Digital Audio-Visual Council

DAVIC 1.2 Specification Part 4

Delivery System Architecture And Interfaces

(Technical Report)

This revision of the DAVIC 1.2 Specification document supersedes all previous versions.

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CONTENTS

FOREWORD

DAVIC

The Digital Audio-Visual Council (DAVIC) is a non-profit Association registered in Geneva. Its purpose is to advance the success of emerging digital audio-visual applications and services, initially of the broadcast and interactive type, by the timely availability of internationally-agreed specifications of open interfaces and protocols that maximise interoperability across countries and applications or services. The DAVIC concept of *Digital Audio-Visual Applications and Services* includes all applications and services in which there is a significant digital audio video component.

The goals of DAVIC are to identify, select, augment, develop and obtain the endorsement by formal standards bodies of specifications of interfaces, protocols and architectures of digital audio-visual applications and services. These are realised through the open international collaboration of all players in the field. DAVIC intends to make the results of such activities available to all interested parties on reasonable terms applied uniformly and openly and to contribute the results of its activities to appropriate formal standards bodies.

DAVIC Membership

Membership of DAVIC is open to any corporation or individual firm, partnership, governmental body or international organisation. DAVIC does not restrict membership on the basis of race, colour, sex, religion or national origin. By joining DAVIC each member agrees—both individually and collectively—to adhere to open competition in the development of digital audio-visual products, technology or services. Associate Member status is usually chosen by those entities, mostly government organisations, who do want to be members of the Council without taking an active role in the precise technical content of specifications.

DAVIC Members are not restricted in any way from designing, developing, marketing or procuring digital audio-visual hardware, software, systems, technology or services. Members are not bound to implement or use specific digital audio-visual standards, recommendations or DAVIC specifications by virtue of their participation in DAVIC.

In September 1996, DAVIC had membership of 219 corporations representing more than 20 countries from all over the world and virtually all business communities with a stake in the emerging field of digital audio-visual applications and services.

The DAVIC 1.2 Specification

This Specification has been developed by participating DAVIC members on the basis of DAVIC 1.0 and DAVIC 1.1 and submissions from both members and non-members in response to Calls For Proposals which were issued in October 1994, March 1995, September 1995, December 1995 and March 1996.

The DAVIC 1.2 Specification is a super-set of DAVIC 1.1 and was frozen in June 1996 in the sense that all multiple choices retained in preceding revisions were reduced to just one solution—either by consensus or, where necessary, by a process of voting within a full meeting of the relevant Technical Committee and subsequent formal approval by the DAVIC General Assembly. Choices were then allowed to be reconsidered before the meeting in December 1996 only where inadequacies or inconsistencies could be demonstrated with other parts of the Specification. The Specification has been openly available on the Internet since June 1996 for the purpose of soliciting comments from all interested parties - both members and non-members - on technical issues pertaining to this version. Comments were considered at the scheduled December 1996 meeting in Hong Kong.

This Specification is a public document. Electronic copies of the document can be obtained from the DAVIC Secretariat or from the DAVIC Website.

Intellectual Property Rights

The DAVIC Technical Committees were instructed to provide, to the best of their knowledge, a complete list of all items of Intellectual Property that are needed for implementation of the DAVIC 1.2 Specification. As a result of this process it was recognised that the ability to exploit Intellectual Property Rights (IPR) will be needed to implement some of the technologies selected by DAVIC for this Specification. As a condition for retaining their technologies, owners of IPR items that are required for implementing a part of the DAVIC specification have been asked to produce a statement of their availability and to either give free use of the patented items, or license on fair and reasonable terms and on a non-discriminatory basis following the IEC/ISO/ITU policy on IPR matters.

Information on such IPR items appears in document DAVIC/280, copy of which can be obtained from the DAVIC Secretariat.
In including an external standard or specification, DAVIC assumes the IEC/ISO/ITU IPR policy has been followed by the entity that produced the standard/specification but DAVIC is not in a position to make any expressed or implied guarantee in this regard.

Interoperability tests

DAVIC has requested its Systems Integration and Interoperability Technical Committee to organise interoperability tests of various implementations of its Specification to confirm interworking of the proposed technologies and protocols. A first interoperability event was held in conjunction with the New York Meeting in June 1996. Other events were held in Tokyo in October 1996 and are planned for Europe in 1997. Some results from interoperability tests conducted during the period September 1995 to September 1996 have already been taken into account in the DAVIC 1.2 Specification.

The DAVIC Website

Much more information which is being continually updated, is available on the Internet at the DAVIC Website at URL http://www.davic.org . The DAVIC Homepage has a brief outline of *What is DAVIC?* and *Latest News.*
There are also hotlinks :-

Introduction to DAVIC	**Membership Information**	**Organisation**
Specifications	**Bulletin Board**	**DAVIC's FAQ's**

Membership Information points to membership guidelines and how to join DAVIC, gives a copy of the Statutes and a current list of members.
Bulletin Board provides recent press releases, Calls for Proposals, the DAVIC Workplan and the meeting schedule.
Organisation describes the structure of DAVIC and the people who populate its committees.
Specifications describes the philosophy of DAVIC's work and offers a directory structure from which the Specifications and Calls for Proposals can be downloaded.
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 DAVIC 1.2 Specification

INTRODUCTION

The DAVIC approach to specifications

The figure below is a very general representation of the type of system addressed by DAVIC specifications. It comprises five entities: the Content Provider System, the Service Provider System and the Service Consumer System; connected by two other entities: a CPS-SPS Delivery System connecting the Content Provider System to the Service Provider System, and a SPS-SCS Delivery System connecting the Service Provider System to the Service Consumer System. In principle, DAVIC specifications can address any subsystem in a similar context.

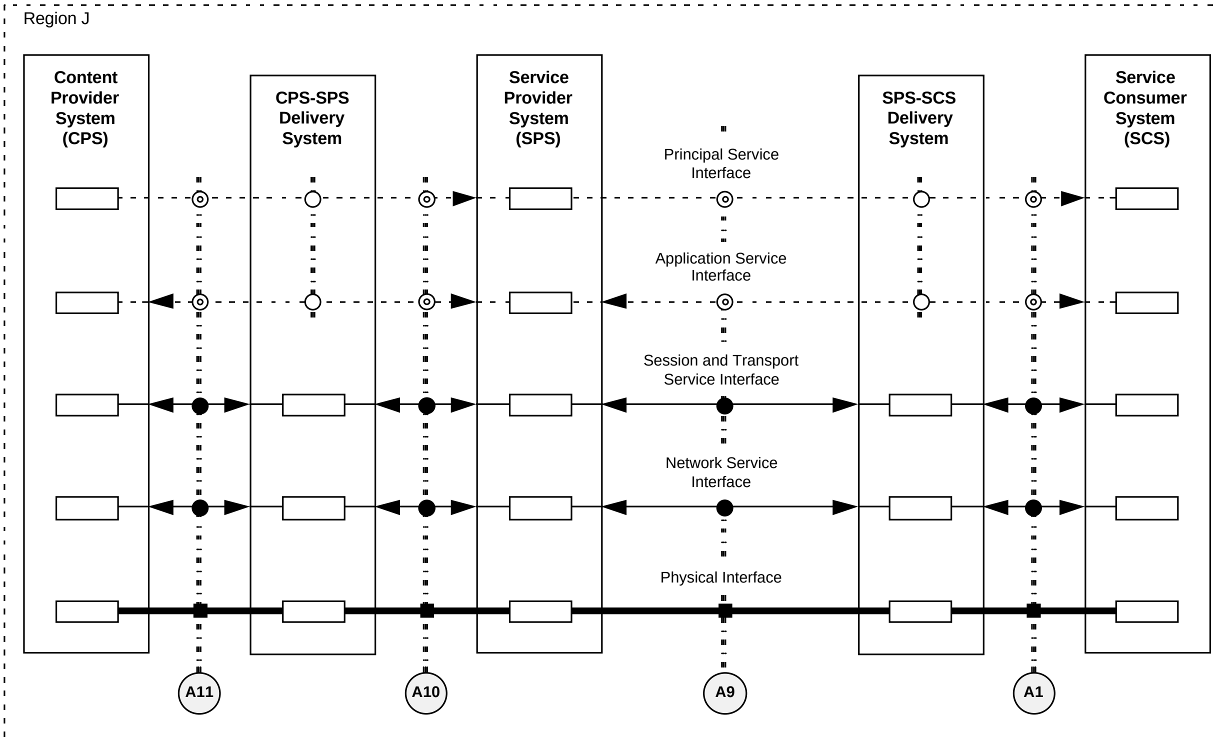

Figure 1. The general DAVIC system

In the analogue world all these systems were independently defined by groupings of companies (*industries*). This was quite natural because of the lack of flexibility of analogue technologies which favoured a tendency to keep services and applications tightly connected to the specific nature of delivery systems. This fact led to multiplication of devices, particularly in the users' domain. The flexibility of digital technologies presents a unique possibility to overcome many of these problems and to realise end-to-end interoperability.

The DAVIC 1.2 Specifications have been developed based on the following guidelines.

1. **Openness of the specification process.** Although only DAVIC members are allowed to take part in DAVIC meetings, the specification development process provides total openness at two critical stages: when a request for technologies is issued, and later when specifications have reached sufficient maturity. Anybody is allowed to submit a response to a Call for Proposals, just as anybody is allowed to propose modifications to specifications which are made publicly available for comments. Of course DAVIC reserved the right to accept or reject a proposed technology or modification.
2. **Specification of "tools"**. DAVIC represents one of the most comprehensive systems integration activities ever undertaken. However, its main added value to the industries it serves comes from its focus and singular identification of tools. Typically the process of tool specification is carried out as follows:

- Analysis of target systems
- Breakdown of systems into components
- Identification of common components across systems
- Specification of all necessary components (tools)
- Verification that tools so defined can be used to assemble the target systems.

Therefore DAVIC-specified tools tend to be non-*system-specific* because they have to be usable by different industries in different systems.

3. **Relocation of tools.** Because DAVIC specifications have to satisfy business and service models of multiple industries, DAVIC tools need not only to be usable in a variety of different systems but also in different parts of the same systems. DAVIC defines its tools in such a way that they can be relocated, whenever this relocation is technically possible and practically meaningful.
4. **One functionality—one tool**. Tools should be unique, a principle sometimes hard to enforce, but compliance to this principle gives substantial benefits in terms of interoperability and availability of technology thanks to the easier achievement of a critical mass because of a wider field of applicability of the technology. Sometimes tools can contain normative improvements to specifications that do not affect backwards compatibility.
5. **DAVIC specifies the minimum**. In the case of specifications developed for a particular purpose in general there is no boundary between what is mandatory and what is added to it because it fits well in the particular application. A multi-industry environment like DAVIC can only produce specifications of tools with the minimum of detail that is needed for interoperability.

Nature of DAVIC specifications

DAVIC specifications contain normative and informative parts. Normative parts have to be implemented as in the specifications in order to claim conformity of a subsystem to DAVIC Specifications. Informative parts are included as well for the purpose of clarifying the normative parts of the specifications and to give general assistance to implementors of specifications.

DAVIC specifications contain the reference model of the DAVIC system and its subsystems. DAVIC specifications also define reference points, i.e., points of particular interest in the system. These points have a normative value if they are accessible. Therefore a digital audio-visual subsystem conforms to DAVIC specifications if its accessible reference points do. This means that a subsystem can be considered as a black box and DAVIC specification conformity is only assessed at the external reference points.

DAVIC specifications define the technical *tools* whose use allows the provision of *functionalities* required by the DAVIC system and the applications that make use of it and with grades that determine the level of performance of a given tool, e.g., mono/stereo/multichannel audio, TV-HDTV, bandwidth of a return channel, etc. Definition of tools may also contain normative extensions that do not affect backwards compatibility.

DAVIC specifications are issued in versions: DAVIC 1.0, DAVIC 1.1, DAVIC 1.2, etc. DAVIC 1.0 which was published in January 1996, selected a set of tools for example which allowed specification of a common interface to most forms of network access, and a convergent view of end-to-end (user/user) signalling, including a download protocol. DAVIC 1.0 aimed to support basic applications such as TV distribution, near video on demand, video on demand and simple forms of teleshopping. DAVIC 1.1 added tools to support basic “Internet Compatibility”, the addition of MMDS and LMDS forms of access, network independent STU’s and STU’s which can behave as a Virtual Machine. Each future version will specify different grades of previously defined tools or more tools in addition to previously specified tools.

DAVIC specifications define only one tool per functionality. However, the exact definition and scope of a tool may change with time depending on the evolution of technology. For instance, at the current state of the art the tools for decoding audio or video at bit rates needed for entertainment-quality moving video require dedicated hard-wired processors. However, with the progress of technology it is quite likely that audio or video decoding at those bit rates will be done by generic processors which are easily reconfigurable under software control to decode a broad class of algorithms.

DAVIC specifications define tools in such a way that they can be relocated in different parts of the DAVIC system whenever this is technically feasible.

DAVIC specifications are developed by making use of the best available technologies or combinations thereof and as far as feasible are validated by technical interoperability tests. Because of the toolkit nature of the specifications, however, no claim can be made as to the suitability of DAVIC specifications or of any of its parts for any intended purpose of a user.
As a rule DAVIC specifications are accompanied by documents specifying methods to test the conformity of reference points to the specifications.

Overview of DAVIC 1.2 Specification

The structure of the DAVIC 1.2 Specification begins with applications, which are of course the driving factor for all players in the audio-visual industry. It then defines some essential vocabulary, and provides an initial Systems Reference Model as the basis for understanding and unifying the parts that follow. Two approaches are subsequently developed:

- Functional blocks and interfaces of the three major components of the audio-visual system (Service Provider System, Delivery System, and Service Consumer System) are described. Content creators and service providers are expected to favour this approach.
- A toolbox of: a) high and mid-layer protocol stacks, modulation, coding, and signalling techniques; and b) a set of protocol walk-throughs, or "*Application Notes*", that rehearse both the steady state and dynamic operation of the system at relevant reference points using specified protocols. Equipment vendors and system designers are expected to find this approach more appropriate to understanding DAVIC specifications.

Two other self-contained parts deal with representation of the audio-visual information and usage information gathering. These parts have more universal relevance to the component documents of the DAVIC 1.2 Specification.

Summary of DAVIC 1.2 Specification parts

Part	*Title*	*Major Sections*
Part 1	**Description of DAVIC Functionalities** (Technical Report)	Functionalities required to support DAVIC Applications Common Requirements of Applications and Services Descriptions of Example Applications
Part 2	**System Reference Models and Scenarios** (Technical Report)	Abstract System Reference Model DAVIC System Reference Model DAVIC System transaction flow scenarios Annexes : Supplementary definitions, Acronyms and abbreviations, Bibliography, Normative references and Interface examples.
Part 3	**Service Provider System Architecture and Interfaces** (Technical Report)	Architecture Service Interfaces Service Elements Networked Server Objects Informative Annexes : Conceptual Server Model, Service Provider Instance, Content Provision and VoD Scenario
Part 4	**Delivery System Architecture And Interfaces** (Technical Report)	The Delivery Systeme Cabled networks Wireless networks Service Architecture Network and service related control Network and service management
Part 5	**Service Consumer System Architecture and High Level API** (Technical Specification)	Service Consumer System (Informative) STU Reference Points Run-time execution environment Annexes - Examples of DSM-CC file structure for an application, of mapping high level API actions on DSM-CC primitives, and of an OSI NSAP address format
Part 6	***Reserved***	
Part 7	**High and Mid-Layer Protocols** (Technical Specification)	S1 Flow : high and mid layer protocols S2 Flow : high and mid layer protocols S3 Flow : high and mid layer protocols S4 Flow : high and mid layer protocols S5 Flow : high and mid layer protocols Common protocols Connection block descriptors and initialisation protocols for A0 STU Dataport Annexes : STU MIB (Management Information Base) and Server MIB

Part	*Title*	*Major Sections*
Part 8	**Lower-Layer Protocols and Physical Interfaces** (Technical Specification)	Tools for digitising the Core network Tools for digitising the Access network :- Low speed symmetrical physical layer interface (PHY) on the PSTN Low speed symmetrical PHY on the ISDN Low speed symmetrical PHY on public land mobile networks Long-range baseband asymmetrical PHY on copper Medium-range baseband asymmetrical PHY on copper Short-range baseband asymmetrical PHY on copper and coax Passband unidirectional PHY on coax Passband bi-directional PHY on coax Passband unidirectional PHY on satellite Passband unidirectional PHY on MMDS Passband PHY on LMDS Baseband symmetrical PHY on copper Baseband symmetrical PHY on fiber Network-Interface-Unit to Set-Top-Unit Interface (A0) STU Dataport Interface
Part 9	**Information Representation** (Technical Specification)	Monomedia components (Character , Text , Language , Service , Telephone Numbers, Compressed & Linear Audio, Compressed Video, Still Pictures, Uncompressed & Compressed Graphics, Compressed Character Data) Monomedia streams Transport of monomedia streams and components Application Format (Interchange Format, MHEG-5 profile , Set of Java API's, and mapping of MHEG Content Classes to monomedia content formats) DAVIC Reference Model for contents decoding Content packaging and Method data Annexes : Coding of linear audio, uncompressed graphics and compressed character data, packetization of monomedia components, stream representation of uncompressed graphics and compressed character data, definition of dsmccuu package, Carriage of private data, Video input format, STU Video decoding capabilities
Part 10	**Basic Security for DAVIC**	Security tools S1 Scrambling S2/S3 Authentication S2/S3 Confidentiality and Integrity S2 Digital Signatures DSM-CC Commands for S1 Security Management Secure Download Parental Control Flows and protocol stacks Security Interfaces : Security Interface CA0 Normative Annexes (profiles/contours, Security Interface CA1, Additional ressources for the DAVIC CA0 interface, Methodology)

DAVIC 1.2 Specification

Part	*Title*	*Major Sections*
Part 11	**Usage Information Protocols** (Technical Specification)	Usage information : - Purpose - Telecommunications Management Network (TMN) Usage Data Functions (Usage Data Generation, Accumulation, Validation, Assembly, Formatting, Correlation Support and Collection Administration) Architecture Usage data collection element DAVIC system manager Usage data collection interface Usage data transfer interface
Part 12	**Reference Points, Interfaces and Dynamics** (Technical Specification)	Requirements for DAVIC Compliant systems Implementation procedure Instance Development Tool DAVIC System dynamic modelling Configuration : Configuration (Boot) STU and Service Provider Configuration Download Specification of the usage of DAVIC protocol tools Annex : Rationale behind the selection of the DAVIC 1.2 specification dynamic systems behaviour
Part 13	**Conformance and Interoperability**	Testing and verification Testing of systems Testing of technology tools Testing of protocols

DAVIC 1.2 Specification

How to use this Specification

It may be helpful to briefly indicate how designers of different parts of the audio-visual system might use the DAVIC 1.2 Specification—a kind of route map to implementors in terms of which parts of the Specification are relevant to their task, and how to proceed. Implementors will typically include Content Providers, Service Providers and Network Operators, and Designers or Manufacturers of servers, set-tops and delivery system components.

1. **Guidance to Content Creators**

   Part 9 defines what the user will eventually see and hear and with what quality.

   Part 5 outlines the actions that can take place with the tools and the kinds of objects and elements of Part 9.

   Part 3 defines how to load an application, once created, onto a server.

   Part 1 gives introductory guidance on what kind of applications are supported by DAVIC 1.2 and identifies the functionalities which must be provided.

   Part 11 relates to formats for the collection of usage data.

2. **Guidance to Service Providers**

   Part 3 is the principal source of information on server architecture. Part 9 defines how information is presented to end-users. Together, these two parts define the *core* DAVIC services that determine what the user actually sees and hears. Part 3 also gives guidance on the protocols in Part 7, transmitted from the set-top user to the server, used to control the set-up and execution of a selected application.

   Usage data collected as defined in Part 11 can be used for billing, and other business-related operations such as customer profile maintenance.

   Part 8 specifies the delivery system requirements for the server with relevant information in Part 4.

3. **Guidance to implementors of sub-systems**

   A digital audio-visual subsystem conforms to DAVIC specifications if its accessible reference points do. Purchasers or designers/manufacturers of set-tops, servers, delivery systems, etc., seeking to be sure of, or to claim compliance to the DAVIC 1.2 Specification, can therefore check against the appropriate reference point(s) A1, A4, A9, or A10 defined in Parts 7 and 8.

   Instantiations of the protocols specified in Part 12 may also illustrate the detailed conformance required in order that a given sub-system will correctly reflect the characteristics of the rest of the DAVIC system at each relevant reference point.

   Parts 5, 3, and 4, respectively, define the requirements for set-top, server and delivery-system architectures, and provide frameworks for the *toolbox* of all protocols listed in Parts 7 and 8.

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Delivery System Architecture And Interfaces

1. Scope

DAVIC 1.2 of this Specification gives an overview of Delivery that are specified to carry DAVIC services. The general rule has been adopted to give descriptions related to the wide DAVIC scope followed by the indication of the cases taken into consideration by **DAVIC 1.2**. The Delivery includes a Core, an Access, Network and Network Management. Figure 1–1 is taken from Part 2 (Figure 7.4) and shows a reference model of a cabled Delivery where a clear distinction is made between external (A1 and A9) and internal reference points and interfaces. The external reference are necessary to be specified for end to end interoperability: Service Provider to Delivery to Service Consumer Systems. The other reference shown are not necessarily to be specified from an operators point of view if it runs the whole Delivery System. The above limitation of interfaces specification, however, is not enough for world wide interoperability because of the necessity of many operators involved in delivery, between which specified interfaces must be implemented.

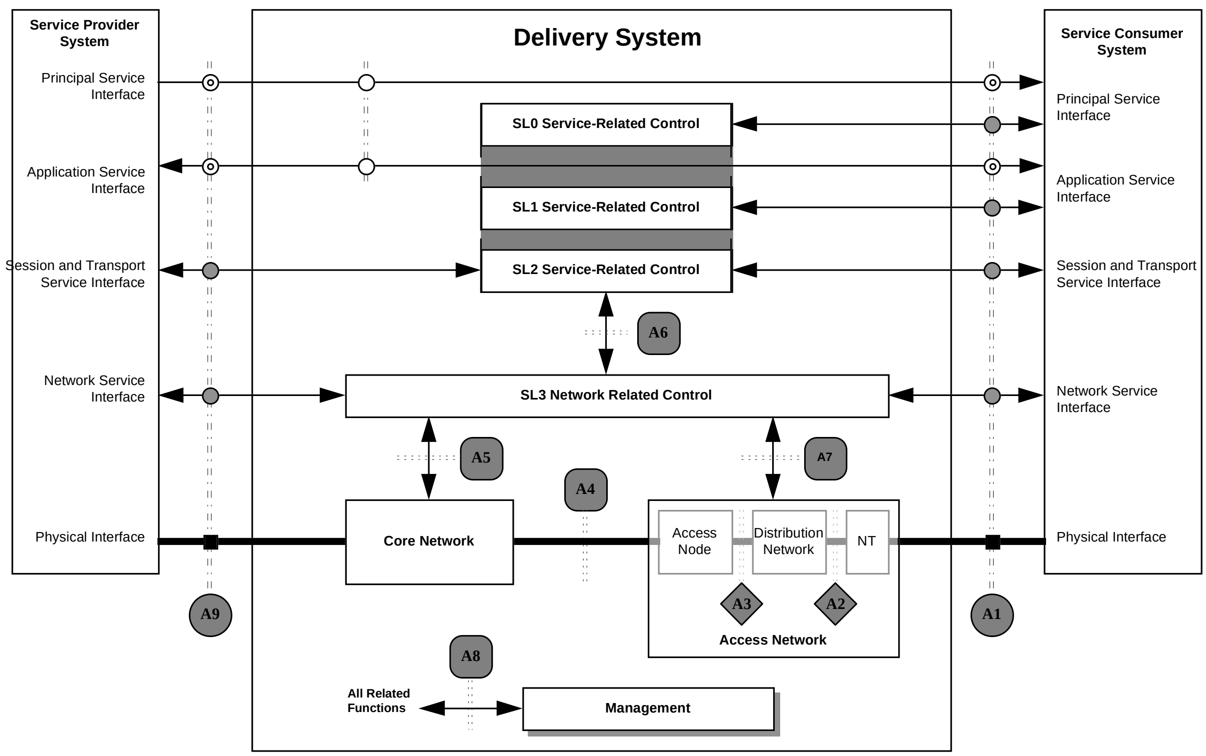

Figure 1–1. Delivery System Control Plane model

2. Normative references

The following documents contain provisions which through reference in this text, constitute provisions of this Specification. At the time of publication, the editions indicated were valid. All referenced documents are subject to revision, and parties to agreements based on this Specification are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The

Telecommunication Standardization Bureau (TSB) maintains a list of currently valid ITU-T Recommendations.

- ANSI Standard T1.413 *Network and Customer Installation Interface - Asymmetric Digital Subscriber Line (ADSL) - Metallic Interface* (ANSI T1E1.4/95-007R2 pre-publication text)
- DTR/SPS-03040: *Signaling Protocols and Switching V interfaces at the digital Service Node (SN); Identification of the applicability of existing protocol specifications for a VB5 interface in an access arrangement with Access*, version 1.1, 22–03–95
- DE/SPS-03046: *V interfaces at the digital Service Node (SN), interfaces at the VB5.1 reference for the support of broadband or combined narrowband and broadband Access.*
- DE/SPS-03047: *V interfaces at the digital Service Node (SN), interfaces at the VB5.2 reference for the support of broadband or combined narrowband and broadband Access.*
- RFC 1157: M. Schoffstall, M. Fedor, J. Davin, J. Case, *A Simple Network Management Protocol (SNMP)*, 05/10/1990
- ITU-T Recommendation M.3010, *Principles for a Telecommunication Management Network*, published October, 1992 (CMIP)
- ITU-T Recommendation H.220.0 (1995) | ISO/IEC 13818-1: 1995, *Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems* (MPEG-2)

3. Definitions

This Section defines new terms, and the intended meaning of certain common terms used in this Specification. Part 02 Annex defines additional terms and, in some cases, alternative interpretations that are appropriate in other contexts. The definitions in the annex were derived from various sources: some are direct quotes, others have been modified.

Supplementary in Part 02 Annex are not normative and are provided for reference purposes only. (For convenience, copies of the normative definitions below are included in the annex.)

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

Access Network**:** a part of the Delivery consisting of a collection of equipment and infrastructures, that link a number of Service Consumer Systems to the rest of the Delivery through a single (or a limited number of) common port(s).

Access Node**:** The element of the Access Network containing centralized functions responsible for processing information flows in preparation for transport through the selected distribution network.

Core Network**:** a portion of the Delivery composed of networks, systems, equipment and infrastructures, connecting the Service Providers to the Access Networks.
NOTE: The term Core Network, in the DAVIC use, is *wide sense* as it includes the notion of the access networks that are needed to link the Service Providers Systems to the core network in strict sense (i.e., exclusive of any access network). This kind of access networks are not under consideration within DAVIC.

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

Distribution Network: a collection of equipment and infrastructures that delivers information flows from the Access Node to the Network Termination elements of the Access Network.

interface: a point of demarcation between two blocks through which information flows from one block to the other. See logical and physical interface definitions for further details. A DAVIC interface may be physical-interface or a logical-interface.

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

Network Interface Unit (NIU): The NIU accepts network specific content-information flows from the Delivery and provides a non-network specific interface to the Connectivity Entity in the STU. (additional definitions of the NIU may exist)

Network Related Control: The Network Related Control entity provides control functions for network configuration, connection establishment and termination and information routing in a network instance of a Delivery.

Network Termination (NT): the element of the Access Network performing the connection between the infrastructure owned by the Access Network operator and the Service Consumer System (ownership decoupling). The NT can be passive or active, transparent or not.

physical interface: An interface where the physical characteristics of signals used to represent information and the physical characteristics of channels used to carry the signals are defined. A physical interface is an external interface. It is fully defined by its physical and electrical characteristics. Logical information flows map to signal flows that pass through physical interfaces.

reference point: a set of interfaces between any two related blocks through which information flows from one block to the other. A reference point comprises one or more logical (non-physical) information-transfer interfaces, *and* one or more physical signal-transfer interfaces.

Service Related Control: an entity that provides all control functions for the services that are offered by a network instance of the Delivery. The DSRM allows for SL0, SL1 and SL2 Service Related Control subsets.

Telecommunications Management Network (TMN): A telecommunications management network provides the means used to transport and process information related to the management functions for telecommunication network.

4. Acronyms and abbreviations

Part 2 Annex, B and C contain a complete set of acronyms and abbreviations used throughout the **DAVIC 1.2** Specification. The following acronyms and abbreviations are used in this Specification:

ADSL	Asymmetric Digital Subscriber Line
AN	Access
ATM	Asynchronous Transfer Mode
BCC	Bearer Channel Connection
BCU	Broadcast Control Unit
CATV	Community Antenna TV

CMIP	Common Management Information Protocol
CPS	Content Provider System
FTTB	Fiber to the Building
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
HFC	Hybrid Fiber Coax
ISDN	Integrated Services Digital Network
IWU	Interworking Unit
LAN	Local Area Network
LE	Local Exchange
LMDS	Local Multipoint Distribution System
MAC	Medium Access Control
MIB	Management Information Base
MMDS	Multi-channel Multipoint Distribution System
MOD	Movies on Demand
MPEG	Moving Pictures Expert Group
MPEG-TS	MPEG-Transport Stream
NIU	Network
NMS	Network Management System
NOD	Network Ownership Decoupling
NRC	Network
NT	Network
OAM	Operation, Administration and Maintenance
ONU	Optical Network Unit
PLMN	Public Land Mobile Network
PON	Passive Optical Network
PSTN	Public Switched Telephony Network
QoS	Quality of Service
RU	Replicator Unit
SCS	Server Provider
SNMP	Simple Network Management Protocol
SPS	Service Provider System
SRC	Service
STB	Set Top Box
STU	Set Top Unit
TMN	Telecommunication Management Network
TTD	Transmission Technology Decoupling
UNI	User Network Interface
UPI	User Premises Interface
VC	Virtual Channel
VCI	Virtual Channel Identifier
VDSL	Very high bit rate Digital Subscriber Line
VP	Virtual Path
VPI	Virtual Path Identifier

5. Conventions

The style of this Specification follows the general guidelines of ISO/IEC 0001: 1993: Information Technology Rules For Presentation Of ITU-T | ISO/IEC Common Text.

6. The Delivery System

Within DAVIC the term 'Delivery System' has a very broad meaning. It refers to virtually any means to deliver information from one entity to another entity in order to support services defined by DAVIC. Entities involved are, among others, Content Provider Systems (CPS), Service Provider Systems (SPS) and, of course, Service Consumer Systems (SCS). Figure 6–1 depicts the general DAVIC model showing how the various entities are connected to the Delivery System and through which reference points. Service Providers can download content from the Content Providers and offer this content to End-Consumers.

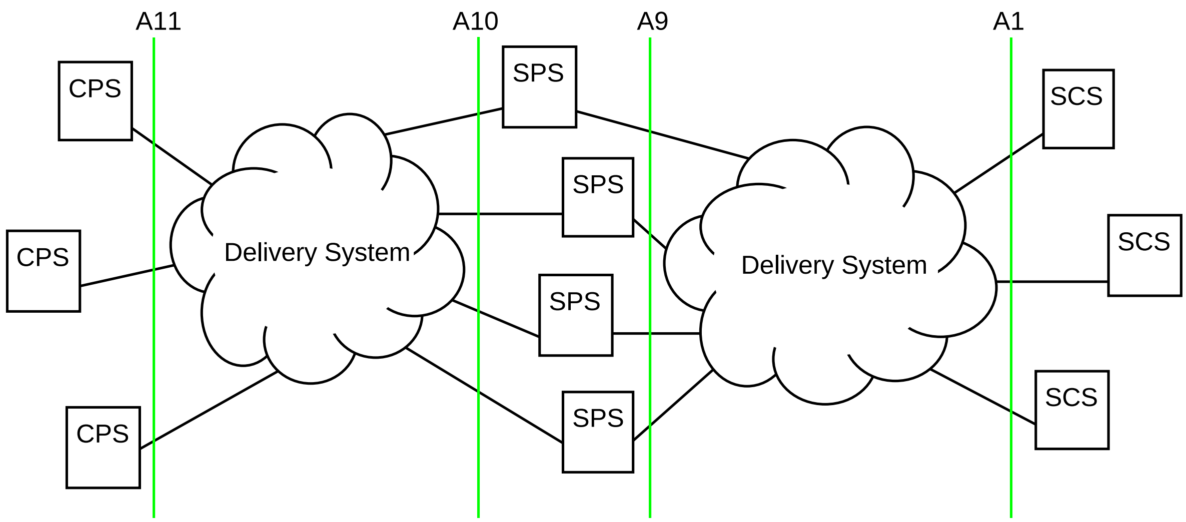

Figure 6–1. General DAVIC model with communication entities, Delivery System and reference points.

For **DAVIC 1.2** only the Delivery System between reference A1 and A9 is considered. This Delivery System is essential to bring the services offered by the Service Provider to the End-Consumers. In future versions of the DAVIC specifications, the Delivery System between the reference points A10 and A11 will be specified as well to ensure easy transfer of content between the Content Providers and the Service Providers.

The Delivery System may consist of several Delivery System domains owned by different network operators. At the boundaries of these domains a new reference may have to be defined in order to guarantee interoperability between Delivery System domains and to ensure end-to-end interoperability. For DAVIC 1.0 no such reference has been defined.

6.1 Definition and classification

The main purpose of a Delivery is to transfer information between Delivery users. Delivery refer to virtually any mean and medium to transfer information. Types of Delivery Systems range from tapes and discs, via telecommunication networks to satellite broadcast systems.

Depending on the type of Delivery used, network and management functions are required to enable the Service Provider to offer a reliable and high quality service to the End Consumers.

Figure 6–2 shows a classification of Delivery considered by DAVIC.

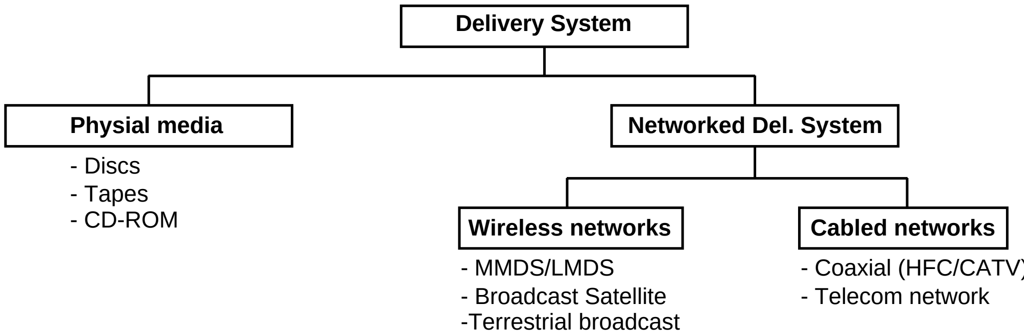

Figure 6–2. Classification of Delivery Systems.

The main distinction in Delivery is between networked Delivery and non-networked Delivery. The latter consists of local storage physical media like discs, tapes and CD-ROMS. This type of Delivery is not specified in **DAVIC 1.2** and is left for future versions of the DAVIC specifications.

Networked Delivery can be split into wireless and cabled.

Wireless do not use wired physical media to transport signals to the End Users. Wireless networks include among others one-way systems such as MMDS, two-way systems like LMDS, direct broadcast satellite and terrestrial broadcasting systems.Cabled networks use physical cables and media to transport signals to the End Users. Examples of cabled are telecommunication networks and cable operator networks.

The general architectures for cabled and wireless will be described below. More detailed descriptions follow in the subsequent clauses.

6.2 Cabled

The general architecture of a cabled network is shown in Figure 6–3. A cabled network Delivery System is split into a Core, an Access and an in-house network. The separation between the Core and the Access is formed between the Local Exchange (LE) and the Access (AN). The separation between the Access and the in-house network is formed by the Network (NT). DAVIC considers the Access and the Network Termination to be part of the Access.

Besides the reference A1 and A9 (corresponding to MACROBUTTON HtmlResAnchor Figure 6–1), other reference are shown as well: A0, A1*, A2, A3 and A4. These reference separate the various system entities.

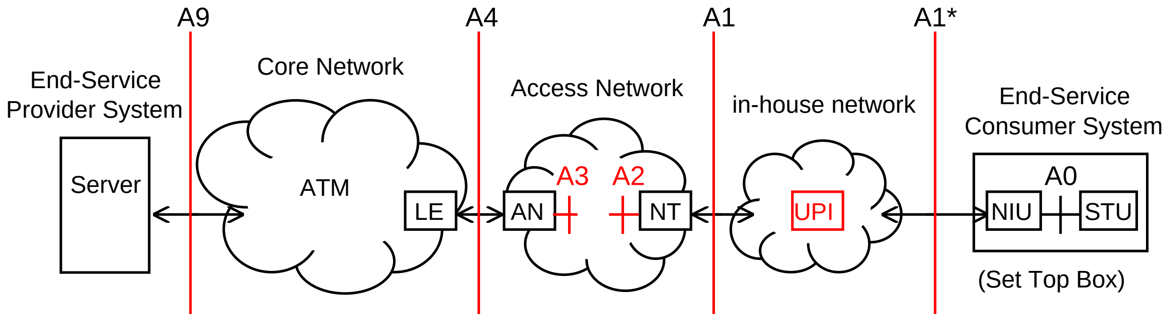

Figure 6–3. Architecture of a cabled network including reference points.

Generally the End-Service contains a Set Top Box (STB) that can be divided into two parts, a network independent part called the Set Top Unit (STU) and a network dependent part called the Network (NIU). In between, a reference A0 is defined that forms the separation between the network independent part and the network dependent part.

The in-house network exists between the NT and the Set Top Box. Reference A1 is defined at the in-house network side of the NT. For **DAVIC 1.2** the STB is connected directly to the NT, therefore the interfaces and protocols at the NIU has to comply to A1. However, it is foreseen that future versions of DAVIC specifications may contain specific in-house networks such as in house LANs, Home Bus, or switched in-house networks. The User Premises Interface (UPI) has been defined as a place holder for these types of in-house networks. As a consequence of introducing a UPI a new reference A1* is introduced. For **DAVIC 1.2** A1 and A1* are identical. However, in future versions of the DAVIC specifications A1* may be a superset of A1 incorporating new in-house network architectures.

The reference A1 is defined between the Access and the End Consumer in-house network. In case of a passive NT, the reference A2 and A1 are identical. Due to possible and optional active components inside the Access, A2 and A3 may differ. At the other side of the Access reference A4 is defined between the Access and the Local Exchange (LE). The Access takes the signals from the Core and makes adaptations for transport in the Access.

The Local Exchange is the first switching unit seen from the customer premises site. The local exchange belongs to the Core. The Core contains network functions to establish, maintain and tear down connections and sessions. Moreover, the Core provides network management functions.

6.3 Wireless

Wireless like MMDS, LMDS, direct broadcast satellite and terrestrial broadcast networks are, in the downstream direction, distributive in nature. To provide interactive services in wireless either a return path has to be defined for this network or a separate network is required to act as a return path. In the first case the architecture shown in MACROBUTTON HtmlResAnchor Figure 6–3 is applicable. This architecture is valid for bi-directional MMDS and LMDS. Figure 6–4 shows the architecture for wireless requiring a separate return path network for interactivity. Examples are uni-directional MMDS and satellite.

Figure 6–4 shows a satellite as an example of a wireless Delivery requiring a separate network as return path. In the downstream direction (from Service Provider to End Consumer) the Service Provider, or rather the distribution source, transmits its broadcast signals via a core to an uplink transmitter in case of a satellite. The Core between the broadcast server and the uplink transmitter can range from a single wire to a fully fledged switched Core. In the latter case an ATM Core is recommended to comply with the cabled Core. The uplink transmitter sends the signals to the satellite. The satellite broadcasts the signals in a wide geographical area where the signals are picked up by satellite dishes owned by the End-Service Consumers. The signals are offered to the Set Top Box to be displayed on a TV or computer.

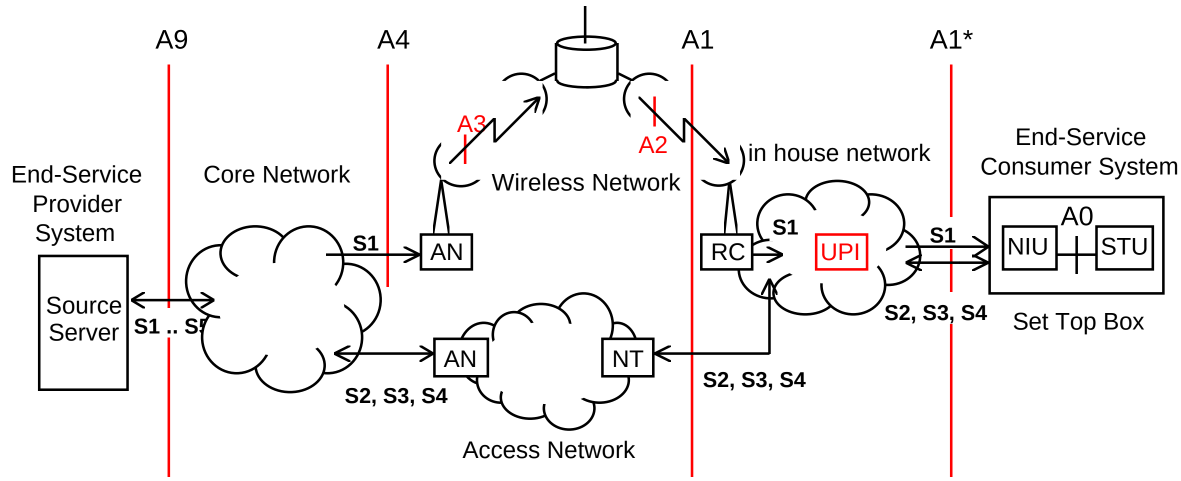

Figure 6–4. Architecture of a hertzian network including reference points.

To allow interactivity (e.g. for enhanced services) a return path network is required. The flows to be carried across the return path network depends on the actual service. In any case the application control flow (S2) and connection control flow (S4) have to be carried, while session control (S3) and management information (S5) may be carried depending on the application.

As in the cabled network model, the return path signals pass an Access and a Core before they arrive at the Service Provider System. The return path network could be the same, a different one or partly different from the Core used for downstream transmission.

7. Cabled networks

7.1 Core

7.1.1 Definition

The Core provides switched connections from and to Content Provider Systems, Service Provider Systems (servers and brokers) and, via an Access, to End Consumer Systems. The Core can be as small as one switch or may extend to a world-wide network.

7.1.2 Functions

It is not the intention of DAVIC to define any particular architecture for the Core. However, DAVIC expects the following functions to be provided by the Core:

- Reliable transfer of information between entities like Content Provider Systems, Service Provider Systems and Access. The Access takes care of the distribution to the End Consumers.
- Switching functionality to provide connections between entities.
- Network functions for addressing and to establish and release connections. The Network functions are described in clause 10 of this document.
- Network Management functions for network configurations, performance and fault monitoring, billing and accounting purposes. Network Management is described in clause 11 of this document.

Within DAVIC it is assumed that the multiplexing and switching technique in the Core is ATM. ATM allows to establish connections of virtually any bit rate up to the maximum capacity of the transmission links. ATM does not impose any restrictions on the topology of the Core.

According to the reference model shown in MACROBUTTON HtmlResAnchor Figure 1–1, taken from Part 2, the server is connected directly to the Core. This implies that the server has only ATM interfaces.

7.2 Access

7.2.1 Definition

The Access is defined as a collection of equipment and infrastructures performing the following functions:

- Transmission, multiplexing, concentration and broadcasting of service/application information flows between the end users of a given area and the rest of the Delivery System (Core and servers),
- Relevant control and management functions,
- Transport of other services (telephony, analogue TV, N-ISDN services, etc.) .

The Access consists of the Access (AN), the Network (NT) and the Distribution in between them, see Figure 7–1. The Access may have multiplexing and cross-connecting functionality but has no switching functionality.

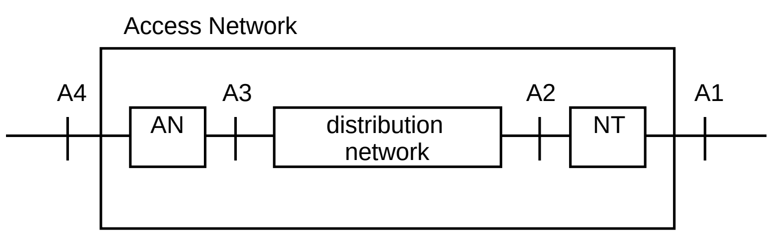

Figure 7–1. The generic model of the Access Network.

With respect to the Access **DAVIC 1.2** is only concerned with the interfaces and protocols at the A4 and A1 reference, i.e., at the edges of the Access. Reference A2 and A3 are considered less critical and are left to future versions of the DAVIC specifications.

7.2.1.1 The Access

The Access performs the adaptation between the Core and the Access. It processes the information flows such that they can be transported through the selected distribution network.

7.2.1.2 The distribution

The distribution takes care of the actual transport of signals from the Core to the customers premises. The distribution may take various topologies, e.g., point-to-point star topology or a shared bus architecture. Also the transmission medium and transmission protocols may change inside the distribution. In this case interfaces and signals may differ at reference A2 and A3.

7.2.1.3 The Network

The primary function of the Network is to form a legal separation between the Access Network owned by the network operator and the in-house network owned by the End Consumer. This function is called the Network Ownership Decoupling (NOD). The NOD function can be as simple as a wall socket, as long as there is a visible point where the ownership changes. There is always an NT having at least the NOD function.

Besides Network Ownership Decoupling, the NT may have another function. It may terminate the medium and transmission technology used in the Access and adapt the signals to a different medium with a different transmission technology in the customer premises. This function is called the Transmission Technology Decoupling (TTD) function. For example in case of a fibre Access, the fibre may be terminated in the NT and the signals may be taken from the fibre and put on coaxial cable or twisted pair wires in the home.

If required, in addition the NT may bear operation and maintenance functions, e.g., measurements functions to facilitate the network operator to check and monitor the quality of the Access.

Depending upon the type of functions inside the NT, two types of NTs can be discerned:

- Passive NT
- Active NT

The passive NT bears the NOD function and maybe some passive adaptation to the in-house network, e.g., passive filters. The active NT bears the NOD function and may have active components to adapt, convert and change the medium and transmission technology from the Access to the in-house network.

The distinction between a passive NT and an active NT is essential since **DAVIC 1.2** specifies the interfaces and protocols at the A1 reference. In the case of a passive NT, the medium and protocols at A2 and A1 are equal. This means that the actual medium and protocols used in the distribution have to be specified. In the case of an active NT, the medium and protocols at reference A2 and A1 may differ. Since only A1 needs to be specified, the actual topology, medium and transmission protocols used in the distribution are not relevant for an Access Network with an active NT.

7.2.2 Classification of Access architectures

Access can be classified in many ways. Access can be classified for example according to the medium that is used or the topology of the Access. Another distinction can be made based on whether the NT is a passive or an active element.

The classification used in this Part is shown in Figure 7–2. The first distinction is made whether the NT is active or passive. In case of an active NT, the Access is terminated before the A1 reference point. In that case the actual type of Access is not relevant, it could be e.g. FTTH, FTTC, HFC, as long as at reference A1 a DAVIC compliant protocol stack is present.

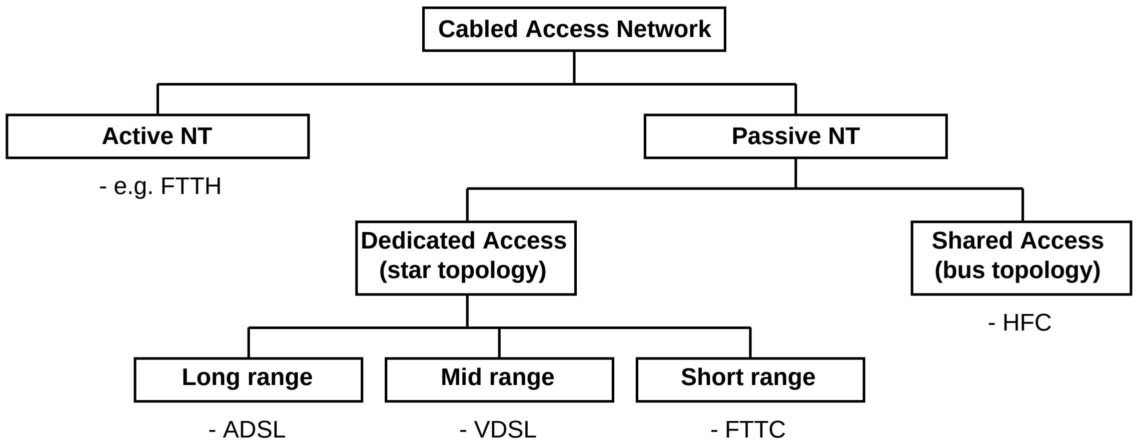

Figure 7–2. Classification of cabled Access Networks..

In the case of a passive NT, a further distinction can be made whether the End Consumers share the medium in the Access or not. A 'shared access' Access has typically a bus topology. An HFC network is an example of an Access where several End Consumers share the medium.

The alternative is that each End Consumer has its own 'dedicated access' to the Access. A 'dedicated access' Access has typically a star topology towards each End Consumer. However, it is not precluded that within the End Consumer premises a shared bus topology exists.

The 'dedicated access' Access can be further subdivided into a long range, a mid range and a short range with respect to the last copper drop (twisted pair or coax). An example of a long range 'dedicated access' Access is an ADSL Access. An example of a mid range 'dedicated access' Access is a VDSL Access. An example of a short range 'dedicated access' Access is a FTTC Access.

The various types of Access are described in more detail in the subclauses below.

7.2.2.1 ADSL copper Access

In a copper Access special techniques are required to upgrade the copper plant to support the high bit rates required for services specified by DAVIC. One method to upgrade the copper Access Network is to use Asymmetric Digital Subscriber Line (ADSL). ADSL is typically used to cross long range distances between 1500 metres and 5000 metres.

ADSL modems provide an asymmetrical digital bit pipe, with a high bit rate channel towards the customer and a low bit rate channel from the customer towards the network. ADSL allows bit rates ranging from 2 Mbit/s for 5 km loops up to 7 Mbit/s for shorter loops from the network to the customer. In the upstream direction (from customer to the network) the typical capacity ranges up to 640 kbit/s.

ADSL offers a point-to-point architecture between a central office ADSL modem located in the Access Node, and the subscriber ADSL modem located at the End Consumers premises. Figure 7–3 shows an ADSL Access with a passive NT.

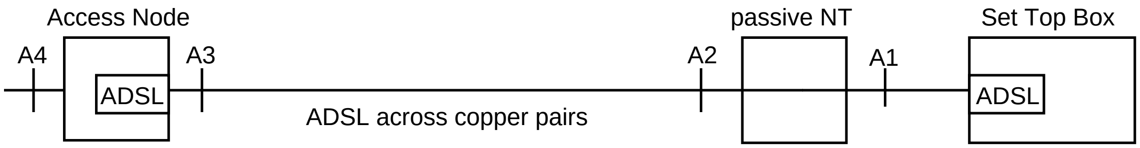

Figure 7–3. Example of an ADSL Access Network with a passive NT.

In the case of a passive NT the medium and the protocols at reference A1, A2 and A3 are equal. In this scenario ADSL has to be specified since these signals are crossing the A1 reference. Refer to Part 8 for the **DAVIC 1.2** physical.

ADSL is specified in ANSI standard T1.413; see Part 8, clause 7.3 for more details. Work is ongoing in ETSI and the ADSL Forum especially in the area of a transmission convergence layer for ATM over ADSL.

7.2.2.2 VDSL copper Access

For medium range copper loops (in the range of 300 metres to 1500 metres) Very high bit rate Digital Subscriber Loop (VDSL) modems can be used. Due to the shorter range compared with ADSL, VDSL allows higher bit rates in up- and downstream direction. Bit rates from 10 Mbit/s to 52 Mbit/s are being considered as are both asymmetrical and symmetrical systems considered.

Figure 7–4 shows an example of a VDSL Access. The topology of a VDSL architecture is expected to be point-to-point. Since VDSL spans only a medium range, the location of the VDSL modems will typically be in a box between the Access and the Network, e.g. in a Optical Network Unit (ONU).

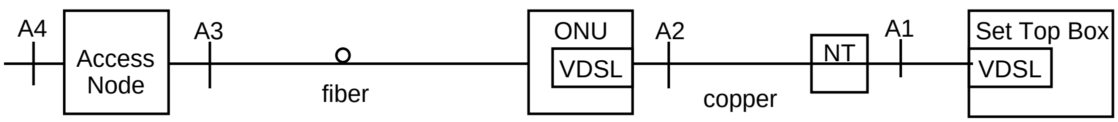

Figure 7–4. Example of an VDSL Access Network with a passive NT.

Work on VDSL has been started by ANSI and ETSI, refer to contributions and documents in these bodies for the status of this work.

7.2.2.3 FTTC Access

The FTTC architecture consists of fibre in the Access up to a curb unit called the Optical Network Unit (ONU), typically located somewhere in a street/curb (FTTC) or in a large building (FTTB) serving some tens of subscribers. The last drop, typically in the order of 300 metres, to the subscribers makes use of coaxial cable or twisted pairs. Each customer is connected with it own twisted pairs or coaxial cable to the ONU, i.e., customers do not share the capacity on the medium in the last drop. Special modulation techniques are required in the twisted pair or coaxial part to allow a high bit rate towards the subscriber.

Figure 7–5 shows an example of a FTTC network with fibre between the Access and the ONUs inside in the Access. The ONU is located at the curb where optical to electrical conversion takes place and where the signals are made suitable for the twisted pair or coax in the last drop. Figure 7–5 shows a

FTTC Access with passive NTs. For an active NT Access scenario, refer to clause MACROBUTTON HtmlResAnchor 7.2.2.5.

Because the NT is passive, the medium and the signals at reference A1 and A2 are identical. However, reference A3 differs since it contains optical signals rather than electrical signals.

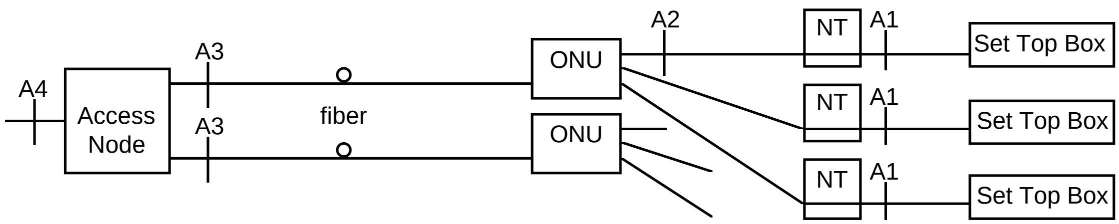

Figure 7–5. Example of a FTTC Access Network with a passive NT.

7.2.2.4 HFC Access

The HFC Access is based on a fibre part and a coaxial part. The fibre extends from the Access to a 'neighbourhood node'. This neighbourhood node serves typically about 100 to 500 subscribers via coaxial cable. These subscribers share the same cable and thus the available capacity of this cable. Because several subscribers share the same downstream and upstream bandwidth, special requirements like privacy and security measures have to be taken. Moreover a special medium access control (MAC) scheme is required in the upstream direction to prevent collision of information from customers to the network.

Figure 7–6 shows an example of an HFC Access. Fibre extends from the Access to a 'neighbourhood node'. The 'neighbourhood node' performs optical to electrical conversion and makes the signals suited to be transported across the coaxial network. The coaxial cable serves several subscribers (bus topology) and is fed trough a passive NT to the Set Top box. Refer to clause MACROBUTTON HtmlResAnchor 7.2.2.5 for a scenario with an active NT.

Because this scenario is based on a passive NT, the medium and protocols at reference A1 and A2 are identical. However, the medium and lower layer protocols are different at reference A3.

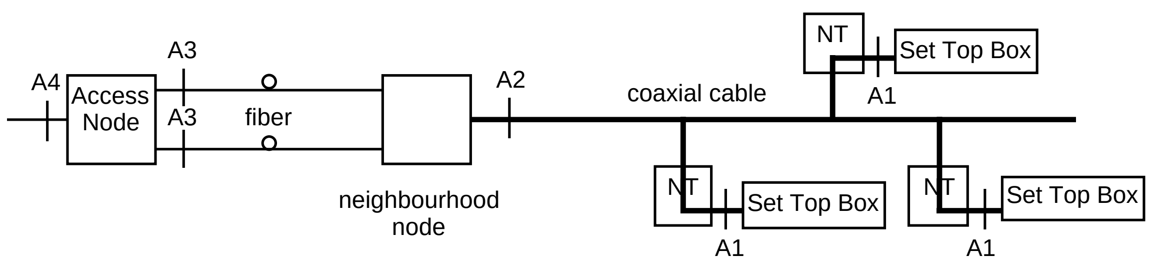

Figure 7–6. Example of an HFC Access Network with a passive NT.

7.2.2.5 Access with active NTs

Since only A1 will be specified (not A2 and A3), in the case of an active NT, **DAVIC 1.2** actually does not care about the Access. The active NT may perform signal processing and adaptation to other media and protocol conversion. The Access may have any implementation as long as at the in-house network side of the NT, at reference A1, the specified protocol stacks in Part 12 are applied.

Figure 7–7 shows an example of an Access with an active NT. In this example the Access Network is a copper plant with ADSL or VDSL technology. The actual transmission technology used is not relevant for **DAVIC 1.2**. The active NT terminates the ADSL/VDSL signals and adapts the signals to the transmission technology used in the in-house network.

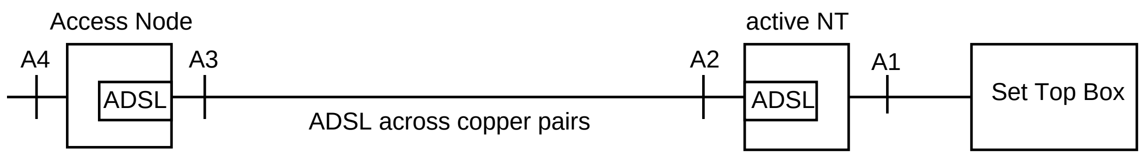

Figure 7–7. Example of an ADSL/VDSL Access Network with an active NT.

Another example of an active NT architecture is shown in Figure 7–8. This example shows a FTTH case with a passive optical network (PON) in the Access. The active NT terminates the PON and adapts the signals to a possible new medium with a different transmission technology. Another FTTH architecture may be a star architecture with direct fibre between the Access and the NT.

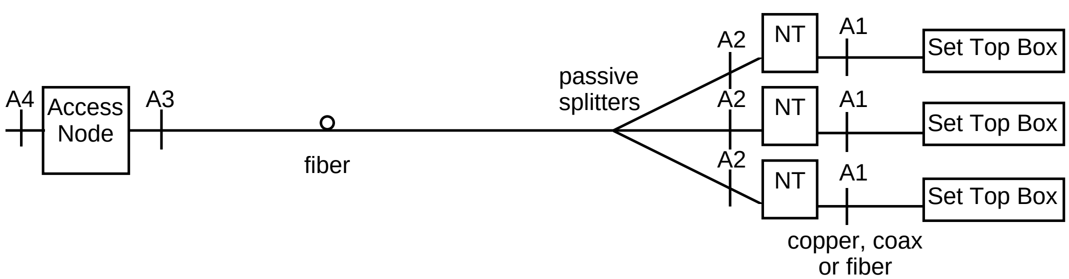

Figure 7–8. Example of a FTTH Access Network (PON) with an active NT.

Note—An active NT allows several interfaces to be offered to the End Consumers. The use of an ISDN interface for the reverse channel for S2, S3 and S4 information flows is being considered to support unidirectional passband coaxial interfaces.

7.3 In-house network

The in-house network exists between the NT and the End-Consumer Equipment, such as a Set Top Box. The in-house network may range from a simple wire to a complete in-house network with local switching functionality. The in-house network may have a bus topology on which equipment can be hooked to, or a may have a star architecture with point-to-point lines to a central (switching) unit.

The actual specification for an in-house network is left for future versions of DAVIC specifications. **DAVIC 1.2** considers only a direct wire (either twisted pair or coaxial) between the NT and the End-Consumer Equipment. Figure 7–9 shows the reference configuration for such an in-house network. In this reference configuration the Set Top Box (STB) is expected to be plugged directly into the NT.

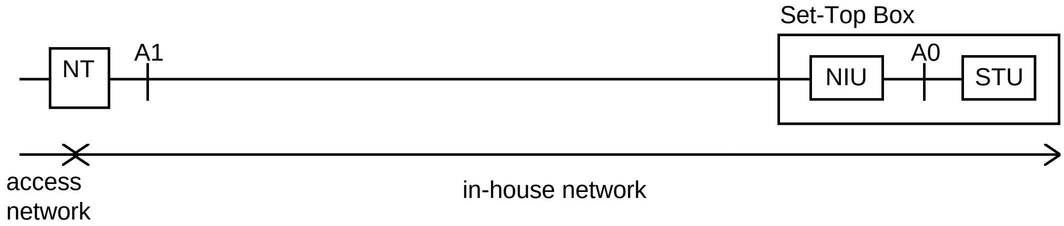

Figure 7–9. In-house network reference configuration.

It is allowed to connect several Set Top Boxes together in as bus topology as shown in Figure 7–10. The number of Set Top Boxes that can be connected like this depends on the actual Physical Layer used. Moreover, the Physical Layer must support a Medium Access Control (MAC) protocol to control access to the medium in the upstream (i.e., from Set Top Box to NT) direction.

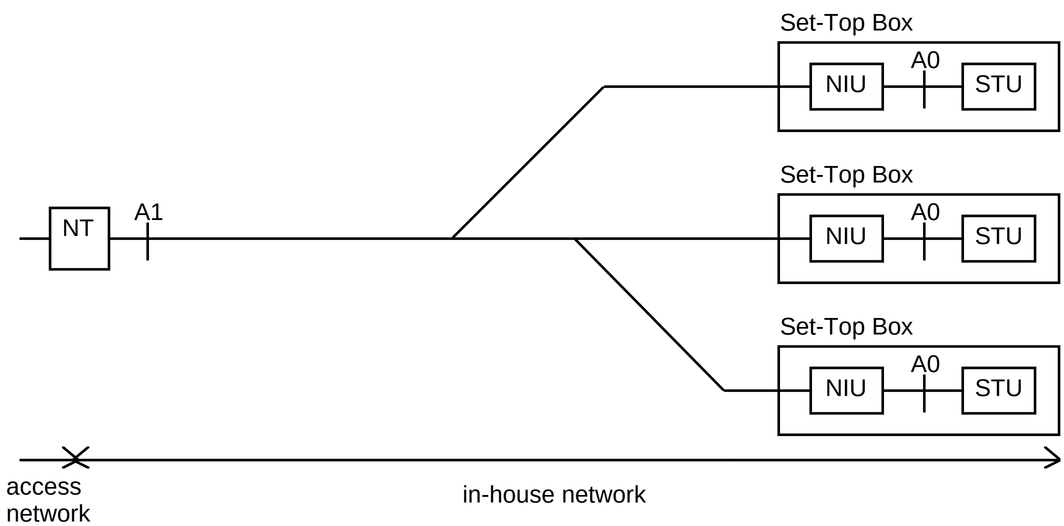

Figure 7–10. Connecting multiple STBs via a passive bus topology.

More advanced in-house networks LANs or fully fledged in-house networks like home bus with switching functionality are left for future versions of the DAVIC specifications. A general figure of such advanced in-house network is shown in Figure 7–11. The User Premises Interface (UPI) comprises the technology for this in-house network. As a consequence of the introduction of the UPI a new reference A1* emerges. This reference is located between the UPI and the NIU inside the Set Top Box. Interfaces and protocols at A1* have to be a subset of the interfaces and protocols at A1, since it must be possible to connect the Set Top Box directly to the NT.

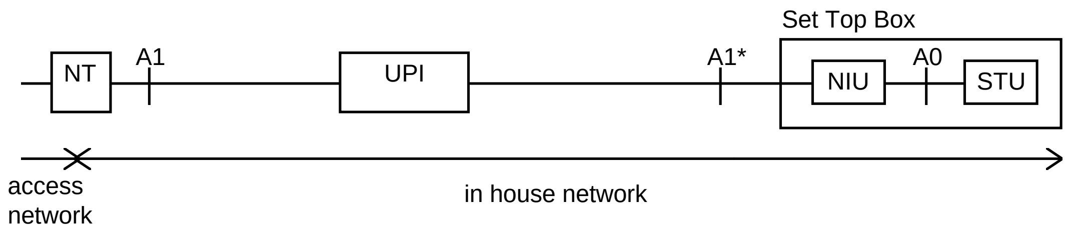

Figure 7–11. Example of a more advanced in-house network.

8. Wireless networks

Besides cabled, wireless networks may be used to deliver content to End-Consumers. Wireless networks do not use wired physical media to transport information to the End-Consumers. Examples of wireless Delivery are MMDS, LMDS, satellite and terrestrial broadcast networks. In the current DAVIC specification only MMDS/LMDS Delivery and satellite Delivery are specified.

For Satellite architectures a clear distinction must be made between the information flow from the End-Service Provider to the End-Consumer (downstream direction) and the return path from the End-Consumer to the End-Service Provider (upstream direction).

In the downstream direction satellite Delivery are broadcast networks by nature: the content information can be received by anyone with an appropriate receiver (e.g., a satellite dish). To allow interactivity a separate (cabled) network must be used.

Therefore the first profile for which hertzian networks are defined is the distribution profile. This allows for broadcast and enhanced services (low interactivity).

8.1 Classification of wireless

Wireless can be classified based on the geographical span that is covered by a single distribution point of the network. In particular, satellite have a large geographical span, in the order of several thousands of kilometers. Terrestrial broadcasting networks cover a medium geographical ares in the order of a few hundreds a kilometers. MMDS serves a small regional area, in the order of some tens of kilometers. Finally, LMDS systems typically serve a very small regional area, in the order of a few kilometers.

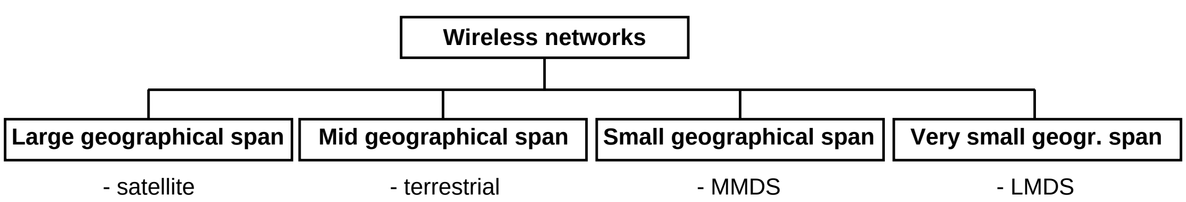

Figure 8–1. Classification of wireless networks.

8.2 MMDS

The Multi-channel Multipoint Distribution System (MMDS) can be considered as a wireless CATV network for delivery of broadcast video programs. However, MMDS can also be used to transport data information. MMDS is a line of sight microwave based transport technology, i.e. the transmitter and receiver more or less have to 'see' each other. Generally the information arrives via the Core Network at the Access Node. The Access Node adapts the signals and transmits the signals to an antenna. This antenna can be either co-located with the Access Node or at a different location, e.g. at the top of a hill. The antenna broadcasts the signals towards the End Users. The broadcast radius is typically in the order of 50 km. The customer premise is equiped with an MMDS receive antenna and block downconverter. The signals are adpated to match the format for the TV or STB. Figure 8–2 shows an example of an MMDS network.

The frequency spectrum for MMDS system is below 10 GHz, typically in the range of 2 to 3 GHz. The bandwidth for MMDS is typically in the order of 200 MHz.

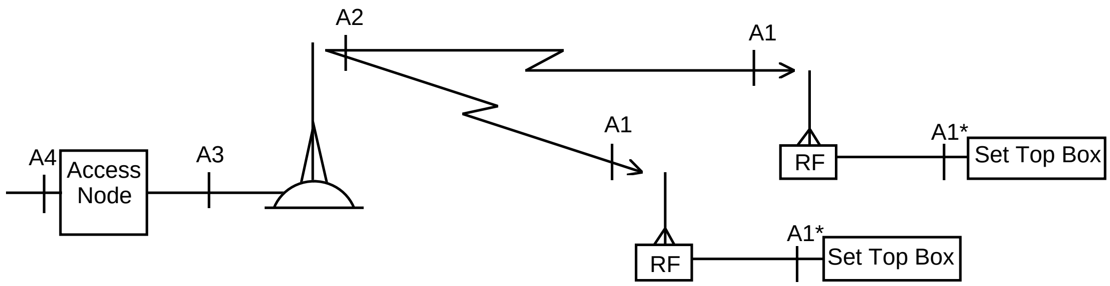

Figure 8–2. Example of a uni-directional MMDS network.

8.3 LMDS

The Local Multipoint Distribution System (LMDS) is a one-way or two way wireless system for data, video and telephony. A two-way LMDS system allows for interactive services. Just like MMDS, LMDS is a more or less line of sight microwave based transport technology. However, LMDS uses much higher RF frequencies than MMDS. LMDS systems operate at frequencies above 10 GHz. As a consequence LMDS has more bandwidth, typically in the order of 1 or 2 GHz.

Signals from the Core Network arrive at the Access Node, where the signals are adapted to the LMDS network and sent to base stations, located relatively close to the End Users. The reach of a single base station is typically in the order of 1 to 5 kilometers. Figure 8–3 shows an example of an LMDS network with several base stations.

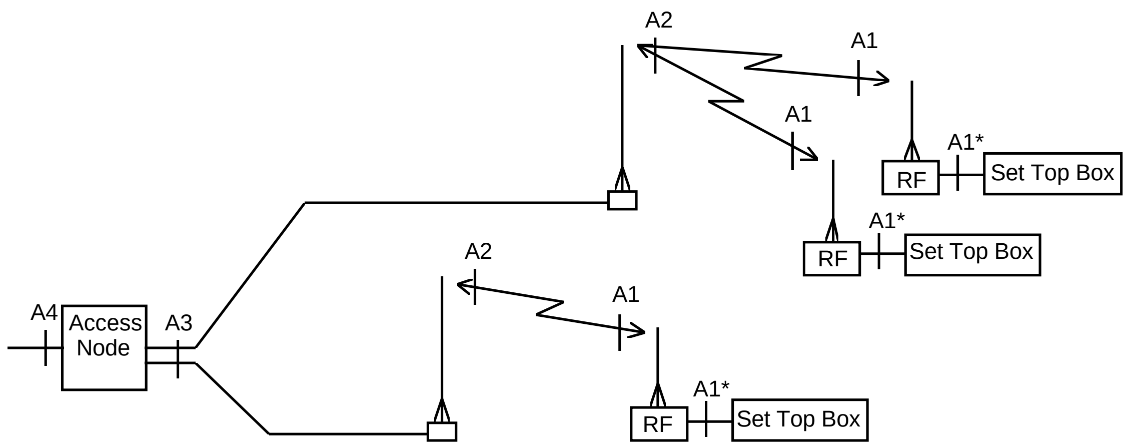

Figure 8–3. Example of a bi-directional LMDS network.

8.4 Satellite network

The main characteristic of the satellite Delivery System architecture is its distributive nature. Figure 8-4 shows the architecture for a satellite Delivery System. The content information is sent by the service provider (or rather the server) via a core network to the uplink transmitter. The Core Network may range from a single wire between server and uplink transmitter to a full switched network. In the latter case it is recommended to have an ATM Core Network to be compliant with Core Networks of cabled Delivery Systems. The uplink transmitter sends the signals to the satellite.The satellite broadcasts the signals over a wide geographic range. The content information may reach the End-Consumer in two ways. Either the End-Consumer may receive the satellite signals directly via a satellite dish see Figure 8–4, or via a CATV network. The CATV network distributes the signals to all End Consumers connected to the CATV network. In both cases the content delivery is distributive.

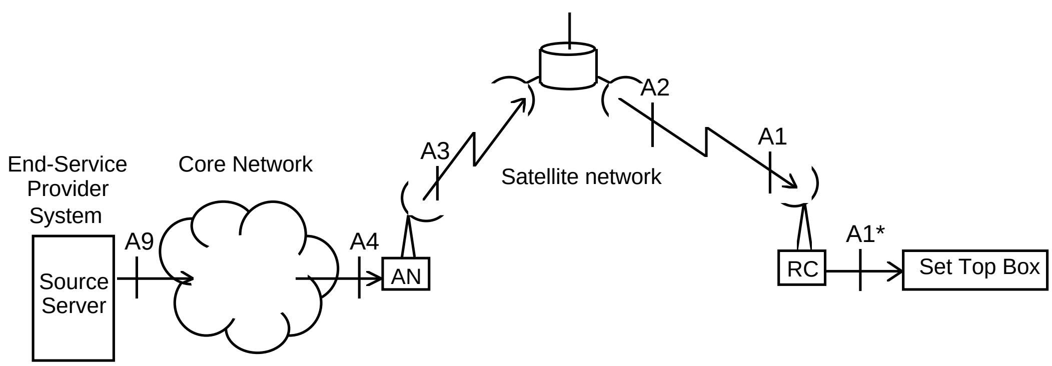

Figure 8–4. Satellite network architecture.

9. Service Architecture

The previous clauses dealt with Network Architecture aspects of Delivery Systems. This clause explains how several services can be implemented on the various specified Delivery Systems.

9.1 Enhanced Broadcast **service**

The Enhanced Broadcast Service offers End Consumer broadcasted TV programs with the inclusion of information that allows End Consumers to react on these programs. Based on this information the Set Top Box knows e.g. the destination for the End Consumers reaction to the TV program. Examples of services that can be offered via an Enhanced Broadcast Service are:

- End Consumer voting during a broadcast programme
- Ordering advertised goods displayed during a broadcast programme
- Selection of different broadcast programme bouquets after initial access to a broadcast service provider.
- Selection of movies in near video on demand systems.

For enhanced Broadcast Services a distinction can be made between the Broadcast Service Provider and the Interactive Service Provider. The Interactive Service Provider provides the Broadcast Service Provider with the information that enables interactivity with the End Consumer. The result of the interaction with the End Consumer may or may not influence the broadcast program. In the case of an interactive movie the course of the movie depends on the outcome of the End Consumer selection. In the case of a tele-advertisement to send a brochure, the End Consumers request does not influence the TV program content.

The Interactive Service Provider and the Broadcast Service Provider can either belong to the same Service Provider System or belong to (non co-located) separate Service Provider Systems. The interface between the Interactive Service Provider and the Broadcast Service Provider is currently not specified in DAVIC.

The broadcast channel is used to deliver the actual content (S1) and may be used for application control information (S2). Once the interaction channel has been established via S4, this channel is used for application control (S2). In addition the interaction channel can be used to deliver additional content information (S1) to the End Consumer.

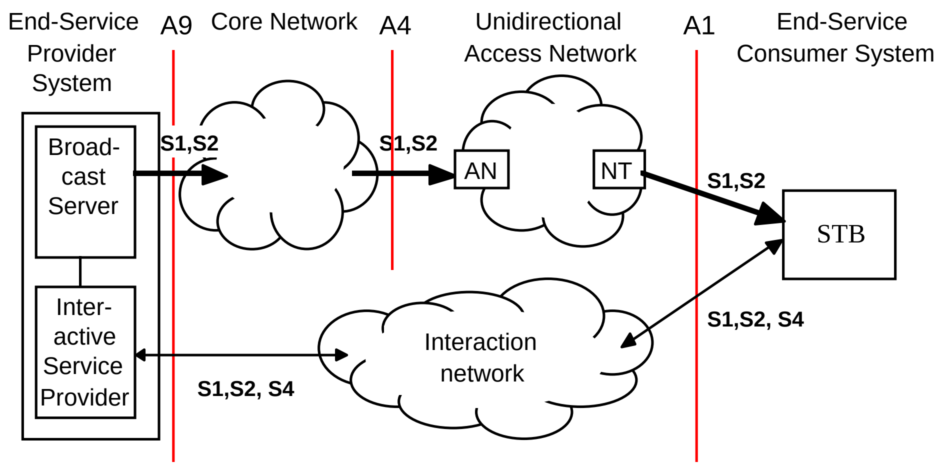

Figure 9-1. Enhanced Broadcast Service architecture.

9.1.1 Downstream architecture

The Enhanced programs are distributed towards the End Consumers either via a distributive Delivery System, or via the Switched service. Examples of distributive networks that can be used are MMDS, satellite broadcast networks and CATV networks.

9.1.2 Upstream architecture

For the Enhanced Service an interaction channel is required to feed the reactions of the End Consumers back to the Interactive Service Provider. This interaction channel can either be implemented within the network for the downstream information, or within a separate network.

In DAVIC 1.1 only PSTN, ISDN and PLMN (public land mobile networks) have been considered to act as an interaction network for Enhanced services. PSTN, ISDN and PLMN interaction networks can be used e.g. in the case of satellite as well as for uni-directional CATV networks.

Since the Enhanced services are intended for deployment in the near future, it is expected that whichever of the PSTN, ISDN, PLMN standards already used in a region is adopted for the DAVIC interaction channel for that region. Interworking between land mobile networks and PSTN/ISDN networks has to take place within the interaction network.

9.2 Switched Video Broadcast **service**

The Switched Video Broadcast Service offers End Users a large number of broadcasted TV programs over Access Networks with a relatively low capacity per End User. E.g. in the case of an ADSL Access Network, due to capacity constraints only one or two TV programs can be delivered to the End User at the same time. However, the End User may want to select these TV streams out of a much larger set of TV programs.

The Switched Video Broadcast service allows End Users to select a TV program by putting a Broadcast Control Unit (BCU) and a Replication Unit (RU) inside the network.. The Broadcast Control Unit accepts commands from the Set Top Box which TV program to direct to the End User. In order to exchange these commands between BCU and STB a zapping protocol is required. Part 7 contains the zapping protocol as specified by DAVIC.

The Replication Unit is the intermediator between the Broadcast Service Providers and the End Users. The Replication Unit accepts the TV streams coming from various Broadcast Service Providers and directs the requested TV programs to the End Users. The Replication Unit is controlled by the Broadcast Control Unit. The Broadcast Control Unit and the Replication Unit can be either co-located inside the network or located at separated places.

In the first case all End User *selected* channels/programs that cross the A4 reference point can be transported to the STBs without need for replication. Then, the Broadcast Control Unit and the Replication Unit from which the selection is made are both located in the Core Network. (Figure 9–1).

In the second case all *broadcasted* channels/programs can be transported across A4. Then the Broadcast Control Unit and the Replication Unit may both be located in the Access Network (Figure 9–2).

In the third case it is assumed that not all *broadcasted* programs can be transported past the A4 reference point and that a selection needs to be made before that point. Furthermore it is asssumed that in order to save bandwidth when more users *select* the same channel/program, it is better to bring one copy of the channel across A4 into the Access Network, and replicate the channel inside the access network before A1. This means that the Broadcast Control Unit and a first Replication Unit (the entity to which all the *broadcasted* programs arrive and from which the programs to bring across A4 into the Access Network are selected) should be located within the Core Network (Assumption 1), while a second Replication Unit should be located in the Access Network (Assumption 2). This is shown in Figure 9–3.

Alternatively the same scenario may be realised with the architecture shown in Figure 9–4 that also distributes the Broadcast Control Unit across Core Network and Access Network.

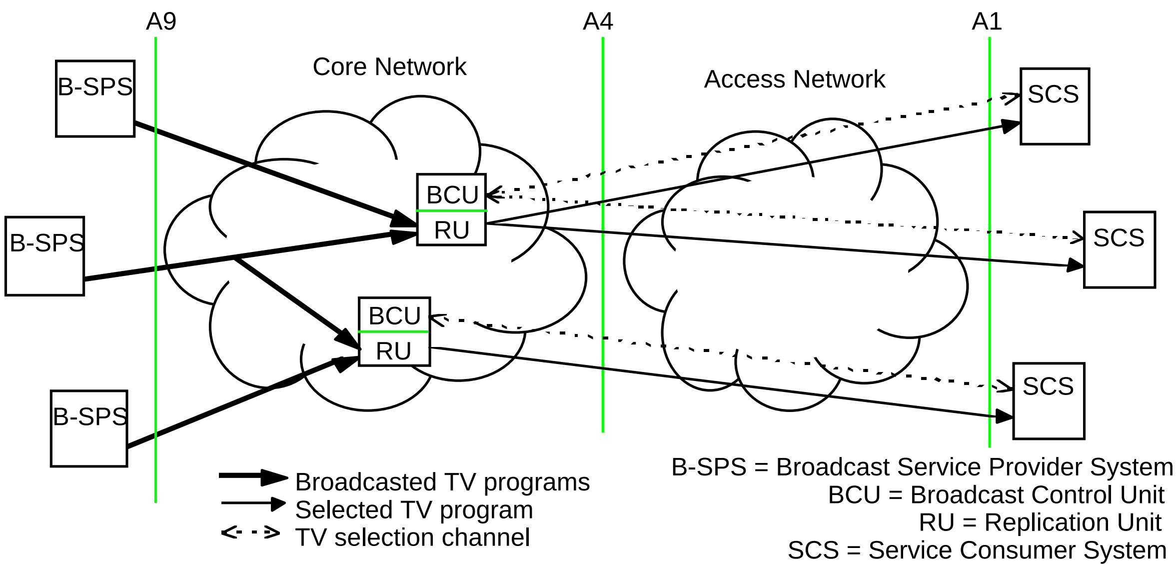

Figure 9–1. Switched Video Broadcast architecture with BCU and RU in the Core Network.

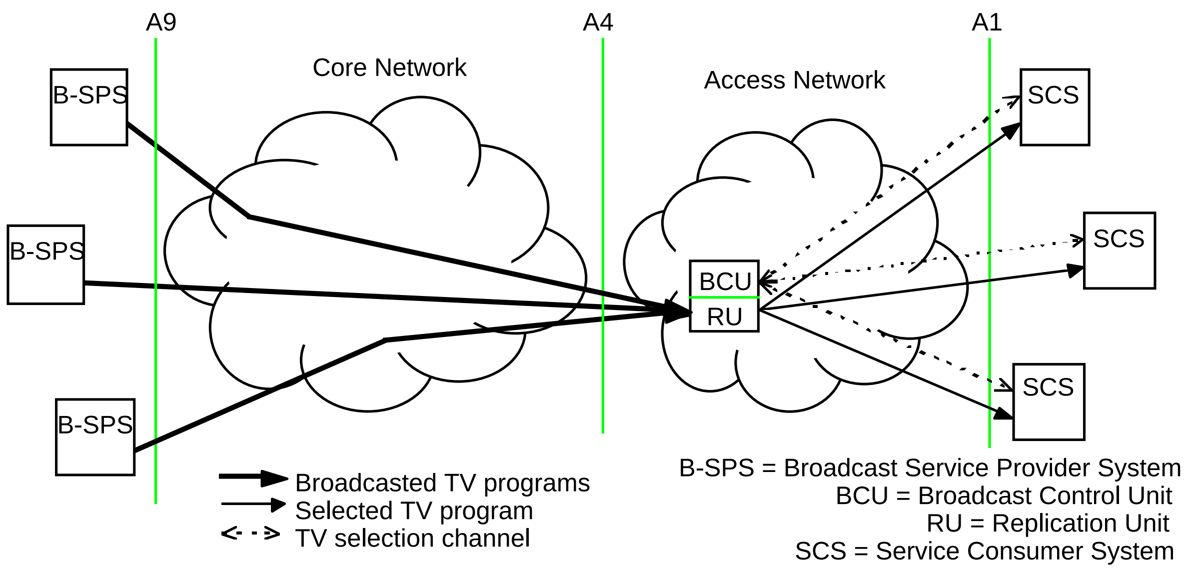

Figure 9–2. Switched Video Broadcast architecture with BCU and RU in the Access Network.

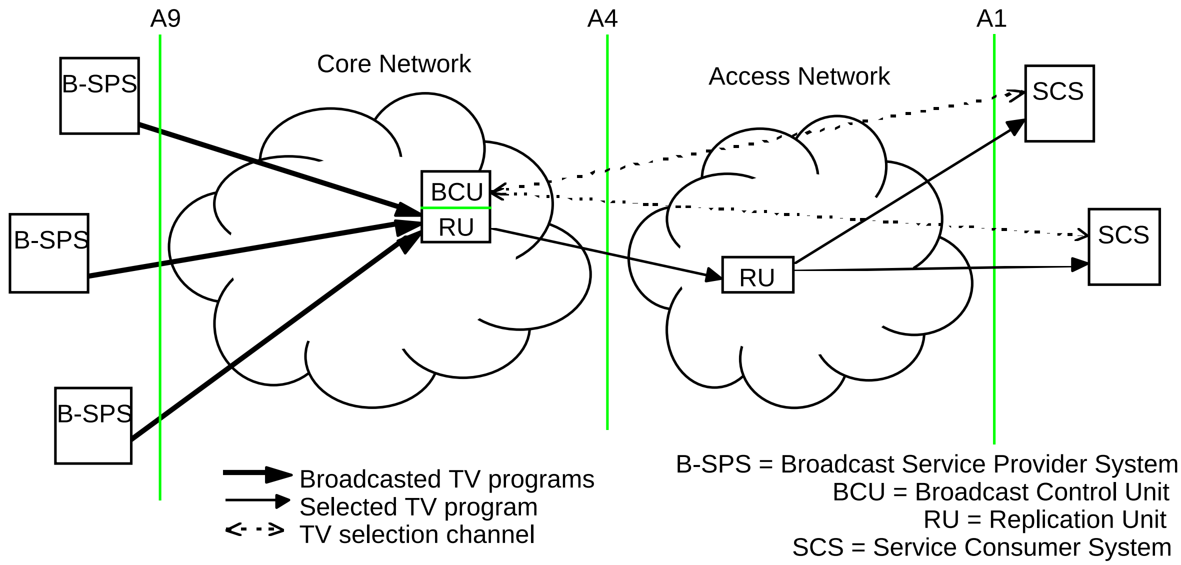

Figure 9–3. Switched Video Broadcast architecture with RU separated in the Access Network.

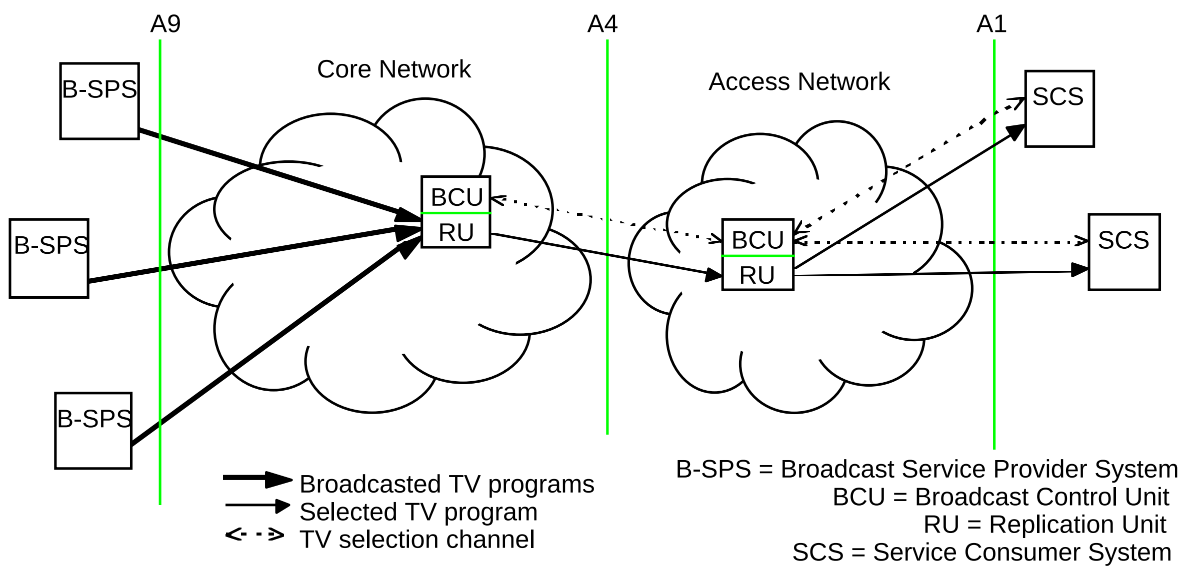

Figure 9–4. Switched Video Broadcast architecture with BCU/RU both in Access and Core Network.

As can be seen in the Figures above, the two transport streams concerned are the transport flow between the Broadcast Service Provider and the Replication Unit, and the transport stream (including the control of the transport stream) between the Replication Unit and the End User. In the scenario where the Broadcast Control Unit is located in the Core Network as well as in the Access Network (Figure 9–4), additional protocols are required to be specified between the two Broadcast Control Units across the A4 reference point.

9.2.1 Delivery of broadcast programs to the Replication Unit

The following drawing provides an illustration of the scenario for the delivery of the broadcast programs from the Broadcast Servers to the Replication Units

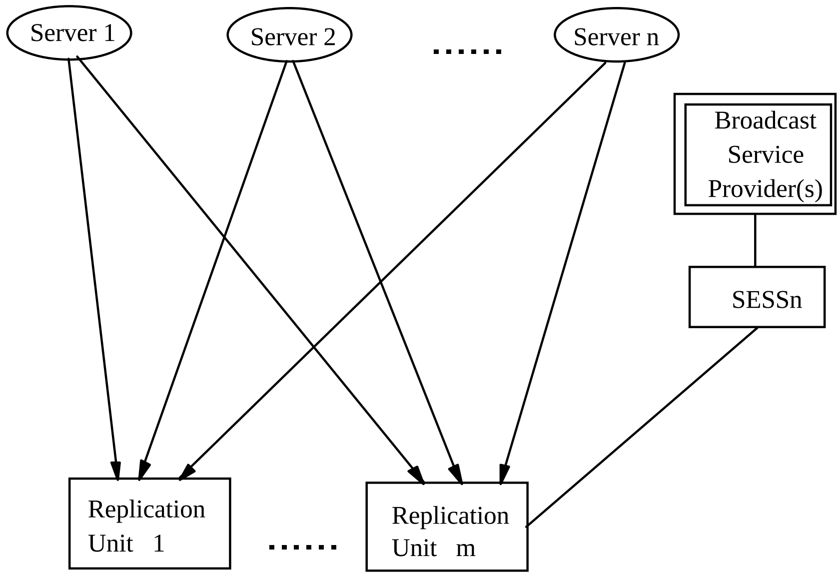

Figure 9–5. General scenario for the delivery of broadcast programs to the replication units.

The scenario assumes that a Broadcast Service Provider may build a service grouping programs coming from several servers.

A Broadcast Service Provider establishes program feeds for a switched broadcast service and obtains the associated Broadcast Program Ids in two ways:

- By administrative means (outside the scope of DAVIC)
- Using DSM-CC Continuous Feed sessions (for further study).

9.2.2 Program Selection Protocol

9.2.2.1 Requirements

The main requirement identified for the protocol is on latency, that should be as small as possible.

9.2.2.2 Architecture and Assumption

The following figure gives a representation of the general architecture:

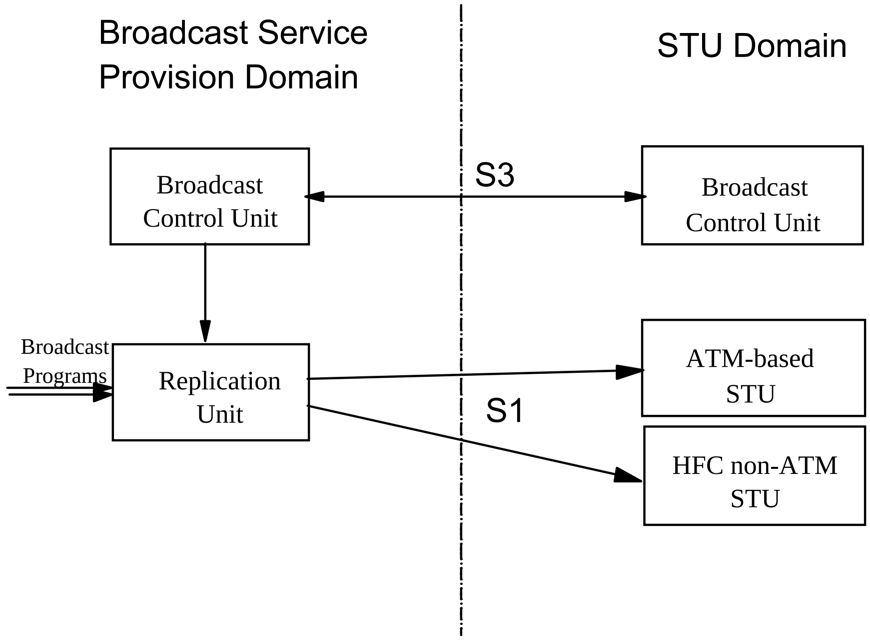

Figure 9–6. General architecture for the provision of switched video broadcasting.

The functional entities specific to SVB are:

- Broadcast Control Unit - This unit terminates the S3 flow which conrols the selection of the broadcast channel.
- Replication Unit - This unit terminates the S1 flow on which the broadcast channels are transmitted. Content sources are provided to the Replication Unit either through satellite pick up at the unit or through ATM PVC/SVC connection to the source which can be either off satellite, a content service server with continuous broadcasting capability or a live source.

DAVIC 1.2 specifies a solution oriented to ATM-based STUs connected to a baseband access network.

1. All the broadcast programs are delivered to the Replication Unit. Within the limitation of the bandwidth available at A1, no blocking shall be guaranteed between the Replication Unit and the STU.
2. A dedicated channel is provided for the Zapping protocol on a PVC.

9.2.2.3 Transport of the program streams

Two possible solutions are defined for VPI/VCI value of the ATM channel used for the transport of the selected programs.

1. The VPI/VCI values of the ATM channel for the transport of the selected program is associated with the STU. When the user requests a program change, the BCU switches the selected program to the VC of the user. More that one ATM channel may be associated to the STU for the provision of switched video broadcasting in order to allow picture-in-picture. During program zapping the user remains “tuned” to the same ATM channel, while its content changes as a result of the program change requests.

2. The VPI/VCI values of the ATM channels for the transport of the selected programs are associated with the broadcast programs. This allows, for some implementations, that the STU may keep a mapping table of the bradcast programs to the ATM channels, so that upon selection of a program the STU may tune directly to the related ATM channel before a confirmation message is received. If the selected program is already present in the drop this would reduce latency.

The choice between solution 1 or 2 is a network option. No impact exists on the STU design. The protocol is designed to support both options as a confirmation from the network on the VPI/VCI value of the ATM channel for viewing the selected program is given.

10. Network and Service related control

10.1 Definition

Control functions are needed to allocate and release resources in the Service Provider System and Delivery System in order to provide services to End Consumers while making efficient use of the available resources. An example of a resource is an output port on the server or transport capacity in the network.

DAVIC distinguishes two levels of control associated with the Delivery System:

- Service Related Control
- Network Related Control

Service Related Control (SRC) is the highest level representing the required control functions at the level of the principal service. Network Related Control (NRC) is the lower level of control associated with the communication service supporting the principal service and is represented by the Core Network functions.

Service Related Control corresponds to the S3 flow in the DAVIC systems reference model. Network Related Control corresponds to the S4 flow in the DAVIC systems reference model.

10.2 Control functions

Service Related Control and Management and Network Related Control and Management functions interact with directories (databases) containing information on End-Consumers, End-Service Providers, service brokers, Set Top Boxes and so on. This is shown in Figure 10–1.

Functions such as user registration/cancellation perform modifications on these databases, while functions as user authentication make use of data contained therein.

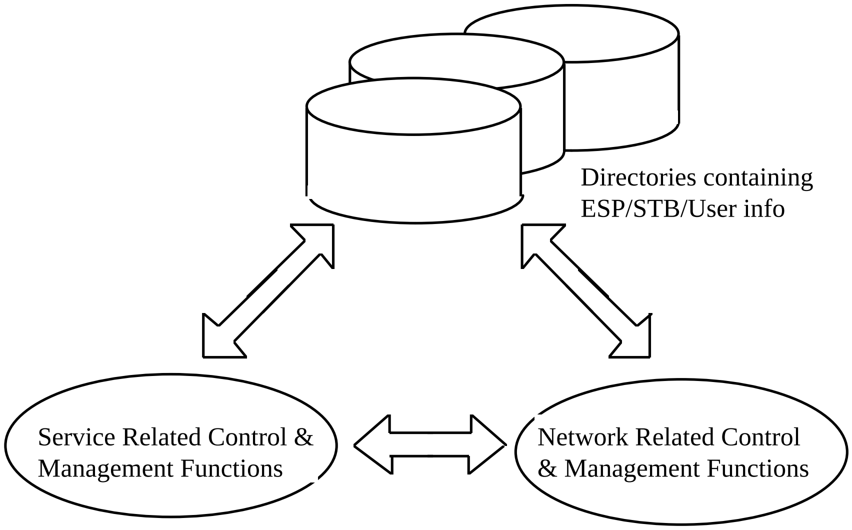

Figure 10–1. Relation between SRC&M, NRC&M and directories.

Coordination is required between Service and Network Control in order to relate the session with the underlying calls/connection (exchange of QoS parameters, network address, etc., will be part of the protocol).

10.2.1 Network functions

Network Related Control functions include connection establishment and termination, information routing and network resource allocation.

Signaling interfaces are used to control the operation of the network with respect to connection handling. It is aimed to use existing and future interfaces that are standardized by bodies such as ITU-T and ATM Forum. Moreover the connection control signaling specification must be service independent.

The protocols for connection signaling that are terminated in the Delivery System are described in details in Part 7.

Functions which are part of the Network Related Control are:

- **Call and Connection control** which is the capability of the network to establish, maintain and release calls together with the related connections.
- **Resource allocation** which is the capability to define the elements to be used for the connection set-up according to the requests of the Session related control and to their availability.
- **Routing** which is the capability to find a path through the network from one end-point to another end-point where sufficient resources can be allocated.
- **STB identification** which is the ability of the NRC to identify the STB (e.g., serial number) or part of the STB characteristics (STB profile, make or capabilities), to use the acceptable dialogue protocol between the NRC and the STB.
- **STB authentication** which is, logically subsequent to identification, a security issue, to ensure that the STB is a certified equipment, authorized to enter the DAVIC system

and does not cause any damage due to its behavior. Depending on the implementation, this phase may be separated or performed together with the identification.

Network Related Control protocols may be terminated both in the Access Network and in the Core Network and in the STB or server.

For Access Network to Core Network flow, the protocol stack used depends on the architecture of the Access Network. Possible architectures are described in the following section.

10.2.2 Service functions

The following functions are part of the Service Related Control specification:

- **STU download:** For some applications, including perhaps basic Gateway Navigation, there is a need to download programs and data to the STU. This function controls this process and maintains any necessary service-related information.
- **Navigation:** This function allows the user to select Brokering Gateways, or ESPs and related DAVIC services.
- **Address resolution:** This function provides translation between a logical name and a network address.
- **Security services:** There are several functions required here, including authorization and authentication.
- **Session control:** This function is the processing required to set up, maintain and release sessions. It assigns session identifiers and maintains the relationships to the supporting network resources, such as calls and connections.

Service Related Control protocols are terminated both in the Delivery Systems and in the STB or Server.

10.3 Access to Core control flow

The reference point between Access Network and Core Network is named the A4 reference point. Within DAVIC it is assumed that the A4 interface is a fully digital ATM based interface. A non-ATM based A4 interface is not considered. The A4 specification is based on the following assumptions:

a) signalling in the Access Network should be handled as transparently as possible (to limit costs)
b) local switching has to be performed in the Core Network
c) routing, channel concentration, user connection and OAM functions are to be performed in the Access Network
d) billing and charging procedures do not relate with the Access Network.

The Access Network beyond the A4 reference point can be based on ATM or on MPEG Transport Stream. In the latter case a mapping function is needed in the Access Network in order to specify the relationship between ATM virtual path/channels and MPEG TSs.

In the case of a fully ATM Access Network A4 can be implemented into two ways:

1. As a pure multiplexing of ATM UNI interfaces (at VP level), for relatively simple implementations with a limited number of users per A4 port. In this case ATM VP are configured on a semi-permanent basis.

2. As an ATM interface with flexible provisioned VPC allocation and flexible VCC allocaton on a per connection basis which provides concentration capabilities at the VC level.

This general architecture of the Access Network is described in more details in ETSI ETR/SPS-03040. Pure multiplexing configuration is referenced as VB5.1 interface and is specified in ETS DE/SPS-03046. Flexible allocation is referenced as VB5.2 interface and is specified in ETS DE/SPS-03047.

For **DAVIC 1.2** only the first implementation is chosen (VB5.1). However it is recognized that in future versions of the DAVIC specifications the second implementation using the VB5.2 interface will become mandatory when the VB5.2 standard has sufficiently matured.

10.3.1 Pure multiplexing of ATM UNI interfaces (VB5.1 confguration)

This method is specified for **DAVIC 1.2**. Pure multiplexing of ATM UNI interfaces does not allow concentration of traffic on a “per connection” basis (DAVIC 1.2) in the upstream direction. However in the downstream direction, bandwidth to the downstream flows can be assigned on a per connection basis directly by the switch to which the customer is connected, known as the Local Exchange (LE).

This means some sort of concentration in the downstream direction is possible. The bandwidth associated with each virtual path is given by the sum of bandwidth of the virtual channels contained in that virtual path. This configuration is particularly suited for services with traffic characteristics such as Video on Demand (small bandwidth in the upstream direction and large bandwidth in the downstream direction), as it allows the allocation of the downstream video channels in a flexible manner without additional burden for the Access Network. In the upstream direction fixed bandwidth virtual channels can be allocated for the transport of control information (both network control and service control).

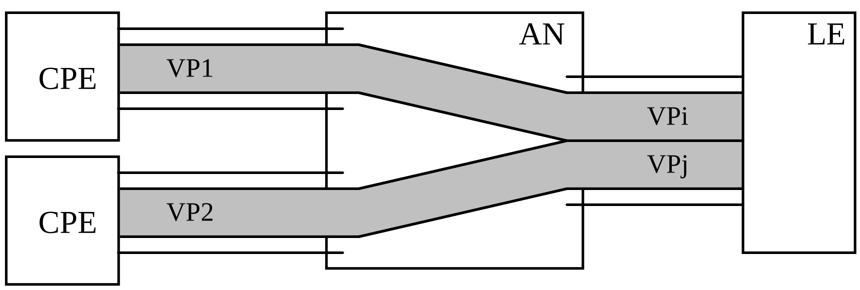

Figure 10–2. Virtual Path multiplexing (VB5.1).

10.3.2 Flexible allocation interface (VB5.2 configuration)

This method is not specified in **DAVIC 1.2**. It has been recognized the importance of the VB5.2 interface for concentrating and dynamically assigning VC connections over the ATM VP links. This approach is mandatory in case of large Access Networks with thousands of subscribers in order to limit the number of physical links (DAVIC 1.2). However, the current status of the VB5.2 interface is not mature enough to be taken into the **DAVIC 1.2** specification and may be incorporated in later versions of the DAVIC specification.

In this configuration the customer-network signaling takes place between the STB and the ATM node via Q.2931. Then, dynamic allocation in the Access Network is obtained by the ATM node via the VB5 interface. Besides dynamic allocation VB5 also provides a concentration function. A Bearer

Channel Connection (BCC) protocol (similar to that defined in V5.1 and V5.2 narrowband interfaces) is needed in order to allocate resources between the Core Network and the Access Network.

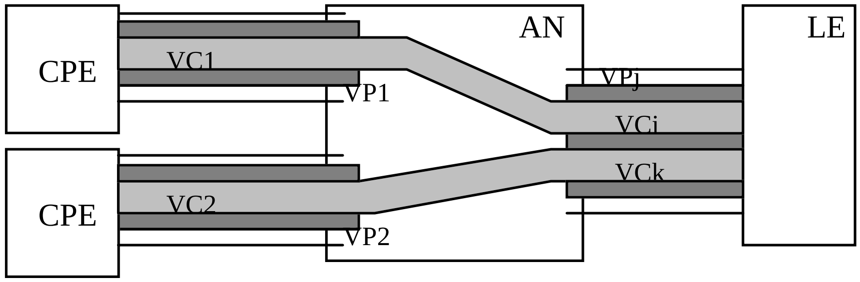

Figure 10–3. Concentration on VC basis (VB5.2).

10.3.3 ATM addressing in the Access

In case of an ATM network only addressing adaptation (VP/VC translation) has to be performed in order to allow routing and channel allocation inside the Access Network.

In the DAVIC 1.2 configuration, to identify the source of the cells in the local exchange the Virtual Path Identifier (VPI) value at the interface AN/LE are allocated in order to assign VPI uniquely to UNI (i.e., a given VPI value at the A4 interface is associated with a given A1 interface). More than one VP may be associated to a single A1 interface. The VPI values are set up by Operation and Administration procedures.

In the DAVIC 1.2 configuration, to identify the source of the cells in the local exchange the combination Virtual Path Identifier/ Virtual Channel Identifier (VPI/VCI) has to be modified in such a way that the pairs VPI/VCI are unique per physical line. The LE handles the bandwidth allocation and assigns the VPI/VCI values at the incoming and outgoing interface. The AN receives the values from the Local Exchange (LE).

10.3.4 Routing in the ATM Access

If the Access Network is completely ATM based, routing of User, Control and Management plane flows is performed on the basis of VPI/VCI field of ATM cells (assigned in a semi-permanent way or on a per call basis via the BCC protocol).

If no concentration of multiple users is done within the Access Network, the Q.2931 protocol can be used directly at the A4 interface for call and connection control, no dynamic allocation of channels across the A4 is possible.

If concentration of multiple users is done within the Access Network, there is a need to allow dynamic allocation of channels across the A4 to individual users. In this case it is required that cells be identified in the Access Network in order to be routed to individual ports. This is required not only for U-plane information, but also for signaling cells.

Identification of cells is done by dynamic mapping of VPI/VCI in the Access Network (the Access Network performs a translation of the routing field mapping of the VPI/VCI used across the A4 interface into the VPI/VCI value used across the A1 interface).

The BCC protocol must maintain a conversion table between VPI/VCI used across the A1 interface and the VPI/VCI used across the A4 interface. The BCC protocol is also responsible for assigning the VPI/VCI values across the A4 interface.

11. Network and Service management

The function of Network and Service Management is to enable a Delivery System provider or End Service Provider to offer a reliable and high level quality service to its End Consumers. Hence, network and end service operators who will provide facilities for the delivery of multimedia services over DAVIC specified networks will need to implement network management systems. As an end-to-end Delivery System may cross the boundaries of multiple network operators, multiple Network Management Systems (NMSs) may be utilized in achieving the goal of providing a reliable service. Likewise, the End Service Providers whose content is delivered over the end-to-end network will need to implement Network Management Systems for their equipment.

The need of network management for DAVIC specified networks, leads to a requirement that DAVIC offer network management alternatives for network operators and End Service Providers. The level of network management functions that may be offered in the Network Management Systems depends upon the availability of equipment managers and agents for management of a particular type of network.

11.1 Management functions

11.1.1 Service Management functions

The following functions are parts of the Service Management specifications:

- **ESP Directory Management:** This function maintains the necessary service information about ESPs, brokers and DAVIC services (e.g., MOD). It provides means to register/deregister, modify, activate/deactivate ESP/Brokers and services and their associated parameters (profile management).
- **User Directory Management:** This function maintains the necessary information about Users (Subscribers, End-Users). It provides means to register/deregister, modify, activate/deactivate End-User and Subscriber data and its associated parameters (profile management).
- **STU Directory Management:** This function maintains the necessary information about users equipment (STUs). It provides means to register/deregister, modify, activate/deactivate End-User equipment (STUs) and its associated parameters (profile management).
- **Usage parameter collection:** There is a need to collect service related information on which charging and billing will be based. This function must cooperate with the equivalent in the Network Related Management

11.1.2 Network Management functions

The following functions are part of the Network Management specifications:

- **Network client directory management:** This function maintains the necessary network information about STU/ESP/other. It provides means to register/deregister, modify, activate/deactivate STU data and its associated parameters (profile management).

- **Configuration Management:** This function is used to configure and provision the network elements which make up an end-to-end multimedia system. It also encompasses setting up and tearing down subscriber sessions including bandwidth allocation and deallocation, and QoS verification.
- **Fault and Performance Management:** This function is used to proactively monitor the health of the system. This includes monitoring failures via alarms, and assisting in disaster recovery by performing root cause analysis and diagnostics.
- **Security Management:** This function is used to manage the security of the system which includes encryption of lower level data, and higher level authorization.
- **Usage parameter collection:** This function is used to collect network related information for charging and billing purposes. In addition, the function includes network resource usage accounting to plan for future network expansion. This function should co-operate with the equivalent in Service related management for billing and charging purposes.

11.2 Management architecture

Conceptually, an End Consumer may utilize several Core Networks owned by different Network Providers to reach one of many servers to receive service. These multiple Core Networks and servers will be managed by separate NMSs to provide reliable service. The business boundaries that exist between enterprises (different providers) in an end-to-end multimedia system provide a foundation for definition of the network management architecture. As the end-to-end multimedia system can be partitioned in several management domains based on provider boundaries, only a few sample scenarios of the management architecture are defined in this section.

The defined network management architecture in turn defines the protocol stacks to be used for different management interfaces involved. These protocol stacks are found in Part 7 of the **DAVIC 1.2** Specification.

11.2.1 Scenario 1

Figure 11–1 shows a scenario in which the end-to-end multimedia system is partitioned into two management domains based on provider boundaries. One management domain contains the Service Provider which owns the server. The second management domain contains the Delivery System provider which owns the Core Network, Access Network and the STB as well. These two management domains are managed by separate Network Management Systems to provide reliability in their portion of the end-to-end system. There is peer to peer communication between the two NMSs. Only the S5 management information flows are identified in the figure.

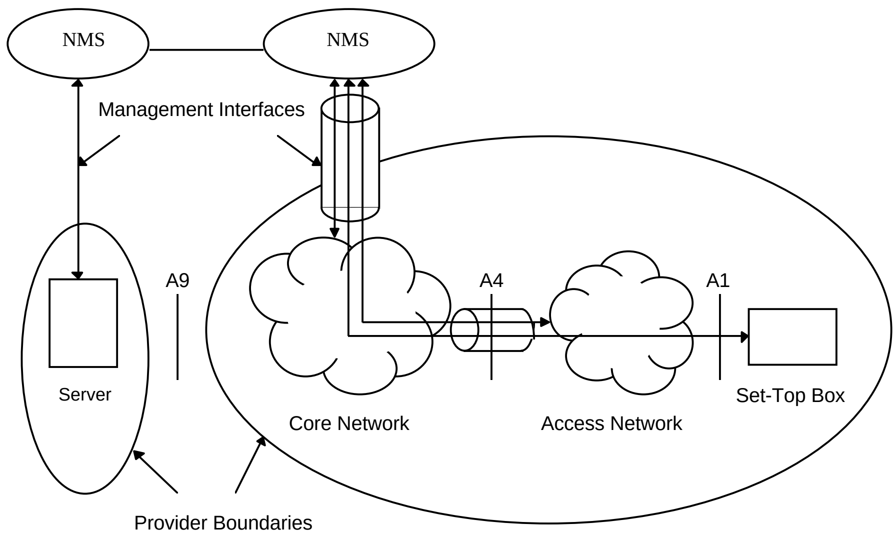

Figure 11–1. Scenario 1.

11.2.2 Scenario 2

The Figure 11–2 shows a scenario in which the end-to-end multimedia system is partitioned into two management domains based on provider boundaries. One management domain contains the Service Provider which owns the server and the STB. The second management domain contains the network provider which owns the Core Network, and the Access Network. The two domains are managed by separate Network Management Systems. There is peer to peer communication between the two NMSs. Only the S5 management information flows are identified in the figure.

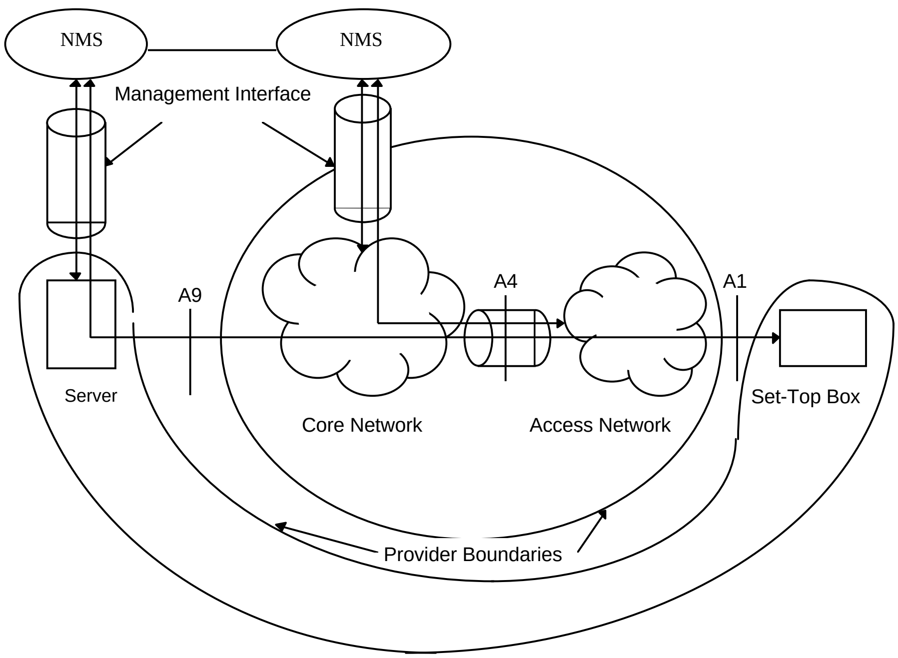

Figure 11–2. Scenario 2.

11.2.3 Scenario 3

The Figure 11–3 shows a scenario in which the STB is owned by the End Consumer. The end-to-end multimedia system without the STB can now be partitioned into management domains based on the ownership of the several components of the system. The figure identifies one of the possible scenarios.

The two NMSs used to manage the management domains have peer to peer communication. Only the S5 management information flows are identified.

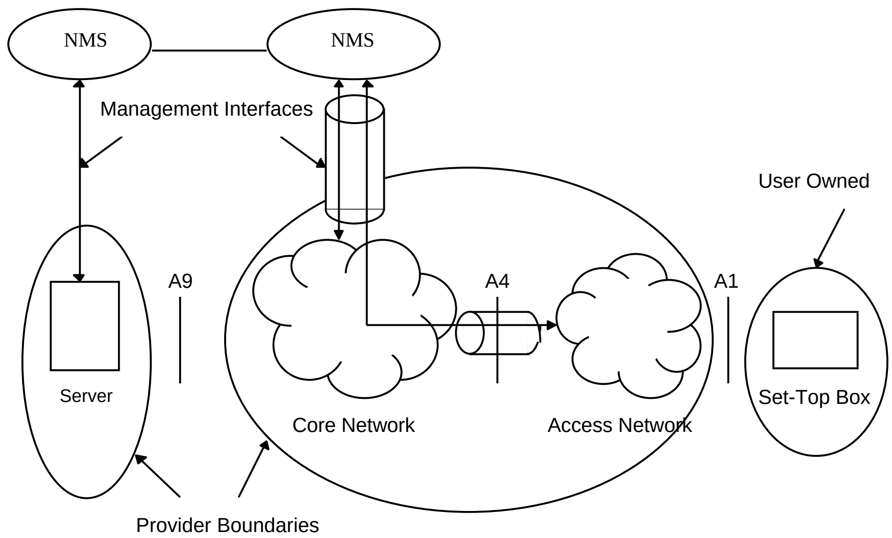

Figure 11–3. Scenario 3.

11.2.4 Scenario 4

The Figure 11–4 shows a single enterprise scenario in which one provider owns the entire network. In this case, conceptually only one NMS is required to manage the network to provide reliable service. However to decrease complexity, the network can be partitioned into subnetworks to provide distributed management. Only the S5 management information flows are identified in the Figure 11–4.

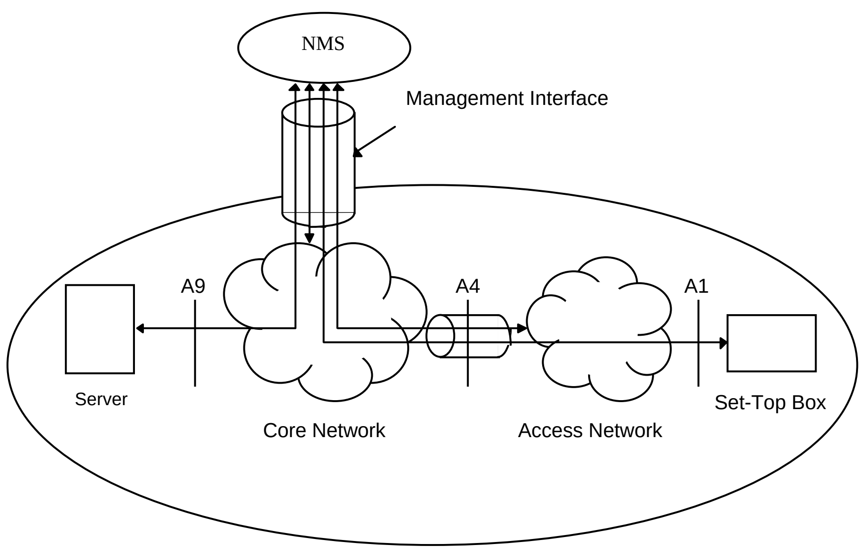

Figure 11–4. Scenario 4.

11.2.5 Scenario 5

The Figure 11–5 shows a scenario in which the access network provider also owns the STB. The end-to-end multimedia system can now be partitioned into management domains based on the ownership of the several components of the system as below.

The three NMSs used to manage the management domains have peer to peer communication. Only the S5 management informaton flows are identified.

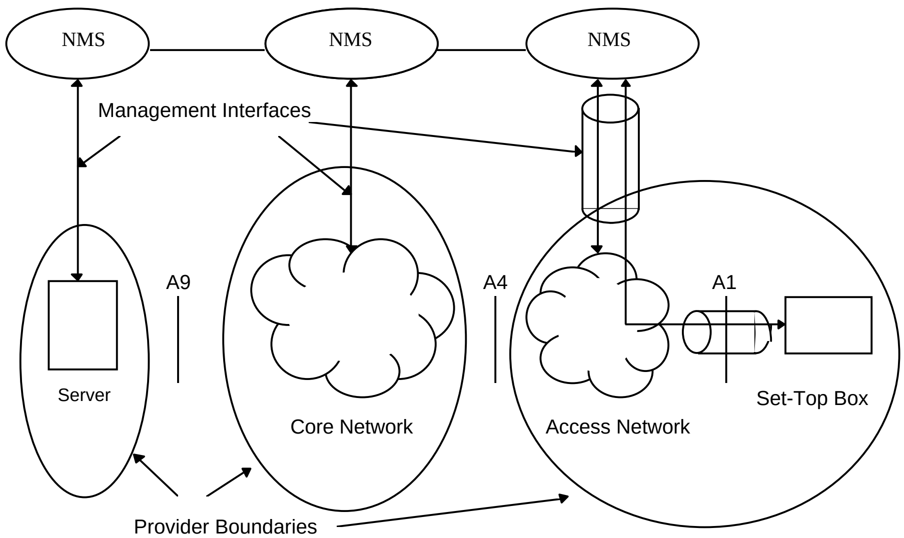

Figure 11–5. Scenario 5.

11.3 Telecommunication Management Network Reference Model

In order to outline a baseline for determining short term and long term network management function options, the TMN reference model is given here. It is expected that network management system solutions in the short term will support a minimal number of functions, selected primarily from the lower layers. Evolution to long term solutions is expected to involve functions being added incrementally.

Table 11–1. TMN reference model.

	performance	fault	configuration	accounting	security
Business Management Layer					
Service Management Layer					
Network Management Layer					
Element Management Layer					
Element Layer					

11.4 Network Management Protocols

There are currently two basic candidates for network management protocols to be used: CMIP defined by ITU-T X.711 and SNMP defined by RFC 1157. SNMPv2 is also a candidate protocol but in this discussion is referred to by “SNMP”. In general, it is said that CMIP is more suited for public networks (core and access networks), while SNMP is more appropriate for server and STU equipment. The DAVIC architecture uses several different types of access networks. The choice of a standard network management protocol for these networks is difficult since: a) most of these access networks have no standard network management protocol associated with them, and b) most of these networks, for example, HFC access network, contain simple network elements such as amplifiers and power supplies for which a standards based approach is seen as too demanding. For the access networks, for the simple network elements in which a standards based approach would mean a large overhead, a proxy-based management approach is recommended, whereas for large and complex elements which can support a standards based approach CMIP or SNMP is recommended. The choice of network management protocols to be used, however, is left to the service or network provider.

11.5 Reference Standards and Requirements

Network management system requirements are currently being defined by several standards bodies and fora.

For the core ATM networks, the ATM Forum has completed the M4 Network Element specification which deals with ATM core network elements, that is, the ATM switches. The ATM Forum is currently working on M4 Network View specification which deals with end-to-end ATM networks.

DAVIC supports many different type of access networks. Currently, some of the access networks specified do not have standard bodies defining manager-agent relationships. For those type of technologies, additional work is needed to fully define the DAVIC network management framework.

DAVIC has specified a STU MIB for Set Top Units.

The management protocol to be used by the server is SNMP.

Management information models should be defined so that all network elements are accessible for the management of DAVIC services.