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Information technology — Generic digital audio-visual systems —

Part 2: System dynamics, scenarios and protocol requirements

Technologies de l'information — Systèmes audiovisuels numériques génériques —

Partie 2: Dynamique, scénarios et exigences de protocole des systèmes

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Foreword

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

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

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

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

International Standard ISO/IEC 16500-2 was prepared by DAVIC (Digital Audio-Visual Council) and was adopted, under the PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

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

— *Part 1: System reference models and scenarios*

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

— *Part 3: Contours: Technology domain*

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

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

— *Part 6: Information representation*

— *Part 7: Basic security tools*

— *Part 8: Management architecture and protocols*

— *Part 9: Usage information protocols*

Introduction

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

A summary of each part follows.

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

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

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

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

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

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

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

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

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

Additional Information

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

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

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

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

Information technology — Generic digital audio-visual systems — Part 2: System dynamics, scenarios and protocol requirements

1 Scope

The purpose of this part of ISO/IEC 16500 is to specify normative protocols and associated dynamic system behavior, including session and connection manipulation, configuration and download, for an ISO/IEC 16500 system. The emphasis is on the significant dynamic system entities (e.g., session control, call/connection control), the behavior of these entities (e.g., information flows, entity actions, parameters passed) and the allowable physical placement(s) of these entities in a DAVIC system (i.e., physical instances). As such, this part of ISO/IEC 16500 complements the static systems reference model described in ISO/IEC 16500-1, specifying normative dynamic behavior as well as specifying the protocol(s) required to realize this behavior.

The protocols themselves are specified primarily through the use of "Protocol Network Architecture" diagrams which visually illustrate, for each of the defined physical instances and application scenarios, the various protocol stacks which are to be used. Detailed specification of the individual protocol tools themselves (e.g., the detailed protocol messages used to realize the DAVIC dynamic flow behavior) is provided in ISO/IEC 16500-5 (mid- and higher layers) and ISO/IEC 16500-4 (lower layers) of this specification.

This results in instance specifications made up of building blocks from the DAVIC tool set organized in a manner describing a system which performs DAVIC functions.

2 Normative references

Detailed bibliographic references for the normative protocols identified in this part of ISO/IEC 16500 (e.g. in Table 9.2-28 and Table 9.2-29) are provided in ISO/IEC 16500-2 Annex E.

3 Definitions

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

3.1 **call entity** or **connection entity:** user or network process which terminates S4 flow (c/c).

3.2 **functional control entities:** call/connection entity and session entity.

3.3 **functional entity:** process which terminates an information flow.

3.4 **proxy signaling agent:** signaling process performing end point signaling function on behalf of the end user. Extended definition is required if proxy is used also in hybrid network, e.g., MPEG HFC and ATM.

3.5 **Q.2931 MACRO:** single notation which summarizes the exchange of information (S4 flow) between call/connection control entities during the call set-up or release phases.

3.6 **session entity:** user or network process which terminates S3 flow (ses).

4 Acronyms and abbreviations

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

c/c	call/connection entity
CRM	Connection Resource Manager
DSDM	DAVIC System Dynamic Modeling
e-e cntrl	end-to-end control

MPTS	Multi-Program Transport Stream (ISO/IEC 13818–1 MPEG-2 Systems)
pses	Pseudo-session control entity (used in some Internet Access scenarios)
Ses	Session control entity
SPTS	Single Program Transport Stream (ISO/IEC 13818–1 MPEG-2 Systems)

5 Conventions

The style of ISO/IEC 16500 follows the *Guide for ITU-T and ISO/IEC JTC1 co-operation. Appendix H: Rules for presentation of ITU-T | ISO/IEC common text (March, 1993).*

6 Requirements for DAVIC Systems

DAVIC systems are characterized as follows:

- The system must be built from the set of tools defined in ISO/IEC 16500.
- The system must reflect one of the allowable physical instances specified in this part of ISO/IEC 16500.
- The system must illustrate DAVIC behavior at the various reference points as defined in ISO/IEC 16500-1.
- The system must perform functionalities outlined in ISO/IEC TR 16501.
- The system dynamic behavior must be in accordance with the dynamic flow scenarios, entity actions, and parameters, and protocols specified in this part of ISO/IEC 16500, utilizing the detailed protocols specified in ISO/IEC 16500-4 and ISO/IEC 16500-5.
- The reference points must be accessible to allow effective interoperability testing at the reference points and throughout the system as appropriate.

7 Implementation Procedure

The following list defines the procedure for the description of a DAVIC system instance:

1. Define the instance in terms of the static DAVIC reference model of ISO/IEC 16500-1 and one of the allowed physical allocations of the dynamic functional entities specified in this part of ISO/IEC 16500. Identify the required protocol tools outlined in ISO/IEC 16500 from the physical instances, dynamic behavior and the protocol network architecture diagrams of this part of ISO/IEC 16500.
2. Define the identified points using the tools outlined in ISO/IEC 16500.
3. Identify the required DAVIC functionalities and demonstrate the implementation of these functions through the network instance, utilizing the system dynamic behavior as specified in the dynamic flows of this part of ISO/IEC 16500.
4. Repeat steps 2 through 3 for the various network types (i.e., for the various physical layer access technologies) to which the instance applies.

8 Instance Development Tool

The instance development tool for definition of a DAVIC system is defined with the following elements:

- Service Provider System (SPS) (e.g., the video server for the case of VoD)
- Delivery System comprising:
  - Core Network (CN)
  - Access Network (AN)
- Service User System (e.g., the Set Top Unit)
- Information Flows S1, S2, S3, S4, S5
- Reference Points A11, A10, A9, A4, A1, A0 (Note: A0 and A4 is not shown in Figure 9.1-1 below. See ISO/IEC 16500-1 for this information).
- Functional Entities: c/c, ses, content source, content sink, e-e cntrl

The SPS, CN, AN, SUS, Information Flows, and Reference Points are as defined in DAVIC static system reference model of ISO/IEC 16500-1.

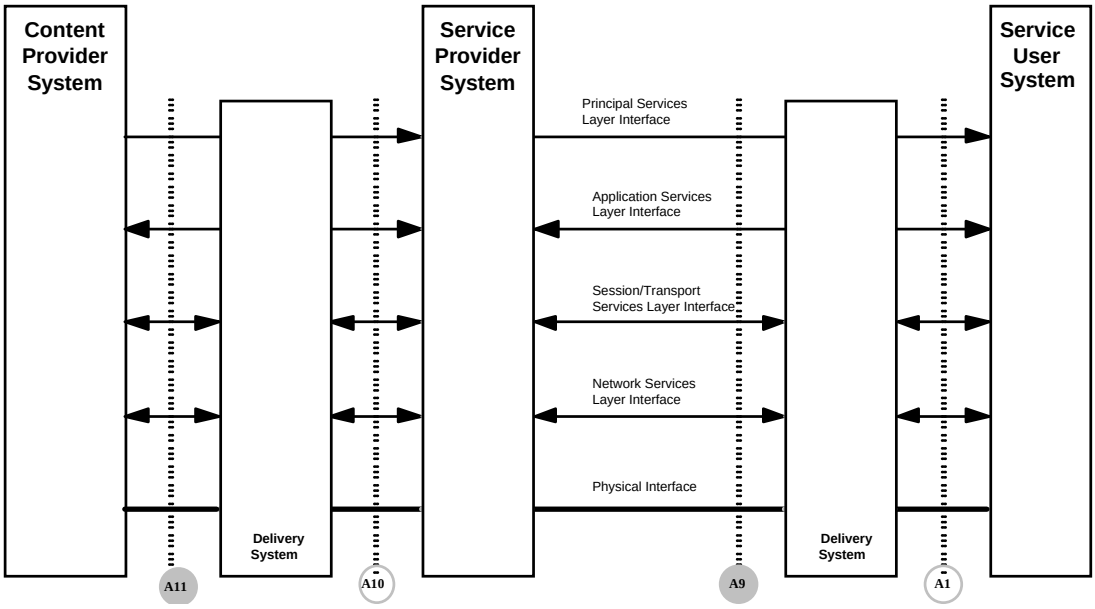


Figure 9.1-1 — DAVIC System Reference Model

The details of the relationships internal to and external to the SPS, Delivery System and SUS are as defined in the DAVIC static Systems Reference Model of ISO/IEC 16500-1.

9 DAVIC System Dynamic Modeling (DSDM) and Required Protocols

9.1 General

9.1.1 DAVIC System Dynamic Modeling

The DAVIC System Dynamic Modeling describes the following:

- Functional Entities used within the Dynamic Model(s)
- DAVIC Physical Scenarios (Physical Instances) for the allowable location(s) of the control functional entities.
- System Dynamic Flows which describe the dynamics of the DAVIC System for, e.g., the following actions, where appropriate:
  - Session & Call/connection Establishment
  - Adding Resources
  - Releasing Resources
  - Session Transfer
  - Service Transfer
  - Session & Call/connection Release
- Functional Entity Actions (performed by entities in conjunction with the dynamic flows)
- DAVIC Dynamic Flow Parameters (carried within the dynamic flows)

Collectively, these descriptive mechanisms specify the overall system dynamic behavior required of a DAVIC system for each application area (e.g., VoD, Interactive Broadcast, etc.)

9.1.2 Protocols Required for System Operation

The protocols required for the dynamic operation of a DAVIC compliant systems are identified in this part of ISO/IEC 16500 (for each application scenario) by means of either protocol network architecture diagrams, tables, or via descriptive text. Regardless of the means of identification, these protocols identified here are actually pointers to further detailed information specified in either ISO/IEC 16500-4 or ISO/IEC 16500-5 or in other documents as appropriate.

9.2 DSDM for VoD

9.2.1 Functional Entities Used in Dynamic Modeling for VoD

Figure 9.2-1 shows the key dynamic functional entities within a DAVIC VoD system.

- Content Source (e.g., MPEG Video Pump)
- Content Sink (e.g., Video decoder in an STU)
- e-e cntrl: entity which terminates the S2 flow and performs end-to-end control (e.g., VCR-like control: pause, fast forward, etc.)
- ses: Session Control Entities which terminate the S3 flow and coordinate the manipulation of resources, e.g., connections, in a DAVIC service instance
- c/c: call/connection control which terminate the S4 flow and set up conventional network connections

Other dynamic functional entities are introduced in the appropriate sections for the corresponding additional capabilities.

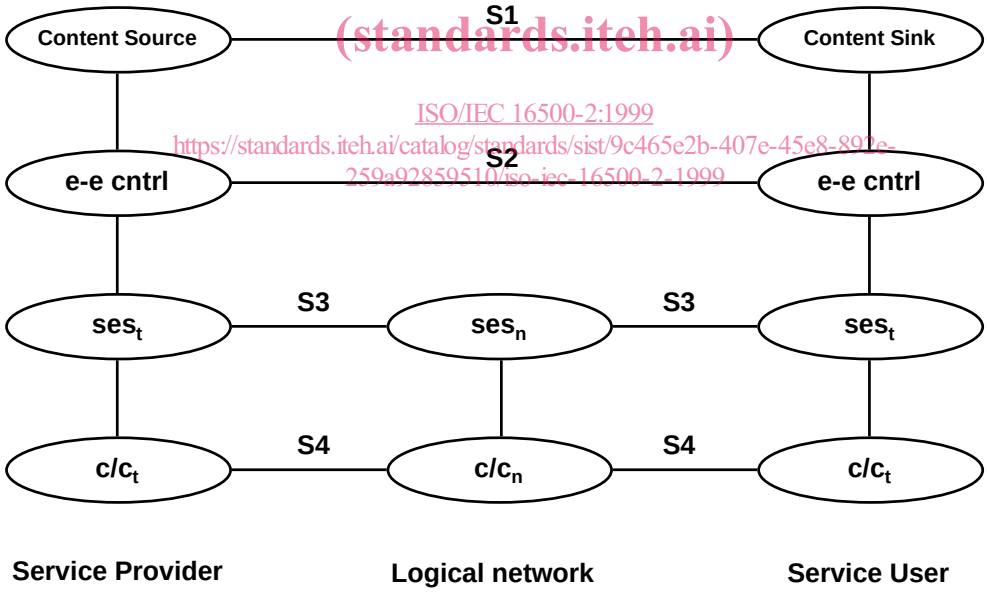
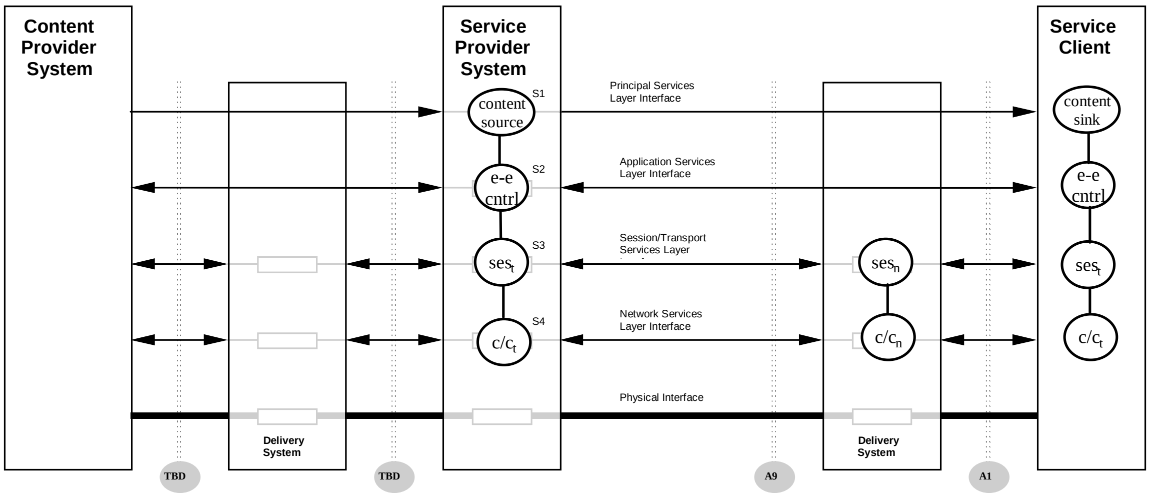


Figure 9.2-1 — Functional Entities and Relationships of a DAVIC System Instance

Figure 9.2-2 shows a mapping of the dynamic functional entities onto the DAVIC static Systems Reference Model. It should be noted that this figure illustrates, for simplicity, only the physical scenario in which the Service Client (i.e., the Set Top Unit) contains call/connection control signaling (c/c(t)). In other scenarios, as shown in Figure 9.2-3, this entity is located within the delivery system, either in the access or core network, and is called "proxy signaling".



Note: In some physical scenarios, the c/c_t call/connection control entity shown in the Service Client (I.e., STU) is actually located inside the network (e.g., proxy signalling).

Figure 9.2-2 — Mapping of Dynamic Modeling Functional Entities to Systems Reference Model

9.2.2 Alternative DAVIC Physical Scenarios for the VoD Control Functional Entities

The DAVIC physical scenarios are a particular allocation of control functional entities (e.g., ses(t), ses(n), c/c(t), c/c(n)) to a specific physical entity or location within a DAVIC VoD system (e.g., STU, access network, etc.). This section also includes a physical scenario which describes the case when pre-provisioned connection resources (VP or VC) are utilized .

9.2.2.1 Physical Scenarios for Switched Connections (SVCs)

The three physical scenarios shown in Figure 9.2-3 are supported in DAVIC VoD. Physical scenario 1 is the only scenario supported for HFC when ATM is terminated in the access. All three scenarios are supported for ATM end-to-end. (Additional physical scenarios are introduced in the appropriate sections.)

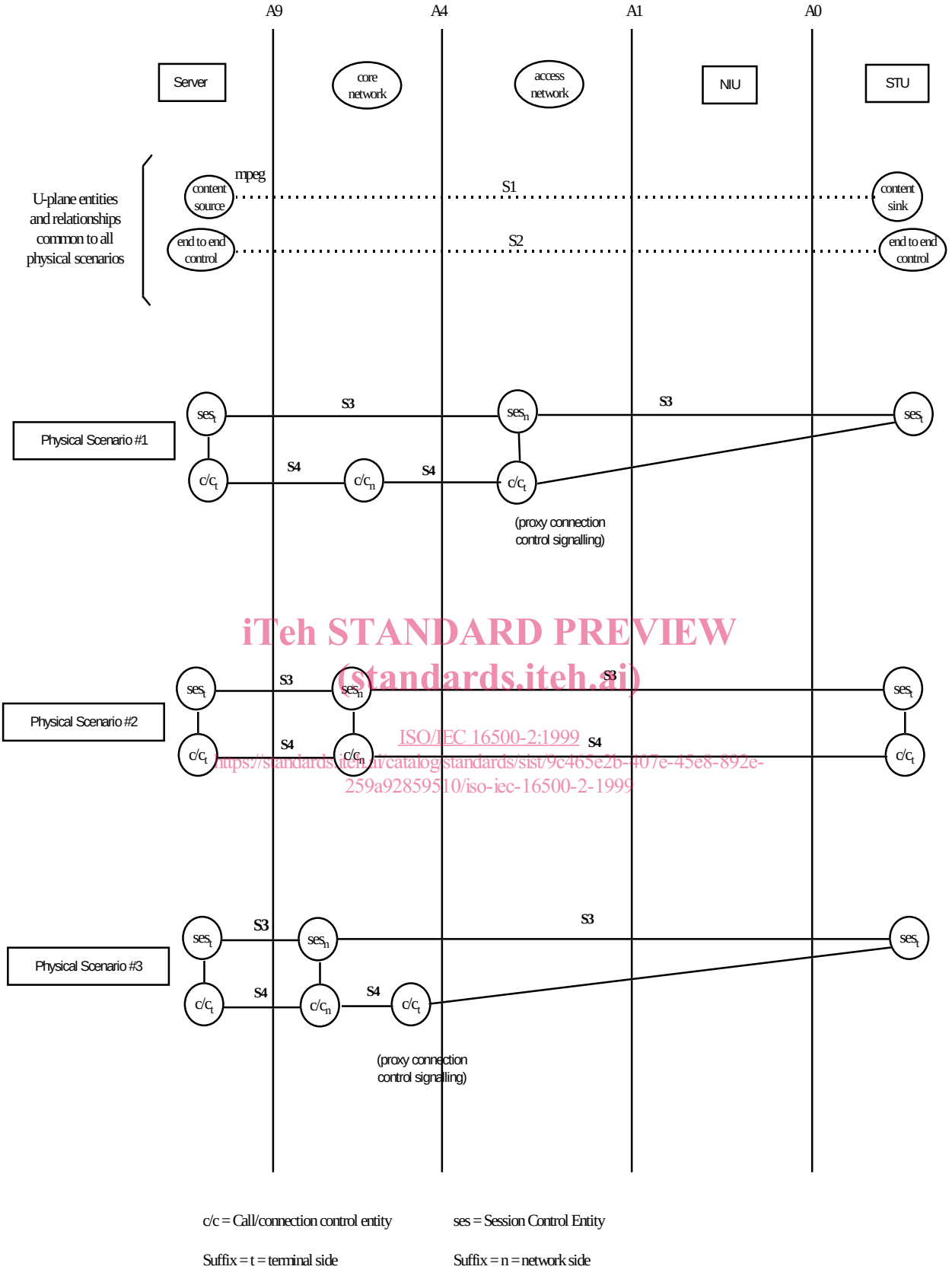


Figure 9.2-3

9.2.2.2 Physical Scenario 4, PVC, pre-provisioned connection resources

The physical scenario model depicted in Figure 9.2-4 shows the case where one or more than one static connection resources (VP or VC) are pre-provisioned. Case 4a shows both the ses(n) and CRM (Connection Resource Manager) located in the access whereas Case 4b shows both ses(n) and CRM located in the core network. As is the case for SVC's discussed earlier, only the Scenario 4a is supported for HFC when ATM is terminated in the access. Both 4a and 4b are supported for ATM end-to-end.

In the case of ATM access network, the connection resources may be end-to-end between the STU and the server, or the server side connection resources and the client side connection resources may be separate.

Physical Scenario 4a includes the case where the client side connection resources are not ATM connections but, rather, are HFC-specific resources providing MPEG transport streams. In this case, the CRM has the capability of establishing the connection between the ATM connections on the server side and the HFC resources on the client side.

In both of these scenario's (4a and 4b), the session manager ses(n) is co-located with a functional entity called CRM (Connection Resource Manager). CRM has knowledge about the pre-provisioned connection resources and selects an appropriate VC (and its VCI) when the ses(n) receives the request.

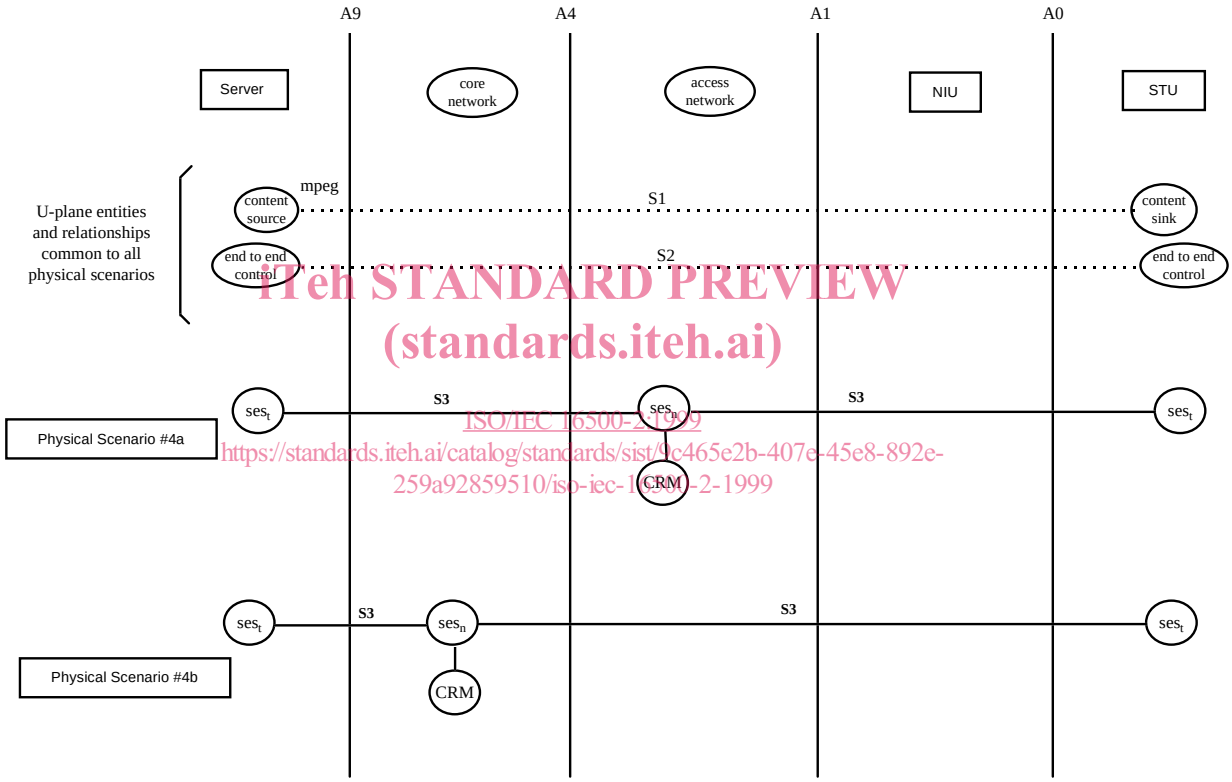


Figure 9.2-4

9.2.3 System Dynamic Flows for VoD

The dynamic behavior of a DAVIC system is described by sequences of information flows which carry information (e.g., parameters) between the control functional entities. Actions taken by functional entities as a result of the information received in these flows are described in clause 9.2.4. The parameters carried in these flows are specified in clause 9.2.5.

When interacting functional entities are located in separate physical equipment or different geographical locations, protocol messages are used to transport these parameters.