandle**; the DMIF User shall acknowledge the receipt of the command, possibly providing additional information in **uuDataOut.**

10.4.15 DA_ChannelMonitor()

DA_ChannelMonitor (IN: channelHandle, qosMode; OUT: response)

This primitive is issued by a user to request the initialisation, termination or single report request of a QoS monitoring process by the DMIF layer. The **channelHandle** identifies the stream to be monitored by the DMIF layer. The mode of the QoS monitoring (see subclause 10.5.2) is set in the **qosMode** parameter. The **qosMode** may contain additional information about the type of QoS report the DMIF user is interested in getting from the DMIF layer. The **response** identifies an acknowledgment (i.e., positive or negative) from the DMIF layer to a QoS monitoring request from the DMIF user.

10.4.16 DA_ChannelEvent()

DA_ChannelEvent (IN: channelHandle, mode, qosReport)

This primitive is issued by a DMIF layer to inform the DMIF user with the measured QoS for the data channel specified by the **channelHandle**. The **mode** identifies the type of QoS monitoring event (see subclause 10.5.2). The **qosReport** parameter contains the QoS profile (e.g., delay and loss parameters) measured for the channel (see subclause 10.5.3).

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10.5 QoS Monitoring

10.5.1 Monitoring events

This clause introduces data structures to allow event monitoring like QoS monitoring and QoS renegotiations of established data channels in a DMIF session.

Three types of QoS monitoring events are defined: *QOS_MONITOR* or periodic monitoring depicted in section 2 of Figure 11; *QOS_VIOLATION* or notification upon violation of the requested QoS by the Application depicted in section 3 of Figure 11; and *QOS_REQUEST* or notification upon a single request from the Application depicted in section 4 of Figure 11.

The QoS monitoring event for a specific channel is initiated at any moment after the establishment of that channel (section 1 in Figure 11). The QoS monitoring process ends either when the channel is deleted or when the application explicitly (i.e., through a stop command) indicates it to the DMIF layer.

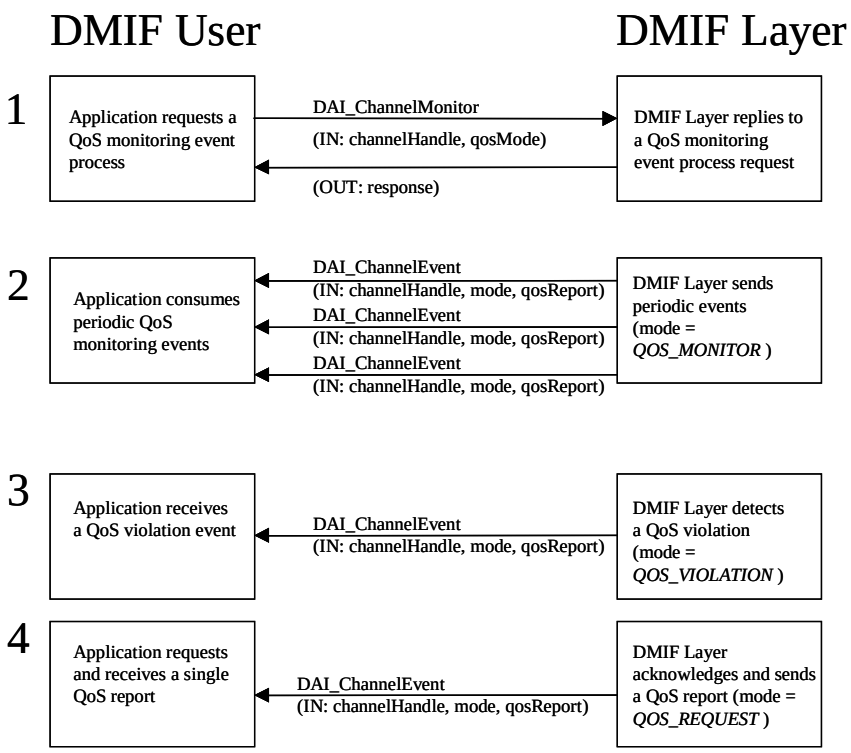

Figure 11 — QoS Monitoring Events

10.5.2 qosMode

Table 10—2 defines the format of the qosMode() structure:

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Table 10—2 — qosMode() format.

Syntax	Num. Of Bytes
QosMode() {	
Mode	**1**
QosMonitorPeriod	**2**
Status	**1**
}	

mode: this parameter indicates the type of QoS mode. The set of modes currently defined and their semantic is summarized in Table 10—3. The application can logically combine QoS modes (e.g., QOS_MONITOR and QOS_VIOLATION). Regardless of the QoS monitoring mode, the application can always requests QoS information for a specific channel.

Table 10—3 — ISO/IEC 14496-6 (MPEG-4 DMIF) defined QoS modes.

Mode	Semantic Description
QOS_MONITOR	The DMIF layer monitors periodically the QoS of a specific data channel and reports to the application the measured QoS every **qosMonitorPeriod** milliseconds.
QOS_VIOLATION	The DMIF layer reports a QoS violation for a specific data channel. A QoS violation is defined when the monitored QoS does not fulfill the requested QoS profile (i.e., delay and loss parameters) specified in the **qosDescriptor** parameter.

qosMonitorPeriod: frequency of QoS reports by the DMIF layer to the application expressed in milliseconds.

status: this parameter indicates when a QoS monitoring process shall start or terminate. The set of status currently defined and their semantic is summarized in Table 10—4.

Table 10—4 — ISO/IEC 14496-6 (MPEG-4 DMIF) defined QoS status.

Status	Semantic Description
START	The DMIF layer starts the QoS monitoring process.
STOP	The DMIF layer terminates the QoS monitoring process.
SINGLE	The DMIF layer reports a single QoS report upon request of the application.

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10.5.3 qosReport

The qosReport shall be able to carry a number of QoS metrics. The set of metrics currently defined and their semantics is summarised in Table 10—1. Table 10—5 describes the generic format of the QoS Report.

Table 10—5 — qosReport.

Syntax	Num. of Bytes
qosReport() {	
QoS_QualifierCount	**1**
for(I=0; i<QoS_QualifierCount; i++) {	
QoS_QualifierTag	**1**
QoS_QualifierDataLength	**1**
QoS_QualifierData	**QoS_QualifierDataLength**
}	
}	

QoS_QualifierCount: Provides the number of QoS qualifiers specified in the descriptor.

QoS_QualifierTag: Identifies the qualifier type.

QoS_QualifierDataLength: Is the length of the following qualifier value.

QoS_QualifierData: Provides the qualifier value.

The **QoS_QualifierTag**s are shown in Table 10—1.

11 The DMIF-Network Interface

11.1 The DMIF-Network Interface key concepts

The DMIF-Network Interface (DNI) is a semantic API for the Control Plane. It abstracts the signalling between DMIF peers irrespectively of the supported delivery technologies. The parameters conveyed through the DNI are then mapped onto network dependent native signalling when possible. The parameters which cannot be mapped to native signalling are carried opaque to the native signalling in which case the necessary syntax is defined in this specification. The mappings to native signalling standards are described in clause 12.

The DMIF-Network Interface comprises the following classes of primitives:

— Session primitives, which allow the management of sessions (setup and release);

— Service primitives, which allow the management of services (attach and detach);

— Transmux primitives, which allow the management of a transmux (setup, release and config);

— Channel primitives, which allow the management of channels (add and delete).

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11.2 Common syntax elements

11.2.1 DMIF Descriptors

Table 11—1 describes the generic format of a DMIF Descriptor:

Table 11—1 — General format of the DMIF Descriptor

Syntax	Num. Of Bytes
dmifDescriptor {	
commonDescriptorHeader()	
descriptorDataFields()	
}	

commonDescriptorHeader: Table 11—2 defines the format of the commonDescriptorHeader.

descriptorDataFields: Provides the actual descriptor data.

Table 11—2 — DMIF commonDescriptorHeader

Syntax	Num. of Bytes
commonDescriptorHeader() {	
DmifDescriptorType	**2**
DmifDescriptorLen	**2**
}	

dmifDescriptorType: Defines the specific descriptor being carried. Table 11—3 defines the dmifDescriptorTypes defined in this specification.

dmifDescriptorLen: Defines the total length in bytes of the descriptorDataFields() that follow.

Table 11—3 — DMIF Descriptor Types

dmifDescriptorType	Value	Description
Reserved	0x0000	ISO/IEC 14496-6 reserved.
UuDataDescriptor	0x0001	Contains uuData as conveyed at the DAI
BypassFlexMuxDescriptor	0x0002	Indicates no flex-multiplexing is used
MPEG4SystemsFlexMuxDescriptor	0x0003	Supports MPEG-4 FlexMux as defined in ISO/IEC 14496-1:2001.
MPEG4SystemsMuxCodeDescriptor	0x0004	Supports MPEG-4 FlexMux MuxCodeTables as defined in ISO/IEC 14496-1:2001.
Reserved	0x0005-0xffff	ISO/IEC 14496-6 reserved.

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11.2.1.1 uuDataDescriptor

This descriptor shown in Table 11—4 is used to carry uuData as exposed at the DAI. uuData is an opaque structure providing upper layer information; it is transparently transported through DMIF from Peer to Peer.

Table 11—4 — uuDataDescriptor

Syntax	Num. Of Bytes
UuDataBuffer	DmifDescriptorLen

uuDataBuffer: Carries the uuDataBuffer as exposed at the DAI.

11.2.1.2 BypassFlexMuxDescriptor

This descriptor shown in Table 11—5 is used to indicate that no additional multiplex tool is used on top of the particular TransMux Channel it is being associated.

Table 11—5 — BypassFlexMuxDescriptor

Syntax	Num. Of Bytes

This descriptor is empty. The dmifDescriptorLen is zero.

11.2.1.3 MPEG4SystemsFlexMuxDescriptor

This descriptor shown in Table 11—6 is used to identify a FlexMux Channel Number as defined in ISO/IEC 14496-1:2001.

Table 11—6 — MPEG4SystemsFlexMuxDescriptor

Syntax	Num. Of Bytes
FlexMuxChannelNumber	1

FlexMuxChannelNumber: Provides the number of the channel in the MPEG-4 FlexMux.

11.2.1.4 MPEG4SystemsMuxCodeDescriptor

This descriptor shown in Table 11—7 is used to carry the FlexMux MuxCodeTables as defined in ISO/IEC 14496-1:2001.

Table 11—7 — MPEG4SystemsMuxCodeDescriptor

Syntax	Num. Of Bytes
MuxCodeTable	DmifDescriptorLen

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MuxCodeTable: Carries the FlexMux MuxCodeTables, whose syntax and semantics is defined in MPEG-4 Systems ISO/IEC 14496-1:2001.

11.2.2 DMIF to DMIF data

Messages which contain information to be passed between DMIF peers but that need not be inspected by the Network use the ddData structure to convey such information. This structure contains a count and a list of DMIF descriptors which are defined in subclause 11.2.1. Table 11—8 defines the format of the ddData() structure:

Table 11—8 — ddData() format

Syntax	Num. of Bytes
ddData(){	
dmifDescriptorCount	**2**
for(i=0;I<dmifDescriptorCount;i++) {	
dmifDescriptor()	
}	
}	

dmifDescriptorCount: Indicates the total number of dmifDescriptor() structures which are included in the list.

dmifDescriptor(): Refer to subclause 11.2.1 for DMIF descriptor definitions.

11.2.3 Resource Descriptors

A Network Session consists of a relationship between two DMIF peers. Messages which are used to request resources contain a Resources() data structure. This structure contains a count and a list of resource descriptors.

Table 11—9 defines the format of the Resources() structure:

Table 11—9 — Resources() format

Syntax	Num. of Bytes
Resources(){	
resourceDescriptorCount	**2**
for(i=0;i<resourceDescriptorCount;i++) {	
ResourceDescriptor()	
}	
}	

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The **resourceDescriptorCount** field shall be set to indicate the total number of ResourceDescriptor() structures which are included in the list.

The **ResourceDescriptor()** structure shall define the type and values of a resource which is being requested or which has been assigned to a session.

Table 11—10 describes the general format of a DMIF Resource Descriptor:

Table 11—10 — General format of the Resource Descriptor

Syntax	Num. of Bytes
ResourceDescriptor {	
commonDescriptorHeader()	
resourceDescriptorDataFields()	
}	

The **commonDescriptorHeader** is normative and shall be included with every resource descriptor definition. Table 11—11 defines the format of the commonDescriptorHeader:

Table 11—11 — Format of the commonDescriptorHeader

Syntax	Num. of Bytes
commonDescriptorHeader() {	
resourceDescriptorType	**2**
resourceLength	**2**
resourceDataFieldCount	**2**
if (resourceDescriptorType == 0xffff) {	
typeOwnerId	**3**
typeOwnerValue	**3**
}	
}	

The **resourceDescriptorType** field defines the specific resource being requested. The resourceDescriptorTypes, and their corresponding descriptors, are specified in ISO/IEC 13818-6, subclause 4.7.5. Annex E provides an extract from that subclause, where the resourceDescriptorTypes useful to this part of ISO/IEC 14496 are defined. The resourceDescriptorTypes used in DMIF are by no means limited to the ones identified in Annex E.

The **resourceLength** field defines the total length of the resourceDescriptorDataField section, which follows the commonDescriptorHeader. The value of the resourceLength field depends on the particular type of the resourceDescriptor being defined and the actual data in the resource descriptor.

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The **resourceDataFieldCount** field indicates the total number of data fields in the resource descriptor, see Annex E.

The **typeOwnerId** and **typeOwnerValue** fields are defined only if the resourceDescriptorType field is set to 0xffff. In this situation, these fields are used to indicate that the resource descriptor data fields are defined by an organization that is outside of the scope of DSM-CC.

The **typeOwnerId** field is the first three bytes of an IEEE Organization Unique Identifier (OUI) as specified in the IEEE-802.1990.

The **typeOwnerValue** field is a resourceDescriptorType field defined by the owner of the typeOwnerId (OUI).

Annex E provides extracts from ISO/IEC 13818-6 that describe the resourceDescriptorDataField and the resourceDescriptors that are useful to this part of ISO/IEC 14496.

11.2.4 Direction parameter

Table 11—12 — Direction codes

Value	Description
0x00	ISO/IEC 14496-6 Reserved
0x01	Downstream (Sender to Receiver)
0x02	Upstream (Receiver to Sender)
0x03-0xff	ISO/IEC 14496-6 Reserved

11.2.5 Reason parameter

Table 11—13 — Reason codes

Value	Description
0x0000	Reason Normal
0x0001	Reason Error
0x0002-0x0fff	ISO/IEC 14496-6 Reserved
0x1000-0xffff	User Private

11.2.6 Response parameter

Table 11—14 — Response codes

Value	Description
0x0000	Response OK
0x0001	Response Error
0x0002-0x0fff	ISO/IEC 14496-6 Reserved
0x1000-0xffff	User Private

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11.2.7 channelDescriptor and qosDescriptors

DMIF defines a ChannelDescriptor at the DMIF-Application Interface to carry all informations related to the channel configuration. This includes in particular Quality of Service parameters for both profile (e.g, loss, delay, priority, etc.) and bandwidth requirements (e.g., peak bit rate, average bit rate, etc.) for an individual Elementary Stream. The ChannelDescriptor may also include information specific to a particular application. The information carried through the DAI in the ChannelDescriptor can be further delivered across the DNI and be mapped in the DMIF Default Signaling Protocol (DDSP).

Only the semantics of the ChannelDescriptor used at the DAI is specified in subclause 10.2.1.

The exact syntax of the ChannelDescriptor and of the qosDescriptor used at the DNI and in the DMIF Default Signaling Protocol (DDSP) is specified here.

The qosDescriptor shall be able to carry a number of QoS metrics. The set of metrics currently defined and their semantic is provided in Table 11—16.

The channelDescriptor shall be able to carry a number of channel parameters. These include all the QoS metrics defined in Table 11—16; the set of parameters currently defined in addition to the QoS metrics and their semantic is provided in Table 11—18.

Table 11—15 describes the generic format of the qosDescriptor.

Table 11—15 — qosDescriptor

Syntax	Num. Of Bytes
QoS_QualifierCount	**1**
for(i=0; il<QoS_QualifierCount; i++) {	
QoS_QualifierTag	**1**
QoS_QualifierDataLength	**1**
QoS_QualifierData	**QoS_QualifierDataLength**
}	

QoS_QualifierCount: Provides the number of QoS metrics specified in the descriptor.

QoS_QualifierTag: Identifies the metric type.

QoS_QualifierDataLength: Is the length of the following metric value.

QoS_QualifierData: Provides the metric value.

The **QoS_QualifierTag**s are shown in Table 11—16.

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Table 11—16 — ISO/IEC 14496-6 defined QoS_QualifierTags

QoS_QualifierTag	Value	Semantic Description
Reserved	0x00	ISO/IEC 14496-6 Reserved
PRIORITY	0x01	Priority for the stream
Reserved	0x02-0x40	ISO/IEC 14496-6 Reserved
MAX_AU_SIZE	0x41	Maximum size of a PDU, as delivered over the transmux
AVG_BITRATE	0x42	Average bit rate measured over an observation time window
MAX_BITRATE	0x43	Maximum bit rate measured over an observation time window
MAX_DELAY	0x44	Maximum delay experienced by any PDU of an Elementary Stream measured over an observation time window
AVG_DELAY	0x45	Average delay experienced by the PDUs of an Elementary Stream measured over an observation time window
LOSS_PROBABILITY	0x46	Allowable probability of loss of any single PDU of an Elementary stream measured over an observation time window
JITTER_TOLERANCE	0x47	Maximum delay variation experienced by any PDU of an Elementary Stream measured over an observation time
Reserved	0x48-0x7f	ISO/IEC 14496-6 Reserved
User defined	0x80-0xff	User Private

Table 11—17describes the generic format of the ChannelDescriptor.

Table 11—17 — ChannelDescriptor

Syntax	Num. Of Bytes
Channel_QualifierCount	**1**
for(I=0; i<Channel_QualifierCount; i++) {	
Channel_QualifierTag	**1**
Channel_QualifierDataLength	**1**
Channel_QualifierData	**Channel_QualifierDataLength**
}	

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Channel_QualifierCount: Provides the number of qualifiers specified in the descriptor.

Channel_QualifierTag: Identifies the qualifier type.

Channel_QualifierDataLength: Is the length of the following qualifier value.

Channel_QualifierData: Provides the qualifier value.

The **Channel_QualifierTag**s are shown in Table 11—18.

Table 11—18 — ISO/IEC 14496-6 defined Channel_QualifierTags

Channel_QualifierTag	Value	Semantic Description
Reserved	0x00-0x70	As for QoS Metrics
SYNC_GROUP	0x71	Identifies the timeline associated to a channel
SL_CONFIG_HEADER	0x72	Describes the MPEG-4 Sync Layer Packet Header format
Reserved	0x73-0x7f	ISO/IEC 14496-6 Reserved
User defined	0x80-0xff	User Private

The semantic meaning of the QoS and Channel qualifiers tags are as follows :

PRIORITY : this qualifier defines a relative measure for the priority of an elementary stream. An elementary stream with a higher priority is more important than one with a lower priority.

Table 11—19 — QoS qualifier : Priority syntax

Syntax	Num. of Bytes
Priority () {	
Priority	**1**
}	

MAX_PDU_SIZE : this qualifier defines the maximum size of any PDU that can be delivered over the transmux channel.

Table 11—20 —qualifier : MaxPDUSize syntax

Syntax	Num. of Bytes
MaxPDUSize () {	
MaxPDUSize	**2**
}	

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AVG_BITRATE : this qualifier defines the average bitrate of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

Table 11—21 —qualifier : AvgBitrate syntax

Syntax	Num. of Bytes
AvgBitrate () {	
AvgBitrate	**4**
ObservationWindow	**4**
}	

MAX_BITRATE : this qualifier defines the maximum bitrate of the elementary stream and the time window over which it is observed. This qualifier is therefore comprised of two semantic elements.

Table 11—22 —qualifier : MaxBitrate syntax

Syntax	Num. of Bytes
MaxBitrate () {	
MaxBitrate	**4**
ObservationWindow	**4**
}	

MAX_DELAY : this qualifier defines the maximum delay expresed in microseconds experienced by any PDU of an elementary stream and the time window over which is observed expressed in milliseconds. This qualifier is therefore comprised of two semantic elements.

Table 11-23 —qualifier : MaxDelay syntax

Syntax	Num. of Bytes
MaxDelay () {	
MaxDelay	**4**
ObservationWindow	**4**
}	

AVG_DELAY : this qualifier defines the average delay expresed in microseconds experienced by the PDUs of an elementary stream and the time window over which is observed expressed in milliseconds. This qualifier is therefore comprised of two semantic elements.

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Table 11-24 —qualifier : AvgDelay syntax

Syntax	Num. of Bytes
AvgDelay () {	
AvgDelay	**4**
ObservationWindow	**4**
}	

LOSS_PROBABILITY : this qualifier defines the allowable probability of loss expressed as a real number between 0 ans 1 experienced by any single PDU of an elementary stream and the time window over which is observed expressed in milliseconds. This qualifier is therefore comprised of two semantic elements.

Table 11-25 —qualifier : LossProb syntax

Syntax	Num. of Bytes
LossProb () {	
LossProb	**8**
ObservationWindow	**4**
}	

JITTER_TOLERANCE : this qualifier defines the maximum delay variation expressed in microseconds experienced by any PDU of an elementary stream and the time window over which is observed expressed in milliseconds. This qualifier is therefore comprised of two semantic elements.

Table 11-26 —qualifier : JitterTol syntax

Syntax	Num. of Bytes
JitterTol () {	
JitterTol	**4**
ObservationWindow	**4**
}	

SYNC_GROUP : this channel qualifier provides an identifier for the timeline associated to a channel.

Table 11-27 — Channel qualifier : SyncGroup syntax

Syntax	Num. of Bytes
SyncGroup () {	
SyncGroup	**2**
}	

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SL_CONFIG_HEADER : this channel qualifier describes the MPEG-4 Sync Layer Packet Header format. This qualifier is comprised by a binary sequence of bytes called slConfig, whose syntax corresponds to SLConfigDescriptor defined in ISO/IEC 14496-1:2001. The lenght of the slConfig is specified by slConfigLen. This qualifier is therefore comprised of two semantic elements.

Table 11-28 — Channel qualifier : SLConfigHeader syntax

Syntax	**Num. of Bytes**
SLConfigHeader () {	
SLConfigLen	**2**
SLConfig	**SLConfigLen**
}	

11.3 DMIF-Network Interface primitives

This subclause lists the primitives specified for the DMIF-Network Interface and describes the parameters used. The C++ like formalism used to describe the primitives only aims at capturing their semantic meaning. IN and OUT keywords allow to clearly distinguish the parameters provided to the other side of the interface from those returned from it; by no means they are meant to force a synchronous implementation. The loop() construct allows to concisely represent an array of elements.

The optional [Callback] construct indicates that there are always pairs of primitives (with and without the suffix Callback) with identical parameters. A primitive without the 'Callback' is issued by the DMIF peer initiating the primitive, as a consequence the corresponding primitive with the 'Callback' is issued at the target DMIF peer (see Walkthrough in Annex B).

The primitives are:

— DN_SessionSetup[Callback] (IN: networkSessionId, calledAddress, callingAddress, compatibilityDescriptorIn; OUT: response, compatibilityDescriptorOut)

— DN_SessionRelease[Callback] (IN: networkSessionId, reason; OUT: response)

— DN_ServiceAttach[Callback] (IN: networkSessionId, serviceId, serviceName, ddDataIn(); OUT: response, ddDataOut())

— DN_ServiceDetach[Callback] (IN: networkSessionId, serviceId, reason; OUT: response)

— DN_TransMuxSetup[Callback] (IN: networkSessionId, loop(TAT, qosDescriptor; resources()); OUT: loop(response, resources()))

— DN_TransMuxRelease[Callback] (IN: networkSessionId, loop(TAT); OUT: loop(response))

— DN_ChannelAdd[Callback] (IN: networkSessionId, serviceId, loop(CAT, channelDescriptor, direction, ddDataIn()); OUT: loop(response, TAT, ddDataOut()))

— DN_ChannelAdded[Callback] (IN: networkSessionId, serviceId, loop(CAT, channelDescriptor, direction, TAT, ddDataIn()); OUT: loop(response, ddDataOut()))

— DN_ChannelDelete[Callback] (IN: networkSessionId, loop(CAT, reason); OUT: loop(response))

— DN_TransMuxConfig[Callback] (IN: networkSessionId, loop(TAT, ddDataIn()); OUT: loop(response))

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— DN_UserCommand[Callback] (IN: networkSessionId, ddDataIn(), loop(CAT))

— DN_UserCommandAck[Callback] (IN: networkSessionId, ddDataIn(), loop(CAT) ; OUT : response, ddDataOut())

The parameters have the following semantics:

calledAddress: the network address of the Target DMIF peer. The Originating DMIF peer, issuing DN_SessionSetup, strips this addressing portion of a URL (see DAI definitions) to identify the location of the Target DMIF where a requested service resides. Depending on the form of the URL the originating DMIF peer may have to invoke directory service to obtain the calledAddress.

callingAddress: the network address of the Originating DMIF peer, i.e. the peer issuing DN_SessionSetup.

CAT: (Channel Association Tag) is an Association Tag which uniquely identifies a channel end-to-end within a Network Session (identified by networkSessionId) and is not changed during its lifetime within this Network Session. It is generated locally at a DMIF peer prior to issuing a DN_DownstreamChannelAdd() or DN_UpstreamChannelAdd().

channelDescriptor: see DAI definitions in subclause 10.3. See also subclause 11.2.4.

compatibilityDescriptor: in the case when native signalling does not provide capability exchange, this parameter instead (opaque to native signalling) provides a descriptor to enable capability exchange between DMIF peers as syntactically defined in subclause 13.1.

ddDataIn(): is an opaque structure providing Delivery layer information; it is transparently transported through native signalling from the local Peer to the remote Peer. The generic syntax of such data is provided in subclause 11.2.2.

ddDataOut(): is an opaque structure providing Delivery layer information; it is transparently transported through native signalling from the remote Peer to the local Peer. The generic syntax of such data is provided in subclause 11.2.2.

direction: see DAI definitions in subclause 10.3. See also subclause 11.2.4.

networkSessionId: uniquely identifies a Network Session end-to-end. It is generated locally at the originating DMIF peer prior to issuing DN_SessionSetup.

qosDescriptor: is a parameter containing the complete description of the Quality of Service requested for a particular channel or transmux. Its syntax and semantic definitions are given in subclause 11.2.7.

reason: see DAI definitions in subclause 10.3. See also subclause 11.2.5.

resources(): is a structure containing a count and a list of DSM-CC resource descriptors which are defined in subclause 4.7 of ISO/IEC 13818-6. See also subclause 11.2.3.

response: see DAI definitions in subclause 10.3. See also subclause 11.2.6.

serviceId: uniquely identifies a service end-to-end within a Network Session (identified by networkSessionId). It is generated locally at a DMIF peer prior to issuing DN_ServiceAttach. It corresponds to a serviceName which is opaque to DMIF.

serviceName: see DAI definitions in subclause 10.3.

TAT: (Transmux Channel Association Tag) is an Association Tag which uniquely identifies a Transmux Channel end-to-end within a Network Session (identified by networkSessionId) and is not changed during its lifetime within this Network Session. It is generated locally at a DMIF peer prior to issuing a DN_TransMuxSetup.

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11.4 DMIF-Network Interface semantics

11.4.1 DN_SessionSetup ()

DN_SessionSetup (IN: networkSessionId, calledAddress, callingAddress, compatibilityDescriptorIn; OUT: response, compatibilityDescriptorOut)

DN_SessionSetupCallback (IN: networkSessionId, calledAddress, callingAddress, compatibilityDescriptorIn; OUT: response, compatibilityDescriptorOut)

DN_SessionSetup() is issued by the Originating DMIF to establish a Network Session with the Target DMIF. This is the very first action performed in establishing a relation between two peers.

The **calledAddress** is extracted by the **URL** provided by the DMIF User in the DA_ServiceAttach(). The **callingAddress** is automatically computed by the Originating DMIF entity. The **networkSessionId** is a network wide unique identifier assigned by the Originating DMIF entity.

Upon receiving the DN_SessionSetupCallback() the Target DMIF peer will analyze the set of tools described in the **compatibilityDescriptorIn** and reply to the Originating DMIF peer with a response code and the indication of the matching set of tools in the **compatibilityDescriptorOut**.

11.4.2 DN_SessionRelease ()

DN_SessionRelease (IN: networkSessionId, reason; OUT: response)

DN_SessionReleaseCallback (IN: networkSessionId, reason; OUT: response)

DN_SessionRelease() is issued by a DMIF peer to close all relations with the other peer. In normal conditions, it is only invoked when all services related to the indicated **networkSessionId** have been already detached (see DN_ServiceDetach[Callback]).

Upon receiving the DN_SessionReleaseCallback() the Target DMIF peer will reply to the Originating DMIF peer with a response code.

After completion of this procedure the **networkSessionId** is invalid.

11.4.3 DN_ServiceAttach ()

DN_ServiceAttach (IN: networkSessionId, serviceId, serviceName, ddDataIn(); OUT: response, ddDataOut())

DN_ServiceAttachCallback (IN: networkSessionId, serviceId, serviceName, ddDataIn(); OUT: response, ddDataOut())

DN_ServiceAttach() is issued by the Originating DMIF to establish a Service Session with the Target DMIF. This Service Session is established inside a previously established Network Session, identified by the **networkSessionId**.

The **serviceName** is extracted by the URL provided by the DMIF User in the DA_ServiceAttach(). The **ddDataIn()** contains the **uuData()** provided by the DMIF User in the DA_ServiceAttach(). The **serviceId** is a Network Session wide unique identifier assigned by the Originating DMIF entity.

Upon receiving the DN_ServiceAttachCallback() the Target DMIF peer will issue DA_ServiceAttachCallback().

Upon returning of the DA_ServiceAttachCallback(), the Target DMIF peer will reply to the Originating DMIF peer with a response code.The **ddDataOut()** contains the **uuData()** provided by the DMIF User in return to the DA_ServiceAttachCallback().

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11.4.4 DN_ServiceDetach ()

DN_ServiceDetach (IN: networkSessionId, serviceId, reason; OUT: response)

DN_ServiceDetachCallback (IN: networkSessionId, serviceId, reason; OUT: response)

DN_ServiceDetach() is issued by the Originating DMIF to detach a Service Session previously established with the Target DMIF. This Service Session is identified by the **serviceId** inside the Network Session identified by the **networkSessionId**.

Upon receiving the DN_ServiceDetachCallback() the Target DMIF peer will issue DA_ServiceDetachCallback().

Upon returning of the DA_ServiceDetachCallback(), the Target DMIF peer will reply to the Originating DMIF peer with a response code.

After completion of this procedure the **serviceId** is invalid.

11.4.5 DN_TransMuxSetup ()

DN_TransMuxSetup (IN: networkSessionId, loop(TAT, direction, qosDescriptor; resources()); OUT: loop(response, resources()))

DN_TransMuxSetupCallback (IN: networkSessionId, loop(TAT, direction, qosDescriptor; resources()); OUT: loop(response, resources()))

DN_TransMuxSetup() is issued by the Originating DMIF to establish one or more Transmux Channels inside a Network Session previously established with the Target DMIF. This Network Session is identified by the **networkSessionId**.

The **TAT** is a Network Session wide unique identifier assigned by the Originating DMIF entity. The **direction** determines the direction of the Transmux Channel. The **qosDescriptor** is set based on the information contained in the **qosDescriptor**s passed in the DA_ChannelAdd() and related to the Elementary Streams being carried in the Transmux Channel. The **resources()** parameter contains the description of the network resources to be reserved for the Transmux Channel.

Upon receiving the DN_TransMuxSetupCallback() the Target DMIF peer will possibly complete and update the **resources()** parameter and reply to the Originating DMIF peer with a response code.

11.4.6 DN_TransMuxRelease ()

DN_TransMuxRelease (IN: networkSessionId, loop(TAT); OUT: loop(response))

DN_TransMuxReleaseCallback (IN: networkSessionId, loop(TAT); OUT: loop(response))

DN_TransMuxRelease() is issued by a DMIF peer to close all logical channels making use of the one or more indicated Transmux Channels. In normal conditions, it is only invoked when all logical channels related to the indicated **TAT**s inside the Network Session identified by the **networkSessionId** have been already detached (see DN_ChannelDelete[Callback]).

Upon receiving the DN_TransMuxReleaseCallback() the Target DMIF peer will reply to the Originating DMIF peer with a response code.

After completion of this procedure the **TAT**s is are invalid.

11.4.7 DN_ChannelAdd()

DN_ChannelAdd (IN: networkSessionId, serviceId, loop(CAT, direction, channelDescriptor, ddDataIn()); OUT: loop(response, TAT, ddDataOut()))

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DN_ChannelAddCallback (IN: networkSessionId, serviceId, loop(CAT, direction, channelDescriptor, ddDataIn()); OUT: loop(response, TAT, ddDataOut()))

DN_ChannelAdd() is issued by the Originating DMIF to open one or more logical channels inside a Service Session. The Service Session is identified by the **serviceId** inside the Network Session identified by the **networkSessionId**.

For each logical channel to be established, a tuple of parameters is provided, some of which is derived from parameters passed in the DA_ChannelAdd() and related to the Elementary Stream being carried in the logical channel. The **CAT** is a Network Session wide unique identifier assigned by the Originating DMIF entity. The **direction** is set based on the related **direction** parameter passed in the DA_ChannelAdd().The **channelDescriptor** contains the complete description of the Quality of Service requested for a particular channel as well as possibly application specific descriptors. It is set based on the information contained in the related **channelDescriptor** passed in the DA_ChannelAdd(). The **ddDataIn()** contains the related **uuData()** provided by the DMIF User in the DA_ChannelAdd().

Upon receiving the DN_ChannelAddCallback() the Target DMIF peer will issue DA_ChannelAddCallback().

Upon returning of the DA_ChannelAddCallback(), the Target DMIF peer will reply to the Originating DMIF peer: for each logical channel established (or not established), a tuple of parameters is provided, some of which is derived from parameters passed in the DA_ChannelAddCallback() and related to the Elementary Stream being carried in the logical channel. **ddDataOut()** contains the related **uuData()** provided by the DMIF User in return to the DA_ChannelAddCallback() and the DMIF descriptor containing the Flexmux information. The **TAT** contains the Association Tag of the Transmux Channel carrying the logical channel (see DN_TransMuxSetup[Callback]).

11.4.8 DN_ChannelAdded()

DN_ChannelAdded (IN: networkSessionId, serviceId, loop(CAT, direction, channelDescriptor, TAT, ddDataIn()); OUT: loop(response, ddDataOut()))

DN_ChannelAddedCallback (IN: networkSessionId, serviceId, loop(CAT, direction, channelDescriptor, TAT, ddDataIn()); OUT: loop(response, ddDataOut()))

DN_ChannelAdded() is issued by the Originating DMIF to notify the Target DMIF peer that one or more logical channels inside a Service Session were added. The Service Session is identified by the **serviceId** inside the Network Session identified by **networkSessionId**.

For each logical channel established, a tuple of parameters is provided, some of which is derived from parameters passed in the DA_ChannelAdd() and related to the Elementary Stream being carried in the logical channel. The **CAT** is a Network Session wide unique identifier assigned by the Originating DMIF entity. The **direction** is set based on the related **direction** parameter passed in the DA_ChannelAdd(). The **channelDescriptor** contains the complete description of the Quality of Service requested for a particular channel as well as possibly application specific descriptors. It is set based on the information contained in the related **channelDescriptor** passed in the DA_ChannelAdd(). The **ddDataIn()** contains the related **uuData()** provided by the DMIF User in the DA_ChannelAdd() and the DMIF descriptor containing the Flexmux information. The **TAT** contains the Association Tag of the Transmux Channel carrying the logical channel (see DN_TransMuxSetup[Callback]).

Upon receiving the DN_ChannelAdded() the Target DMIF peer will issue DA_ChannelAddCallback().

Upon returning of the DA_ChannelAddCallback(), the Target DMIF peer will reply to the Originating DMIF peer: for each logical channel established (or not established), a tuple of parameters is provided, some of which is derived from parameters passed in the DA_ChannelAddCallback() and related to the Elementary Stream being carried in the logical channel. **ddDataOut()** contains the related **uuData()** provided by the DMIF User in return to the DA_ChannelAddCallback().

11.4.9 DN_ChannelDelete ()

DN_ChannelDelete (IN: networkSessionId, loop(CAT, reason); OUT: loop(response))

DN_ChannelDeleteCallback (IN: networkSessionId, loop(CAT, reason); OUT: loop(response))

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DN_ChannelDelete() is issued by the Originating DMIF to close one or more logical channels previously established inside a Network Session. The logical channels are identified by their **CAT** inside the Network Session identified by the **networkSessionId**.

Upon receiving the DN_ChannelDeleteCallback() the Target DMIF peer will issue DA_ChannelDeleteCallback().

Upon returning of the DA_ChannelDeleteCallback(), the Target DMIF peer will reply to the Originating DMIF peer with a response code.

NOTE Since DA_ChannelDelete() may refer to channels in different Network Sessions there may be several DN_ChannelDelete() primitives issued, one for each invoked Network Session.

11.4.10 DN_TransMuxConfig ()

DN_TransMuxConfig (IN: networkSessionId, loop(TAT, ddDataIn()); OUT: loop(response))

DN_TransMuxConfigCallback (IN: networkSessionId, loop(TAT, ddDataIn()); OUT: loop(response))

DN_TransMuxConfig() is issued by the Originating DMIF to reconfigure one or more Transmux Channels previously established inside a Network Session. The Transmux Channels are identified by their **TAT** inside the Network Session identified by the **networkSessionId**.

For each Transmux Channel a tuple of parameters is provided. The **TAT** contains the Association Tag of the Transmux Channel; **ddDataIn()** contains the DMIF descriptor containing the Flexmux information.

Upon receiving the DN_TransMuxConfigCallback() the Target DMIF peer will reply to the Originating DMIF peer with a response code.

11.4.11 DN_UserCommand ()

DN_UserCommand (IN: networkSessionId, ddDataIn(), loop(CAT))

DN_UserCommandCallback (IN: networkSessionId, ddDataIn(), loop(CAT))

DN_UserCommand() is issued by the Originating DMIF to pass user data to the corresponding peer that refers to specific channels. Each channel is identified by its CAT, that is scoped inside the Network Session identified by the **networkSessionId**.

Upon receiving the DN_UserCommandCallback() the Target DMIF peer will issue DA_UserCommandCallback().

NOTE the DA_UserCommand() user call returns immediately since there is no expected response.

11.4.12 DN_UserCommandAck ()

DN_UserCommandAck (IN: networkSessionId, ddDataIn(), loop(CAT) ; OUT : response, ddDataOut())

DN_UserCommandAckCallback (IN: networkSessionId, ddDataIn(), loop(CAT) ; OUT : response, ddDataOut())

DN_UserCommandAck() is issued by the Originating DMIF to pass user data to the corresponding peer that refers to specific channels. Each channel is identified by its CAT, that is scoped inside the Network Session identified by the **networkSessionId**.

Upon receiving the DN_UserCommandAckCallback() the Target DMIF peer will issue DA_UserCommandAckCallback().

Upon returning of the DA_UserCommandAckCallback(), the Target DMIF peer will reply to the Originating DMIF peer. The **ddDataOut()** contains the **uuData()** provided by the DMIF User in return to the DA_UserCommandAckCallback().

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12 Control Plane mappings

12.1 Default syntax

When DMIF operates on a network that cannot extend its signalling to map the DNI primitives, a DMIF signalling channel shall be established. DMIF signalling messages as defined in this specification will be exchanged over that channel.

The following DNI primitives are mapped into DMIF signalling messages:

— DN_SessionSetup ()

— DN_SessionRelease ()

— DN_ServiceAttach ()

— DN_ServiceDetach ()

— DN_TransMuxSetup ()

— DN_TransMuxRelease ()

— DN_ChannelAdd ()

— DN_ChannelAdded ()

— DN_ChannelDelete ()

— DN_TransMuxConfig ()

— DN_UserCommand ()

12.1.1 Syntax elements

12.1.1.1 General message format

All DMIF signalling messages have a common message format. Table 12—1 defines the DMIF Signalling Message format. This format is called the DMIFSignallingMessage().

Table 12—1 — General Format of DMIF Signalling Message

Syntax

DMIFSignallingMessage () {
DsmccMessageHeader()
MessagePayload()
Padding()
}

The **dsmccMessageHeader** is defined in the subclause 12.1.1.2.

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The **MessagePayload** is dependent on the particular message. Subclause 12.1.2 illustrates the syntax of each such message.

The **Padding** is a series of up to 3 bytes, encoded as 0s, that enforces 4 bytes alignment.

12.1.1.2 DSM-CC message header

All MPEG-4 DMIF signalling messages conform to the generic format of MPEG-2 DSM-CC messages and begin with the DSM-CC MessageHeader as defined in clause 2 of ISO/IEC 13818-6. This header contains information about the type of message being passed. Table 12—2 defines the format of a DSM-CC message header as used for MPEG-4 DMIF signalling messages.

Table 12—2 — MPEG-2 DSM-CC message header format

Syntax	Num. of Bytes
DsmccMessageHeader () {	
protocolDiscriminator	**1**
dsmccType	**1**
messageId	**2**
transactionId	**4**
reserved	**1**
adaptationLength	**1**
messageLength	**2**
}	

The **protocolDiscriminator** field is used to indicate that the message is a MPEG-2 DSM-CC message. The value of this field shall be 0x11

The **dsmccType** field is used to indicate the type of MPEG-2 DSM-CC message. Table 12—3 defines the possible dsmccTypes.

Table 12—3 — MPEG-2 DSM-CC dsmccType values

DsmccType	Description
0x00	ISO/IEC 13818-6 Reserved
0x01-0x05	ISO/IEC 13818-6 Defined.
0x06	Identifies the message as an ISO/IEC 14496-6 DMIF Signalling message.
0x07-0x7F	ISO/IEC 13818-6 Reserved.
0x80-0xFF	User Defined message type.

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The **messageId** field indicates the type of message which is being passed. The values of the messageId are defined within the scope of the dsmccType.

The **transactionId** field is used for session integrity and error processing and shall remain unique for a period of time such that there will be little chance that command sequences collide. The transactionId contained in the request-confirm command pair shall be identical. Its format follows the normative definition in ISO/IEC 13818-6.

The transactionId is constructed of a 2 bit transactionId originator indication and a 30 bit transaction number. Figure 12 describes the format of the transactionId field:

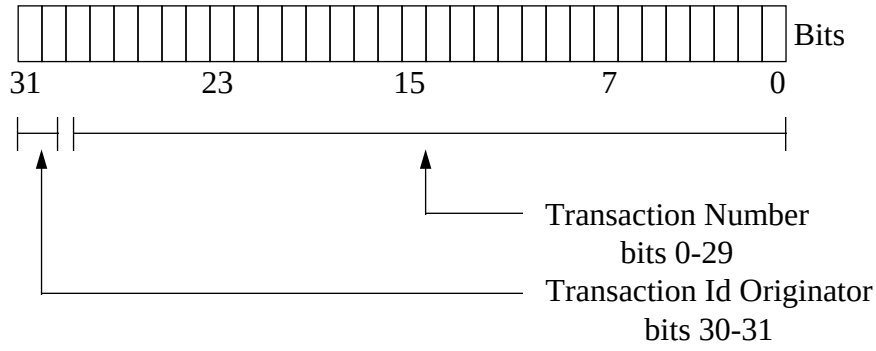

Figure 12 — Format of transactionId field

The coding of the transactionId originator indication is described in Table 12—4:

Table 12—4 — MPEG-2 DSM-CC transactionId originator

Originator	Description
0x00	TransactionId is assigned by the Session Originator.
0x01	TransactionId is assigned by the other Peer.
0x02	not used for ISO/IEC 14496-6 DMIF signalling messages.
0x03	ISO/IEC 13818-6 Reserved.

The **reserved** field is ISO/IEC 13818-6 reserved. This field shall be set to 0xFF.

The **adaptationLength** field shall be set to 0 for MPEG-4 DMIF signalling messages.

The **messageLength** field is used to indicate the total length in bytes of the message following this field. This length includes the padding required for 4 bytes alignment.

12.1.1.3 Message identifiers

Each message is identified by a specific messageId which is encoded to indicate the class and direction of the message. The messageId is carried in the dsmccMessageHeader which is defined in subclause 12.1.1.2. Figure 13 defines the encoding of the messageId fields used in DMIF signalling messages. Bit 0 is the least significant bit and bit 15 is the most significant bit.

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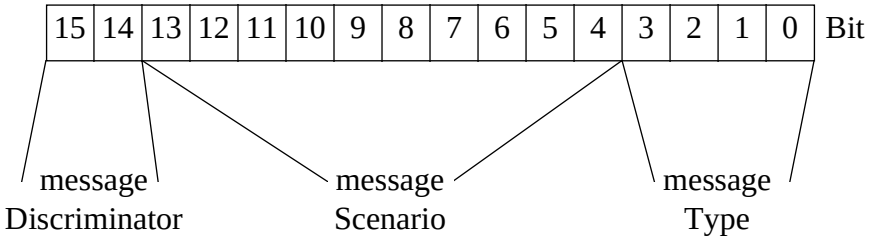

Figure 13 — Format of DMIF Signalling messageId

The **messageDiscriminator** field shall be set to 00. Other values are ISO/IEC 14496-6 Reserved.

The **messageScenario** field is used to indicate the message group to which the message belongs. Table 12—5 defines the possible values for the messageScenario field.

Table 12—5 — messageScenario field values

MessageScenario	Description
00 0000 0000	ISO/IEC 14496-6 Reserved.
00 0000 0001	SessionSetup
00 0000 0010	SessionRelease
00 0000 0011	ServiceAttach
00 0000 0100	ServiceDetach
00 0000 0101	TransmuxSetup
00 0000 0110	Transmux Release
00 0000 0111	ChannelAdd
00 0000 1000	ChannelAdded
00 0000 1001	ChannelDelete
00 0000 1010	TransmuxConfig
00 0000 1011	UserCommand
00 0000 1100	UserCommandAck
00 0000 1101 - 01 1111 1111	ISO/IEC 14496-6 Reserved.
10 0000 0000 - 11 1111 1111	User Defined Message Scenario

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Most of the control messages in this part of ISO/IEC 14496 use a confirmation mechanism. When a DMIF peer issues a request message, the receiver of that message issues a definite response to that message. There are however some cases which do not use this mechanism.

The **messageType** field is used to indicate the directionality of the message. Table 12—6 defines the possible values for the messageType field.

Table 12—6 — messageType field values

MessageType	Description
0000	Request Message.
0001	Confirm Message. This indicates that the message is being sent in response to a Request message.
0010-1111	ISO/IEC 14496-6 Reserved.

Table 12—7 defines the messageId's which are used in the DMIF signalling messages.

Table 12—7 — DMIF signalling messages

Command	messageId
ISO/IEC 14496-6 reserved	0x0000 - 0x000f
DS_SessionSetupRequest	0x0010
DS_SessionSetupConfirm	0x0011
ISO/IEC 14496-6 reserved	0x0012 - 0x001f
DS_SessionReleaseRequest	0x0020
DS_SessionReleaseConfirm	0x0021
ISO/IEC 14496-6 reserved	0x0022 - 0x002f
DS_ServiceAttachRequest	0x0030
DS_ServiceAttachConfirm	0x0031
ISO/IEC 14496-6 reserved	0x0032 - 0x003f
DS_ServiceDetachRequest	0x0040
DS_ServiceDetachConfirm	0x0041
ISO/IEC 14496-6 reserved	0x0042 - 0x004f
DS_TransMuxSetupRequest	0x0050
DS_TransMuxSetupConfirm	0x0051

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Command	messageId
ISO/IEC 14496-6 reserved	0x0052 - 0x005f
DS_TransMuxReleaseRequest	0x0060
DS_TransMuxReleaseConfirm	0x0061
ISO/IEC 14496-6 reserved	0x0062 - 0x006f
DS_ChannelAddRequest	0x0070
DS_ChannelAddConfirm	0x0071
ISO/IEC 14496-6 reserved	0x0072 - 0x007f
DS_ChannelAddedRequest	0x0080
DS_ChannelAddedConfirm	0x0081
ISO/IEC 14496-6 reserved	0x0082 - 0x008f
DS_ChannelDeleteRequest	0x0090
DS_ChannelDeleteConfirm	0x0091
ISO/IEC 14496-6 reserved	0x0092 - 0x009f
DS_TransMuxConfigRequest	0x00a0
DS_TransMuxConfigConfirm	0x00a1
ISO/IEC 14496-6 reserved	0x00a2 - 0x00af
DS_UserCommand	0x00b0
ISO/IEC 14496-6 reserved	0x00b1
ISO/IEC 14496-6 reserved	0x00b2 - 0x00bf
ISO/IEC 14496-6 reserved	0x00c0 - 0x1fff
User defined messageId's.	0x2000 - 0x3fff
ISO/IEC 14496-6 reserved	0x4000 - 0xffff

12.1.1.4 Use of Resources() structure in DMIF signalling messages

A Network Session consists of a relationship between two DMIF peers. Messages which are used to request resources contain a Resources() data structure. The Resources() structure is defined in subclause 11.2.3.

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12.1.1.5 Use of ddData() structure in DMIF signalling messages

Messages which contain information to be passed between DMIF peers but that need not be inspected by the Network use the ddData() structure to convey such information. In this part of ISO/IEC 14496 ddData() contains DMIF descriptors. The ddData() structure is defined in subclause 11.2.2.

12.1.1.6 The relation between DNI and DS messages

Each DNI primitive pair (i.e. primitives with and without callback suffix) has two associated messages. One which corresponds to the ”IN:” parameters the and one which corresponds to the ”OUT:” parameters. As follows:

DN_<xxx>[Callback](IN: <yyy>; OUT: <zzz>)

gives:

DS_<xxx>Request(){<yyy>}

and

DS_<xxx>Confirm(){<zzz>}

12.1.2 DNI mapping to DMIF signalling messages

12.1.2.1 DS_SessionSetupRequest

Table 12—8 — DS_SessionSetupRequest message

Syntax	Num. Of Bytes
DS_SessionSetupRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
compatibilityDescriptor()	
}	

The format of the **compatibilityDescriptor()** is defined in subclause 13.1.

12.1.2.2 DS_SessionSetupConfirm

Table 12—9 — DS_SessionSetupConfirm message

Syntax	Num. of Bytes
DS_SessionSetupConfirm(){	
dsmccMessageHeader()	
Response	**2**
compatibilityDescriptor()	
}	

The format of the **compatibilityDescriptor()** is defined in subclause 13.1.

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12.1.2.3 DS_SessionReleaseRequest

Table 12—10 — DS_SessionReleaseRequest message

Syntax	Num. Of Bytes
DS_SessionReleaseRequest(){	
dsmccMessageHeader()	
NetworkSessionId	**10**
Reason	**2**
}	

12.1.2.4 DS_SessionReleaseConfirm

Table 12—11 — DS_SessionReleaseConfirm message

Syntax	Num. of Bytes
DS_SessionReleaseConfirm(){	
dsmccMessageHeader()	
response	**2**
}	

12.1.2.5 DS_ServiceAttachRequest

Table 12—12 — DS_ServiceAttachRequest message

Syntax	Num. Of Bytes
DS_ServiceAttachRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
serviceId	**2**
serviceNameLen	**1**
serviceName	**serviceNameLen**
ddData()	
}	

If uuData() is provided through DA_ServiceAttach(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

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12.1.2.6 DS_ServiceAttachConfirm

Table 12—13 — DS_ServiceAttachConfirm message

Syntax	Num. Of Bytes
DS_ServiceAttachConfirm(){	
dsmccMessageHeader()	
response	**2**
ddData()	
}	

If uuData() is provided through DA_ServiceAttachCallback(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

12.1.2.7 DS_ServiceDetachRequest

Table 12—14 — DS_ServiceDetachRequest message

Syntax	Num. Of Bytes
DS_ServiceDetachRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
serviceId	**2**
reason	**2**
}	

12.1.2.8 DS_ServiceDetachConfirm

Table 12—15 — DS_ServiceDetachConfirm message

Syntax	Num. Of Bytes
DS_ServiceDetachConfirm(){	
dsmccMessageHeader()	
response	**2**
}	

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12.1.2.9 DS_TransMuxSetupRequest

Table 12—16 — DS_TransMuxSetupRequest message

Syntax	Num. Of Bytes
DS_TransMuxSetupRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
count	**1**
loop(count) {	
TAT	**2**
direction	**1**
qosDescriptor()	
resources()	
}	
}	

The format of the **qosDescriptor()** is defined in subclause 11.2.3.

resources() contains DSM-CC resource descriptors.

12.1.2.10 DS_TransMuxSetupConfirm

Table 12—17 — DS_TransMuxSetupConfirm message

Syntax	Num. Of Bytes
DS_TransMuxSetupConfirm(){	
dsmccMessageHeader()	
count	**1**
loop(count) {	
response	**2**
resources()	
}	
}	

resources() contains DSM-CC resource descriptors.

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12.1.2.11 DS_TransMuxReleaseRequest

Table 12—18 — DS_TransMuxReleaseRequest message

Syntax	Num. Of Bytes
DS_TransMuxReleaseRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
count	**1**
loop(count) {	
TAT	**2**
}	
}	

12.1.2.12 DS_TransMuxReleaseConfirm

Table 12—19 — DS_TransMuxReleaseConfirm message

Syntax	Num. Of Bytes
DS_TransMuxReleaseConfirm(){	
dsmccMessageHeader()	
count	**1**
loop(count) {	
response	**2**
}	
}	

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12.1.2.13 DS_ChannelAddRequest

Table 12—20 — DS_ChannelAddRequest message

Syntax	Num. Of Bytes
DS_ChannelAddRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
serviceId	**2**
count	**1**
loop(count) {	
CAT	**2**
direction	**1**
channelDescriptor()	
ddData()	
}	
}	

If uuData() is provided through DA_ChannelAdd(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

12.1.2.14 DS_ChannelAddConfirm

Table 12—21 — DS_ChannelAddConfirm message

Syntax	Num. Of Bytes
DS_ChannelAddConfirm(){	
dsmccMessageHeader()	
count	**1**
loop(count) {	
response	**2**
TAT	**2**
ddData()	
}	
}	

ddData() shall contain a BypassFlexMuxDescriptor or an MPEG4SystemsFlexMuxDescriptor.

If uuData() is provided through DA_ChannelAddCallback(), **ddData()** shall also contain a UuDataDescriptor containing the uuData().

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12.1.2.15 DS_ChannelAddedRequest

Table 12—22 — DS_ChannelAddedRequest message

Syntax	Num. Of Bytes
DS_ChannelAddedRequest(){	
dsmccMessageHeader()	
NetworkSessionId	**10**
ServiceId	**2**
Count	**1**
loop(count) {	
CAT	**2**
direction	**1**
channelDescriptor()	
TAT	**2**
ddData()	
}	
}	

ddData() shall contain a BypassFlexMuxDescriptor or an MPEG4SystemsFlexMuxDescriptor.

If uuData() is provided through DA_ChannelAdd(), **ddData()** shall also contain a UuDataDescriptor containing the uuData().

12.1.2.16 DS_ChannelAddedConfirm

Table 12—23 — DS_ChannelAddedConfirm message

Syntax	Num. Of Bytes
DS_ChannelAddedConfirm(){	
dsmccMessageHeader()	
Count	**1**
loop(count) {	
Response	**2**
ddData()	
}	
}	

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If uuData() is provided through DA_ChannelAddCallback(), **ddData()** shall also contain a UuDataDescriptor containing the uuData().

12.1.2.17 DS_ChannelDeleteRequest

Table 12—24 — DS_ChannelDeleteRequest message

Syntax	Num. Of Bytes
DS_ChannelDeleteRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
count	**1**
loop(count) {	
CAT	**2**
reason	**2**
}	
}	

12.1.2.18 DS_ChannelDeleteConfirm

Table 12—25 — DS_ChannelDeleteConfirm message

Syntax	Num. Of Bytes
DS_ChannelDeleteConfirm(){	
dsmccMessageHeader()	
count	**1**
loop(count) {	
response	**2**
}	
}	

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12.1.2.19 DS_TransMuxConfigRequest

Table 12—26 — DS_TransMuxConfigRequest message

Syntax	Num. Of Bytes
DS_TransMuxConfigRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
count	**1**
loop(count) {	
TAT	**2**
ddData()	
}	
}	

ddData() may contain an MPEG4SystemsMuxCodeDescriptor.

12.1.2.20 DS_TransMuxConfigConfirm

Table 12—27 — DS_TransMuxConfigConfirm message

Syntax	Num. Of Bytes
DS_TransMuxConfigConfirm(){	
dsmccMessageHeader()	
count	**1**
loop(count) {	
response	**2**
}	
}	

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12.1.2.21 DS_UserCommand

Table 12—28 — DS_UserCommand message

Syntax	Num. Of Bytes
DS_UserCommand(){	
dsmccMessageHeader()	
networkSessionId	**10**
ddData()	
count	**1**
loop(count) {	
CAT	**2**
}	
}	

If uuData() is provided through DA_UserCommand(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

12.1.2.22 DS_UserCommandAckRequest()

Table 12—29 — DS_UserCommandAckRequest message

Syntax	Num. Of Bytes
DS_UserCommandAckRequest(){	
dsmccMessageHeader()	
networkSessionId	**10**
ddData()	
count	**1**
loop(count) {	
CAT	**2**
}	
}	

If uuData() is provided through DA_UserCommandAck(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

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12.1.2.23 DS_UserCommandAckConfirm()

Table 12—30 — DS_UserCommandAckConfirm message

Syntax	Num. Of Bytes
DS_UserCommandAckConfirm(){	
dsmccMessageHeader()	
networkSessionId	**10**
response	**2**
ddData()	
}	

If uuData() is provided through DA_UserCommandAckCallback(), **ddData()** shall contain a UuDataDescriptor containing the uuData().

12.2 Syntax for IP networks with (or without) RSVP signalling, using TCP for DMIF signalling

When DMIF operates with IP networks with (or without) RSVP signalling, and uses TCP for DMIF signalling, it shall use a DMIF signalling channel and the Default Syntax for DMIF signalling messages as specified in subclause 12.1 for all DNI primitives except:

— DN_SessionSetup ()

— DN_SessionRelease ()

— DN_TransMuxSetup ()

— DN_TransMuxRelease ()

The mapping of the above primitives into DMIF signalling messages and socket actions is described in subclause 12.2.5.

12.2.1 Approach overview

Whenever a new session is started, a DMIF signalling channel is established on a TCP socket. Whenever a new TransMux is requested, a new TCP or UDP socket is created.

12.2.2 DSM-CC Resource Descriptors used

The DSM-CC Resource Descriptor used is the IP resource descriptor that is defined in subclause 4.7.5.9 of ISO/IEC 13818-6, and is reported in Annex E for convenience.

12.2.3 Usage of networkSessionIds

A DMIF Signalling channel is established for each Network Session; there is a 1 to 1 relation between the socket carrying the DMIF signalling messages and the networkSessionId. Therefore the networkSessionId field contained in the DMIF signalling messages although present is not used.

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12.2.4 Usage of transactionIds

The state machine for transactionIds (see Annex D) allows the repetition of a message up to a certain number of times when a certain timeout expires. Timeouts and number of retries are predefined locally.

Since in this case the DMIF signalling messages are carried on a reliable channel, the number of retries shall be set to 0.

12.2.5 DNI mapping to socket actions and RSVP signalling

12.2.5.1 DN_SessionSetup ()

The DN_SessionSetup () functionality is obtained through the setup of a DMIF Signalling channel, and the exchange of DS_SessionSetup messages. This procedure works as follows:

the target peer is supposed to listen on a well known TCP port number (DMIF_PORT)

the originating peer creates a TCP socket and connects to the target peer, using the DMIF_PORT port number and the TCP protocol.

the target peer accepts the connection: this connection carries the DMIF signalling channel.

the originating peer sends a DS_SessionSetupRequest message on the just established connection.

the target peer replies with a DS_SessionSetupConfirm message.

NOTE Steps 4 and 5 are only needed for the compatibility exchange.

12.2.5.2 DN_SessionRelease ()

The DN_SessionRelease () functionality is obtained through the deletion of the DMIF Signalling channel. Since the networkSessionId field in the DS messages is not used, the DS_SessionRelease messages are not transmitted. This procedure works as follows:

the originating peer closes the TCP socket corresponding to the DMIF signalling channel.

the target peer is notified that the peer has closed the socket corresponding to the DMIF signalling channel, and closes the socket.

NOTE 1 Since the networkSessionId parameter is not used, the DS_SessionRelease messages are omitted.

NOTE 2 The reason code is always set at the target peer to indicate “remote disconnection”.

NOTE 3 The response code is always set at the originating peer to indicate “OK”.

NOTE 4 In case the socket is automatically closed by the operating system or network, both sides behave as targets.

12.2.5.3 DN_TransMuxSetup ()

The DN_TransMuxSetup () functionality is obtained through the setup of a new socket, and the exchange of DS_TransMuxSetup messages. This procedure works as follows:

UDP sockets

the originating peer creates a UDP socket and binds it to some port number.

the originating peer creates an IP resource descriptor, setting the **sourceIpAddress**, **sourceIpPort** and **ipProtocol** fields.

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the originating peer generates a Transmux Association Tag, and sends a DS_TransMuxSetupRequest message containing the above TAT and resource.

the originating peer associates the socket to the Transmux Association Tag carried in the DS_TransMuxSetup messages.

the target peer creates a UDP socket.

the target peer associates the socket to the Transmux Association Tag carried in the DS_TransMuxSetup messages.

the target peer updates the received IP resource descriptor, setting the **destinationIpAddress** and **destinationIpPort** fields.

the target peer sends a DS_TransMuxSetupConfirm message containing the above resource.

the originating peer receives the DS_TransMuxSetupConfirm message and retrieves the address and port number of the peer.

the originating peer generates a RSVP PATH with Sender_Tspec (containing the destination address and port, and the QoS requirements) and ADSpec.

the intermediate routers modify the ADSpec.

the target peer receives the RSVP message with Sender_Tspec and the updated ADSpec, and based on meeting the QoS designated for the socket generates a RESV message with the FlowSpec.

the originating peer receives the RESV message

the setup is complete

NOTE 1 Steps 10 to 13 are only executed if RSVP is used.

NOTE 2 RSVP may require a reduction of the MTU size which is presently not supported in this part of ISO/IEC 14496.

TCP sockets

the originating peer creates a TCP socket, binds it to some port number, and listens on that socket.

the originating peer creates an IP resource descriptor, setting the **sourceIpAddress**, **sourceIpPort** and **ipProtocol** fields.

the originating peer generates a Transmux Association Tag, and sends a DS_TransMuxSetupRequest message containing the above TAT and resource.

the originating peer _provisionally_ associates the listening socket to the Transmux Association Tag carried in the DS_TransMuxSetup messages.

the target peer creates a TCP socket and connects to the target peer socket, as identified by the IP resource descriptor.

the originating peer accepts the connection, thus gets a new socket, and looks at the new socket' peer address and port; it associates the new socket to the TAT that was provisionally associated to the corresponding listening socket and closes the listening socket.

the target peer associates the socket to the Transmux Association Tag carried in the DS_TransMuxSetup messages.

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the target peer updates the received IP resource descriptor, setting the **destinationIpAddress** and **destinationIpPort** fields.

the target peer sends a DS_TransMuxSetupConfirm message containing the above resource.

the originating peer receives the DS_TransMuxSetupConfirm message and retrieves the address and port number of the peer.

the originating peer compares the sockets' peer address and port with the peer address and port as conveyed in the fields of the IP resource descriptors and associates the socket to the Transmux Association Tag carried in the relevant DS_TransMuxSetup messages.

the setup is complete

NOTE The originating peer should be prepared to receive the DS_TransMuxSetupConfirm message and accept an incoming connection in any order, thus the comparison in step 11 shall support both sequences.

12.2.5.4 DN_TransMuxRelease ()

The DN_TransMuxRelease () functionality is obtained through the deletion of the socket corresponding to a particular TAT, and possibly the exchange of DS_TransMuxRelease messages (UDP case). Since the networkSessionId field in the DS messages is not used, the DS_TransMuxRelease messages are not transmitted in the TCP case. This procedure works as follows:

UDP sockets

the originating peer sends a DS_TransMuxReleaseRequest message containing the TAT associated to the socket being closed.

the target peer closes the UDP socket corresponding to the above TAT.

the target peer sends a DS_TransMuxReleaseConfirm message.

the originating peer closes the UDP socket corresponding to the above TAT.

TCP sockets

the originating peer closes the TCP socket corresponding to a particular TAT.

the target peer is notified that the peer has closed the socket corresponding to a particular TAT, and closes the socket.

NOTE 1 The reason code is always set at the target peer to indicate "remote disconnection".

NOTE 2 The response code is always set at the originating peer to indicate "OK"

NOTE 3 In case the socket is automatically closed by the operating system or network, both sides behave as targets.

12.3 Syntax for IP networks with (or without) RSVP Signalling, using UDP for DMIF signalling

When DMIF operates with IP networks with (or without) RSVP Signalling, and uses UDP for DMIF signalling, it shall use a DMIF signalling channel and the Default Syntax for DMIF signalling messages as specified in subclause 12.1 for all DNI primitives except:

— DN_SessionSetup ()

— DN_SessionRelease ()

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— DN_TransMuxSetup ()

— DN_TransMuxRelease ()

The mapping of the above primitives into DMIF signalling messages and socket actions is described in subclause 12.3.5.

12.3.1 Approach overview

Whenever a new session is started, a DMIF signalling channel is established on a UDP socket. Whenever a new TransMux is requested, a new TCP or UDP socket is created.

12.3.2 DSM-CC Resource Descriptors used

See subclause 12.2.2.

12.3.3 Usage of networkSessionIds

A DMIF Signalling channel is established for each Network Session; there is a 1 to 1 relation between the full address of the socket carrying the DMIF signalling messages and the networkSessionId. Therefore the networkSessionId field contained in the DMIF signalling messages although present is not used.

12.3.4 Usage of transactionIds

The state machine for transactionIds (see Annex D) allows the repetition of a message up to a certain number of times when a certain timeout expires. Timeouts and number of retries are predefined locally.

12.3.5 DNI mapping to socket actions and RSVP signalling

12.3.5.1 DN_SessionSetup ()

The DN_SessionSetup () functionality is obtained through the setup of a DMIF Signalling channel, and the exchange of DS_SessionSetup messages. This procedure works as follows:

The target peer is supposed to have created a UDP socket on a well known UDP port number (DMIF_PORT).

The originating peer creates a UDP socket and sends a DS_SessionSetupRequest message on the just established connection.

The target peer replies with a DS_SessionSetupConfirm message.

NOTE 1 The target peer shares a single UDP socket among many Network Sessions.

NOTE 2 The originating peer always creates a new UDP socket, which shall not be shared with any other Network Session.

12.3.5.2 DN_SessionRelease ()

The DN_SessionRelease () functionality is obtained through the exchange of DS_SessionRelease messages and the deletion of the DMIF Signalling channel. This procedure works as follows:

The originating peer sends a DS_SessionReleaseRequest message on the just established connection.

The target peer replies with a DS_SessionReleaseConfirm message.

The originating peer closes the UDP socket corresponding to the DMIF signalling channel.

NOTE 1 The reason code is always set at the target peer to indicate “remote disconnection”.

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NOTE 2 The response code is always set at the originating peer to indicate “OK”.

NOTE 3 The target peer does not close the UDP socket, since it is shared among multiple Network Sessions.

12.3.5.3 DN_TransMuxSetup ()

See subclause 12.2.5.3.

12.3.5.4 DN_TransMuxRelease ()

See subclause 12.2.5.4.

12.4 Syntax for ATM networks with Q.2931 signalling

When DMIF operates with ATM with Q.2931, it shall use the Default Syntax as specified in subclause 12.1 for all DNI primitives except:

— DN_SessionSetup ()

— DN_SessionRelease ()

— DN_TransMuxSetup ()

— DN_TransMuxRelease ()

The mapping of the above primitives into Q.2931 signalling messages is described in subclause 12.4.5.

12.4.1 Approach overview

Whenever a new session is started, a DMIF signalling channel is established on an ATM connection. Whenever a new TransMux is requested, a new ATM connection is created.

12.4.2 DSM-CC Resource Descriptors used

Since the DN_TransMuxSetup () primitive is mapped into native Q.2931 signalling messages, no DSM-CC Resource Descriptors are used.

12.4.3 Usage of networkSessionIds

In order to be able to compress the networkSessionId + TAT field of 12 bytes to fit within an 8-byte B-HLI information field, the networkSessionId field carried in the B-HLI information field will contain the 5 least significant bytes of the 10-byte networkSessionId.

A DMIF Signalling channel is established for each Network Session; there is a 1 to 1 relation between the SVC carrying the DMIF signalling messages and the networkSessionId. Therefore the networkSessionId field contained in the DMIF signalling messages although present is not used.

12.4.4 Usage of transactionIds

The state machine for transactionIds (see Annex D) allows the repetition of a message up to a certain number of times when a certain timeout expires. Timeouts and number of retries are predefined locally.

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12.4.5 DNI mapping to Q.2931 signalling messages

12.4.5.1 DN_SessionSetup ()

The DN_SessionSetup () functionality is obtained through the setup of a DMIF Signalling channel, and the exchange of DS_SessionSetup messages. This procedure works as follows:

The target peer listens on a BHLI for a bilaterally agreed DMIF_SelectorByte

the originating peer generates a 5 bytes NetworkSessionId and builds a Q.2931 SETUP message, with the following rules:

— Call Reference = X1

— Call Reference Flag = 0 (originator)

— Called Party Number = calledAddress

— Calling Party Number = callingAddress

— QoS parameter = 0 (forward and backward)

— ATM traffic descriptor - forward peak cell rate CLP=0 = 100 (suggested)

— ATM traffic descriptor - forward peak cell rate CLP=0+1 = 100 (suggested)

— ATM traffic descriptor - backward peak cell rate CLP=0 = 100 (suggested)

— ATM traffic descriptor - backward peak cell rate CLP=0+1 = 100 (suggested)

— AAL parameters - AAL type = AAL5

— AAL parameters – forward and backward maximum CPCS-SDU size = 1000 (suggested)

— AAL parameters - SSCS type = NULL

— Broadband bearer capability - bearer class = bcob-x (suggested)

— Broadband bearer capability - traffic type = no indication (suggested)

— Broadband bearer capability - timing requirements = no indication (suggested)

— Broadband bearer capability - susceptibility to clipping = not susceptible (suggested)

— Broadband bearer capability - bearer class = user plane connection configuration = point-to-point

— BHLI - High Layer Information Type = User specific

— BHLI - octets 1 = DMIF_SelectorByte

— BHLI - octets 2-6 = NetworkSessionId

— BHLI - octets 7-8 = 0x0000

the target peer receives the SETUP message with in particular the following fields:

— Call Reference = X2

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— Call Reference Flag = 1 (target)

— Connection Identifier - VP = VPX2

— Connection Identifier - VC = VCX2

— ...

— BHLI - High Layer Information Type = User specific

— BHLI - octets 1 = DMIF_SelectorByte

— BHLI - octets 2-6 = NetworkSessionId

— BHLI - octets 7-8 = 0x0000

the target peer generates the CONNECT message with in particular the following fields:

— Call Reference = X2

— Call Reference Flag = 0 (originator)

the originating peer receives the CONNECT message with in particular the following fields:

— Call Reference = X1

— Call Reference Flag = 1 (target)

— Connection Identifier - VP = VPX1

— Connection Identifier - VC = VCX1

both peers associate the SVC just established to the 5-bytes networkSessionId carried in the Q.2931 SETUP message. All further message exchanges over this SVC shall be associated to this Network Session.

the originating peer sends a DS_SessionSetupRequest message on the just established connection.

the target peer replies with a DS_SessionSetupConfirm message.

NOTE 1 Steps 7 and 8 are only needed for the compatibility exchange

NOTE 2 The CONNECT message may be preceeded by a CALL_PROCEEDING message. In this case, at the originating side, the CALL_PROCEEDING and not the CONNECT will carry the Connection Identifier.

12.4.5.2 DN_SessionRelease ()

The DN_SessionRelease () functionality is obtained through the deletion of the DMIF Signalling channel. Since the networkSessionId field in the DS messages is not used, the DS_SessionRelease messages are not transmitted. This procedure works as follows:

the originating peer generates a Q.2931 RELEASE message, with the following rules:

— Call Reference = X1

— Call Reference Flag = 0 (originator)

the target peer receives the RELEASE message with in particular the following fields:

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— Call Reference = X2

— Call Reference Flag = 1 (target)

the target peer generates the RELEASE COMPLETE message with in particular the following fields:

— Call Reference = X2

— Call Reference Flag = 0 (originator)

the originating peer receives the RELEASE COMPLETE message with in particular the following fields:

— Call Reference = X1

— Call Reference Flag = 1 (target)

NOTE In case the SVC is automatically closed by the network, both sides behave as targets.

12.4.5.3 DN_TransMuxSetup ()

The DN_TransMuxSetup () functionality is obtained through the setup of a new ATM channel. This procedure works as follows:

the originating peer allocates a new Transmux Association Tag

the originating peer generates a Q.2931 SETUP message, with the following rules:

— Call Reference = Y1

— Call Reference Flag = 0 (originator)

— Called Party Number = calledAddress

— Calling Party Number = callingAddress

— QoS parameter = 0

— ATM traffic descriptor - forward peak cell rate CLP=0 = as appropriate

— ATM traffic descriptor - forward peak cell rate CLP=0+1 = as appropriate

— ATM traffic descriptor - backward peak cell rate CLP=0 = as appropriate

— ATM traffic descriptor - backward peak cell rate CLP=0+1 = as appropriate

— AAL parameters - AAL type = AAL5

— AAL parameters - forward maximum CPCS-SDU size = as appropriate

— AAL parameters - SSCS type = NULL

— Broadband bearer capability - bearer class = bcob-x (suggested)

— Broadband bearer capability - traffic type = as appropriate

— Broadband bearer capability - timing requirements = as appropriate

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— Broadband bearer capability - susceptibility to clipping = as appropriate

— Broadband bearer capability - bearer class = user plane connection configuration = point-to-point

— BHLI - High Layer Information Type = User specific

— BHLI - octets 1 = DMIF_SelectorByte

— BHLI - octets 2-6 = NetworkSessionId

— BHLI - octets 7-8 = Transmux Association Tag

the target peer receives the SETUP message with in particular the following fields:

— Call Reference = Y2

— Call Reference Flag = 1 (target)

— Connection Identifier - VP = VPY2

— Connection Identifier - VC = VCY2

— ...

— BHLI - High Layer Information Type = User specific

— BHLI - octets 1 = DMIF_SelectorByte

— BHLI - octets 2-6 = NetworkSessionId

— BHLI - octets 7-8 = Transmux Association Tag

the target peer generates the CONNECT message with in particular the following fields:

— Call Reference = Y2

— Call Reference Flag = 0 (originator)

the originating peer receives the CONNECT message with in particular the following fields:

— Call Reference = Y1

— Call Reference Flag = 1 (target)

— Connection Identifier - VP = VPY1

— Connection Identifier - VC = VCY1

the setup is complete: each side associates its own SVC and Call Reference to the same TAT

NOTE The CONNECT message may be preceeded by a CALL_PROCEEDING message. In this case, at the originating side, the CALL_PROCEEDING and not the CONNECT will carry the Connection Identifier.

12.4.5.4 DN_TransMuxRelease ()

The DN_TransMuxRelease () functionality is obtained through the deletion of the SVC corresponding to a particular TAT. Since the networkSessionId field in the DS messages is not used, the DS_TransMuxRelease messages are not transmitted. This procedure works as follows:

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the originating peer generates a Q.2931 RELEASE message, with the following rules:

— Call Reference = Y1

— Call Reference Flag = 0 (originator)

the target peer receives the RELEASE message with in particular the following fields:

— Call Reference = Y2

— Call Reference Flag = 1 (target)

the target peer generates the RELEASE COMPLETE message with in particular the following fields:

— Call Reference = Y2

— Call Reference Flag = 0 (originator)

the originating peer receives the RELEASE COMPLETE message with in particular the following fields:

— Call Reference = Y1

— Call Reference Flag = 1 (target)

NOTE In case the SVC is automatically closed by the network, both sides behave as targets.

12.5 Syntax for Networks with ITU-T H.245 Signaling

When DMIF operates with H.245 based terminals, it uses H.245 signaling instead of DMIF signaling.

Mapping of the DMIF primitives into H.245 signaling messages is described in subclause 12.5.5.

This case is valid for any network, e.g. PSTN or mobile, radio-based networks when a real-time service is required. It is however not precluded that those networks use other transport means to carry ISO/IEC 14496 streams, for instance IP.

12.5.1 Approach overview

Whenever a new session is started, an H.245 signaling channel is created. DMIF Signaling messages are mapped into H.245 primitives, and no additional DMIF Signaling channel is used. There is no support to provide multiple services concurrently, thus a network session corresponds to a service. For each MPEG-4 Elementary Stream, a Logical Channel is created. The BypassFlexMux mode shall always be used for mobile networks as there is no support for multiplexing multiple MPEG-4 Elementary Streams into a single Logical Channel.

Currently, two different options for transferring the Object Descriptors (as defined in ISO/IEC 14496-1:2001) are considered. In one case, the ODs are delivered as usual in the Object Descriptor Stream; in the other case, they are delivered as part of the **IS14496Capability** element in the **OpenLogicalChannel** message.

12.5.2 DSM-CC Resource Descriptors used

No DSM-CC Resource Descriptors are used.

12.5.3 Usage of networkSessionIds

There is no networkSessionId in H.245 signaling messages.

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12.5.4 Usage of transactionIds

The state machine for transactionIds (see Annex D) allows the repetition of a message up to a certain number of times when a certain timeout expires. Timeouts and number of retries are predefined locally.

Since in this case the DMIF signaling messages are carried (mapped) on a reliable channel, the number of retries shall be set to zero.

12.5.5 DNI mapping to H.245 Signaling messages

12.5.5.1 DN_SessionSetup

The DN_SessionSetup is not mapped onto H.245. Instead, it obtains the signaling channel, including any capability exchange procedures and multiplex setup required doing this. The exact method to obtain the H.245 signaling channel (on LC0 in H.223) depends on the physical transport and is not explicitly specified in this standard. Where applicable, the procedure described in ITU-T Recommendation H.324, annexes A and C, shall be used.

The MasterSlaveDetermination procedure of H.245 shall be used in ISO/IEC 14496-6 terminals.

The terminal identifies itself by a H.245 Capability of **IS14496Capability**. The capability for OD shall be included to indicate that the terminal is IS-14496 based.Capabilities for BIFS, Audio, Video and other IS-14496 functions are included, according to terminal configuration. The capability information includes the Profile and Level information for each function. Capabilities are grouped according to the H.245 signaling procedure, into multiple **SimultaneousCapabilities**.

12.5.5.2 DN_SessionRelease

This message is mapped onto an **EndSessionCommand**.

12.5.5.3 DN_ServiceAttach

In H.245, only one service can be active at a certain time. The service is automatically selected by the sender, based on the capabilities exchanged. There is no need for the receiver to specify a particular service using URLs. There is no support for multiple concurrent services.

The sender side opens a logical channel with the **DataType** field in the **OpenLogicalChannel** message indicating a **streamType** of **object descriptor (OD) stream**. This channel will initially carry the Initial Object Descriptor (InitialOD) as specified in ISO/IEC 14496-1:2001. This channel shall use an error protection protocol that guarantees error free transmission.

12.5.5.4 DN_ServiceDetach

This message not mapped onto H.245, since there is no distinction between service and network session.

12.5.5.5 DN_ChannelAdd

This message is not mapped onto H.245, since it will always result in a DN_TransMuxSetup.

12.5.5.6 DN_ChannelDelete

This request is not mapped onto H.245, since it will always result in a DN_TransMuxRelease.

12.5.5.7 DN_TransMuxSetup

This is mapped onto H.245 **OpenLogicalChannel** signaling, indicating a **DataType** field of **IS14496Capability**, and containing the MPEG-4 Elementary Stream Id (known at this level from the uuData) in the **ES_ID** field. H.245 does not allow the local peer to request the remote peer to establish an upstream channel. Neither is it allowed that the

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local peer establishes a downstream channel. A request for opening a channel in the reverse direction is therefore mapped onto a **RequestMode** message with a **dataMode** field of **is14496Data**. The request shall result in an **OpenLogicalChannel** being issued by the remote peer.

12.5.5.8 DN_TransMuxRelease

This is mapped onto H.245 **CloseLogicalChannel** signaling.

12.5.5.9 DN_TransMuxConfig

This message not mapped onto H.245, since the FlexMux tool is not supported.

12.5.6 Data transmission procedures

The mapping of Access Units onto H.223 Adaptation Layer payloads is done such that one MPEG-4 Sync Layer packet equals one H.223 AL-SDU.

13 Terminal Capability Matching

Terminal Capability matching is required to check the ability of two peer end-systems to setup connections between them, and select the possible protocol stack supported. This stage is performed at session setup time. Whenever possible, DMIF makes use of the facilities provided by the network. When the existing network facilities cannot be used, DMIF defines its own mechanism (subclause 13.1)

13.1 DMIF Default signalling with Compatibility Descriptors

This stage is used when the native network signalling is not capable to accommodate the DMIF-Network Interface requirements. The originating DMIF compatibility descriptors are carried in the DMIF SessionSetUpRequest and a subset is returned from the target DMIF from which the originating DMIF can choose from. If no such subset exists then the originating terminal will release the session. The Compatibility Descriptor is defined in ISO/IEC 13818-6 clause 6.

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Annex A
(informative)

Overview of DAI and DNI parameters

This Annex provides the glue to link concepts and parameters as defined in subclause 10.3 for the DAI and in subclause 11.3 for the DNI.

A.1 Sessions and services

This clause correlates the following parameters:

URL: as defined in subclause 10.3.

serviceName: as defined in subclause 10.3.

serviceSessionId: as defined in subclause 10.3.

networkSessionId: as defined in subclause 11.3.

serviceId: as defined in subclause 11.3.

An application only identifies a particular service through its **URL**. The **serviceName** is then obtained from the **URL** by stripping out the addressing information. Each **URL** will have a 1 to 1 correspondance with a **serviceSessionId**. The service identified by the **URL** will be further referred to by its **serviceSessionId**.

Inside DMIF, the **serviceSessionId** is mapped 1 to 1 with a tuple <**networkSessionId**, **serviceId**>. This allows several **serviceSessionId**s to share a single **networkSessionId**. Depending on the network type, the **networkSessionId** can be implicit, in the sense that the DMIF Signalling channel established between two DMIF peers uniquely identifies a Network Session: for example a **networkSessionId** could be identified, on a homogeneous IP network, with the tuple <peer1IpAddress, peer1IpPort, peer2IpAddress, peer2IpPort, IpProtocol> identifying the socket providing the DMIF Signalling channel.

A.2 Channels

This clause correlates the following parameters:

channelHandle: as defined in subclause 10.3.

CAT: as defined in subclause 11.3.

TAT: as defined in subclause 11.3.

An ISO/IEC 14496-1:2001 based application may identify a particular elementary stream through its ES_ID, scoped by the Service Session it belongs to. At the DAI the ES_ID parameter is made more generic to be ISO/IEC 14496-1:2001 independent, and carried in **uuData**. Each <**serviceSessionId**, **ES_ID**> will have a 1 to 1 correspondance with a **channelHandle**. The stream identified by the <**serviceSessionId**, **ES_ID**> will be further referred to through its **channelHandle**.

Inside DMIF, the **channelHandle** is mapped 1 to 1 with the **CAT**. This allows to decouple a parameter (the **channelHandle**) that has to be unique at the local application / DMIF boundary, from another parameter (the **CAT**) that instead has to be unique in the scope of a Network Session. Moreover, the syntax of the **channelHandle** is a

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local matter, related to the DAI implementation, while the syntax of the **CAT** relates to the network, irrespectively of the terminal type. This decoupling also allows to maintain uniformity at the DAI, regardless of the network, the file format or the broadcast/multicast technology being used.

Multiple streams can be multiplexed together on a single network connection (transmux). As a consequence, the concepts of **TAT** and *transmuxHandle* are defined in a similar manner. The latter however is not explicitely mentioned in this specification since it does not affect the DAI nor the network signalling (it is a purely internal entity).

CAT and **TAT** do not affect the DAI, but are useful concepts for the DMIF signalling messages. They convey a unique identifier (scoped by the Network Session) to identify the resources that are used by a particular stream or group of streams (transmux). Depending on the network type, the syntax of **CAT** and **TAT** may vary. **CAT** and **TAT** are useful concepts also for scenarios were no network exists, e.g., for local files. In this case, **CAT** and **TAT** may convey information which is appropriate for a particular file format, and which does not restrict necessarily to MPEG-4 only.

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Annex B
(informative)

Information flows for DMIF

The following clauses provide information flows for Remote Interactive, Broadcast and Local Storage implementations. These flows show the ability of DAI to hide the delivery technologies. A DMIF terminal can simultaneously operate on Remote Interactive (clause B.1), Broadcast (clause B.2) and Local Storage delivery technologies (clause B.3) through a uniform procedure at the DAI.

The names for primitives and parameters in the following clauses are abbreviated to save space. It should be obvious to the reader how they relate to the primitives and parameters indicated in clause 10 and clause 11. In particular the suffix, Callback, has been dropped. The reader should understand that every DAI primitive initiated by DMIF results in a DAI callback. Also the information presented must be complemented with the specific mappings for each delivery technology.

The flows provided are not exhaustive, they represent frequent cases, and provide hints on how to deal with infrequent scenarios.

B.1 Information flows for Remote Interactive DMIF

The following figures represent information crossing the interfaces, for simplicity only the DNI primitives are shown. These need to be complemented with their mappings to supported network technologies. The central column in the figures thus represents the conceptual flows that occur between two DNI interfaces, without considering the details of how such primitives are mapped into signalling messages and reconstructed at the peer DNI.

The other columns in the figures represent the application, the Delivery layer, and the DAI.

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B.1.1 Initiation of a service in a Remote Interactive DMIF

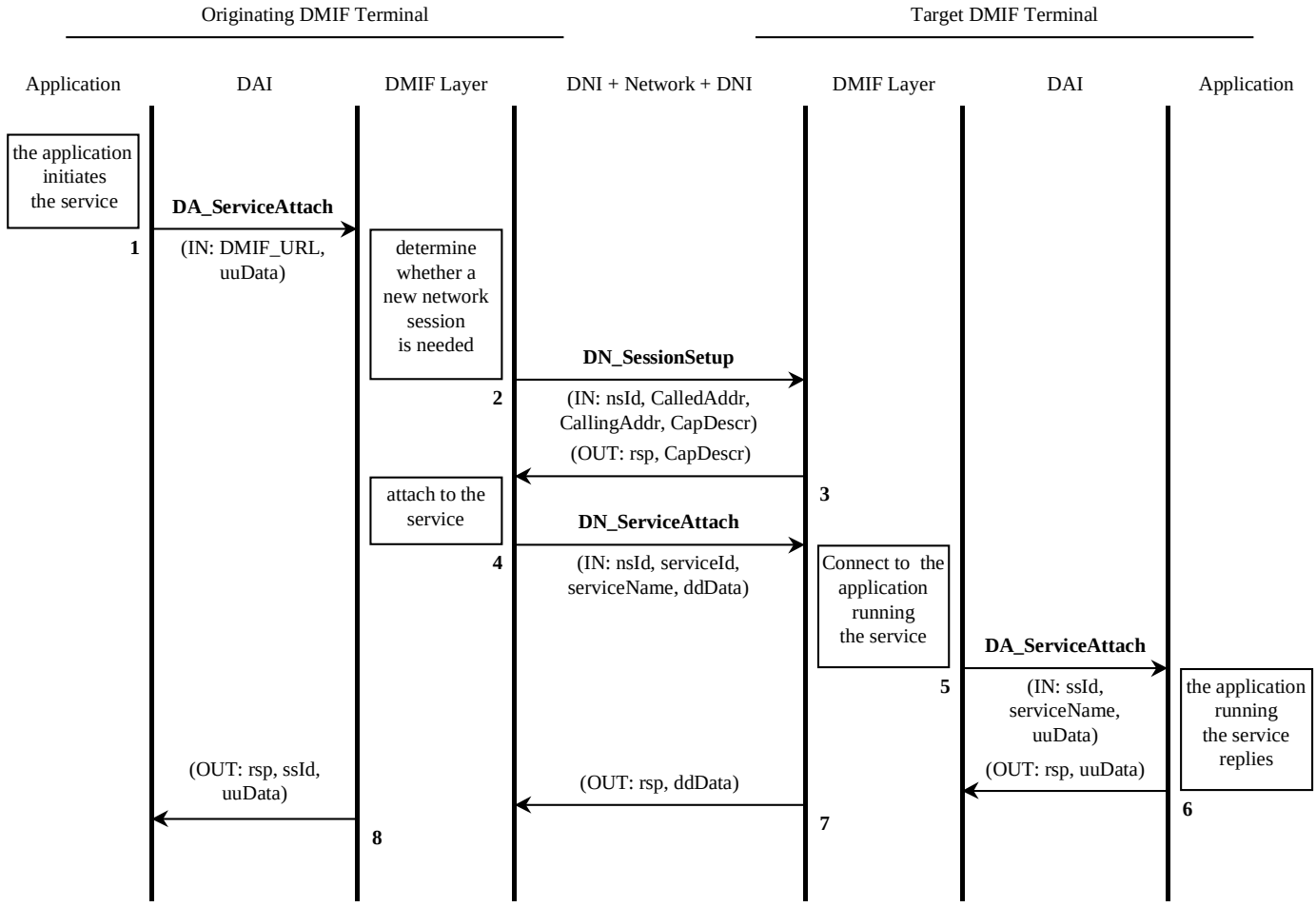

Figure B.1 — Initiation of a service in a Remote Interactive DMIF

Preconditions:

— The Application at the Originating DMIF has acquired a URL from a previous action (e.g.; Web browsing, advertisement, specific contracts).

— The Service is registered at the Target DMIF Terminal by means that are outside this specification

Step 1

The Application at the Originating DMIF passes a DA_ServiceAttach() indicating the URL, the parentServiceSessionId and additional uuData (e.g.; for client credentials).

The URL is expanded if necessary and parsed and the appropriate DMIF Instance is invoked according to the protocol part of the URL.

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Step 2

The Originating DMIF Instance strips the <serviceName> part of the URL for later use. It assigns a locally significant unique serviceSessionId; based on its own criteria, if there is already a Network Session active with the remote peer, the Originating DMIF Instance might decide to reuse that Network Session (and skip to step 4); otherwise it shall create a new Network Session by passing through the DNI a DN_SessionSetup() primitive. In this case it assigns a network unique networkSessionId. Moreover Capability (and compatibility) Matching is performed (by means of a Compatibility Descriptor or by other means possibly supported by the Network).

Step 3

The Target DMIF Instance receives DN_SessionSetupCallback() and replies. Both peers now have knowledge of the networkSessionId. The compatibility is verified and the appropriate reply is returned identifying the common set of compatibility in the preferred order of choice.

Step 4

The Originating DMIF Instance assigns a serviceId which is unique in that particular Network Session, and passes the DN_ServiceAttach() through the DNI, indicating the networkSessionId and the serviceId along with the serviceName it has previously stripped from the URL and additional ddData that actually contains the uuData provided by the Originating Application.

Step 5

The Target DMIF Instance receives DN_ServiceAttachCallback() determines the Executive managing the services, assigns a locally significant unique serviceSessionId and then sends a DA_ServiceAttachCallback() to it, containing the serviceSessionId along with the serviceName and the uuData sent by the Originating Application. The mechanism used at the Target DMIF to identify the Application Executive running the service and to deliver the message to it is out of the scope of this specification.

The Target DMIF Instance maintains a table associating the locally meaningful <serviceSessionId> and the network wide meaningful tuple <networkSessionId, serviceId>

Step 6

The Target Application interprets the uuData and potentially performs tests on client credentials. Then it replies with uuData (which in the case of MPEG-4 contains the Initial OD) and a response code.

Step 7

The Target DMIF Instance replies to the DN_ServiceAttachCallback() through the DNI, providing a response code and ddData that contains the uuData provided by the Target Application.

Step 8

The Originating DMIF Instance uses the locally significant unique serviceSessionId and then replies to the DA_ServiceAttach() with the serviceSessionId, a response code and the uuData originally set by the Target Application.

The Originating DMIF Instance maintains a table associating the locally meaningful <serviceSessionId> and the network wide meaningful tuple <networkSessionId, serviceId>

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B.1.2 Addition of Channels in a Remote Interactive DMIF

B.1.2.1 Addition of Channels by Target DMIF

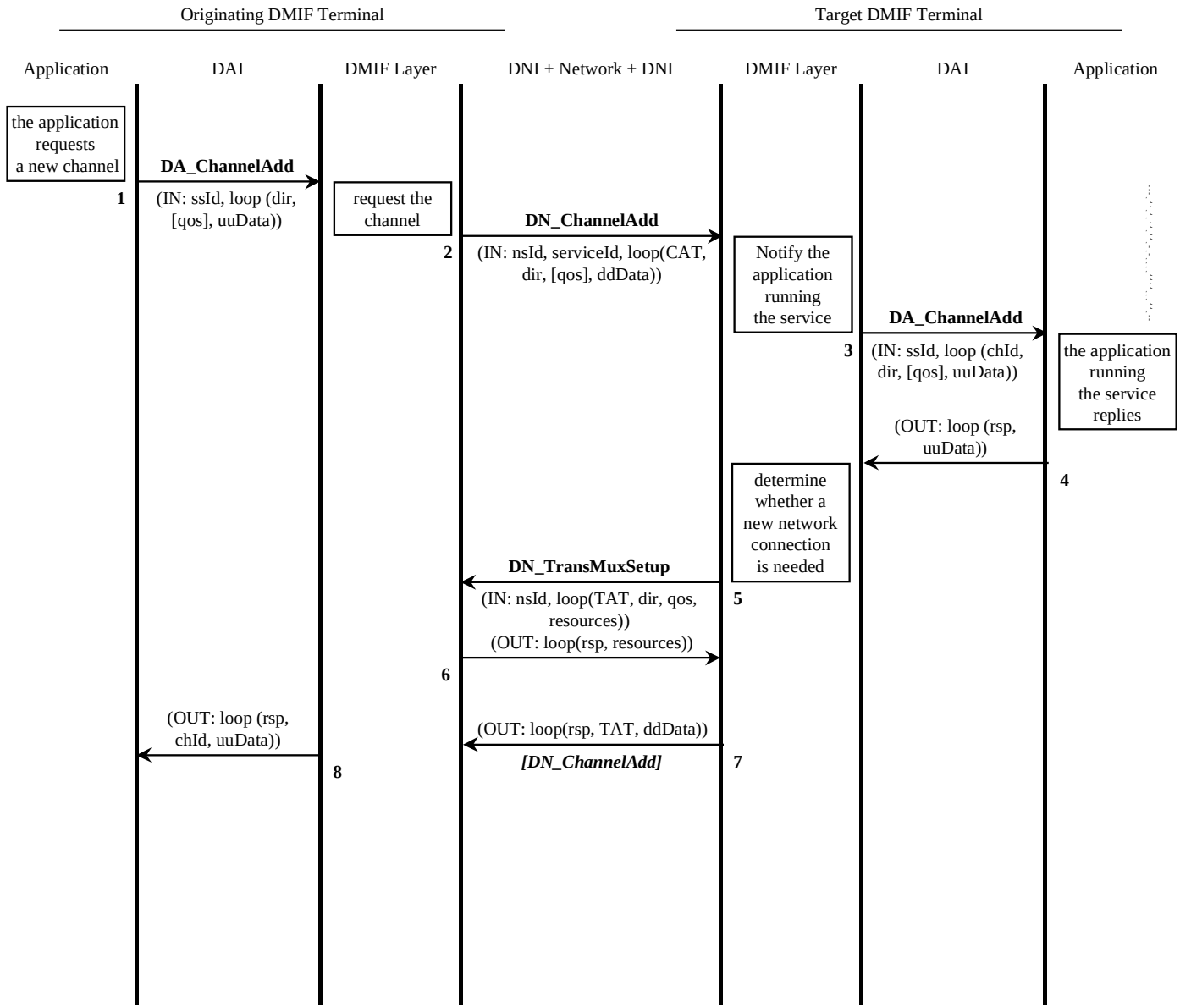

Figure B.2 — Addition of Channels in a Remote Interactive DMIF (by Target DMIF)

Preconditions:

— The service between the Originating and Target applications has been initiated succesfully

— The location of the source of the stream is available from previous interaction.

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Step 1

The Application at the Originating DMIF passes a DA_ChannelAdd() indicating the channels it requires. The primitive contains the serviceSessionId for which the Channels are requested. Each channel is characterized by the channelDescriptor parameter (optional), the direction parameter and by uuData.

Step 2

The Originating DMIF Instance assigns a channelAssociationTag (CAT) for each requested channel. It then forwards the request to the peer by passing the DN_ChannelAdd() through the DNI, containing the network-wide unique tuple <networkSessionId, serviceId> corresponding to the serviceSessionId, and for each requested channel its CAT, direction, (optional) qosDescriptor and associated ddData (which conveys the original uuData).

Step 3

The Target DMIF Instance receives the DN_ChannelAddCallback() from the DNI; assigns a locally unique channelHandle for each requested channel and then issues a DA_ChannelAddCallback() to the Target Application, containing the locally unique serviceSessionId corresponding to the tuple <networkSessionId, serviceId>, and for each requested channel its locally unique channelHandle, the channelDescriptor parameter (optional), the direction parameter and associated uuData (which conveys the original uuData). At this point the Target DMIF Instance is able to associate the locally unique channelHandle to the end-to-end significant, networkSession unique CAT.

Step 4

The Target Application interprets the uuData to determine what stream is actually being requested (e.g., in the case of an ISO/IEC 14496-1:2001 based application uuData may convey the ES_ID), and checks the availability of such stream. It then replies with a response code for each requested channel, along with (possibly) uuData.

Step 5

The Target DMIF Instance inspects the media stream QoS metric and values of its parameters, and decides whether existing network resources are sufficient for carrying the new Channel(s). If additional resources are needed, it starts network signalling to setup new connection(s) (TransMux Channel(s)) in the same Network Session, otherwise it skips to step 7. For each additional TransMux Channel needed it assigns an end-to-end significant networkSession unique transmuxAssociationTag (TAT); it passes a DN_TransmuxSetup() through the DNI, indicating the networkSessionId, and for each requested TransMux Channel indicates the QoS, the direction parameter, the TAT and the TransMux nested resource descriptors.

Step 6

The Originating DMIF Instance receives the DN_TransMuxSetupCallback() from the DNI, and is therefore able to associate a particular TAT to particular network resources and to a particular Network Session. It then replies through the DNI providing a response code. Note that the TAT is not necessarily bound to a specific serviceId, just to a specific networkSessionId. However it is reasonable that further restrictions be applied, such that TAT cannot be shared among different Service Sessions.

If required this step may be followed by DN_TransMuxConfig() in order for the Target DMIF to configure e.g., a FlexMux in MuxCode mode.

Step 7

The Target DMIF Instance replies to the original DN_ChannelAddCallback() providing for each channel TAT and further ddData that characterize it, along with a response code. In particular ddData would contain in this case further information on how a particular channel is flexmultiplexed in the TAT, that is in the case of MPEG-4 FlexMux, it provides the FlexMux Channel Number. At this point the Target DMIF Instance is able to associate the CAT to networkSessionId, serviceId, TAT and further flexmultiplexing configuration. DdData may also contain uuData returned by the Target Application.

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Step 8

The Originating DMIF Instance receives the reply to the DN_ChannelAdd(), assigns a locally unique channelHandle for each requested channel, and replies to the original DA_ChannelAdd() by providing for each requested channel its channelHandle, uuData and a response code. At this point the Originating DMIF Instance is able to associate the locally unique channelHandle to the end-to-end significant, networkSession unique CAT and to associate the CAT to networkSessionId, serviceId, TAT and further flexmultiplexing configuration.

Post channel establishment:

— The Receiving Application may request to start getting the data by issuing a DA_UserCommandAck() specifying the appropriate command in the uuData field.

— The Receiving DMIF Instance forwards the request to the peer by passing the DN_UserCommandAck() through the DNI, containing the networkSessionId, serviceId and ddData that actually contains the uuData provided by the Receiving Application

— The Sending DMIF Instance forwards the request to the Sending Application by issuing the DN_UserCommandAckCallback() specifying the appropriate command in the uuData field.

— The Sending Application inspects the uuData, determines the command, and replies with uuData (which is supposed to possibly contain application level error indications); then executes the command, i.e. in this case begins to send the data.

— The Target DMIF Instance replies to the original DN_UserCommandAckCallback() providing ddData along with a response code. In particular ddData would contain in this case the uuData returned by the Target Application.

— The Originating DMIF Instance receives the reply to the DN_UserCommandAckCallback() and replies to the original DA_UserCommandAck() providing uuData and a response code.

— The Elementary Streams are now received by the Receiving Application.

NOTE 1 DA_UserCommand() may be used for purposes other than stream control.

NOTE 2 The Receiving Application is a euphemism for the decoder side and the Sender Application is euphemism for the source sending the encoded stream. Either an Originating or Target DMIF terminal may hold either or both receiving and sending applications.

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B.1.2.2 Addition of Channels by Originating DMIF

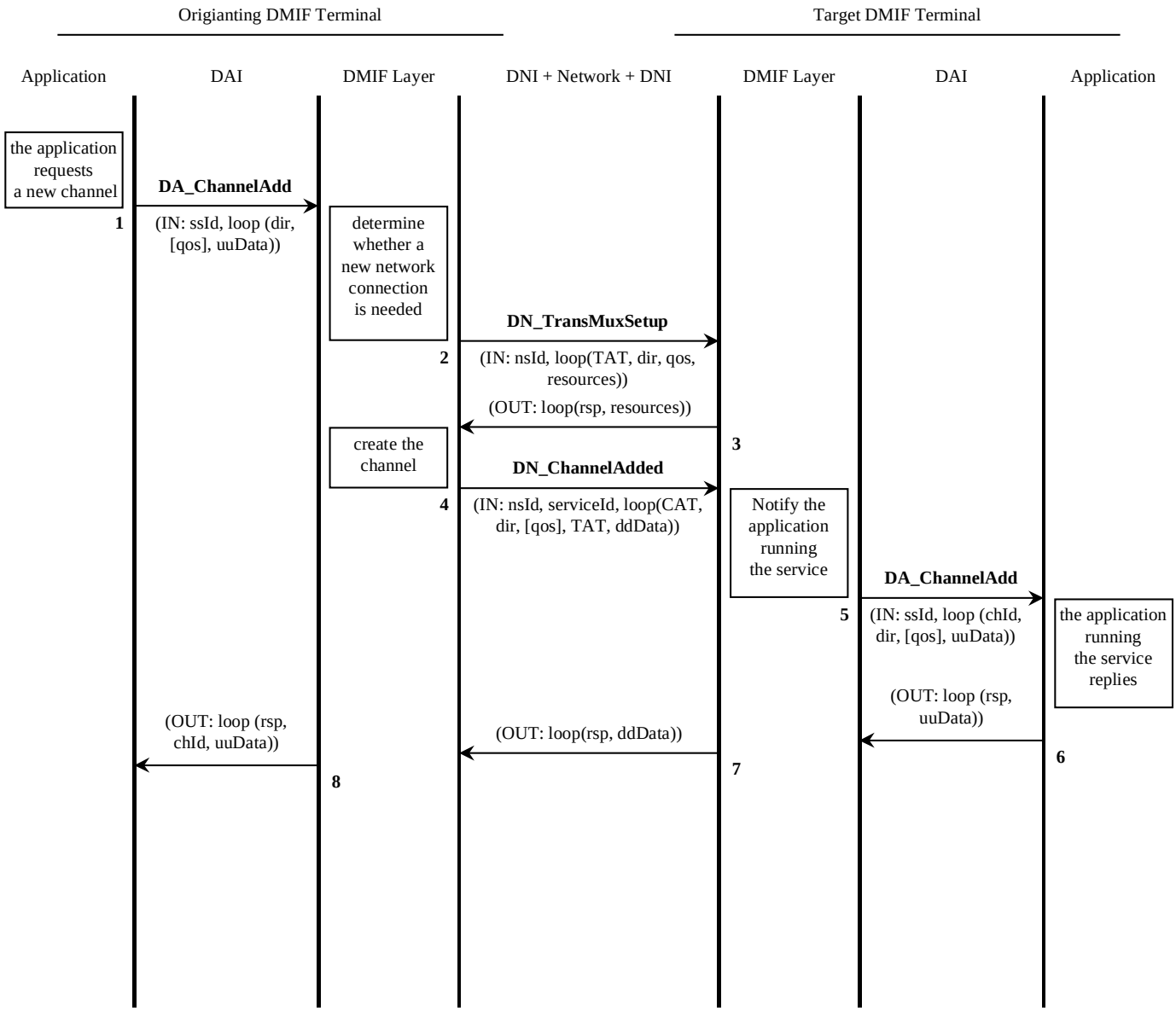

Figure B.3 — Addition of Channels in a Remote Interactive DMIF (by Originating DMIF)

Preconditions:

— The service between the Originating and Target applications has been initiated succesfully

— The location of the source of the stream is available from previous interaction.

Step 1

The Application at the Originating DMIF passes a DA_ChannelAdd() indicating the channels it requires. The primitive contains the serviceSessionId for which the Channels are requested. Each channel is characterized by the channelDescriptor parameter (optional), the direction parameter and by uuData.

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Step 2

The Originating DMIF Instance inspects the media stream QoS metric and values of its parameters, and decides whether existing network resources are sufficient for carrying the new Channel(s). If additional resources are needed, it starts network signalling to setup new connection(s) (TransMux Channel(s)) in the same Network Session, otherwise it skips to step 4. For each additional TransMux Channel needed it assigns an end-to-end significant, networkSession unique transmuxAssociationTag (TAT); it passes a DN_TransmuxSetup() through the DNI, indicating the networkSessionId, and for each requested TransMux Channel indicates the QoS, the direction parameter, the TAT and the TransMux nested resource descriptors.

Step 3

The Target DMIF Instance receives the DN_TransMuxSetupCallback() from the DNI, and is therefore able to associate a particular TAT to particular network resources and to a particular Network Session. It then replies through the DNI providing a response code. Note that the TAT is not necessarily bound to a specific serviceId, just to a specific networkSessionId. However it is reasonable that further restrictions be applied, such that TAT cannot be shared among different Service Sessions.

If required this step may be followed by DN_TransMuxConfig() in order for the Originating DMIF to configure e.g., a FlexMux in MuxCode mode.

Step 4

The Originating DMIF Instance assigns a channelAssociationTag (CAT) for each requested channel. It then forwards the request to the peer by passing the DN_ChannelAdded() through the DNI, containing the network-wide unique tuple <networkSessionId, serviceId> corresponding to the serviceSessionId, and for each requested channel its CAT, TAT, direction and associated ddData (which conveys the original uuData as well as further information on the nested TransMux stacks and how a particular channel is flexmultiplexed in the TAT, that is in the case of MPEG-4 FlexMux, the FlexMux Channel Number). At this point the Originating DMIF Instance is able to associate the CAT to networkSessionId, serviceId, TAT and further flexmultiplexing configuration.

Step 5

The Target DMIF Instance receives the DN_ChannelAddedCallback() from the DNI; assigns a locally unique channelHandle for each established channel and then issues a DA_ChannelAddCallback() to the Target Application, containing the locally unique serviceSessionId corresponding to the tuple <networkSessionId, serviceId>, and for each established channel its locally unique channelHandle, the channelDescriptor parameter (optional), the direction parameter and associated uuData (which conveys the original uuData). At this point the Target DMIF Instance is able to associate the locally unique channelHandle to the end-to-end significant, networkSession unique CAT, and to associate the CAT to networkSessionId, serviceId, TAT and further flexmultiplexing configuration.

Step 6

The Target Application interprets the uuData to determine what stream is actually being requested (e.g., in the case of an ISO/IEC 14496-1:2001 based application uuData may convey the ES_ID), and checks the availability of such stream. It then replies with a response code for each requested channel, along with (possibly) uuData.

Step 7

The Target DMIF Instance replies to the original DN_ChannelAddedCallback() providing for each channel further ddData (ddData may contain uuData returned by the Target Application), along with a response code.

Step 8

The Originating DMIF Instance receives the reply to the DN_ChannelAdded(), assigns a locally unique channelHandle for each requested channel, and replies to the original DA_ChannelAdd() by providing for each requested channel its channelHandle, uuData and a response code. At this point the Originating DMIF Instance is able to associate the locally unique channelHandle to the end-to-end significant, networkSession unique CAT.

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Post channel establishment:

— The Receiving Application may request to start getting the data by issuing a DA_UserCommandAck() specifying the appropriate command in the uuData field.

— The Receiving DMIF Instance forwards the request to the peer by passing the DN_UserCommandAck() through the DNI, containing the networkSessionId, serviceId and ddData that actually contains the uuData provided by the Receiving Application

— The Sending DMIF Instance forwards the request to the Sending Application by issuing the DN_UserCommandAckCallback() specifying the appropriate command in the uuData field.

— The Sending Application inspects the uuData, determines the command, and replies with uuData (which is supposed to possibly contain application level error indications); then executes the command, i.e. in this case begins to send the data.

— The Target DMIF Instance replies to the original DN_UserCommandAckCallback() providing ddData along with a response code. In particular ddData would contain in this case the uuData returned by the Target Application.

— The Originating DMIF Instance receives the reply to the DN_UserCommandAckCallback() and replies to the original DA_UserCommandAck() providing uuData and a response code.

— The Elementary Streams are now received by the Receiving Application.

NOTE 1 DA_UserCommand() may be used for purposes other than stream control.

NOTE 2 The Receiving Application is a euphemism for the decoder side and the Sender Application is euphemism for the source sending the encoded stream. Either an Originating or Target DMIF terminal may hold either or both receiving and sending applications.

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B.1.3 Deletion of Channels in a Remote Interactive DMIF

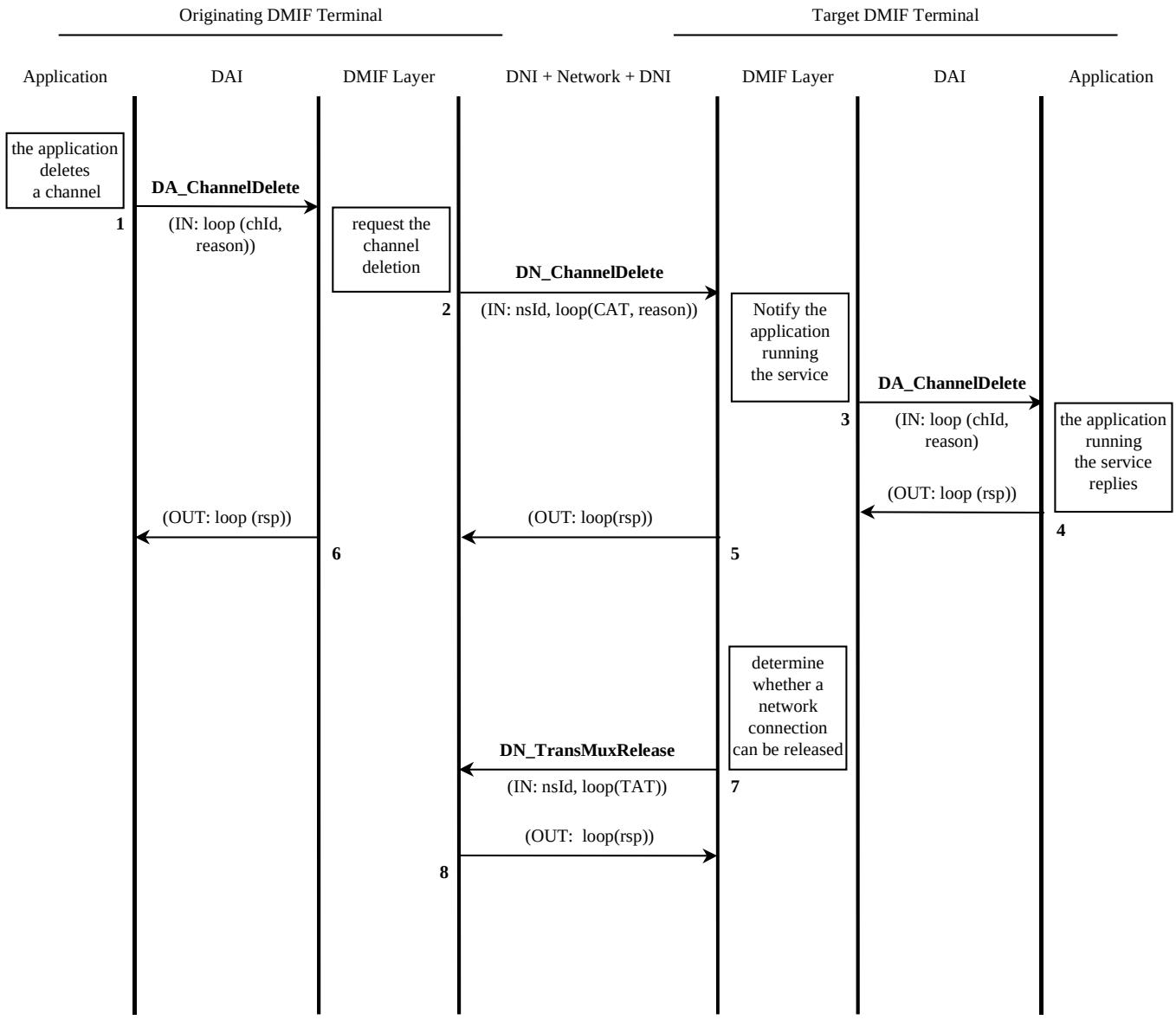

Figure B.4 — Deletion of Channels in a Remote Interactive DMIF (controlled by the Originating DMIF peer)

Preconditions:

— The service has been established between the Originating and Target applications.

— At least a channel has been successfully added.

— A stream being carried on a channel is no longer required.

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Step 1

The Application at the Originating DMIF passes a DA_ChannelDelete() indicating the channels it wants to delete. The primitive contains the channelHandle(s) along with reason codes.

Step 2

The DMIF Instance stops the actual delivery of data on the indicated Channel(s).

The Originating DMIF Instance forwards the request to the peer by passing the DN_ChannelDelete() through the DNI, containing the network-wide unique networkSessionId, and for each requested channel its CAT and the reason code.

Step 3

The Target DMIF Instance receives the DN_ChannelDeleteCallback() from the DNI; and issues a DA_ChannelDeleteCallback() to the Target Application, containing for each requested channel its locally unique channelHandle and the reason code.

Step 4

The Target Application stops the actual delivery of data on the indicated Channel(s), and replies with response codes. At this point channelHandle(s) are invalidated at the Target Application

Step 5

The Target DMIF Instance replies to the original DN_ChannelDeleteCallback() providing for each channel a response code. At this point channelHandle(s) and CAT(s) are invalidated at the Target DMIF Instance.

Step 6

The Originating DMIF Instance replies to the original DA_ChannelDelete() by providing for each channel a response code. At this point channelHandle(s) and CAT(s) are invalidated at the Originating DMIF Instance.

The Originating Application receives the reply and invalidates the channelHandle(s).

NOTE The Originating or the Target DMIF depending on which scenario was used to add channels can carry out the following steps 7 and 8.

Step 7

The Originating (Target) DMIF Instance determines that some network resource is not needed anymore, and might decide to release them. In that case it starts network signalling to release connection(s) (TransMux Channel(s)) in the same Network Session. It passes a DN_TransmuxRelease() through the DNI, indicating the networkSessionId and the TAT of the TransMux Channels to be released.

Step 8

The Target (Originating) DMIF Instance receives the DN_TransmuxReleaseCallback() from the DNI, and replies through the DNI providing a response code. TATs are invalidated at both sides.

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B.1.4 Termination of a Service in a Remote Interactive DMIF

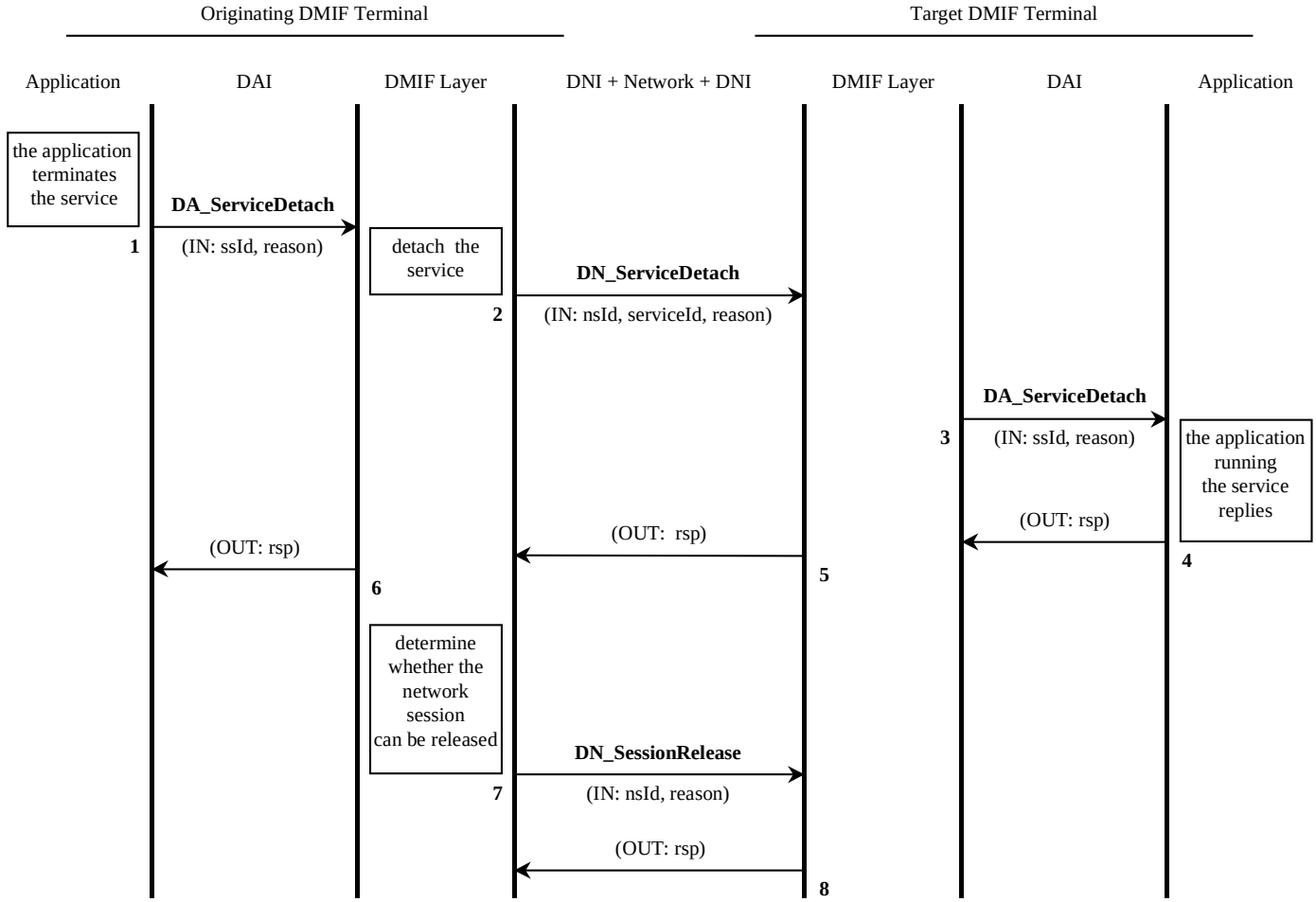

Figure B.5 — Termination of a service in a Remote Interactive DMIF

Preconditions:

— The service has been established between the Originating and Target applications.

— The Service Session is no longer required.

Step 1

The Application at the Originating DMIF passes a DA_ServiceDetach() indicating the service it wants to terminate. The primitive contains the serviceSessionId along with a reason code.

Step 2

The Originating DMIF Instance passes a DN_ServiceDetach() through the DNI indicating the service it wants to terminate (which is now identified by the tuple <networkSessionId, serviceId> along with a reason code.

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Step 3

The Target DMIF Instance receives the DN_ServiceDetachCallback() from the DNI; and passes a DA_ServiceDetachCallback() to the Target Application indicating the service that must be terminated (which is now identified by the locally meaningful serviceSessionId) along with a reason code.

Step 4

The Target Application stops the provision of the service, and frees all resources used for it. It then replies to the DA_ServiceDetachCallback() providing a response code. At this point the locally meaningful serviceSessionId is no more valid.

Step 5

The Target DMIF Instance replies to the DN_ServiceDetachCallback() through the DNI along with the response code. At this point the Network Session unique serviceId is no more valid.

Step 6

The Originating DMIF Instance replies to the DA_ServiceDetach() along with the response code. At this point the locally meaningful serviceSessionId is no more valid.

NOTE The Originating or the Target DMIF irrespective of which one initiated the service detach can carry out the following steps 7 and 8.

Step 7

The Originating (Target) DMIF Instance might recognize that the Network Session need not be active anymore (this was the last service present on that Network Session). It might therefore decide to release the Network Session, and passes a DN_SessionRelease() through the DNI.

Step 8

The Target (Originating) DMIF Instance receives a DN_SessionReleaseCallback() and replies to it through the DNI. At this point the network wide unique networkSessionId is no longer valid.

B.2 Information Flows for Broadcast DMIF

The following figures represent the semantic information crossing the borders of a DMIF implementation for a Broadcast scenario. No details are provided on the internal exchanges between modules in DMIF.

The first two columns in the figures represent the application and the DAI, with the same information and formalism as in clause B.1; the third column represents a generic DMIF implementation, including all the internal conceptual modules according to the DMIF communication architecture of Figure 3, that is Originating DMIF Instance, Target DMIF Instance and Target Application. The right side of the figures represents Broadcast Network and shows the data entering the DMIF implementation. Note that such data flows purely provide a hint of what could be exchanged, while the real flows could differ significantly: therefore, they are not tagged with any number, and their description is purely textual.

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B.2.1 Initiation of a service in a Broadcast DMIF

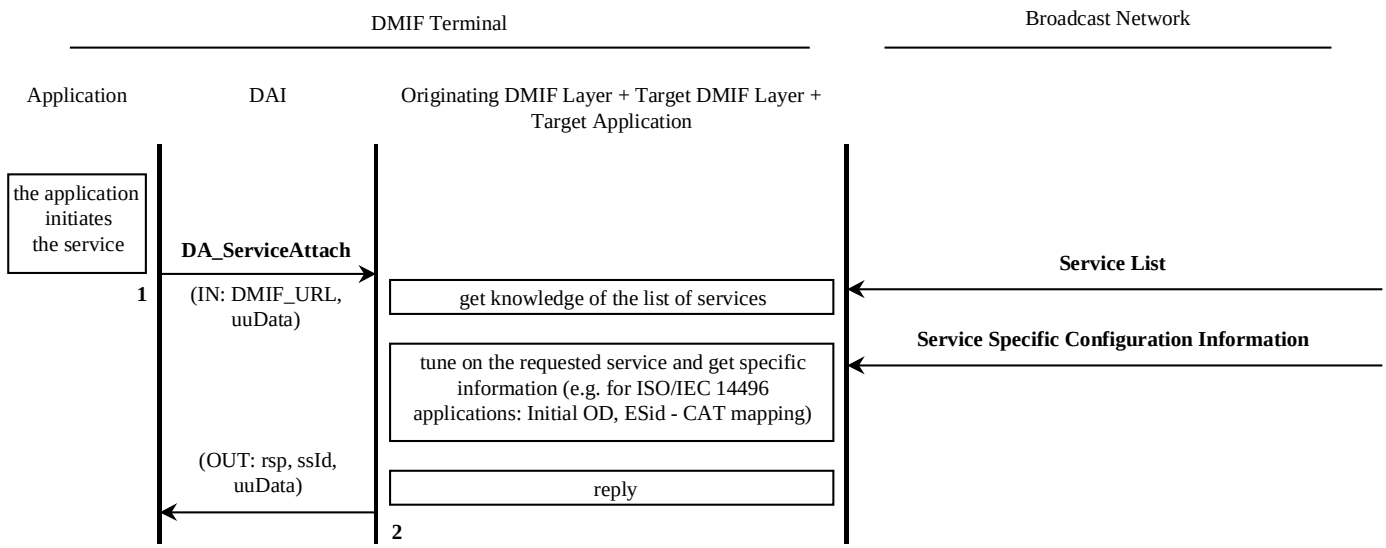

Figure B.6 — Initiation of a service in a Broadcast DMIF

Preconditions:

— The Application at the Originating DMIF has acquired an URL from a previous action (e.g.; Web browsing, advertisement, specific contracts).

Step 1

The Application at the Originating DMIF passes a DA_ServiceAttach() indicating the URL, the parentServiceSessionId and additional uuData (e.g.; for client credentials).

The URL is expanded if necessary and parsed and the appropriate DMIF Instance is invoked according to the protocol part of the URL.

The Originating DMIF Instance assigns a locally significant unique serviceSessionId. The Target Application module interprets the whole URL including the serviceName, and checks whether the requested service is available. It possibly gets additional service specific data from the broadcast network (e.g., in the case of an ISO/IEC 14496-1:2001 based application, the Initial OD and possibly the table mapping the ES_IDs with the actual channels delivering them). Moreover, the Target Application module potentially interprets the uuData field for client verification.

Additional checks are performed through compatibility matching procedures: the mechanism adopted depends on the Broadcast Network.

Step 2

After the successful conclusion of the compatibility match and the correct tuning to the requested service, the Originating DMIF Instance replies to the DA_ServiceAttach() along with the locally significant serviceSessionId and possibly uuData. In the case of ISO/IEC 14496 applications the uuData would contain the InitialOD.

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B.2.2 Addition of Channels in a Broadcast DMIF

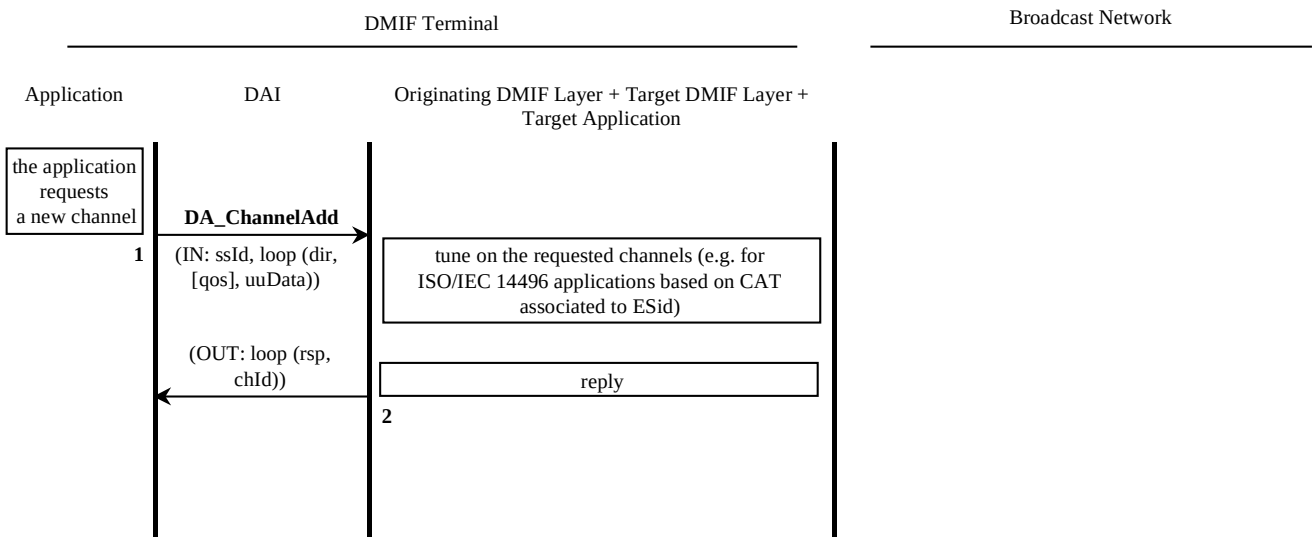

Figure B.7 — Addition of Channels in a Broadcast DMIF

Preconditions:

— The service between the Originating and Target applications has been initiated succesfully

— The location of the source of the stream is available from previous interaction.

Step 1

The Application at the Originating DMIF passes a DA_ChannelAdd() indicating the channels it requires. The primitive contains the serviceSessionId for which the Channels are requested. Each channel is characterized by a channelDescriptor parameter (optional), by a direction parameter (usually DOWNSTREAM; UPSTREAM for back-channels, that will be terminated at the Target Application module), and uuData. The Target Application module interprets the uuData to determine what stream is actually being requested (e.g., in the case of an ISO/IEC 14496-1:2001 based application uuData may convey the ES_ID), and checks the availability of this stream.

Step 2

After the successful conclusion of the above check, the Originating DMIF Instance replies to the DA_ChannelAdd() along with the locally significant channelHandle(s).

Post channel establishment:

— The Originating Application may request to start getting the data by issuing a DA_UserCommand() specifying the appropriate command in the uuData field.

— The Target Application portion of the DMIF Instance inspects the uuData, determines the command, and replies with uuData (which is supposed to possibly contain application level error indications); then executes the command, i.e. in this case begins to send the data.

— The Elementary Streams are now received by the Originating Application.

NOTE DA_UserCommand() may be used for purposes other than stream control.

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B.2.3 Deletion of Channels in a Broadcast DMIF

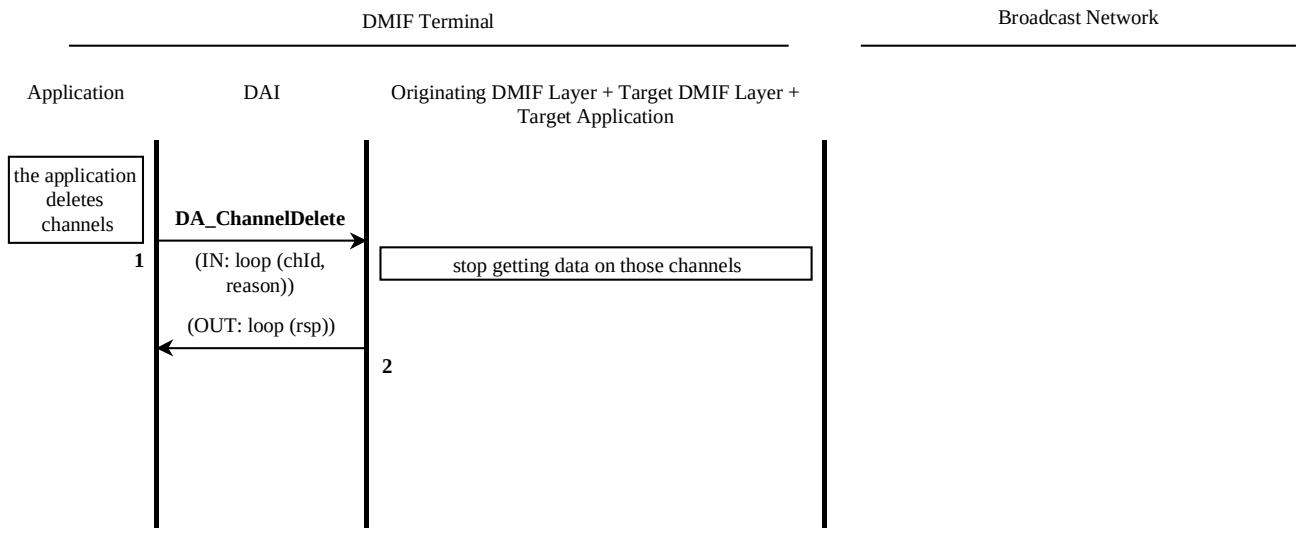

Figure B.8 — Deletion of Channels in a Broadcast DMIF

Preconditions:

— The service has been established between the Originating and Target applications.

— At least a channel has been successfully added.

— A stream being carried on a channel is no longer required.

Step 1

The Application at the Originating DMIF passes a DA_ServiceAttach() indicating the URL, the parentServiceSessionId and additional uuData (e.g.; for client credentials).

The URL is expanded if necessary and parsed and the appropriate DMIF Instance is invoked according to the protocol part of the URL.

Step 2

The Originating DMIF Instance replies to the DA_ChannelDelete() along with response codes. At this point the channelHandle(s) are no longer valid.

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B.2.4 Termination of a service in a Broadcast DMIF

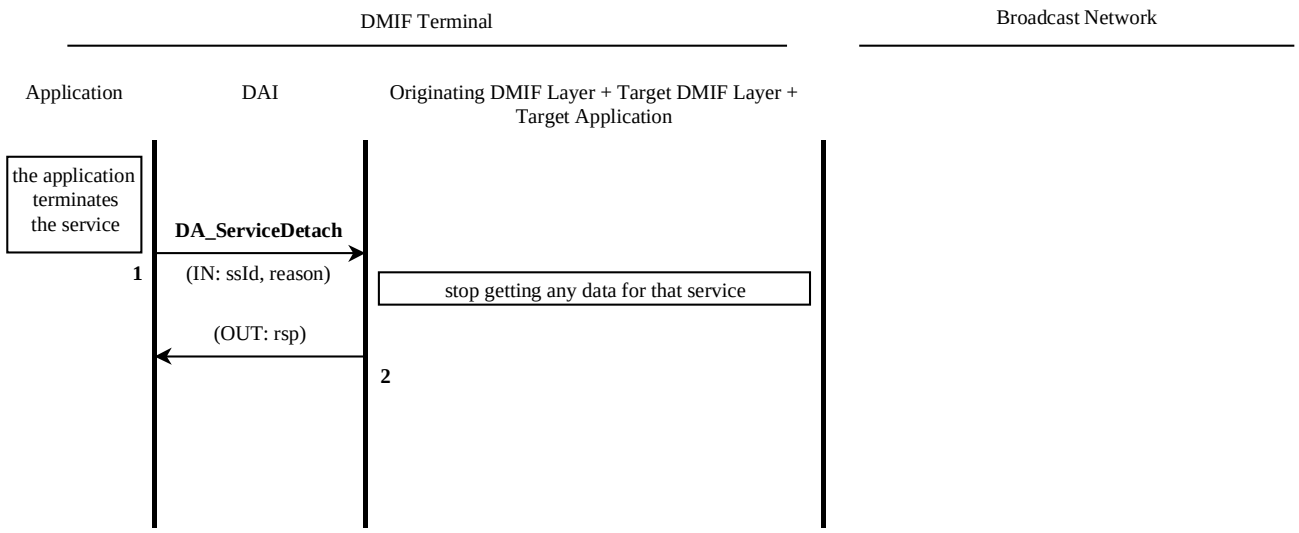

Figure B.9 — Termination of a service in a Broadcast DMIF

Preconditions:

— The service has been established between the Originating and Target applications.

— The Service Session is no longer required.

Step 1

The Application at the Originating DMIF passes a DA_ServiceDetach() indicating the service it wants to terminate. The primitive contains the serviceSessionId along with a reason code.

The DMIF Instance stops the provision of the service, and frees all resources used for that

Step 2

The Originating DMIF Instance replies to the DA_ServiceDetach() along with a response code. At this point the serviceSessionId is no longer valid.

B.3 Information Flows for Local Storage DMIF

The following figures represent the semantic information crossing the borders of a DMIF implementation for a Local Storage scenario. No details are provided on the internal exchanges between modules in DMIF.

The first two columns in the figures represent the application and the DAI, with the same information and formalism as in clause B.1; the third column represents a generic DMIF implementation, including all the internal conceptual modules according to the DMIF communication architecture of Figure 3, that is Originating DMIF Instance, Target DMIF Instance and Target Application. The right side of the figures represents the File Systems and shows the basic commands emitted by the DMIF implementation and the data entering the DMIF implementation. Note that such commands and data flows purely provide a hint of what could be exchanged, while the real flows could differ significantly: therefore, they are not tagged with any number, and their description is purely textual.

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B.3.1 Initiation of a service in a Local Storage DMIF

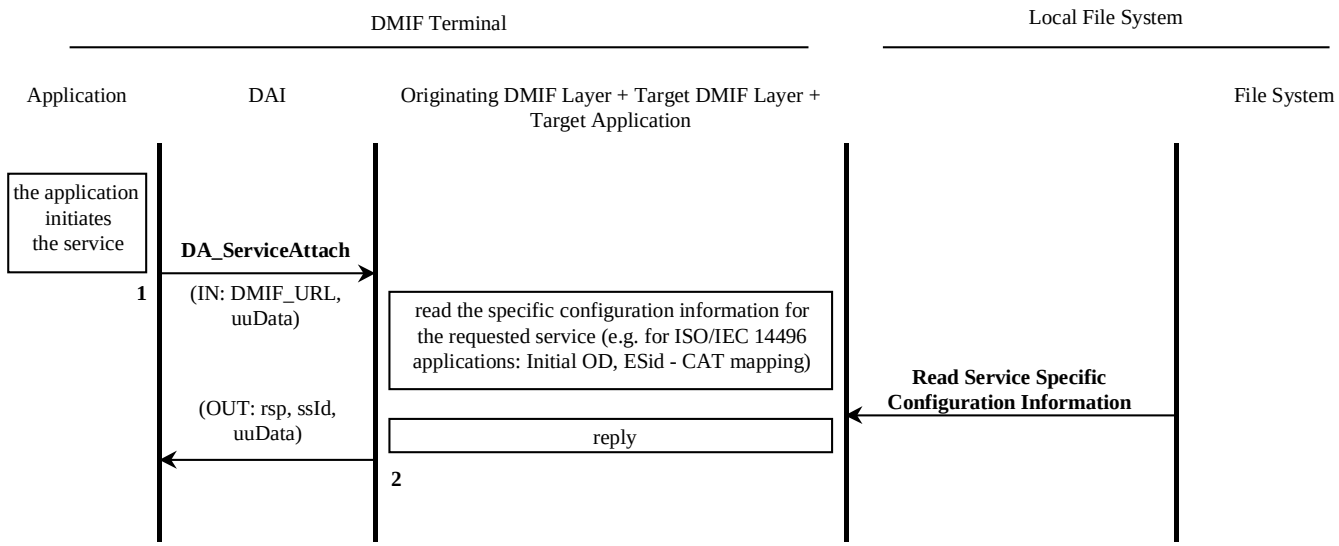

Figure B.10 — Initiation of a service in a Local Storage DMIF

Preconditions:

— The Application at the Originating DMIF has acquired an URL from a previous action (e.g.; Web browsing, advertisement, specific contracts).

Step 1

The Application at the Originating DMIF passes a DA_ServiceAttach() indicating the URL, the parentServiceSessionId and additional uuData (e.g.; for client credentials).

The URL is expanded if necessary and parsed and the appropriate DMIF Instance is invoked according to the protocol part of the URL.

The Originating DMIF Instance assigns a locally significant unique serviceSessionId. The Target Application module interprets the whole URL including the serviceName, and checks whether the requested service is available. If possibly gets additional service specific data from the file system (e.g., in the case of ISO/IEC 14496-1:2001 based applications, the Initial OD and possibly the table mapping the ES_IDs with the actual channels delivering them). Moreover, the Target Application module possibly interprets the uuData field.

Additional checks are performed through compatibility matching procedures: the mechanism adopted depends on the file system.

Step 2

After the successful conclusion of the compatibility match and the correct identification of the requested service, the Originating DMIF Instance replies to the DA_ServiceAttach() along with the locally significant serviceSessionId and possibly uuData. In the case of ISO/IEC 14496 applications the uuData would contain the InitialOD.

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B.3.2 Addition of Channels in a Local Storage DMIF

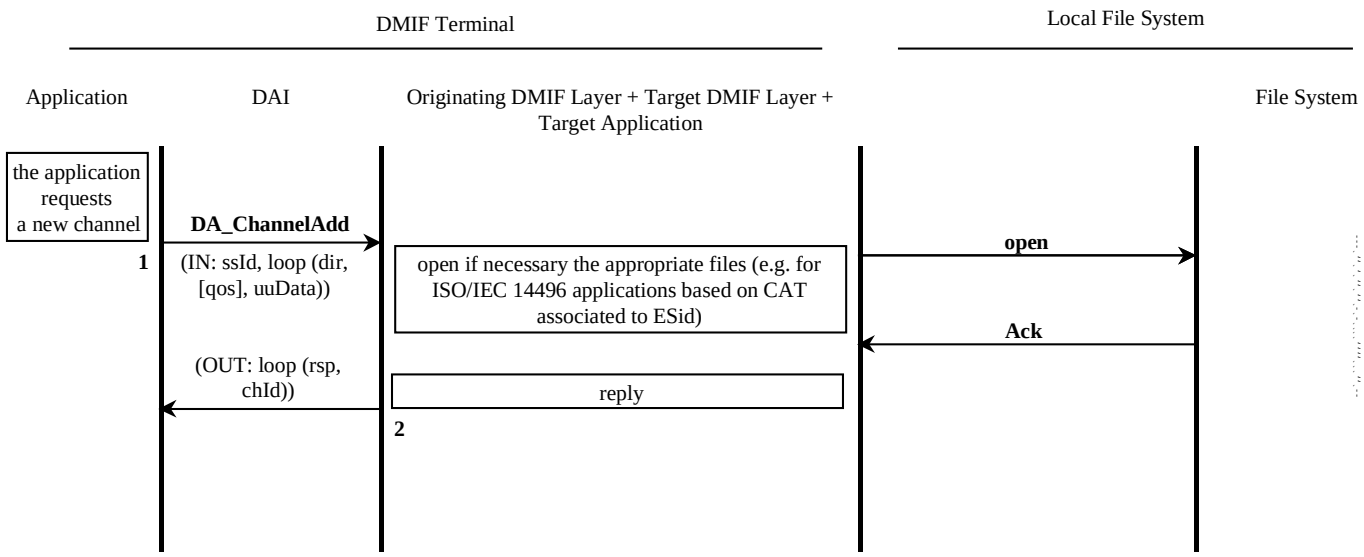

Figure B.11 — Addition of Channels in a Local Storage DMIF

Preconditions:

— The service between the Originating and Target applications has been initiated succesfully

— The location of the source of the stream is available from previous interaction.

Step 1

The Application at the Originating DMIF passes a DA_ChannelAdd() indicating the channels it requires. The primitive contains the serviceSessionId for which the Channels are requested. Each channel is characterised by a channelDescriptor parameter (optional), by a direction parameter (usually DOWNSTREAM; UPSTREAM for back-channels, that will be terminated at the Target Application module), and uuData. The Target Application module interprets the uuData to determine what stream is actually being requested (e.g., in the case of an ISO/IEC 14496-1:2001 based application uuData may convey the ES_ID), and checks the availability of such stream.

Step 2

After the successful conclusion of the above check, the Originating DMIF Instance replies to the DA_ChannelAdd() along with the locally significant channelHandle(s).

Post channel establishment:

— The Originating Application may request to start getting the data by issuing a DA_UserCommand() specifying the appropriate command in the uuData field.

— The Target Application portion of the DMIF Instance inspects the uuData, determines the command, and replies with uuData (which is supposed to possibly contain application level error indications); then executes the command, i.e. in this case begins to send the data.

— The Elementary Streams are now received by the Originating Application.

NOTE DA_UserCommand() may be used for purposes other than stream control.

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B.3.3 Deletion of Channels in a Local Storage DMIF

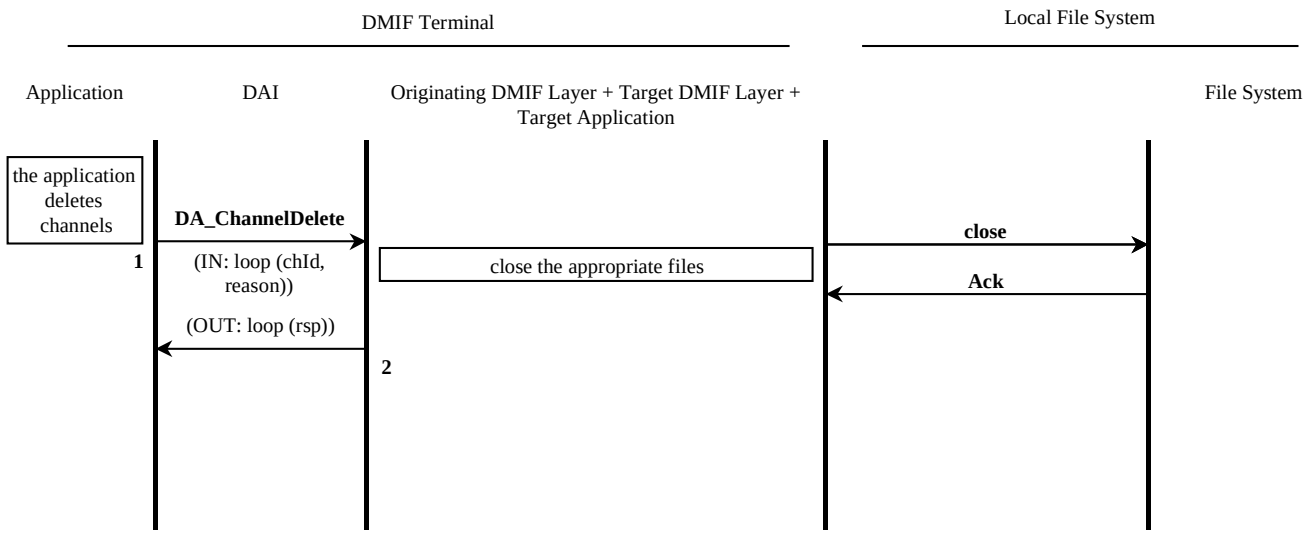

Figure B.12 — Deletion of Channels in a Local Storage DMIF

Preconditions:

— The service has been established between the Originating and Target applications.

— At least a channel has been successfully added.

— A stream being carried on a channel is no longer required.

Step 1

The Application at the Originating DMIF passes a DA_ChannelDelete() indicating the channels it wants to delete. The primitive contains the channelHandle(s) along with reason codes.

The DMIF Instance stops the actual delivery of data on the indicated Channel(s).

Step 2

The Originating DMIF Instance replies to the DA_ChannelDelete() along with response codes. At this point the channelHandle(s) are no more valid.

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B.3.4 Termination of a service in a Local Storage DMIF

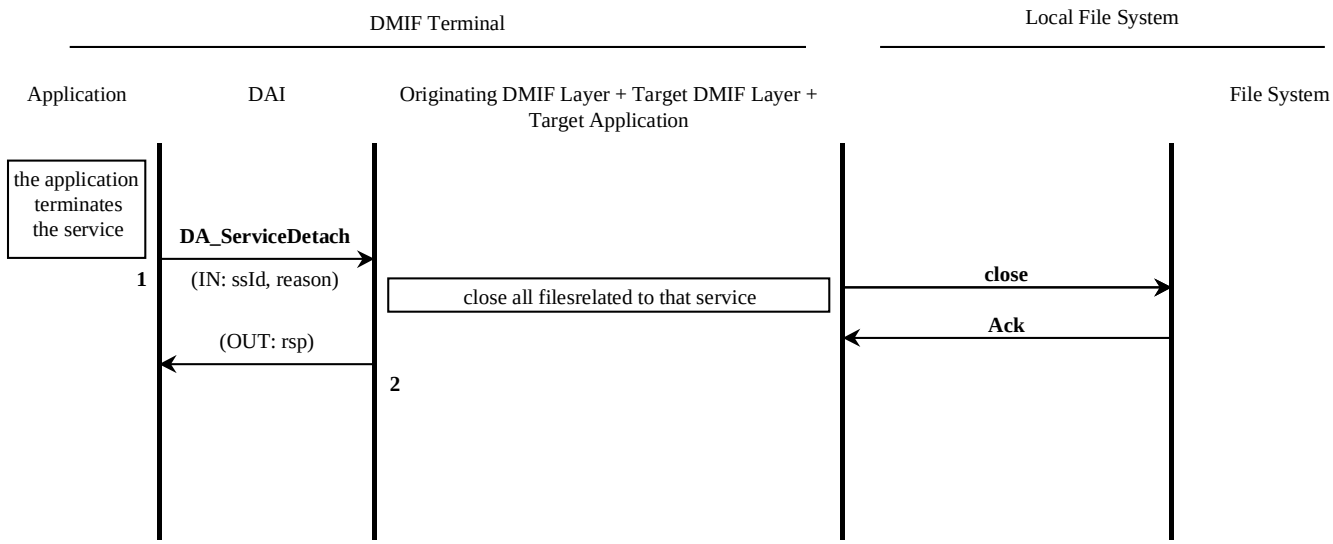

Figure B.13 — Termination of a service in a Local Storage DMIF

Preconditions:

— The service has been established between the Originating and Target applications.

— The Service Session is no longer required.

Step 1

The Application at the Originating DMIF passes a DA_ServiceDetach() indicating the service it wants to terminate. The primitive contains the serviceSessionId along with a reason code.

The DMIF Instance stops the provision of the service, and frees all resources used for that.

Step 2

The Originating DMIF Instance replies to the DA_ServiceDetach() along with a response code. At this point the serviceSessionId is no more valid.

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Annex C
(informative)

Use of URLs in DMIF

C.1 Introduction

This Annex provides a list of URL schemes that are allowed in DMIF (see clause C.3); moreover it provides a specification for those schemes that are new, i.e., not yet registered with the Internet Corporation for Asssigned Names and Numbers (ICANN) (see clause C.4).

C.2 Generic concepts

A URL contains the name of the scheme being used (<scheme>) followed by a colon and then a string (the <scheme-specific-part>) whose interpretation depends on the scheme.

<scheme>:<scheme-specific-part>

The local DMIF parses the <scheme> part of the URL in order to identify and activate the appropriate DMIF Instance. The local DMIF Instance in turn parses a portion of the <scheme-specific-part> in order to establish a session with the designated remote (or emulated remote in the case of local storage and broadcast scenarios) DMIF; the remote (or emulated remote) DMIF parses a further portion of the <scheme-specific-part> to identify the remote application program; the remote (or emulated remote) application program parses the remaining portion of the <scheme-specific-part> to identify and activate the desired service.

C.3 URL schemes allowed in DMIF

The following are the URL schemes currently allowed in this part of ISO/IEC 14496:

— "dudp:"

— "dtcp:"

— "datm:"

C.4 New URL schemes

Warning:

*The URL schemes here specified are new schemes, which are not yet officially registered at the time when this Annex is written. URLs for experimental schemes may be used by mutual agreement between parties. Scheme names starting with the characters "**x-**" are reserved for experimental purposes. In time the URL schemes here specified shall be registered with the Internet Corporation for Asssigned Names and Numbers (ICANN) that maintains the registry of URL schemes. As long as the URL schemes here specified are not officially registered, characters "**x-**" have to be added in front of it.*

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C.4.1 URL scheme for DMIF signalling over UDP/IP

The URL for default DMIF signalling over UDP/IP follows the generic syntax for new URL schemes defined in RFC1738. Usually the URLs that involve the direct use of an IP-based protocol to a specified target on the Internet use a common Internet specific syntax:

//<user>:<password>@<host>:<port>/<url-path>

The URL for default DMIF signalling over UDP/IP consists of the following:

x-dudp://<user>:<password>@<target dmif>:<dmif port>/<url-path>

The <host> is the target DMIF and hence for the "x-dudp:" scheme it will be named <target dmif>.

The <port> indicates the UDP/IP socket port number over which the DMIF signalling messages will be delivered and hence for the "x-dudp:" scheme it will be named <dmif port>.

C.4.2 URL scheme for DMIF signalling over TCP/IP

The URL for default DMIF signalling over TCP/IP follows the generic syntax for new URL schemes defined in RFC1738. Usually the URLs that involve the direct use of an IP-based protocol to a specified target on the Internet use a common Internet specific syntax:

//<user>:<password>@<host>:<port>/<url-path>

The URL for default DMIF signalling over TCP/IP consists of the following:

x-dtcp://<user>:<password>@<target dmif>:<dmif port>/<url-path>

The <host> is the target DMIF and hence for the "x-dtcp:" scheme it will be named <target dmif>.

The <port> indicates the TCP/IP socket port number over which the DMIF signalling messages will be delivered and hence for the "x-dtcp:" scheme it will be named <dmif port>.

C.4.3 URL scheme for DMIF signalling over networks using NSAP addresses format

The URL for default DMIF signalling over ATM follows the generic syntax for new URL schemes defined in RFC1738. Usually the URLs that involve the direct use of an IP-based protocol to a specified target on the Internet use a common Internet specific syntax:

//<user>:<password>@<host>:<port>/<url-path>

This scheme does not involve direct use of an IP-based protocol, thus the "//" is omitted. The other fields have however similar meaning, as explained below.

The URL for default DMIF signalling over ATM consists of the following:

x-datm:<user>:<password>@<target dmif>:<dmif selector>/<url-path>

The <host> is the target DMIF and hence for the "x-datm:" scheme it will be named <target dmif>. The <target dmif> represents an E.164 number that will be used for the E.164 portion of the NSAP address of the calledAddress in the Q.2931 signalling messages.

The <port> indicates the Selector Byte that will be used for the Selector Byte portion of the NSAP address of the calledAddress in the Q.2931 signalling messages and hence for the "x-datm:" scheme it will be named <dmif selector>.

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Annex D
(informative)

Protocol error recovery

D.1 Timouts and retransmission

The DMIF Default Signalling Protocol includes facilities to detect the non-receipt of messages and message retransmission algorithms to provide error recovery from lost or corrupt messages. Detection of the non-receipt of a message is accomplished by the use of the Tid.tMessage timer. When a timeout occurs an event is generated of the form [Tid.tMessage]. At that time error recovery procedures will be performed.

Because the DMIF Default Signalling Protocol uses a basic request/reply transaction-based messaging scheme the transmit and receive windows for the protocol are at most 1 at any given time for each message. The Transaction ID used in each message allows multiple messages to be sent with simultaneous outstanding replies. The receipt of the associated Confirm indicates acknowledgment that a Request was received. Similarly the non-receipt of a Confirm message is indicated by the timeout of the Tid.tMessage timer for the associated Request and its subsequent retransmission. Therefore the sending entity of a Request message uses the Tid.tMessage timer as a retransmission timer whereas the sending entity of a Confirm message uses the Tid.tMessage timer as a holding timer to keep the message available in case the Request message is resent. Each time either of these conditions occurs the entity will resend the message and increment its Tid.numRetrans state variable. If Tid.numRetrans exceeds Tid.retransBound the entity will perform any session protocol actions and state transitions necessary to abort the current message sequence and move the transaction into the TExpire state.

The initial value of the Tid.tMessage timer as well as the algorithm chosen to compute its successive values are out of the scope of this part of ISO/IEC 14496; the same applies to the Tid.retransBound parameter.

D.2 Transaction state variables

Each transaction whose completion has not yet been verified has an instance of the Transaction State Machine alive to encode its status. The Transaction State Machine is realized by the following state variables.

D.2.1 Transaction identifier: Tid

The transactionId field value used in the DSMCCMessageHeader() to identify the transaction of which this message is a part.

D.2.2 Transaction state: Tid.state

The current state of the transaction with transactionId value of Tid.

D.2.3 Associated session: Tid.Sid

The value used to identify the networkSession in which the transactionId Tid pertains. This variable is used to correlate the transaction state variables with its associated networkSession.

D.2.4 Transaction message timeout: Tid.tMessage

The holding timer for the transaction message with transactionId value Tid. When initiating a Request message this timer is used to detect non-receipt of the corresponding Confirm message and initiates retransmission procedures. When initiating a Confirm message this timer serves as a holding timer used to keep the message available for possible retransmission if its associated Request message is retransmitted.

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D.2.5 Expired transactionId holding timer: Tid.tHold

The timer set when the transaction state machine moves to the expired state. The Tid will be held in this state until Tid.tHold expires and transition is made to the TUndefined state and the corresponding Tid may be used again. This will prevent possible collisions of messages with the same transactionId in the network due to premature reuse of transactionIds.

The value assigned to Tid.tHold is not within the scope of this part of ISO/IEC 14496.

Note that although this functionality is represented as a timer in the Transaction Identifier State Machine, alternative methods can be used in implementations to achieve the same results without timers. For example, a cyclic allocation space sufficiently large to guarantee non-reuse within the required period of time is acceptable.

D.2.6 Transaction message: Tid.message

The message contents of the transaction with transactionId value of Tid. This is what will be retransmitted in the event that a transaction remains unacknowledged for an extended period of time.

D.2.7 Tid.retransBound

The number of retransmissions of an unacknowledged transaction before the protocol state machine is to give up and invalidate the transaction.

Tid.retransBound is assigned when Tid is allocated.

D.2.8 Tid.numRetrans

The current number of retransmissions that have been performed on this transaction.

D.3 Transaction Identifier State Machine

A transaction is a pair of messages which share the same transactionId value in their DSMCCMessageHeader(). The transaction pair consists of either a Request message followed by a Confirm message. The transactionId value is used to correlate the message pairs on the sending or receiving entities. To insure integrity of messages, it is important that transactionId value not be re-used by an entity until it can guarantee that all copies of a transaction's messages have been cleared from the session. In the Transaction Identifier State Machine this is accomplished by moving all transactionIds into the Texpired state for some period of time before they can be reused.

The following states are defined:

TUndefined: The Transaction ID has not been assigned

TActiveRetrans: The Transaction ID has been assigned and the state is permitted to retransmit the message.

TActiveNoRetrans: The Transaction ID has been assigned and the state is not permitted to retransmit the message.

TExpire: The Transaction ID is retired.

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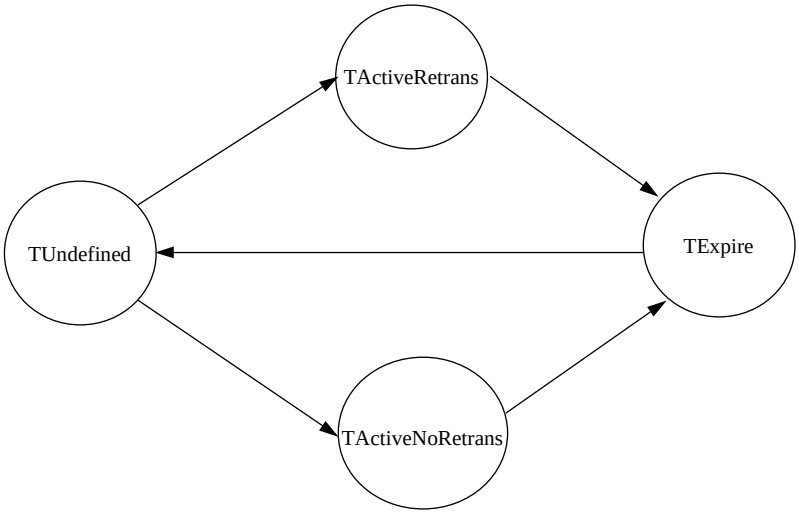

Figure D.1 — Transaction Identifier State Machine

D.4 Transaction Identifier State table

Description of the events:

[new-tid-retrans]	Sending a Request message with Tid.retransBound > 0
[new-tid-noretrans]	Sending a Request message with Tid.retransBound = 0
[free-tid]	Transaction ID no longer required.
[Tid.tMessage]	Tid.tMessage timer has expired
[retrans-req]	An administrative request to retransmit.
[Tid.tHold]	Tid.tHold timer has expired

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Table D.1 — Transaction Identifier State table

Current State	Event	Conditions	Actions	Next State
Tundefined	[new-tid-retrans]	Tid.retransBound > 0	Allocate a new transactionId and create a new set of Transaction State Machine variables. Initialize Tid to transactionId Tid.numRetrans = 0 Tid.Sid = Sid Set Tid.tMessage timeout for retransmission procedure.	TActiveRetrans
	[new-tid-noretrans]	Tid.retransBound = 0	Allocate a new transactionId and create a new set of Transaction State Machine variables Tid.numRetrans = 0 Tid.Sid = Sid Set Tid.tMessage timeout for message holding time.	TActiveNoRetrans
TactiveRetrans	[free-tid]		free Tid.message stop Tid.tMessage Tid.tHold = tTidHold	TExpire
	[Tid.tMessage] [retrans-req]	Tid.numRetrans < Tid.retransBound	resend Tid.message if present Tid.numRetrans=Tid.numRetrans + 1 Calculate new Tid.tMessage timeout	TActiveRetrans
			stop Tid.tMessage free Tid.message Tid.tHold = tTidHold [retrans-failed]	TExpire
TactiveNoRetrans	[free-tid] [Tid.tMessage]		free Tid.message stop Tid.tMessage Tid.tHold = tTidHold	TExpire
	[retrans-req]	Tid.numRetrans < Tid.retransBound	resend Tid.message, if present Tid.numRetrans = Tid.numRetrans+1 Calculate new Tid.tMessage timeout	TActiveNoRetrans
			stop Tid.tMessage free Tid.message Tid.tHold = tTidHold [retrans-failed]	TExpire
TExpire	[Tid.tHold]			TUndefined

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Annex E
(informative)

Subset of DSM-CC resource descriptors from DSM-CC ISO/IEC 13818-6

NOTE This Annex is derived from subclause 4.7 of ISO/IEC 13818-6 for DSM-CC resource descriptors. It by no means limits DMIF implementations to the DSM-CC resources identified in this Annex. It does not reflect any amendments, which could have been incorporated since the issue of the DSM-CC ISO/IEC 13818-6 specification.

E.1 ResourceDescriptor format

E.1.1 ResourceDescriptorDataField

Resource descriptor data fields define the actual data fields associated with a particular resourceDescriptorType. The syntax for defining these fields is defined in Table E.1:

Table E.1 — Syntax of DSM-CC Resource Descriptor data fields

Syntax	Encoding	Variable	Num. of Bytes

Syntax defines the data field name and any conditionals or loops associated with the data field.

Encoding defines whether the field value may be requested as a single value (s), list of values (l), or range of values (r).

Variable is a yes or no field, which defines if a data field uses the dsmccResourceDescriptorValue format of the field value (yes) or if the data field uses a simple string of bytes (no). In the case of variable being set to no, the Encoding specified for the data field has no meaning.

Num of Bytes indicates the length of each instance of the data field. There shall be exactly Num of bytes of data, for each occurrence of the data field in a resource descriptor.

Table E.2 defines the format of the resourceDescriptorDataFields:

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Table E.2 — DSM-CC User-to-Network resourceDescriptorDataFields

Syntax	Num. Of Bytes
resourceDescriptorDataFields() {	
for(i=0;i<resourceDataFieldCount;i++) {	
if (Variable == Yes) {	
dsmccResourceDescriptorValue()	
} else {	
for(i=0;i<resourceLength;i++) {	
resourceDataValueByte	**1**
}	
}	
}	
}	

The **resourceDescriptorDataFields** structure contains a list of data fields which are specific to the resourceDescriptorType defined in the commonResourceHeader. The **resourceDataFieldCount** field is defined in the commonResourceHeader. The Variable attribute is defined for each field in the resource descriptor data field for the specific resource descriptor type. If a data field is defined with the Variable attribute defined as yes, then the data field shall used the dsmccResourceDescriptorValue format defined in the following clause. If the Variable attribute is defined as no, then the content of the resourceDataByte field shall contain exactly the number of bytes specified for that data field.

E.1.2 Specifying ranges and lists of values in resource descriptors

When requesting that the network assign a value to a field in a resource descriptor, it is possible that the field has more than one acceptable value. DSM-CC permits the use of a range or list of values when requesting a resource value. For instance, if a User is requesting a connection resource, it may have several possible ports from which the session may be delivered. In this case the request may contain a list of ports from which the network may choose. A Server may be able to deliver the service at a variable rate in which case the resource request would specify an upper and lower range of bandwidth values and the network may choose a value which is optimum.

If a resource descriptor data field is defined as being variable, then that field shall be encoded using the dsmccResourceDescriptorValue() format as described in Table E.3. If a resource descriptor data field is defined as not variable, that resource descriptor value shall be not use the dsmccResourceDescriptorValue() format.

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Table E.3 — dsmccResourceDescriptorValue() field format

Syntax	Num. Of Bytes
dsmccResourceDescriptorValue() {	
resourceValueType	**2**
if (resourceValueType = singleValue) {	
resourceValue()	
}	
else if (resourceValueType = listValue) {	
resourceListCount	**2**
for(i=0;i<resourceListCount;i++) {	
resourceValue()	
}	
}	
else if (resourceValueType = rangeValue) {	
mostDesiredRangeValue()	
leastDesiredRangeValue()	
}	
}	

The **resourceValueType** field indicates the format of the value which is being requested. This field corresponds to Encoding definition specified in the resource descriptor data field definitions. Table E.4 defines the possible resourceValueTypes:

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Table E.4 — DSM-CC resource value types

resourceValueType	Encoding	Value	Description
Reserved		0x0000	ISO/IEC 13818-6 reserved.
singleValue	s	0x0001	Indicates that a single value is being requested for this resource. In this instance, the resource value field shall contain only one element which is the length of the specific data field for this resource.
listValue	l	0x0002	Indicates that the requested value contains a list of possible values that the requester will accept. In this instance, the resource value field shall contain a resourceValueCount field and exactly resourceValueCount elements which are the length of the specific data field for this resource. The list of values shall be ordered with the most desired value as the first entry and the least desired value as the last entry.
rangeValue	r	0x0003	Indicates that the requested value contains a range of values that the requester will accept. In this instance, the resource value field shall two elements which are the length of the specific data field for this resource. The first value shall specify the most desired end of the range of values that will be accepted and the second value shall specify the least desired end of the range that will be accepted.
reserved		0x0004 – 0x7fff	ISO/IEC 13818-6 reserved.
UserDefined		0x8000 - 0xffff	Resource value types in this range are user definable.

The **resourceListCount** field is included as the first field of the resource value when the resourceValueType field is set to indicate that the value is a listValue. This field indicates the number of list items which follow this field.

A resource descriptor data field which is defined as using the dsmccResourceDescriptorValue() format shall be encoded with the resourceValueTypes which are possible for that field. A descriptor data field may be encoded in different formats depending on the application.

E.2 Resource descriptor types useful to this part of ISO/IEC 14496

The resourceDescriptorTypes, and their corresponding descriptors, are specified in ISO/IEC 13818-6, subclause 4.7.5. Table E.5 provides the list of the subset of DSM-CC User-to-Network resourceDescriptorTypes useful to this part of ISO/IEC 14496 (but by no means limits the resourceDescriptorTypes that can be used to that list); the following clause provides the corresponding definition.

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Table E.5 — DSM-CC User-to-Network resourceDescriptorTypes used in this part of ISO/IEC 14496

resourceDescriptorType	Value	Description
AtmSvcConnection	0x0007	Provides ATM SVC SETUP parameters. This is used when the Network or Client is responsible for initiating a call.
IP	0x0009	This is requested from the Server to indicate that data will be exchanged between the Server and the Client using IP protocol.
AtmVcConnection	0x0010	Indicates the VPI / VCI of an ATM virtual connection.
UserDefined	0x8000 - 0xfffe	Resource descriptors in this range are user definable.
TypeOwner	0xffff	Defines owner of the UserDefined resource type

E.3 Resource descriptor definitions

E.3.1 AtmSvcConnection resource descriptor definition

The **AtmSvcConnection** resource descriptor is used when requesting an ATM connection resource. Table E.6 describes the format of the AtmSvcConnection resource descriptor.

Table E.6 — AtmSvcConnection3.0 resource descriptor

Field Name	Encoding	Variable	Field Length In Bytes
AtmSvcSetUp	**s**	**no**	Parameters as they appear in the SETUP message of the specific signaling specification ATM UNI 3.0, 3.1, 4.0 or ITU-T Q.2931

The **AtmSvcSetUp** field contains all the set up message parameters required to set up the ATM SVC connection.

E.3.2 IP resource descriptor definition

The IP resource descriptor is requested by the server to indicate that IP data is being transported. Table E.7 defines the format of the IP resource descriptor.

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Table E.7 — IP resource descriptor

Field Name	Encoding	Variable	Field Length In Bytes
sourceIpAddress	**s**	**no**	**4**
sourceIpPort	**s**	**no**	**2**
destinationIpAddress	**s**	**no**	**4**
destinationIpPort	**s**	**no**	**2**
ipProtocol	**s**	**no**	**2**

The **sourceIpAddress** field indicates the IP address of the device, which is sending the IP messages.

The **sourceIpPort** field indicates the port, which the data will be transmitted from.

The **destinationIpAddress** field indicates the IP address of the device to which the IP messages are sent.

The **destinationIpPort** field indicates the port, which the data will be transmitted to.

The **ipProtocol** field indicates the protocol, which is being carried over this IP stream. Table E.8 defines these protocol types:

Table E.8 — IP protocol types

ipProtocol	Value	Description
reserved	0x0000	ISO/IEC 13818-6 reserved.
TCP	0x0001	Indicates that TCP is being carried over IP.
UDP	0x0002	Indicates that UDP is being carried over IP.
reserved	0x0003 - 0x7fff	ISO/IEC 13818-6 reserved.
user defined	0x8000 - 0xffff	user defined

E.3.3 AtmVcConnection resource descriptor definition

The **AtmVcConnection** resource descriptor describes an AtmVcConnection. Table E.9 defines the format of the AtmVcConnection resource descriptor.

Table E.9 — AtmVcConnection descriptor

Field Name	Encoding	Variable	Field Length In Bytes
atmVpi	**s**	**no**	**2**
atmVci	**s**	**no**	**2**

The **atmVpi** and **atmVci** parameters contain the VPI and VCI values for the ATM connection.

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Annex F
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ISO/IEC 14496 content carried over an ETS 300 401 system

F.1 Introduction

This Annex describes how to manage and deliver an MPEG-4 service inside an ETS 300 401 system, which is well-known under the name DAB (Digital Audio Broadcast). It details the format of the MPEG-4 information to be carried in the DAB multiplex and provides a walkthrough of the different aspects when carrying MPEG-4 content over a DAB system.

Furthermore the DAI procedures are mapped to the information flows in a DAB systems considering it as a Broadcast DMIF and hence, giving an example of one possible implementation of such a Broadcast DMIF as described in Annex B.2.

For interpretation of the syntax definitions in the subsequent sections refer to the specification of SDL in ISO/IEC 14496-1:2001, clause 12.

F.2 ISO/IEC 14496 content embedded in an ETS 300 401 multiplex

This section describes a way to transmit in an ETS 300 401 multiplex the InitialObjectDescriptor, ObjectDescriptorStream, SceneDescriptionStream, ClockReferenceStream and audio-visual elementary stream data specified in ISO/IEC 14496-1:2001, ISO/IEC 14496-2:1999 and ISO/IEC 14496-3:1999 . This clause also describes a method on how to specify the ISO/IEC 14496 stream indication in the ETS 300 401 Service Information.

F.2.1 Overview of ETS 300 401 payload transmission

In an ETS 300 401 multiplex, the payload data is transmitted in the subchannels of the *Main Service Channel (MSC).* In the sense of ETS 300 401 the MPEG-4 content forms a service which is defined by its components, i.e. the elementary streams, that can be transmitted in different subchannels. Each subchannel can choose one of two specific transmission modes, i.e. either *Stream Mode* or *Packet Mode*.

The transmission mode is chosen according to the characteristics of the payload data. Whereas *Packet Mode* is dedicated to asynchronous data transmission *Stream Mode* provides for transparent, synchronous transmission of larger data amounts.

F.2.1.1 Stream Mode

For transmission in *Stream Mode* payload data (i.e., MPEG-4 elementary streams in this case) shall be divided into *logical frames*. Each logical frame consist of a regular data bursts of a predefined duration (24ms normally) that can be recovered at the receiver site. The available data rate per sub-channel is fixed to multiples of 8 kbit/s. If the application does not provide for a bit rate of multiples of 8 kbit/s stuffing is required by that application. Thus data carried in one *logical frame* always totals multiples of 8 kbit/s * 24 ms = multiples of 24 bytes.

A *Stream Mode* channel can therefore be considered as a transparent data channel that provides for framing without any inherent overhead.

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F.2.1.2 Packet Mode

For *Packet Mode* transmission the payload is packetized into *MSC data groups* the structure of which is shown in Figure F.1. Further adaptation of the *MSC data groups* to the transmission frame structure is performed by ETS 300 401 mechanisms and is therefore not subject of this document.

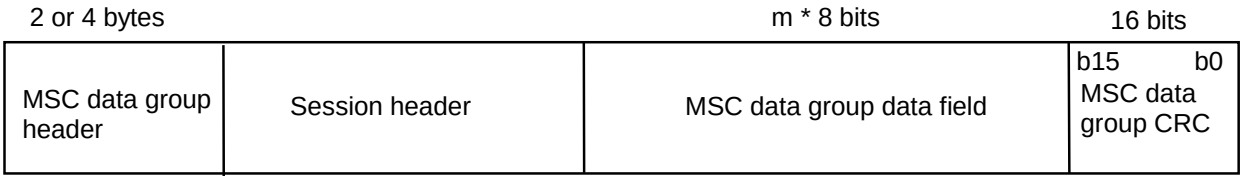

Figure F.1 — Structure of the MSC data group

F.2.1.2.1 Semantics

`MSC data group header` - is defined in subclause 5.3.3.1 of ETS 300 401

`Session header` - is defined in subclause 5.3.3 of ETS 300 401

`MSC data group data field` – is defined in subclause 5.3.3.3 of ETS 300 401; here to be used for ISO/IEC 14496 payload, e.g., SL-packetized streams or InitialObjectDescriptorDataFields

`MSC data group CRC` - is defined in subclause 5.3.3 of ETS 300 401

F.2.2 Object descriptor encapsulation

Each ISO/IEC 14496 elementary stream has an associated ES_Descriptor as part of an ObjectDescriptor specified in ISO/IEC 14496-1:2001, subclause 8.6.2. The ES_Descriptor contains information of the associated elementary stream such as the decoder configuration, SL packet header configuration, IP information etc.

The InitialObjectDescriptor is treated differently from the subsequent ObjectDescriptors, since it has the content access information and it has to be retrieved as the first ObjectDescriptor at the receiving terminal.

F.2.2.1 InitialObjectDescriptorDataField

The InitialOD shall be retransmitted periodically in broadcast applications to enable random access, and it must be received at the receiving terminal without transmission errors. For these purposes, the transmission of the InitialObjectDescriptor in InitialObjectDescriptorDataFields (InitialOD-DataField) is defined here. The InitialOD-DataField consists of the version_number, the InitialObjectDescriptor and a DABStreamMapTable. The DABStreamMapTable is specified in subclause F.2.2.3.

Since its data rate may vary significantly the InitialOD-DataField is transmitted in one *Packet Mode* subchannel of the ETS 300 401 *Main Service Channel*. Hence, for transport the InitialOD-DataField must be packed into one `MSC data group data field`.

An InitialOD-DataField shall always start with the first byte of the `MSC data group data field` in an *MSC data group*. Due to the constraints of the `MSC data group data field` the InitialOD-DataField is always limited to 8191 bytes maximum.

Access to the *MSC data group* that conveys the InitialOD-DataField is provided by means of the *MCI* described in subclause F.2.6.

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F.2.2.1.1 Syntax

```
class InitialObjectDescriptorDataField {

        bit(8)  version_number;

        DABStreamMapTable  streamMapTbl;

        InitialObjectDescriptor  initialObjDescr;

}
```

F.2.2.1.2 Semantics

version_number – is incremented by 1 modulo 256 when a streamMapTbl or an initialObjDescr is changed.

streamMapTbl – is a DABStreamMapTable as specified in subclause F.2.2.3. The streamMapTbl shall contain a list of the ES_IDs of all elementary streams that are referred to by the initialObjDescr and associate each of them to the MSC Packet `Address` and FlexMux channel, if applicable, that conveys the elementary stream data.

initialObjDescr – is an InitialObjectDescriptor as specified in ISO/IEC 14496-1:2001, subclause 8.6.3.

F.2.2.2 ObjectDescriptorStreamDataField

ObjectDescriptors are conveyed in an ObjectDescriptorStream as specified in ISO/IEC 14496-1:2001, subclause 8.5. The sync layer, specified in ISO/IEC 14496-1:2001, subclause 8.5, may divide the ObjectDescriptorStream access units into more than one SL packet. The `accessUnitStartFlag` in the SL packet header is used to identify whether an access unit starts in this packet as defined in ISO/IEC 14496-1:2001, subclause 8.5.2. Similarly, the `randomAccessPointFlag` is used to identify a random access point.

The ObjectDescriptorStream shall be retransmitted periodically to enable random access, and it must be received at the receiving terminal without transmission errors. For these purposes, the transmission of an ObjectDescriptorStream in ObjectDescriptorStreamDataFields (ODStream-DataField) is defined here.

The ODStream-DataFields are transmitted in an ETS 300 401 Packet Mode subchannel. The first byte of such an `MSC data group data field` in an *MSC data group* shall always be equal to the first byte of the ODStream-DataField. Due to the constraints of the `MSC data group data field` the InitialOD-DataField is always limited to 8191 bytes maximum.

The ODStream-DataField is similar to the InitialOD-DataField. However, the presence of the DABStreamMapTable and the subsequent SL packet are optional. The DABStreamMapTable is specified in subclause F.2.2.3. The SL packet contains a complete or a part of an access unit of the ObjectDescriptorStream.

As mentioned, the size of an ODStream-DataField shall not exceed 8191 bytes. However, up to 256 ODStream-DataFields may share the same `version_number` and, hence, form one version. Each new version shall start with `data_field_number` set to ‘0’ and shall allow random access to a complete set of ObjectDescriptors as they are required at the current time.

Access to the `MSC data groups` that convey the ODStream-DataFields is provided by the DABStreamMapTable in the InitialOD-DataField.

F.2.2.2.1 Syntax

```
class ObjectDescriptorStreamDataField {

        bit(5)  version_number;

        bit(1)  current_next_indicator;
```


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```
        bit(8)  data_field_number;

        bit(8)  last_data_field_number;

        bit(1)  streamMapTblFlag;

        bit(1)  OD_PacketFlag;

        if (streamMapTblFlag)

                DABStreamMapTable  streamMapTbl[[data_field_number]];

        if (OD_PacketFlag)

                bit(13)         SL_packet_length;

                SL_Packet       objDescrStrmPacket[[data_field_number]];

}
```

F.2.2.2.2 Semantics

`version_number` – is incremented by 1 modulo 32 when the content of a `streamMapTbl` or an `objDescrStrmPacket` in one of the ODStream-DataFields that constitute this version is changed.

`current_next_indicator` – When this flag is set to '1', then the `version_number` shall be that of the currently applicable ODStream-DataField. When the bit is set to '0', it indicates that the ODStream-DataField sent is not yet applicable and shall be the next ODStream-DataField with the same `data_field_number` to become valid.

`data_field_number` – indicates the number of this ODStream-DataField. The `data_field_number` of the first ODStream-DataField in a version of a set of ODStream-DataFields shall be 0x00. The `data_field_number` shall be incremented by 1 with each additional ODStream-DataField within one version.

`last_data_field_number` – specifies the number of the last ODStream-DataField (i.e., the ODStream-DataField with the highest `data_field_number`) of the version of which this ODStream-DataField is a part.

`streamMapTblFlag` – if set to '1' indicates the `streamMapTbl` field will follow.

OD_PacketFlag – if set to '1' indicates that an `objDescrStrmPacket` will follow.

`streamMapTbl[]` – is a DABStreamMapTable as specified in subclause F.2.2.3. At least one `streamMapTbl` shall exist in the set of ODStream-DataFields that constitute one version of an object descriptor stream. The set of DABStreamMapTables in one such version shall map the complete list of all ES_IDs that are referred to in this object descriptor stream to their respective ETS 300 401 channel and their FlexMux channels, if applicable.

`SL_packet_length` – indicates the length of the subsequent `objDescrStrmPacket`

`objDescrStrmPacket[]` – is an SL packet as defined in ISO/IEC 14496-1:2001, subclause 10.2.2, that contains a complete or a part of an access unit of the ObjectDescriptorStream.

F.2.2.3 DABStreamMapTable

The DABStreamMapTable associates elementary stream descriptors contained in object descriptors with the actual ETS 300 401 channels in which the streams are carried. The association is performed based on the ES_ID number contained in the elementary stream descriptor, and indicates the ETS 300 401 channel as well as the FlexMux channel number (when FlexMux is used in the respective ETS 300 401 channel). In case of usage of Packet Mode for the respective ETS 300 401 channel, this channel is referred to by its Service Component Identifier (SCId –

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defined in ETS 300 401) whereas for a Stream Mode channel the Sub-channel Identifier is provided (SubChId - defined in ETS 300 401). For data transmitted in *Stream Mode* the synchronisation method (see subclauses F.2.5.1 and F.2.5.2) in this channel can be signalled by the `usePacketStartPointer` flag.

The DABStreamMapTable furthermore allows to provide more information on an additional, optional FEC mechanism applied to the MPEG-4 Elementary Streams before being fed into the ETS 300 401 Multiplexer and its error protection mechanisms.

The DABStreamMapTable is a list of the ES_ID, FlexMux channel number and SCId or SubChId within this ETS 300 401 multiplex for each elementary stream within the name scope of the respective object descriptor stream. The DABStreamMapTable is located in the InitialOD-DataField specified in subclause F.2.2.1and the ODStream-DataField specified in subclause F.2.2.2.

F.2.2.3.1 Syntax

```
class DABStreamMapTable () {
        const bit(6)  reserved=0b1111.11;
        bit(10)  streamCount;
        for (i=0; i<streamCount; i++) {
                bit(16)  ES_ID;
                bit(1)  FlexMuxFlag;
                if (FlexMuxFlag) {
                        bit(8)  FlexMuxChannel;
                }
                bit(1)    PacketModeFlag;
                if (PacketModeFlag) {           // Packet Mode
                        bit(12)         SCId;
                }
                else {                                          // Stream Mode
                        bit(6)    SubChId;
                        bit(1)    usePacketStartPointer;
                        const bit(5)      reserved=0b1111.1;
                }
                bit(1)    FEC_flag;
                if(FEC_flag)
                {
                        bit(8)    FEC_type;
                }
                const bit(1)      reserved=0b1;
        }
}
```


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F.2.2.3.2 Semantics

`streamCount` – is the number of streams for which the stream association is conveyed in this DABStreamMapTable.

`ES_ID` – provides a unique label for each elementary stream as defined in ISO/IEC 14496-1:2001, subclause 8.6.4.

`FlexMuxFlag` – if set to '1' indicates the presence of the `FlexMuxChannel` field. If this flag is set to '0', it indicates the FlexMux as specified in ISO/IEC 14496-1:2001, subclause 11.2 is not used.

`FlexMuxChannel` – is the FlexMux channel number for this stream.

`PacketModeFlag` – if set to '0' indicates that this elementary stream is transmitted in Stream Mode. If set to '1' indicates that this elementary stream is transmitted in Packet Mode.

`SCId` – is the *Service Component Identifier* in the ETS 300 401 multiplex that conveys the elementary stream.

`SubChId` – is the *Sub-channel Identifier* in the ETS 300 401 multiplex that conveys the elementary stream.

`usePacketStartPointer` – indicates which synchronisation to be used in case of Stream Mode transmission. If set to '1', the method described in subclause F.2.5.1 shall be used. If set to '0', the method described in subclause F.2.5.2 shall be used.

`FEC_flag` – indicates whether additional FEC mechanisms – apart from those provided by ETS 300 401 mechanisms – are applied to the MPEG-4 elementary stream. If set to '0', no additional FEC mechanism is applied.

`FEC_type` – indicates which additional FEC mechanism according to Table F.1 is applied.

Table F.1 — Indication of FEC type in `FEC_type` field

`FEC_type` code	FEC mechanism
0x00	none
0x01	RS(188, 204)
0x02 – 0xFF	reserved

F.2.3 Scene description stream encapsulation

A SceneDescriptionStream as defined in ISO/IEC 14496-1:2001 may convey two types of information. The first is BIFS-Commands, specified in ISO/IEC 14496-1:2001, subclause 9.3.6, which conveys the necessary information to compose the audio-visual objects in a scene. The second one is BIFS-Anim, specified in ISO/IEC 14496-1:2001, subclause 9.3.8, which is used to transmit updated parameters for the various fields of specific (user-specified) BIFS nodes. The type of SceneDescriptionStream is identified by the BIFSConfig structure, as defined in ISO/IEC 14496-1:2001, subclause 9.3.5.2. that is encapsulated in the specificInfo fields of the general DecoderSpecificInfo. The DecoderSpecificInfo in turn is contained in the DecoderConfigDescriptor that is carried in the ES_Descriptor for this stream.

Only encapsulation of BIFS-Command streams is considered here, since the BIFS-Anim stream is just another elementary stream, that shall be encapsulated in the same way as other audio-visual elementary streams as described in subclause F.2.5.

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F.2.3.1 BIFSCommandDataField

The BIFS-Command structure contains one or more update commands to either convey an entire scene or perform a partial update. The SceneReplaceCommand, in particular, specifies a complete scene.

The sync layer divides the BIFS-Commands into one or more access units. An access unit contains one or more BIFS-Commands that become valid at the same time in the receiver terminal. An access unit may be divided into more than one SL packet. The `accessUnitStartFlag` in the SL packet header is used to identify if an access unit starts at this packet.

If the `randomAccessPointFlag` in the SL packet header is set to '1', an access unit shall have the SceneReplaceCommand. Otherwise, the randomAccessPointFlag shall be set to '0'.

The SceneReplaceCommand shall be retransmitted periodically to enable random access, and it must be received at the receiving terminal without transmission errors. For these purposes, the transmission of SceneDescriptionStreams with BIFS-Command information in BIFSCommandDataFields is defined here.

The BIFSCommandDataField shall be transmitted in Packet Mode and is therefore packed into an *MSC data group* like the InitialOD-DataField and the ODStream-DataField. The first byte of such an `MSC data group data field` in an *MSC data group* shall always be equal to the first byte of the BIFSCommandDataField. It follows from this that the size of a BIFSCommandDataField shall not exceed 8191 bytes. However, up to 256 BIFSCommandDataFields may share the same `version_number` and, hence, form one version. Each version shall allow random access to a complete set of BIFS-Command information as it is required at the current time.

Access to the ETS 300 401 *MSC data groups* that convey the BIFSCommandDataFields is achieved by the DABStreamMapTable in the InitialOD-DataField or the ODStream-DataField.

F.2.3.1.1 Syntax

```
BIFSCommandDataField {

        bit(5)  version_number;

        bit(1)  current_next_indicator;

        bit(8)  data_field_number;

        bit(8)  last_data_field_number;

        const bit(5)      reserved=0b1111.1

        bit(13)                 SL_packet_length;

        SL_Packet               BIFSCommandFrmPacket[[DataField_number]];

}
```

F.2.3.1.2 Semantics

`version_number` – is incremented by 1 modulo 32 when the content of a `BIFSCommandFrmPacket` in one of the BIFSCommandDataFields that constitute this version is changed.

`current_next_indicator` – When this flag is set to '1', then the `version_number` shall be that of the currently applicable BIFSCommandDataField. When the bit is set to '0', it indicates that the BIFSCommandDataField sent is not yet applicable and shall be the next BIFSCommandDataField with the same `data_field_number` to become valid.

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`data_field_number` – indicates the number of this BIFSCommandDataField. The `data_field_number` of the first BIFSCommandDataField in a version of a set of BIFSCommandDataFields shall be 0x00. The `data_field_number` shall be incremented by 1 with each additional BIFSCommandDataField within one version.

`last_data_field_number` – specifies the number of the last BIFSCommandDataField (i.e., the BIFSCommandDataField with the highest `data_field_number`) of the version of which this BIFSCommandDataField is a part.

`SL_packet_length` – indicates the length of the subsequent `BIFSCommandFrmPacket`

`BIFSCommandFrmPacket[]` – is an SL packet that contains a complete or a part of an access unit of the BIFS-Command. The size of `BIFSCommandFrmPacket[]` shall not exceed 8186 bytes.

F.2.4 ClockReferenceStream encapsulation

SL-packetized ClockReferenceStreams shall be transmitted in *Packet Mode* and are therefore packed into an *MSC data group* like any other payload transmitted in *Packet Mode*. In case of FlexMux not being used an `MSC data group data field` shall only contain one SL-packet. This SL-packet or the first FlexMux-packet - if FlexMux is applied - per `MSC data group data field` shall be aligned to the start of the `MSC data group data field`.

Although this might not be a real restriction in practice it should be noticed that an SL-packet or the FlexMux-packets are limited to 8191 bytes.

Access to the ETS 300 401 *MSC data groups* that convey the BIFSCommandDataFields is achieved by the DABStreamMapTable in the InitialOD-DataField or the ODStream-DataField.

F.2.5 Audiovisual stream encapsulation

Representations of audio and visual objects, defined in ISO/IEC 14496-2:1999 and ISO/IEC 14496-3:1999, as well as the BIFS-Anim information, are conveyed in separate elementary streams. The sync layer divides each elementary stream into one or more access units. An access unit may be divided into more than one SL packets. Furthermore, SL packets of different elementary streams may be conveyed through the same ETS 300 401 channel by using FlexMux.

Audio-visual Elementary Streams shall be transmitted in *Stream Mode* due to the synchronous nature of its data rate.

If a packetization of the elementary stream is chosen where the packet length is neither explicitly nor implicitly known (i.e. SL packets) to the receiver an ETS 300 401 Stream Mode sub-channel's *logical frame* shall only contain one packet of an MPEG-4 elementary stream.

In case of using a packetization of the elementary stream where the packet length is explicitly or implicitly known (i.e. SL packets FEC encoded with a fixed packet length or FlexMux packets) to the receiver an ETS 300 401 Stream Mode sub-channel's *logical frame* may contain more than one such packet.

There exist two methods of synchronisation to the packet(s) in a *logical frame* that will be described in the following two sections. The method that is actually used is signalled by the `usePacketStartPointer` flag in the DABStreamMapTable.

F.2.5.1 Synchronisation by use of a PacketStartPointer

If the `usePacketStartPointer` flag is set to '1', the first two bytes of each *logical frame* shall be a PacketStartPointer that contains address (in bits) of the first complete packet in that *logical frame*. I.e., if the first complete packet starts with the first bit following these two first bytes the PacketStartPointer is set to 0x0000.

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F.2.5.2 Synchronisation by packet alignment to logical frames

If the `usePacketStartPointer` flag is set to '0' the first packet of a *logical frame* shall be aligned to that *logical frame*.

F.2.5.3 Framing of SL Packets and FlexMux packets into logical frames

When an SL packet or one or more FlexMux packets do not fit the size of a logical frame (multiples of 24 bytes, see subclause F.2.1.1), stuffing is required. Stuffing for adaptation to *logical frames* shall be performed by use of the fields `paddingFlag` and `paddingBits` in the SL packet header, as defined in ISO/IEC 14496-1:2001, subclause 10.2.4.

F.2.6 ISO/IEC 14496 stream indication in ETS 300 401 Service Information

Signalling of the MPEG-4 elementary streams transmitted in different *MSC* subchannels is performed by means of the *Multiplex Configuration Information (MCI)* and the *Service Information (SI)* that is transmitted in the *Fast Information Channel (FIC)*. Information in the *FIC* is conveyed in *Fast Information Groups (FIG)* which are subdivided into several types and their respective extensions.

ISO/IEC 14496 content is accessed through an InitialObjectDescriptor (InitialOD). For content access, the InitialOD must first be acquired at the receiving terminal as described in ISO/IEC 14496-1:2001, subclause 8.7.3. The InitialOD contains one or more ES_Descriptors with `streamType` of SceneDescriptionStream and `streamType` of ObjectDescriptorStream. These descriptors allow to locate the respective streams using an additional stream map table.

When an ETS 300 401 multiplex contains ISO/IEC 14496 elementary streams, these elementary streams form service components in terms ETS 300 401 and shall be described in the *MCI* and *SI* accordingly. Their stream type shall be signalled in the `Extended Data Service Component Type (ExtDSCTy)` field of the *MCI* that identifies an entry in the service-specific (proprietary) or the general (standardised) *extension table* for service components. Two alternatives described below exist for enabling further access to the MPEG-4 content.

F.2.6.1 Alternative 1 – InitialOD-DataField as the primary service component

All service components carrying MPEG-4 elementary streams are identified by the same general entry (i.e. "MPEG-4") in the `ExtDSCTy` field. The subchannel that carries the InitialOD-DataField through which further access to the whole MPEG-4 content is achieved shall be identified by the `Primary/Secondary (P/S)` flag of the *MCI*. This flag that indicates the primary component of the (MPEG-4) service shall be set to '1' for the service component that carries the InitialOD-DataField and shall be set to '0' for all other components of a service carrying MPEG-4 elementary streams.

F.2.6.2 Alternative 2 – Identification of InitialOD-DataField by DSCTy extension table entry

All service components carrying MPEG-4 elementary streams are identified by different entries in the `ExtDSCTy` field, i.e., one entry respectively for InitialOD-DataField, ODStream-DataField, BIFSCommandDataField, OCR, Audio and Visual Stream. Again, access to the MPEG-4 content can be achieved by the service component carrying the InitialOD-DataField.

F.3 Walkthrough of a typical MPEG-4 session carried in an ETS 300 401 system

F.3.1 General

In any DAB system the MCI (Multiplex Configuration Information) lists the available service in a DAB ensemble (that always corresponds to one DAB multiplex, see ETS 300 401) and links the services and the service components. Due to its frequent retransmission the MCI is always available to a receiver.

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When switching on a DAB receiver it tunes in on a default radio frequency corresponding to a default ensemble. The receiver immediately parses the MCI of that ensemble. It then tunes in a default service of that multiplex after checking whether this default service is available. The receiver furthermore gets a list of other available services by evaluating the MCI. If the default service is an MPEG-4 service the receiver tunes in the channel carrying the IOD-DataField referred to by the MCI and evaluates the InitialOD and the DABStreamMapTable.

The DAB mechanisms that enable the MCI to list the services and link their components is described in section 0 and - more in detail - in ETS 300 401.

F.3.2 Start of a session

Following from the above, an MPEG-4 session is started by selecting the corresponding MPEG-4 service entry from the MCI. This entry will provide the receiver for the necessary link to the channel carrying the InitialOD-DataField.

F.3.3 Retrieval of the InitialOD

After tuning in this channel the receiver will retrieve the InitialObjectDescriptor and the DABStreamMapTable. Whereas the InitialObjectDescriptor will provide more information on the MPEG-4 application and the required elementary streams (i.e. the ObjectDescriptors and the BIFS stream at this stage) the DABStreamMapTable will link the elementary streams' IDs (ES_ID) to the respective DAB transport channel. Links to these channels are given by the DAB Service Component Identifier (SCId) or the Sub-channel Identifier (SubChId) depending on the transmission mode (Stream or Packet mode, see above).

F.3.4 Retrieval of the subsequent BIFS and Object Descriptor streams

Consequently the receiver proceeds by evaluating the InitialOD and the DABStreamMapTable and determines the elementary streams and their location in the DAB multiplex. The receiver then tunes in the respective channels and retrieves the ODStream-DataFields and the CommandDataFields. Whereas the CommandDataField contains the BIFS stream linking all the audio-visual objects into a scene, the ODStream-DataFields contain the ObjectDescriptors for the subsequent elementary streams (i.e. the audio-visual and the clock reference stream(s)) and further DABStreamMapTables. These DABStreamMapTables again link the ES_IDs referred to by the ObjectDescriptors to the elementary stream's DAB transport channel.

F.3.5 Retrieval of the clock reference and the audio-visual streams

Finally the receiver gets the clock reference and the audio-visual streams, all of them being previously announced by ObjectDescriptors in ODStream-DataFields, by evaluating the respective DAB transport channels and MPEG-4 scene composition starts.

F.3.6 Dynamic changes to the scene

Later changes to the scene are enabled by dynamic changes of the MCI if necessary, possibly announcing new service components (i.e. new MPEG-4 objects and their object descriptors along with their transport channel mapping).

F.4 Mapping of DAI procedures to ETS 300 401 procedures

This section describes the mapping of the DAI procedures to the information flow in a DAB system. Note that the *application* as being referred to in the following paragraph as well as the *Local DMIF Layer* and the *Remote (emulated) DMIF Layer* are to be considered as conceptual entities which are all located in the DAB receiver. Hence, procedures and messages described in these subclauses are all internal to a DAB receiver and may differ in their concrete implementation. Nonetheless they are described here in order to clarify the role of the DAI in a DAB systems.

It should be kept in mind that the DAI, being a conceptual interface that separates the delivery-aware from the delivery-unaware part of a system, will be internal as well to a common DAB receiver.

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Note that all steps of the mapping given below refer to Annex B.2: “Information Flows for Broadcast DMIF”.

F.4.1 Initiation of an MPEG-4 service in a DAB system

The following steps describe the implementation of a DA_ServiceAttach() message and the corresponding actions in a DAB system.

Step 1

Starting an MPEG-4 session is always done by passing a DA_ServiceAttach() message via the DAI. Parameters exposed at the DAI include the URL and the uuData structure.

In the DAB case this means tuning a new radio frequency or selecting a new service within the same ensemble. Hence, for DAB the URL[1] maps to a radio frequency (corresponding to a DAB multiplex or ensemble) and the DAB Service Identifier (SId, see ETS 300 401) in this ensemble. The uuData structure might e.g., be represented by IPMP related information as provided by keycards etc.

The value of the serviceSessionId parameter is assigned by the Local DMIF layer. Note however, that for DAB-only receivers, this parameter does not actually carry any real meaning, since one and only one Service Session can be active at any time.

The Remote (emulated) Application module interprets the information contained in the URL and checks whether the corresponding service is available in the broadcast network. If the service is available the Remote (emulated) Application module gets the InititalOD and the DABStreamMapTable from the network.

Step 2

The parameters returned to the application via the DAI include the serviceSessionId and the uuData structure. The latter contains the InitialOD read from the IOD-DataField by the Local DMIF Layer but not the DABStreamMapTable, which is kept by the Local DMIF Instance. As explained above the serviceSessionId does not have to carry any real meaning in a DAB-only system since it is a single Service Session system.

The InitialOD is evaluated by the application providing further information to the user.

F.4.2 Addition of channels in an MPEG-4 service in a DAB system

The following steps describe the implementation of a DA_ChannelAdd() message and the corresponding actions in a DAB system.

Step 1

An ISO/IEC 14496-1:2001 based application may identify the channels it requires by their ES_ID (corresponding to the uuData structure of the DA_ChannelAdd() message) and passes this information via the DAI along with the serviceSessionId. The direction parameter of the DA_ChannelAdd() message maps to DOWNSTREAM whereas QoS information, if present, will be ignored by the Local DMIF Layer.

The Remote (emulated) Application module determines the DAB Service Component Identifier (SCId, see ETS 300 401) or the Sub-channel Identifier (SubChId, see ETS 300 401) corresponding to the requested ES_ID. Determination of these identifiers is done by use of the DABStreamMapTable. The Remote (emulated) Application module then checks the availability of the stream(s). Note that these procedures – as all actions of the Local DMIF Instance - are carried out internally in a DAB receiver.

[1] Note that so far no such URL for DAB has been defined normatively!

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Step 2

The Local DMIF Layer replies to the DA_ChannelAdd(); in case of a positive reply it provides the channel handle that should be used to further refer to this channel, and maintains a map between this channel handle and the DAB Service Component Identifier (SCId, see ETS 300 401) in case of the stream being delivered in Packet mode or to the Sub-channel Identifier (SubChId, see ETS 300 401) in case of the stream being delivered in Stream mode.

Post channel establishment:

Stream control in a DAB system will be implementation dependent. However, indication by the application that it is ready to receive data will of course be performed by referring to a specific channel handle as well as by referring to a data buffer as contained in the DA_UserCommand() message.

F.4.3 Deletion of Channels in an MPEG-4 service in a DAB system

The following steps describe the implementation of a DA_ChannelDelete() message in a DAB system.

Step 1

The application indicates the request for the deletion of a channel by passing the respective channel handles. The DMIF Layer determines the corresponding Service Component Identifier (SCId) or Sub-channel Identifier (SubChId). Reason codes are depending on the actual implementation in a DAB receiver.

After that the DMIF Layer stops passing data on the indicated channels via the DAI.

Step 2

As defined in Annex B.2. Mapping of response codes will be implementation dependent.

F.4.4 Termination of a service in an MPEG-4 service in a DAB system

The following steps describe the implementation of a DA_ServiceDetach() message in a DAB system.

Step 1

As defined in Annex B.2.

Step 2

As defined in Annex B.2. Mapping of response codes will again be implementation dependent.

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Annex G
(informative)

Patent statement

G.1 Patent statement

The user's attention is called to the possibility that, for some of the processes specified in this part of ISO/IEC 14496, conformance with this specification may require use of an invention covered by patent rights.

By publication of this part of ISO/IEC 14496, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. Information regarding such patents can be obtained from the following organisations.

The table summarises the formal patent statements received and indicates the parts of the standard to which the statement applies. (S: Systems, V: Visual, A: Audio, R: Reference Software, D: DMIF) The list includes all organisations that have submitted informal patent statements. However, if no "X" is present, no formal patent statement has yet been received from that organisation.

Table G.1 — Patent statement

		S	V	A	R	D
1.	Apple	x			x	
2.	Alcatel	x	x	x	x	x
3.	AT&T	x	x	x		
4.	BBC	x	x	x	x	x
5.	Bosch	x	x	x	x	x
6.	British Telecommunications	x	x	x	x	x
7.	Canon	x	x	x	x	x
8.	CCETT	x	x	x	x	x
9.	Columbia Innovation Enterprise	x	x	x	x	x
10.	Columbia University	x	x	x	x	x
11.	Creative	x		x	x	
12.	CSELT			x		
13.	DEmoGraFX	x	x	x	x	x
14.	DirecTV	x	x	x		
15.	Dolby	x	x	x	x	x
16.	EPFL	x	x	x	x	
17.	ETRI	x	x	x	x	x
18.	FhG	x	x	x	x	x
19.	France Telecom	x	x	x	x	x
20.	Fraunhofer			x	x	
21.	Fujitsu Limited	x	x	x	x	x
22.	GC Technology Corporation	x	x	x		
23.	General Instrument		x		x	
24.	Hitachi	x	x	x	x	x

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		S	V	A	R	D
25.	Hyundai	x	x	x	x	x
26.	IBM	x	x	x	x	x
27.	Institut für Rundfunktechnik	x	x	x		x
28.	InterTrust					
29.	JVC	x	x	x	x	x
30.	KDD Corporation	x	x			
31.	KPN	x	x	x	x	x
32.	LG Semicon					
33.	Lucent					
34.	Matsushita Electric Industrial Co., Ltd.	x	x	x	x	x
35.	Microsoft	x	x	x	x	x
36.	MIT					
37.	Mitsubishi	x	x	x	x	x
38.	Motorola		x		x	
39.	NEC Corporation	x	x	x	x	x
40.	NHK	x	x	x	x	x
41.	Nokia	x	x	x	x	
42.	NTT	x	x	x	x	x
43.	NTT Mobile Communication Networks			x		
44.	OKI	x	x	x	x	x
45.	Optibase	x			x	
46.	Philips	x	x	x	x	x
47.	PictureTel Corporation		x		x	
48.	Rockwell	x	x	x	x	x
49.	Samsung	x	x	x	x	
50.	Sarnoff	x	x	x	x	x
51.	Scientific Atlanta	x	x	x	x	x
52.	Sharp	x	x	x	x	x
53.	Siemens	x	x	x	x	x
54.	Sony	x	x	x	x	x
55.	Sun	x				
56.	Telenor	x	x	x	x	x
57.	Teltec DCU		x		x	
58.	Texas Instruments					
59.	Thomson	x	x	x	x	x
60.	Toshiba		x			
61.	Unisearch Ltd.		x		x	
62.	Vector Vision		x			

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Annex H
(informative)

ISO/IEC 14496 content carried over an H.324 system

H.1 Introduction

This Annex describes how to manage and deliver an MPEG-4 service inside an H.324 system. It provides a walkthrough of the different aspects when carrying MPEG-4 content over an H.324 system.

Furthermore the DAI procedures are mapped to the information flows in an H.324 systems considering it as a remote interactive DMIF. It is hence also giving an example of one possible implementation of such a remote interactive DMIF, as described in Annex B.1.

H.2 Walkthrough of a typical MPEG-4 session carried in an H.324 system

H.2.1 General

When the connection is established between H.324 Systems, their receiving capabilities are exchanged using H.245 control messages. At this stage, capabilities that can be simultaneously processed are grouped into a set, and multiple sets may be transmitted to show possible alternatives of the terminal.

Capabilities referring to ISO/IEC 14496 functionalities are signaled by **is14496Capability**.

H.324 terminals capable to receive the MPEG-4 Systems send multiple **is14496Capability** as a part of this capability set, which includes ObjectDescriptor capability at least, and includes BIFS capability, Visual capability, and/or Audio Capability according to the terminal's capability.

H.2.2 Start of a session

Following from the above, an MPEG-4 session is started by opening a logical channel with the DataType indicating a streamType of object descriptor (OD) stream. Through this channel, the initial object descriptor (initialOD) is transmitted. There is only one service available per session, so selection of service is not possible.

H.2.3 Retrieval of the InitialOD

The receiver receives the initialOD through this first logical channel.

H.3 Mapping of DAI procedures to H.245 procedures

This section describes the mapping of the DAI procedures to the information flow in a H.324 system.

It should be kept in mind that the DAI could be internal to a H.324 terminal, as it is a conceptual interface that separates the delivery-aware and delivery-unaware parts of a system.

Note that all steps of the mapping given below refer to Annex B.1: "Information Flows for Remote Interactive DMIF".

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H.3.1 Initiation of a service in a Remote Interactive DMIF

In H.324 Systems, DMIF does not support multiple services within a session, and thus the Session Setup and Service Attach procedures at the DNI collapse into a single signaling procedure.

Step 1

As usual.

Step 2

This step is not applied.

Step 3

This step is not applied.

Step 4

This step establishes the physical connection to the remote application and triggers the H.324 setup between the two terminals. The transport of uuData is not supported, and thus is ignored.

Step 5

As usual.

Step 6

As usual.

Step 7

The Target DMIF Instance opens a logical channel with the DataType (in the OpenLogicalChannel message) indicating a streamType of object descriptor (OD) stream selecting an error protection protocol that guarantees error-free transmission. Then the initialOD is transmitted over this logical channel. The initialOD is transmitted as one AL-SDU of the H.223.

Step 8

As usual.

H.3.2 Addition of Channels in a Remote Interactive DMIF

In H.324 Systems, DMIF does not support multiplexing of different elementary streams into a single logical channel, and thus the TransMux Setup and ChannelAdd procedures at the DNI collapse into a single signaling procedure. Moreover, the channel setup using H.245 OpenLogicalChannel Signaling shall be done by the transmitting terminal and this may require a RequestMode message.

H.3.2.1 Addition of Channels by Target DMIF

Step 1

As usual.

The uuData shall always identify the ES_ID, which is therefore extracted.

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Step 2

If the channel for the requested ES_ID is already opened, proceed to step 8.

Otherwise, for each indicated channel the originating DMIF Instance starts the H.245 **RequestMode** signaling indicating the ES_ID.

Step 3

As usual.

Step 4

As usual.

Step 5

The Target DMIF Instance starts the **OpenLogicalChannel** Signaling of H.245 to open the new logical channel, indicating the ES_ID that is delivered through this channel. A **LogicalChannelNumber** is assigned.

Step 6

The Originating DMIF Instance responds to the H.245 **OpenLogicalChannel** Signaling.

Step 7

The Target DMIF Instance responds to the H.245 **RequestMode** Signaling. However, this message can be sent before step 5.

Step 8

As usual.

H.3.2.2 Addition of Channels by Originating DMIF

Step 1

As usual.

The uuData shall always identify the ES_ID, which is therefore extracted.

Step 2

This step is not applied.

Step 3

This step is not applied.

Step 4

If the channel for the requested ES_ID is already opened, proceed to step 8.

Otherwise, for each of the indicated channel(s) the Originating DMIF Instance starts the H.245 **OpenLogicalChannel** Signaling to open the new logical channel, indicating the ES_ID that is delivered through this channel. A **LogicalChannelNumber** is assigned.

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Step 5

As usual.

Step 6

As usual.

Step 7

The Target DMIF Instance responds to the H.245 **OpenLogicalChannel** Signaling.

Step 8

As usual.

H.3.3 Deletion of Channels in a Remote Interactive DMIF

In H.324 Systems, DMIF does not support multiplexing of different elementary streams into a single logical channel, and thus the TransMux Release and ChannelDelete procedures at the DNI collapse into a single signaling procedure. Moreover, the channel closure using H.245 **CloseLogicalChannel** Signaling shall be done by the transmitting terminal and this may require a **CloseLogicalChannelRequest** message.

H.3.3.1 Deletion of Channels by Target DMIF

Step 1

As usual.

Step 2

If the Originating DMIF Instance acts as a transmitter for the indicated channel, it stops the actual delivery of data on the indicated channel(s). For each indicated channel, it starts the H.245 **CloseLogicalChannel** signaling containing the **LogicalChannelNumber** associated with the channelHandle.

If the Originating DMIF Instance acts as a receiver for the indicated channel(s), it forwards the request to the Target DMIF peer for each indicated channel by passing a H.245 **CloseLogicalChannelRequest** Message containing the **LogicalChannelNumber** associated with the channelHandle.

Step 3

As usual.

Step 4

As usual.

Step 5

This step is not applied.

Step 6

This step is not applied.

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Step 7

If the Target DMIF Instance acts as a transmitter, it starts the **CloseLogicalChannel** signaling of H.245 for the indicated logical channel.

Step 8

This step is not applied.

H.3.4 Termination of a Service in a Remote Interactive DMIF

In H.324 Systems, DMIF does not support multiple services within a session, and thus the Session Release and Service Detach procedures at the DNI collapse into a single signaling procedure.

Step 1

As usual.

Step 2

The Originating DMIF Instance starts the **EndSessionCommand** signaling of H.245.

Step 3

As usual.

Step 4

As usual.

Step 5

This step is not applied.

Step 6

As usual

Step 7

This step is not applied.

Step 8

This step is not applied.

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Annex I
(informative)

DMIF Application Programming Interface – Syntax definition

I.1 Objectives of this Annex

This Annex defines the syntax of the DMIF Application Interface, following the semantic specifications given in clause 10 of this part of ISO/IEC 14496. This Annex specifies the syntax for ANSI C/C++ programming language. This ANSI C/C++ syntax declaration is derived directly from this part of ISO/IEC 14496, permitting an accurate evaluation of reference software's semantic adherence to standard.

The definition of a DAI syntax in ANSI C/C++ intends to:

— Provide a clean and clear design, allowing the DMIF separation principle between application and delivery layers.

— Allow verifying conformance with the current ISO/IEC 14496-6 standard.

— Allow having interoperability between Applications (e.g., based on MPEG-4 technology) and delivery mechanisms based on different networking technologies (e.g., IP, broadband, wireless, cable, satellite, etc.). There, to ensure and facilitate interoperability and reusability of application code the definition of a DAI syntax enables this goal.

— Dictate the way the application interoperates with the delivery layer, that is to say, a non-blocking architecture, which is an additional requirement to ensure the aforementioned interoperability.

— Align with the majority of implementations of available MPEG-4 players and servers, as well as, with the rest of the MPEG-4 reference source code. However, the definition of a C/C++ interface does not preclude the definition or use of other platforms such as JAVA.

I.2 DAI protocol flow

The DAI provides two abstract classes for communication between Application (DMIF User) and DMIF instance. The `CDMIFInstance` class is implemented on behalf of the DMIF instance and is therefore used for communication from the Application (DMIF user) to the DMIF instance. The `CDMIFApplication` class is implemented on behalf of the Application (DMIF user) and is therefore used for communication from a DMIF instance to the Application (DMIF user).

These two classes are described in the following sections and act as interface classes. In order to instantiate and release a DMIF instance, a function call is provided as an access point to the library for exchanging the two classes during instantiation. All DMIF information flows are based on the interchange of DAI primitives according to the sequence depicted in Figure I.1.

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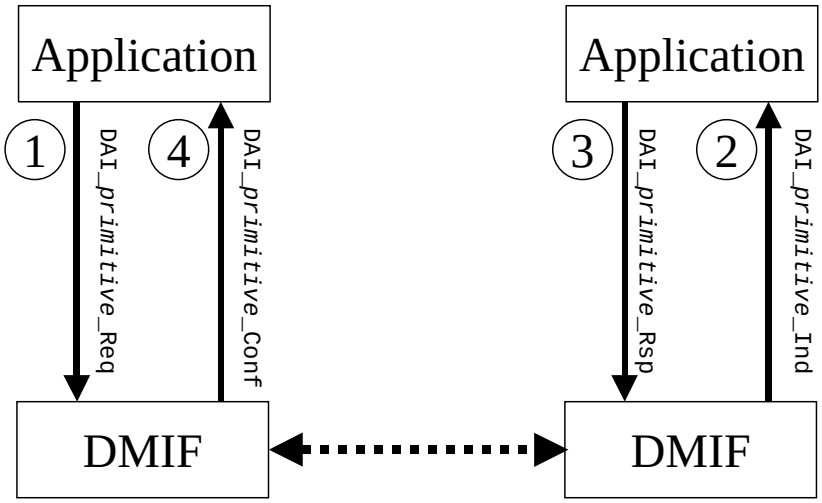

Figure I.1 — DAI primitive sequence in DMIF information flows

Figure I.1 describes one Application (DMIF user) on the originating side (left) and one Application (DMIF user) at the destination side (right). The DMIF instances use DMIF-DMIF-signalling over the network that is out of scope of this Annex.

At the Application side *Requests* and *Responses* are initiated by the Application and consumed by the DMIF instance. These methods are provided by the `CDMIFInstance` class. *Indications* and *Confirmations* are allocated by the DMIF instance and consumed by the Application. These methods are provided by the `CDMIFApplication`.

I.3 Application Programming Interface

I.3.1 DMIF primitives

This section lists the primitives specified for the DMIF Application Interface (DAI), and specifies the parameters used. The "`..._Req`", "`..._Ind`", "`..._Rsp`" and "`..._Cnf`" keywords allow to clearly distinguish between the parameters provided to the other side of the interface and those returned from it. The primitives shall be implemented in such a way that they never block.

I.3.2 CDMIFInstance

This interface class is used for communication from the Application (DMIF user) to the DMIF layer. It provides an abstract view of the methods that the application should call in order to issue a request to DMIF (functions with "`_Req`" extension) or to respond to a DMIF request originated by the peer entity (functions with "`_Rsp`" extension). This interface class defines the methods that an application expects to be available from a DMIF. A `CDMIFInstance` class is the one that implements the DAI methods with "`_Req`" or "`_Rsp`" extension and is implemented in the DMIF. Therefore, in this case the direction of the methods calls is always Application → DMIF Instance.

I.3.3 CDMIFApplication

This interface class is used for communication from the DMIF layer to the Application (DMIF User) layer. It provides an abstract view of the methods that the DMIF calls in order to inform the Application about the confirmation of a requested service (functions with "`_Cnf`" extension) or about services requested by the peer entity (functions with "`_Ind`" extension). This interface class defines the methods that a DMIF expects to be available from the Application. The Application shall define an `CDMIFApplication` interface class and implement the DAI methods with "`_Ind`" or "`_Cnf`" extension. Therefore in this case the direction of the method calls is DMIF → Application.

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I.3.4 Mapping of DAI primitives to DAI Syntax primitives

Table I.1 shows the relationship between DAI primitives and DAI API primitives.

Table I.1 — Mapping DAI primitives – DAI Syntax primitives

Item	DAI Primitives	ISO/IEC 14496-6 reference	DAI API Primitive	Class
1	DA_ServiceAttach (IN)	10.4.1	DAI_Service_Attach_Req	CDMIFInstance
2	DA_ServiceAttach (OUT)	10.4.1	DAI_Service_Attach_Cnf	CDMIFApplication
3	DA_ServiceAttachCallback (IN)	10.4.2	DAI_Service_Attach_Ind	CDMIFApplication
4	DA_ServiceAttachCallback (OUT)	10.4.2	DAI_Service_Attach_Rsp	CDMIFInstance
5	DA_ServiceDetach (IN)	10.4.3	DAI_Service_Detach_Req	CDMIFInstance
6	DA_ServiceDetach (OUT)	10.4.3	DAI_Service_Detach_Cnf	CDMIFApplication
7	DA_ServiceDetachCallback (IN)	10.4.4	DAI_Service_Detach_Ind	CDMIFApplication
8	DA_ServiceDetachCallback (OUT)	10.4.4	DAI_Service_Detach_Rsp	CDMIFInstance
9	DA_ChannelAdd (IN)	10.4.5	DAI_Channel_Add_Req	CDMIFInstance
10	DA_ChannelAdd (OUT)	10.4.5	DAI_Channel_Add_Cnf	CDMIFApplication
11	DA_ChannelAddCallback (IN)	10.4.6	DAI_Channel_Add_Ind	CDMIFApplication
12	DA_ChannelAddCallback (OUT)	10.4.6	DAI_Channel_Add_Rsp	CDMIFInstance
13	DA_ChannelDelete (IN)	10.4.7	DAI_Channel_Delete_Req	CDMIFInstance
14	DA_ChannelDelete (OUT)	10.4.7	DAI_Channel_Delete_Cnf	CDMIFApplication
15	DA_ChannelDeleteCallback (IN)	10.4.8	DAI_Channel_Delete_Ind	CDMIFApplication
16	DA_ChannelDeleteCallback (OUT)	10.4.8	DAI_Channel_Delete_Rsp	CDMIFInstance
17	DA_UserCommand (IN)	10.4.9	DAI_User_Command_Req	CDMIFInstance
18	DA_UserCommandCallback (IN)	10.4.10	DAI_User_Command_Ind	CDMIFApplication
19	DA_Data (IN)	10.4.11	DAI_SendData	CDMIFInstance
20	DA_DataCallback (IN)	10.4.12	DAI_DataReceived	CDMIFApplication
21	DA_UserCommandAck (IN)	10.4.13	DAI_UserCommandAck_Req	CDMIFInstance
22	DA_UserCommandAck (OUT)	10.4.13	DAI_UserCommandAck_Cnf	CDMIFInstance
23	DA_UserCommandAckCallback (IN)	10.4.14	DAI_UserCommandAck_Ind	CDMIFApplication
24	DA_UserCommandAckCallnack (OUT)	10.4.14	DAI_UserCommandAck_Rsp	CDMIFApplication

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I.4 DMIF Application Programming Interface – ANSI C/C++

I.4.1 Reference Implementation

```
#ifndef __MPEG4_DAI_H__
#define __MPEG4_DAI_H__

#ifdef __cplusplus // for C linkage
extern "C"
{
#endif __cplusplus

#ifdef  _DLL_EXPORT
#define FUNC_DECL __declspec(dllexport)
#else
#define FUNC_DECL __declspec(dllimport)
#endif


////////////////////////////////////////////////////////////////////////////
// Common types
////////////////////////////////////////////////////////////////////////////
typedef unsigned char           UCHAR;
typedef unsigned short          USHORT;
typedef unsigned long           ULONG;
typedef int                           INT;
typedef double                        REAL;

typedef INT                           ERROR_CODE;

// opaque types
typedef long                    CHANNEL_ID_HANDLE;
typedef long                    SESSION_ID_HANDLE;
typedef long                    TEMPORARY_ID_HANDLE;

// Global defines
typedef UCHAR                   CHANNEL_DIRECTION;
#define UNSPECIFIED 0x00
#define DOWNSTREAM        0x01
#define UPSTREAM          0x02
#define BIDIRECTIONAL     0x03

typedef USHORT                  REASON_CODE;       //input
typedef USHORT                  RESPONSE_CODE;           //output
typedef INT                     ERROR_CODE;              //function return

////////////////////////////////////////////////////////////////////////////
// Channel related structures
////////////////////////////////////////////////////////////////////////////

// types of Channel parameters

typedef UCHAR                   CHANNEL_TAG_TYPE;

#define CHANNEL_PRIORITY                    0x01

#define CHANNEL_MAX_PDU_SIZE                0x41
#define CHANNEL_AVG_BITRATE                 0x42
```


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```
#define CHANNEL_MAX_BITRATE                  0x43
#define CHANNEL_MAX_DELAY                    0x44
#define CHANNEL_AVG_DELAY                    0x45
#define CHANNEL_LOSS_PROBABILIY        0x46
#define CHANNEL_JITTER_TOLERANCE       0x47

#define CHANNEL_SYNC_GROUP             0x71
#define CHANNEL_SL_CONFIG_HEADER       0x72

//channel structures

typedef struct tagPriority {
      UCHAR priority;
} PriorityRec;

typedef struct tagMaxPDUSize {
      USHORT max_pdu_size;
} MaxPDUSizeRec;

typedef struct tagAvgBitrate {
      ULONG avg_bitrate;
      ULONG window;
} AvgBitrateRec;

typedef struct tagMaxBitrate {
      ULONG max_bitrate;
      ULONG window;
} MaxBitrateRec;

typedef struct tagMaxDelay {
      ULONG max_delay;
      ULONG window;
} MaxDelayRec;

typedef struct tagAvgDelay {
      ULONG avg_delay;
      ULONG window;
} AvgDelayRec;

typedef struct tagLossProbability {
      REAL loss_prob;
      ULONG window;
} LossProbabilityRec;

typedef struct tagJitterTolerance {
      ULONG jitter_tolerance;
      ULONG window;
} JitterToleranceRec;

typedef struct tagSyncGroup {
      USHORT sync_group;
} SyncGroupRec;

typedef struct tagSLConfigHeader {
      USHORT sl_config_len;
      UCHAR *sl_config;
} SLConfigHeaderRec;

typedef struct tagDAI_ChannelElement {
      CHANNEL_TAG_TYPE tag_type;
```

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```
	union {
		PriorityRec  *priority;
		MaxPDUSizeRec *max_pdu_size;
		AvgBitrateRec *avg_bitrate;
		MaxBitrateRec *max_bitrate;
		MaxDelayRec *max_delay;
		AvgDelayRec *avg_delay;
		LossProbabilityRec *loss_prob;
		JitterToleranceRec *jitter_tolerance;
		SyncGroupRec *sync_group;
		SLConfigHeaderRec *sl_config;
	} t;
} DAI_ChannelElement;

typedef struct tagDAI_ChannelDescriptor {
	DAI_ChannelElement *channel_element;
	USHORT num_elements;
} DAI_ChannelDescriptor;

////////////////////////////////////////////////////////////////////////////
// Loop structures
////////////////////////////////////////////////////////////////////////////

//structures for parameter passing:

//DAI_Channel_Add_Req()
typedef struct tagDAI_ChannelAddReqElement {
	TEMPORARY_ID_HANDLE tid;		// temporary id
	DAI_ChannelDescriptor chDescr;   // channel descriptor
	CHANNEL_DIRECTION dir;			// direction
	UCHAR *uuDataInBuffer;			// user data
	USHORT uuDataInLen;			// length of user data
} DAI_ChannelAddReqElement, *DAI_ChannelAddReqLoop;

//DAI_Channel_Add_Cnf()
typedef struct tagDAI_ChannelAddCnfElement {
	TEMPORARY_ID_HANDLE tid;		// temporary id
	RESPONSE_CODE response;		// response
	CHANNEL_ID_HANDLE ch_id;		// channel handle
	UCHAR *uuDataOutBuffer;		// user data
	USHORT uuDataOutLen;			// length of user data
} DAI_ChannelAddCnfElement, *DAI_ChannelAddCnfLoop;

//DAI_Channel_Add_Ind()
typedef struct tagDAI_ChannelAddIndElement {
	CHANNEL_ID_HANDLE ch_id;		// channel handle
	DAI_ChannelDescriptor chDescr;   // channel descriptor
	CHANNEL_DIRECTION dir;			// direction
	UCHAR *uuDataInBuffer;			// user data
	USHORT uuDataInLen;			// length of user data
} DAI_ChannelAddIndElement, *DAI_ChannelAddIndLoop;

//DAI_Channel_Add_Resp()
typedef struct tagDAI_ChannelAddRspElement {
	RESPONSE_CODE response;		// response
	CHANNEL_ID_HANDLE ch_id;		// channel handle
	UCHAR *uuDataOutBuffer;		// user data
	USHORT uuDataOutLen;			// length of user data
} DAI_ChannelAddRspElement, *DAI_ChannelAddRspLoop;
```

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```
//DAI_Channel_Delete_Req()
//DAI_Channel_Delete_Rsp()
//DAI_Channel_Delete_Cnf()
//DAI_Channel_Delete_Ind()
typedef struct tagChannelHandleElement {
       CHANNEL_ID_HANDLE ch_id;         // channel handle
       union {
       REASON_CODE  reason;                          // delete reason (input)
       RESPONSE_CODE response;          // delete result (output)
       } t;
} DAI_ChannelHandleElement, *DAI_ChannelHandleLoop;

//structures for parameter passing for
//DAI_User_Command_Req()
//DAI_User_Command_Ind()
//DAI_User_CommandAck_Req()
//DAI_User_CommandAck_Rsp()
//DAI_User_CommandAck_Cnf()
//DAI_User_CommandAck_Ind()
typedef struct tagUserCommandElement {
       CHANNEL_ID_HANDLE ch_id;         // channel handle
} DAI_UserCommandElement, *DAI_UserCommandLoop;


////////////////////////////////////////////////////////////////////////////
// Other structures
////////////////////////////////////////////////////////////////////////////
typedef struct tagDAI_DMIFOption {
       char *option_name;                    // name of option
       char *option_value;              // stringified option value
} DAI_DMIFOptionRec;



#ifdef __cplusplus //guard class definitions
////////////////////////////////////////////////////////////////////////////
// Definition of DMIF Session Interface
////////////////////////////////////////////////////////////////////////////
class class CDMIFInstance
{
public:

       // Request for creation of a service session with remote peer
       virtual ERROR_CODE DAI_Service_Attach_Req(
              TEMPORARY_ID_HANDLE tid,         // temporary id
              const char *url,                       // URL of peer DMIF service
              const char *uuDataInBuffer,      // pointer to user data to pass
              USHORT uuDataInLen                     // length in chars of user data
              ) = 0;

       // Respond to service attach request from remote peer
       virtual ERROR_CODE DAI_Service_Attach_Rsp (
              RESPONSE_CODE response,          // response from remote peer
              SESSION_ID_HANDLE ss_id,         // session id of service session created
              const UCHAR *uuDataOutBuffer,    // pointer to user data
              USHORT uuDataOutLen              // length in chars of user data
              ) = 0;

       // Request for destruction of a service session
       virtual ERROR_CODE DAI_Service_Detach_Req (
```

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```
 SESSION_ID_HANDLE ss_id,        // id of service session to be detached
       REASON_CODE reason                    // reason for detachment
       ) = 0;

// Respond to a service detach request from remote peer
virtual ERROR_CODE DAI_Service_Detach_Rsp (
       SESSION_ID_HANDLE ss_id,         // id of service session detached
       RESPONSE_CODE response           // response from remote peer
       ) = 0;

// Request to add one or more channels to a session
virtual ERROR_CODE DAI_Channel_Add_Req (
       SESSION_ID_HANDLE ss_id,               // parent session id
       const DAI_ChannelAddReqLoop loop,      // loop of parameters
       USHORT num_elements                    // # of elements in loop
       ) = 0;

// Respond to a channel add request from remote peer
virtual ERROR_CODE DAI_Channel_Add_Rsp (
       SESSION_ID_HANDLE ss_id,               // parent session id
       const DAI_ChannelAddRspLoop loop,      // loop of parameters
       USHORT num_elements                    // # of elements in loop
       ) = 0;

// Request the deletion of an existing channel
virtual ERROR_CODE DAI_Channel_Delete_Req (
       const DAI_ChannelHandleLoop loop,      // loop of parameters
       USHORT num_elements                    // # of elements in loop
       ) = 0;

// Respond to a channel delete request from remote peer
virtual ERROR_CODE DAI_Channel_Delete_Rsp (
       const DAI_ChannelHandleLoop loop,      // loop of parameters
       USHORT num_elements                    // # of elements in loop
       ) = 0;

// Request transmission of a user command to remote peer
virtual ERROR_CODE DAI_User_Command_Req (
       const UCHAR *uuDataInBuffer,           // user data
       USHORT uuDataInLen;,                         // length of user data
       const DAI_UserCommandLoop loop,  // loop of parameters
       USHORT num_elements                    // # of elements in loop
       ) = 0;

// Request transmission of a user command with acknowledgment
// to remote peer
virtual ERROR_CODE DAI_User_CommandAck_Req (
       TEMPORARY_ID_HANDLE tid,               // temporary id
       const UCHAR *uuDataInBuffer,                 // user data;
       USHORT uuDataInLen;,                               // length of user data
       const DAI_UserCommandLoop loop,        // loop of parameters
       USHORT num_elements                          // # of elements in loop
       ) = 0;

// Respond to a user command with acknowledgement request
// from remote peer
virtual ERROR_CODE DAI_User_CommandAck_Rsp (
       TEMPORARY_ID_HANDLE tid,                     // temporary id
       RESPONSE_CODE response,                      // response
       const UCHAR *uuDataOutBuffer,                // user data;
```


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```
            USHORT uuDataInLen;,                                    // length of user data
            const DAI_UserCommandLoop loop,         // loop of parameters
            USHORT num_elements                             // # of elements in loop
            ) = 0;


      // Transmit bulk data to remote peer
      virtual ERROR_CODE DAI_Send_Data(
            CHANNEL_ID_HANDLE ch_id,                        // channel id
            const UCHAR *streamDataBuffer,          // user data
            USHORT streamDataLen                            // length of user data
            ) = 0;
};

////////////////////////////////////////////////////////////////////////
// Definition of DMIF Application Interface
////////////////////////////////////////////////////////////////////////

class CDMIFApplication
{
public:

      // Upcall from DMIF indicating service attach request on remote peer
      virtual void DAI_Service_Attach_Ind(
            SESSION_ID_HANDLE ss_id,                // service session id of new session
            const char *service_name,               // service name of new session
            const UCHAR *uuDataInBuffer,            // pointer to user data
            USHORT uuDataInLen                              // length of user data
            ) = 0;

      // Upcall from DMIF confirming service attach request on local peer
      virtual void DAI_Service_Attach_Cnf(
            TEMPORARY_ID_HANDLE tid,                // temporary id
            SESSION_ID_HANDLE ss_id,                // service session id of new session
            RESPONSE_CODE response,                 // response code
            const UCHAR *uuDataOutBuffer,           // pointer to user data
            USHORT uuDataOutLen                     // length of user data
            ) = 0;

      // Upcall from DMIF indicating service detach request on remote peer
      virtual void DAI_Service_Detach_Ind(
            SESSION_ID_HANDLE ss_id,                // service session id of session session
                                    // to detach
            REASON_CODE reason                              // reason for detachment
            ) = 0;

      // Upcall from DMIF confirming service attach request on local peer
      virtual void DAI_Service_Detach_Cnf(
            SESSION_ID_HANDLE ss_id,                // service session id of
                                    // session detached
            RESPONSE_CODE response                          // response code
            ) = 0;

      // Upcall from DMIF indicating channel add request on remote peer
      virtual void DAI_Channel_Add_Ind(
            SESSION_ID_HANDLE ss_id,                // service session id of parent session
            const DAI_ChannelAddIndLoop loop,       // loop of parameters
            USHORT num_elements                     // # of elements in loop
            ) = 0;
```

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```
      // Upcall from DMIF confirming channel add request on local peer
      virtual void DAI_Channel_Add_Cnf(
            SESSION_ID_HANDLE ss_id,               // service session id of parent session
            const DAI_ChannelAddCnfLoop loop,      // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Upcall from DMIF indicating channel delete request on remote peer
      virtual void DAI_Channel_Delete_Ind(
            const DAI_ChannelHandleLoop loop,      // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Upcall from DMIF confirming channel delete request on local peer
      virtual void DAI_Channel_Delete_Cnf(
            const DAI_ChannelHandleLoop loop,      // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Upcall from DMIF indicating user command request on remote peer
      virtual void DAI_User_Command_Ind(
            const DAI_UserCommandLoop loop,  // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Upcall from DMIF indicating user command request with
   // acknowledgement on remote peer
      virtual void DAI_User_CommandAck_Ind(
            TEMPORARY_ID_HANDLE tid,               // temporary id
            const UCHAR *uuDataInBuffer,           // user data;
            USHORT uuDataInLen,                    // length of user data
            const DAI_UserCommandLoop loop,  // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Upcall from DMIF indicating user command request with with
   // acknowledgement on local peer
      virtual void DAI_User_CommandAck_Cnf(
            TEMPORARY_ID_HANDLE tid,               // temporary id
            RESPONSE_CODE response,                // response code
            const UCHAR *uuDataOutBuffer,          // user data;
            USHORT uuDataOutLen,                        // length of user data
            const DAI_UserCommandLoop loop,  // loop of parameters
            USHORT num_elements                    // # of elements in loop
            ) = 0;

      // Function for data reception
      virtual void DAI_Received_Data(
            CHANNEL_ID_HANDLE ch_id,               // channel handle
            const UCHAR *streamDataBuffer,   // pointer to user data
            USHORT streamDataLen,                       // length of streamDataBuffer
                                    // streamDataBuffer in chars
            UCHAR error_flag                            // error flag
            ) = 0;
};

#else
typedef void *CDMIFInstance;
typedef void *CDMIFApplication;
#endif //__cplusplus guard class definitions
```


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```
////////////////////////////////////////////////////////////////////////////
// Global Initialization Routines //////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////

// Initialize and announce a DMIF service instance
FUNC_DECL CDMIFInstance *Init_DMIF_Instance(
            CDMIFApplication *appInterfacePtr,     // DAI callback
                                                   // interface ptr
            DAI_DMIFOptionRec *options,                  // options for service
            int num_options                                    // number of options
            );

// Terminate, uninitialize and de-announce a DMIF service instance
FUNC_DECL void Close_DMIF_Instance(
            CDMIFInstance *dmifInstancePtr         // pointer to DMIF Instance
            );

// Returns a string explanation of error code
FUNC_DECL char *Get_DMIF_Error_Message(
            int error_code
            );

#ifdef __cplusplus
}
#endif __cplusplus

#endif // __MPEG4_DAI_H__
```

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