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SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Overall network aspects and functions – General network requirements and functions

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Network capabilities to support multimedia services: Example of multimedia retrieval service class – Video-on-demand service using an ATM-based network

ITU-T Recommendation I.375.2

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION I.375.2

NETWORK CAPABILITIES TO SUPPORT MULTIMEDIA SERVICES: EXAMPLE OF MULTIMEDIA RETRIEVAL SERVICE CLASS – VIDEO-ON-DEMAND SERVICE USING AN ATM-BASED NETWORK

Summary

This Recommendation specifies network requirements for one type of multimedia retrieval services, namely the Video-on-demand service. The Network capabilities to support the service are described by means of reference configurations and corresponding network architectures. Functional blocks in the architecture are identified and the physical and logical relationships among these blocks are described. Although assumptions must necessarily be made regarding the functionality of Customer Premises Equipment (CPE), specific requirements for CPE are outside the scope of this Recommendation.

This Recommendation focuses on IN-based solutions. Non-IN-based solutions are also included, but in much less detail.

General aspects of network capabilities to support multimedia services covering all service classes are provided in a separate Recommendation, I.375.1.

Source

ITU-T Recommendation I.375.2 was prepared by ITU-T Study Group 13 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 1st of June 1998.

Keywords

Functional groups, Multimedia services, Network capabilities, Reference configuration, Video-on-demand.

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

NETWORK CAPABILITIES TO SUPPORT MULTIMEDIA SERVICES: EXAMPLE OF MULTIMEDIA RETRIEVAL SERVICE CLASS – VIDEO-ON-DEMAND SERVICE USING AN ATM-BASED NETWORK

(Geneva, 1998)

1 Scope

This Recommendation specifies network requirements for the support of multimedia retrieval services. Network capabilities to support multimedia services and applications are described by means of reference configurations and corresponding network architectures. Functional blocks in the architecture, whether generic to the multimedia retrieval service class or specific to a service within the class, are identified and the physical and logical relationships among these blocks are described. Although assumptions must necessarily be made regarding the functionality of Customer Premises Equipment (CPE), specific requirements for CPE are outside the scope of this Recommendation.

This Recommendation focuses on IN-based solutions for multimedia retrieval services, e.g. Video-on-demand (VOD). Non-IN-based solutions for VOD are included in clauses 4 to 6, although not detailed.

General aspects of network capabilities to support multimedia services are covered in a separate Recommendation, I.375.1.

2 Multimedia retrieval services – Reference configuration

Multimedia retrieval services are characterized by point-to-point communication and unidirectional information exchange. The reference configuration for the multimedia retrieval services class is shown in Figure 1. It presents the functions of multimedia retrieval services to be supported by network capabilities.

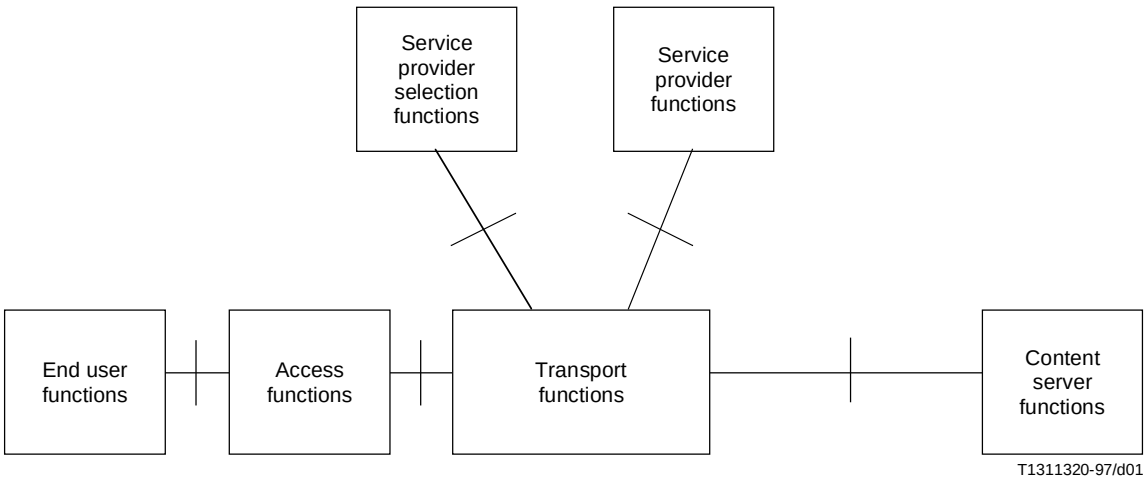

Figure 1/I.375.2 – Reference configuration for multimedia retrieval services class

The functional groups contain the following functions to be supported:

NOTE 1 – The following list may not necessarily be exhaustive.

- *End user functions*
  - Application control functions:

    These functions are needed to control the application by the exchange of messages between the end user and the content provider via the service provider. They differ from retrieval service to retrieval service and will therefore not be described on this level.
  - Network control functions:

    These functions are needed to control the network by the exchange of messages between the end user and the service provider. They also differ from retrieval service to retrieval service and will therefore not be described on this level.
  - Information handling functions, e.g.:
    - Access control functions:

      These functions are related to security aspects, e.g. needed to ensure authentication and authorization.
    - Information conversion.
    - Information encoding and decoding.
    - Information encryption and decryption.
  - Data stream termination functions, e.g.:
    - ATM termination (if applicable).
    - MPEG-2 transport stream termination (if applicable).
    - Error correction handling.
- *Access functions*
  - End user interface termination function.
  - Transport interface termination function.
  - Access bearer handling.
  - Bearer channel concentration.
  - Signalling and packet information multiplexing/demultiplexing.
  - Circuit emulation for the ATM transport.
  - Multiplexing/demultiplexing.
  - Cross-connect function including grooming and configuration.
- *Transport functions*
  - Point-to-point transport of bearer information (user information).
  - Point-to-point transport of protocol information for signalling.
  - Point-to-point transport of protocol information for operation and maintenance.
  - Network control functions.
- *Service provider selection functions*
  - Termination of network control functions.
  - Selection of service provider.
  - Navigation functions related to the service provider.
- *Service provider functions*
  - Content selection functions.
  - Broker functions.
  - Billing functions.
  - Navigation functions related to the content server, including Directory services.

- *Content server functions*

  – Application preparation and storage.

  – Termination of application control functions.

NOTE 2 – The Servers from which content is loaded onto the Content Server Functions as well as the network through which this process is carried out is outside the scope of this Recommendation.

These functional groups are separated by reference points. The definition and description of the reference points is for further study.

3 The video-on-demand service

VOD is an interactive multimedia retrieval service providing residential and business users individual access from their home or workplace to a remote library of recorded video programs for entertainment, distance learning, remote education and training, information, etc. The features of VOD can be compared with renting a film from the local video store, watching the video using a Video Cassette Recorder (VCR), and controlling the presentation of the video by functions similar to those of a VCR.

4 The reference configuration and its functional elements

Two examples of reference configurations, one with and one without Intelligent Network (IN), and the functions of their major elements for VOD are given. Those reference configurations (Figures 2 and 3) are derived from the general reference configuration in Figure 1. These network functions could, with possibly necessary amendments, also support other residential and business multimedia services/applications such as Advanced Pay Per View (APPV), Games, Home Shopping, Joint Editing, Multimedia Mail, Targeted Advertisement, Interactive Distant Learning, etc.

This Recommendation addresses a two-level selection mechanism in order to retrieve information content. However, this does not imply that the two-level selection should be used always.

Different scenarios for VOD provision are possible depending on Level 1 and Level 2 selection functionality and on the degree of IN integration in a B-ISDN environment as follows:

- without the support of IN;
- IN provides only authentication and address information of Gateways and Servers;
- IN provides access to and use of Intelligent Peripheral (IP) with Specialized Resource Function (SRF) at Level 1 selection;
- IN provides Specialized Resource Function (SRF) at Level 2 selection.

It is also assumed that Intelligent Network (IN) functions (Figure 3) that encompass Broadband ISDN requirements are used as a target solution; i.e. in Figure 3, the IN functional elements SCP, IP, SCF, SRF, etc. cover besides N-ISDN also B-ISDN requirements. Besides other functionalities, the IN may provide Level 1 selection functionality for the Service Provider Selection for multimedia services/applications. As an evolutionary step and in particular in smaller networks, VOD may also be implemented without the support of IN (Figure 2).

These reference configurations also contain Network Management System functions (TMN).

The reference configurations given indicate Reference Points (RPs) between the functional elements. These are used to identify the physical interfaces and logical interrelations between the network elements of the VOD delivery system.

The reference configuration presented in Figure 3 is intended as a solution in which ATM transport functions are used throughout the network. The evolutionary path to implement this reference configuration may be done in stages by using sub-configurations of this reference configuration (see, for example, subclause 4.2 on Access Network).

The reference configurations for VOD are represented by four major functional areas named as follows:

- Customer Premises Equipment Functions (CPE).
- Access Network Functions (ACCESS).
- ATM Core Network Functions (ATM CORE).
- VOD Server System Functions.

The functional elements of these four areas and their functionality are described in detail in the following subclauses. A further description of the IN Functional Entities realized in the functional elements of the VOD delivery system is provided in Annex A.

The selection mechanism provided by the VOD Service to the user to select the information to be retrieved is a two-level selection mechanism: Level 1 offers the selection of the service provider (e.g. Level 1 gateway), and Level 2 offers the selection of the VOD content, i.e. of the video program, within a service provider's domain. This two-level selection mechanism is reflected in the VOD reference configuration by two individual functional elements of the VOD delivery system, one for the Level 1 selection: the Service Provider Selection [may be provided by the network operator in the ATM core network functional area or by a separate service providers' broker (or possibly also a service provider)] and another for the Level 2 selection: the Content Selection (provided by the service provider in the VOD server system). This two-level selection mechanism is also reflected in the description of the functional interactions in clause 7.

4.1 Customer premises equipment functions

The functional area Customers Premises Equipment Functions (CPE) includes in the described scenario the functions of devices at the customer's (user's) home used to provide VOD. The functions of the CPE for VOD include the functions of **Set Top Box (STB)** and functions of the **Terminal Equipment (TE)**. The TE, in the case of VOD in the residential environment, may be a TV set. The TE may also include existing equipment such as Work Stations, Personal Computer (PC), Telephone, etc., for VOD and/or other services.

The **STB** functions present to the user various forms of menus and selection objects, and other typical graphical user interfaces. They contain the necessary hardware and software functions to provide VOD services in the home. The STB acts as an interface and an adaptation unit between the NT and the TE.

The STB functions provide the platform on which the service's user application runs, and the infrastructure for user applications to offer sophisticated user interfaces.

If the STB does not contain the procedures needed for control of selection processes and applications, the relevant software may be downloaded by an "STB Server" [in Figure 2 as part of the Service Related Control and in Figure 3 as part of the Intelligent Peripheral (IP)] and/or the Content Selection as part of the VOD Server System.

Depending on the functional scenario, the STB may support a basic and partly optional set of features, as shown in Appendix I. The list of functions is not exhaustive and is provided as a basis for further study of network capabilities to support VOD.

4.2 Access network functions

The Access Network Functions (ANF) support the physical interconnection and information transport of video streams (e.g. 1.544-8 Mbit/s), and of signalling and interactive data and control bit streams between the CPE and the ATM Core Network (ATM node). Dependent on the different access media and topologies used, different access functions have to be provided.

In the long term, network operators will preferably implement all-fibre access networks. But in the short term, the introduction of VOD will be primarily based on existing and upgraded access infrastructures using different transmission media.

The long-term and target solution will use ATM from the ATM core network till the CPE. But as evolutionary steps and as interim solutions, ATM may also be terminated in the AU of the access network.

The main alternatives of distribution technologies with different transmission media and topologies within the access network shown in Figure 4 are (not exhaustive):

- UTP (Unshielded Twisted Pair).
- Pure coax (current CATV).

  NOTE – CATV is upgraded by upstream channels. Upstream channels may also be provided by separate network, e.g. N-ISDN, PSTN.

- HFC (Hybrid Fibre Coax) with coax bus (concatenated fibre coax).
- HFC with coax star (concatenated fibre coax).
- Hybrid Fibre UTP with UTP star (concatenated fibre coax).
- Broadband Passive Optical Network with ATM (BPON).
- Point-to-point fibre access network.

The ANFs contain **Network Termination Functions (NTFs)** and **Access Unit Functions (AUFs)**.

- The **NT** terminates the public network and its functions support several interfaces to the users, e.g. for CATV, N-ISDN, B-ISDN (ATM), PSTN, etc. This includes transmission media such as Coax or Unshielded Twisted Pair (UTP) for broadcast and interactive video services, CATV, telephony, N-ISDN, B-ISDN, data access (e.g. Ethernet), or others respectively, via standard interfaces.

  The demarcation between the NT functions and the STB functions is indicated in Figures 2 and 3 as Reference Point 1 (RP1). However, it is open at this time what functions will remain in the STB and what will be implemented in the NT.

- The **AU** functions provide a standard (uniform) interface between the AN and the ATM CORE Network. Between the AU and the NT, several distribution technologies such as Hybrid Fibre Coax (HFC), Broadband Passive Optical Network (BPON), Radio, etc., may be used. In Figure 4, several AUs are shown, each of them dedicated to a particular transmission medium. Depending on the access medium and topology used, one or several alternatives of access network functions are supported. The demarcation between the AN functions and the functions of the ATM Core Network (ATM node) is indicated as Reference Point 2 (RP2).

4.3 ATM core network functions

The **ATM Core Network**'s main functions are to provide the main switching functionality and to allow for the flexible allocation of bandwidth needed by users of VOD. The ATM Core Network functions are composed of **ATM Node Functions** and the **Service Provider Selection** Functions. They are visualized in Figure 2 for a non-Intelligent Network (IN)-based solution, and in Figure 3 for an IN-based solution of VOD. The Service Provider Selection contains in the non-IN-based solution the functional elements **Session Related Control** and **Service Related Control** and in the IN-based solution the IN functional elements Service Control Function and Service Data Function, and Specialized Resource Function.

The **ATM Node Functions** provide routing and switching functions and contain for the IN-based solution the Broadband Service Switching Point (**B-SSP**).

The **Service Provider Selection Functions** provide control and management functions for the selection of the service provider by the user. This selection is Level 1 of the two-level selection mechanism (see clause 4).

The Session Related Control/SCF & SDF provides real-time processing of the user's call requesting (via the STB) an interactive service session. It contains service logic programs and a database with service, content provider and user related data. Within IN, the SCP communicates with every B-SSP using INAP. See Reference Point 3 (RP3). The Session Related Control/SCF & SDF determines the Service Related Control/SRF unit which can serve the user's request, and initiates its connection to the STB. After information from the Service Related Control/SRF about the user's selection of the service provider (RP7), it initiates the B-SSP to set up a

control channel between the STB and the functional entity for Content Selection (see below) as part of the VOD Server System.

The Service Related Control/SRF acts as the communication partner to the STB during user-interactive dialogue for the selection of the service provider (RP4). It receives and sends control information and may also send audiovisual information. It offers to the user interactive menus listing the available service providers, and optionally updated copies of content lists and additional information, e.g. tariffing. It may also serve the downloading of the STB with base application software, configuration parameters, and initial menus, if necessary. After the user's selection of the service provider, it informs the Session Related Control/SCF & SDF (RP7) in order to initiate the set-up of the relevant connection.

The **Service Management** functional element as part of the functions of the Service Provider Selection (in the case of IN-based solution the IN element **SMP**) provides service management functions for the Session Related Control and the Service Related Control (in the case of IN-based solution, the SCF & SDF and the SRF), such as collection, administration and update of Session Related Control (SCF & SDF) and Service Related Control (SRF) data, e.g. routing addresses, traffic statistics, billing data, video content navigation data. It provides features supporting the VOD service, such as:

- Routing and Address Screening[1] which are dependent on originating area, calling party address, traffic distribution scheme, load conditions, server status/availability, user related data, and user identification and authentication.
- Service related billing.
- Provision of statistical data.

4.4 VOD server system functions

The **VOD Server System** functions consist of two functional elements: the **Content Selection** functions (Service Provider functions) and the **Content Server(s) Video Server(s)** functions which may be realized in separate systems (Figures 2 and 3) or also together in one system. When realized in different systems they may be connected via the ATM BSN (RP8 and 5) or directly (RP11). They may be operated either by different service provider(s) and content provider(s) or by the same service and content provider. The functions of the Content Selection (or Gateway for Level 2 Selection) support and perform the service and content selection. These service gateway functions act as a service platform and contain functions for the content management.

After the Content Selection of the Service Provider selected by the user is connected to the user's STB, these gateway functions support the user selecting the video program, e.g. by offering service provider specific menus and acting as the communication partner to the STB functions during the user-interactive selection. These functions manage the set of video program material onto a group of Video (Content) Servers. After selection of the video program, these gateway functions initiate the set-up of the broadband channel between the Video Server and the STB for sending the selected video program. If video servers are physically distributed within the ATM core network, connection rerouting among these video servers might be accomplished by using call rerouting, possibly provided by ATM core network functions.

The Video Server or Content Server contains the video program material to be offered to the user, stored on mass storage, and is equipped with the capability to support user control. It delivers the video program under the control of the user's STB. Refer to Reference Point 5 (RP5).

The user, after selecting a program, receives this program at the viewing device. The Video Server provides functionality for the user to interactively control the display of the program (e.g. PLAY, PAUSE, REWIND, etc.).

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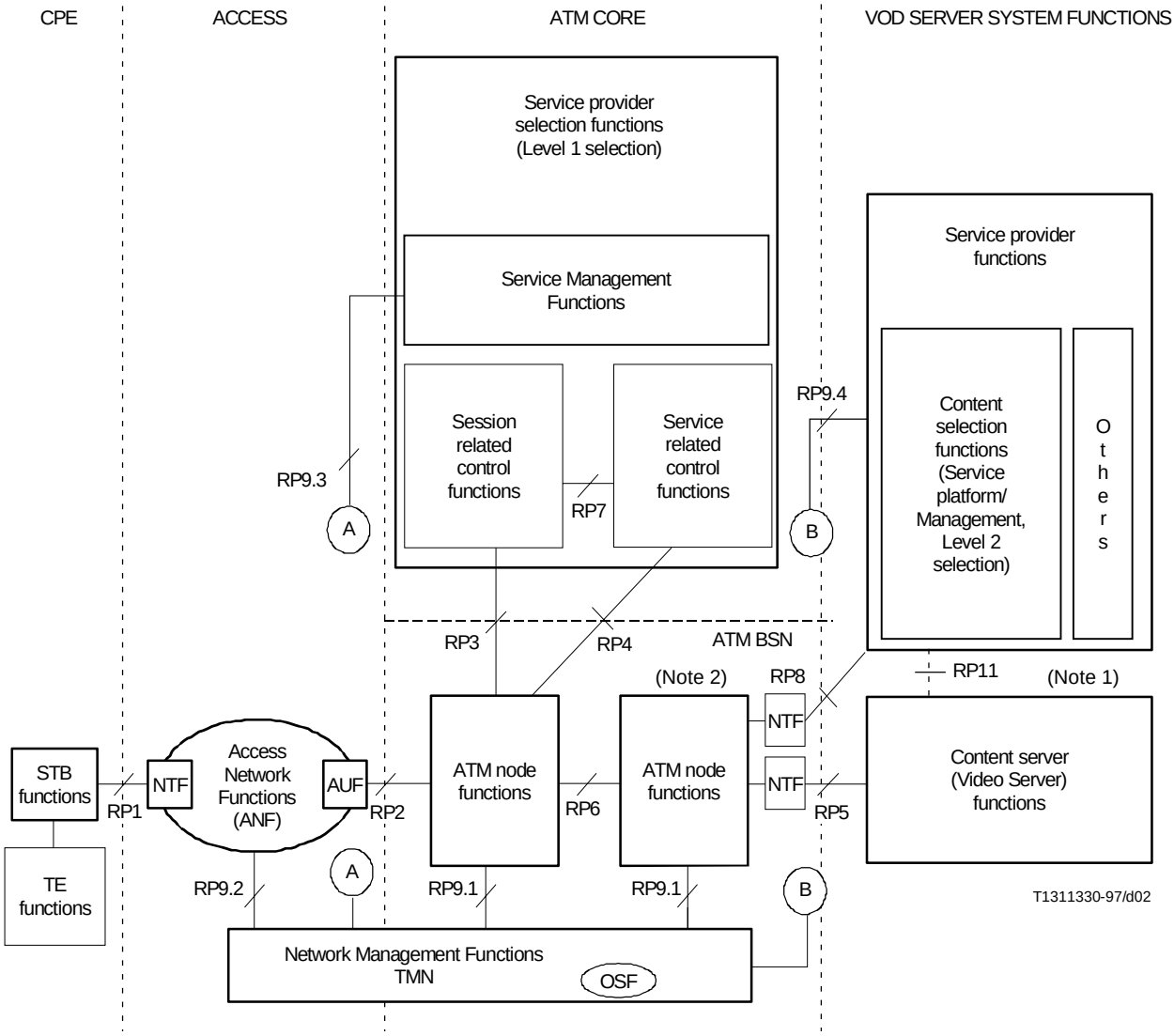
[1] Screening provides the capabilities to compare an incoming source address of a user's service request with the reference list of users authorized to use the service. The reference list may be an "allow list" or a "deny list" containing the authorized or non-authorized users, respectively.

It should be noted that the Service Platform and Management functions in the Content Selection and the Content Server control functions may also be supported by the Intelligent Network.



ACCESS	Access Network functional area
ATM BSN	ATM Broadband Switching Network functional area
ATM CORE	ATM Core Network functional area
ANF	Access Network Functions
AUF	Access Unit Functions
CPE	Customer Premises Equipment functional area
TMN	Telecommunications Management Network
NTF	Network Termination Functions
OSF	Operations System Function
RPn	Reference Point
STB	Set Top Box
TE	Terminal Equipment

NOTE 1 – At RP11, it has to be studied whether and what type of interface should be standardized. The Gateway Content Selection and the Video (Content) Server functional elements may be realized in one system (no interface necessary) or may be connected either via a proprietary or via a standardized interface when realized in separate systems. This interface has to be standardized. In the case that both those elements are realized in separate systems and will be connected via a transport network, e.g. ATM core network, no interface at RP11 but interfaces at RP5 and RP8 have to be standardized.

NOTE 2 – The ATM BSN is to be viewed as part of the ATM CORE network functional area.

Figure 2/I.375.2 – Video-on-demand reference configuration

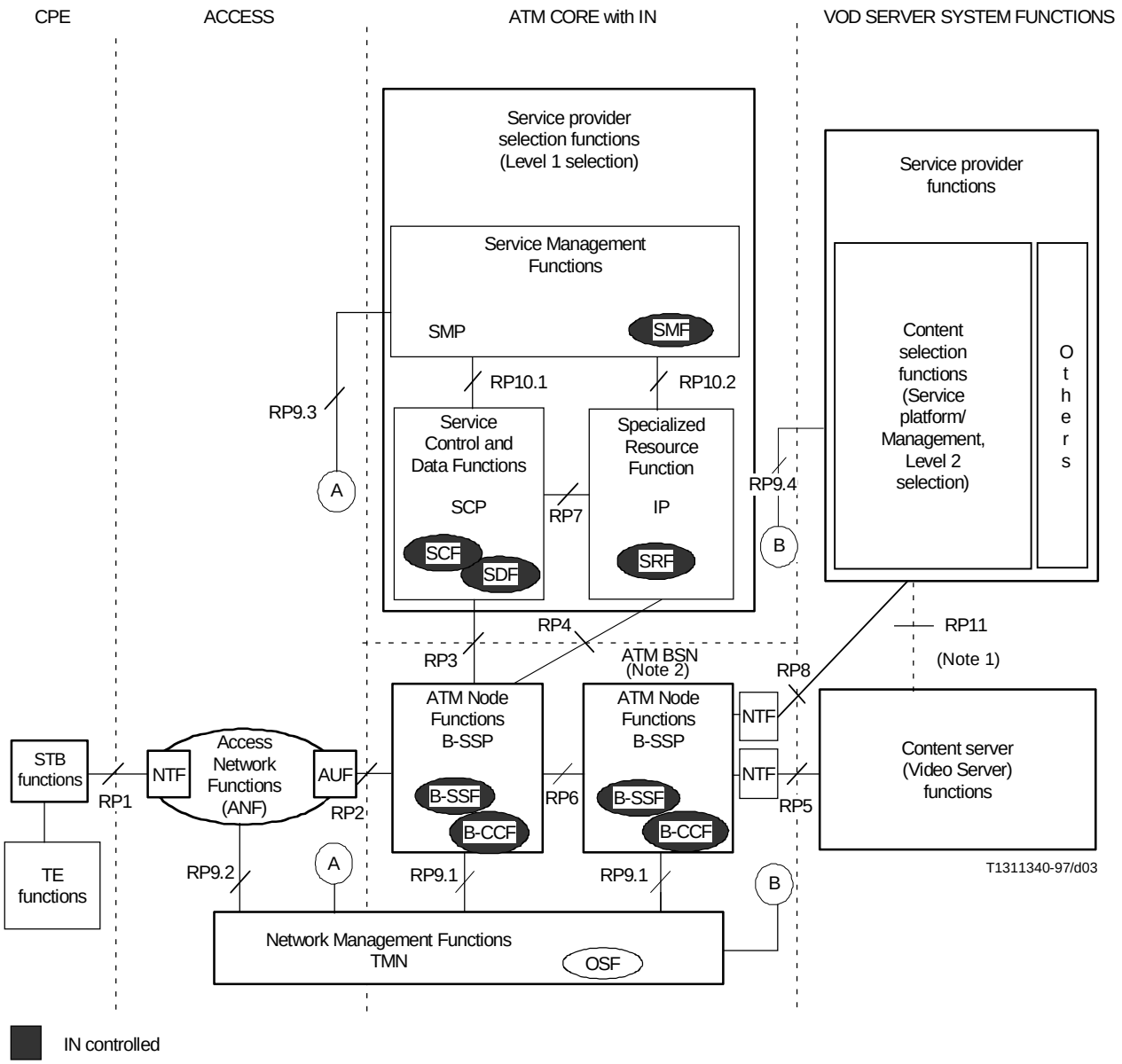


Figure 3/I.375.2 – Video-on-demand reference configuration with IN (target solution)

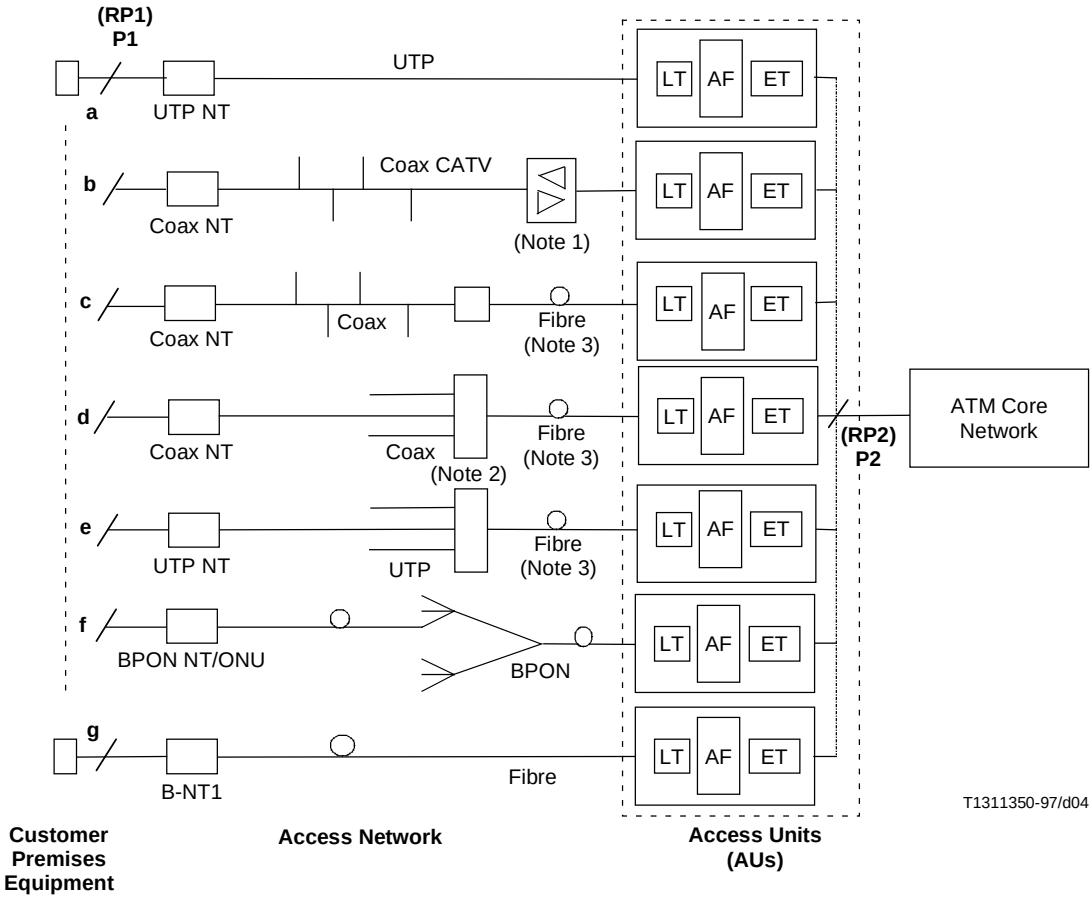
Legend and Notes for Figure 3/I.375.2:

ACCESS	Access Network functional area
AN	Access Network
ANF	Access Network Functions
ATM BSN	ATM Broadband Switching Network functional area
AU	Access Unit (Access Node)
AUF	Access Unit Functions
B-CCF	Broadband Call Control Function
CPE	Customer Premises Equipment functional area
IN	Intelligent Network
IP	Intelligent Peripheral
NT	Network Termination
NTF	Network Termination Functions
OSF	Operations System Function
RPn	Reference Point
SCF	Service Control Function
SCP	Service Control Point
SDF	Service Data Function
SMF	Service Management Function
SMP	Service Management Point
SRF	Specialized Resource Function
SSF	Service Switching Function
SSP	Service Switching Point
STB	Set Top Box
TE	Terminal Equipment
TMN	Telecommunications Management Network

NOTE 1 – At RP11, it has to be studied whether and what type of interface should be standardized. The Gateway Content Selection and the Video (Content) Server functional elements may be realized in one system (no interface necessary) or may be connected either via a proprietary or via a standardized interface when realized in separate systems. This interface has to be standardized. In the case that both those elements are realized in separate systems and will be connected via a transport network, e.g. ATM core network, no interface at RP11 but interfaces at RP5 and RP8 have to be standardized.

NOTE 2 – The ATM BSN is to be viewed as part of the ATM CORE network functional area.

NOTE 3 – The B-SSP functional entities must cater for the possibility that the nodes of which they are a part may be in different transport networks.



AF Adaptation, multiplexing, cross-connect functions

NOTE 1 – CATV is upgraded by upstream channels. Upstream channels may also be provided by separate network, e.g. N-ISDN, PSTN.

NOTE 2 – Active star. Note that some or all of the functionality of these units may be encompassed within the functions of the AU.

NOTE 3 – May also be point-to-multipoint (PON).

Figure 4/I.375.2 – Possible access network topologies and media

5 Reference points

Based on the reference configuration(s) described above, Table 1 contains the proposed interfaces between the functional network elements. The reference points are those shown in Figures 2 and 3.

Table 1/I.375.2 – Reference points and interfaces

Reference point	Interface	Between		Type of interface	Comments
RP1	P1	STB	NT	To be determined (TBD)	This interface may provide for the following: CATV; B-ISDN (ATM); N-ISDN; PSTN; etc.
RP2	P2	Access Network	ATM Node	VB5	
RP3	P3	ATM Node	Session Related Control/SCF & SDF	TBD	In Figure 2, the interface is UNI. If Figure 3 is applicable, the interface is TBD and INAP is used.
RP4	P4	ATM Node	Service Related Control/SRF	UNI	Standard interface defined by Rec. I.432.
RP5	P5	ATM Node	Content (Video) Server	UNI	Standard interface defined by Rec. I.432.
RP6	P6	ATM Node	ATM Node	NNI	Standard interface defined by ITU-T.
RP7	P7	Session Related Control/SCF & SDF	Service Related Control/SRF	TBD	If Figure 3 is applicable, INAP is used.
RP8	P8 (Note 1)	ATM Node	Content Selection	UNI	Standard interface defined by Rec. I.432.
RP9.1 RP9.2	P9	Network Management	ATM Nodes, Access Network (Note 2)	TMN Interfaces	Under study by ITU-T.
RP9.3 RP9.4	– (Note 3)	Network Management	Service Management functions of Service Provider Selection, Content Selection	–	
RP10.1 RP10.2	– (Note 4)	Service Management Functions	Session/ Service Related Control; SCF & SDF/SRF	–	
RP11	(Note 5)	Content Selection	Content (Video) Server	TBD, (Note 5)	

NOTE 1 – At RP8, an interface P8 has to be defined in the case that the Content Selection and the Video (Content) Server will be realized in separate systems and has to be standardized when connected via a transport network, e.g. ATM core network (Figures 2 and 3). Both functional groups may also be directly connected via a proprietary interface. No interface between those functional groups is necessary when they are realized in one system.

NOTE 2 – At RP9.1 and RP9.2, it has to be studied whether P9 is appropriate for both the ATM Node and the Access Network.

NOTE 3 – It has to be studied whether at RP9.3, RP9.4 (Figures 2 and 3) interfaces are to be standardized or TMN messages will be carried via interfaces P9 and P3 (or P4), or P9 and P8 (Note 1) respectively.

NOTE 4 – No interfaces are identified.

NOTE 5 – At RP11, it has to be studied whether and what type of interface should be standardized. The Content Selection and the Video (Content) Server functional elements may be realized in one system (no interface necessary) or may be connected either via a proprietary or via a standardized interface when realized in separate systems. In the case that those elements are realized in separate systems and connected via a transport network, e.g. ATM core network, no interface at RP11 but interfaces at RP5 and RP8 have to be standardized.

6 Logical interrelations

In addition to the interfaces, logical interrelations between the functional elements of the VOD system elements are described. Logical interrelations between communicating functional entities provide for the flow of information between those peer-to-peer entities. Logical interrelations span one or more interfaces (and/or reference points) and several VOD system elements. Each logical interrelation has two endpoints assigned to the communication entities or systems using it. The endpoints are (or may be) connected through a permanent, semi-permanent, or switched communication channel characterized by transport network interfaces. A logical interrelation is characterized by the communication protocols on the layers above those of the transport network.

In the following, logical interrelations so far identified are listed and mapped to the interfaces between the VOD system elements (Figure 5 and Table 2). Figure 5 illustrates the location of the logical interrelations L1-9 (without those to TMN) via the interfaces P1-8.

The mapping of the logical interrelations to communication phases, and the description of communication phases by information flows for an IN-based VOD session are provided in clause 7.

7 Communication phases and information flows of IN-based VOD solutions

This clause provides a description of an IN-based VOD session (defined by the user-to-user VOD application) by means of the communication phases (Table 3) and visualization of information flows (Figures 6 and 7) between the elements of the VOD delivery system (based on the reference configuration given in Figure 3). These communication phases are mapped to the logical interrelations Ln described in clause 6 (Figure 5). This clause provides some indication of what functional elements are involved and which components communicate with which others. The order presented here indicates the rough form of chronological order of communication.

The two-level selection mechanism for the selection of information to be retrieved by the user is described in clause 4.

Assumptions:

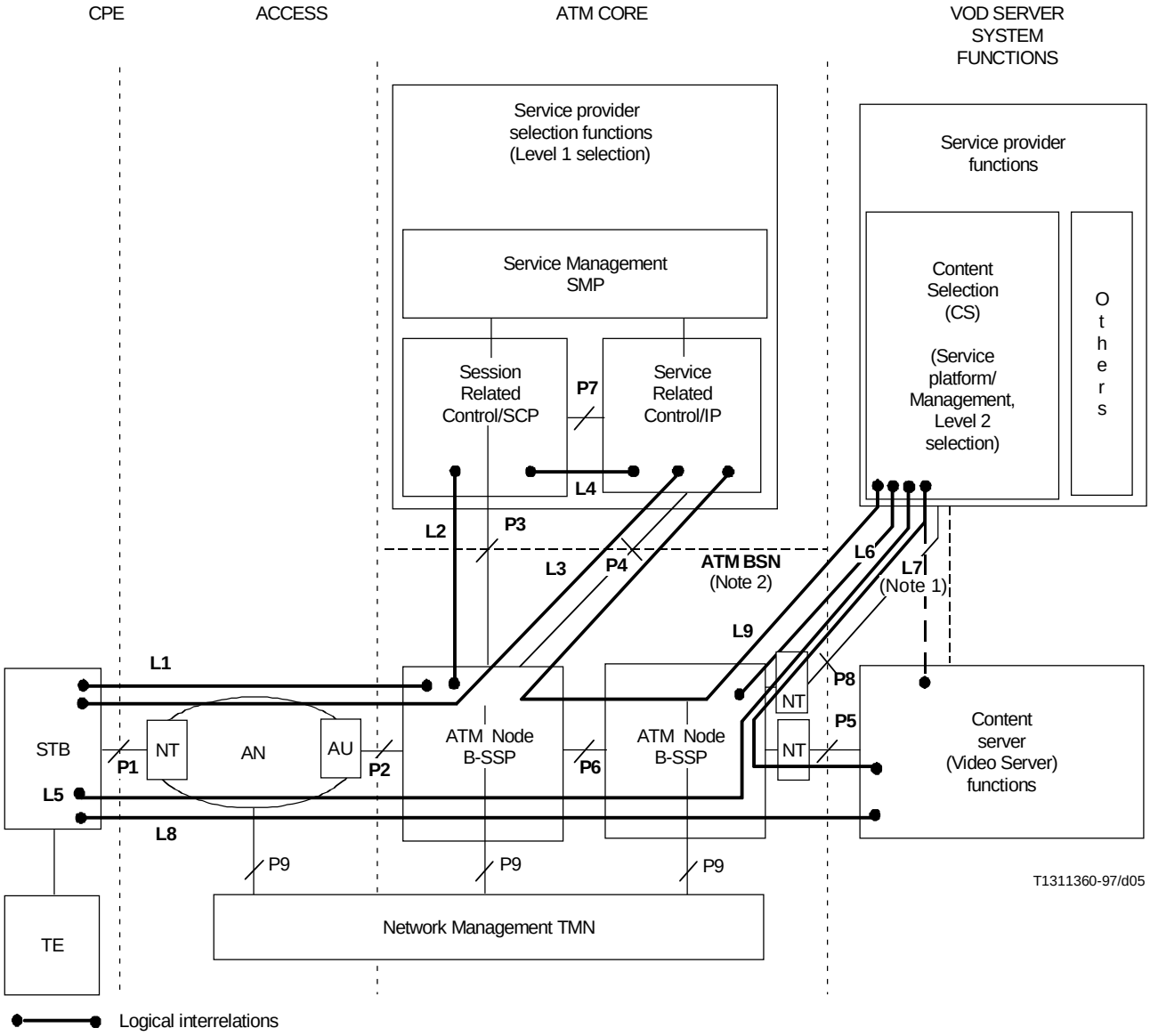
- The STB may contain all control and communication procedures needed for control of, for example, selection processes and applications. If the STB does not contain the necessary procedures, it may be downloaded by the IP in the Service Provider Selection. For the latter case, the functional interactions for STB downloading are described here. The STB may be downloaded with an initial interactive application (e.g. service selection software or primitive operations menu). Further, the STB may run in a "stand-by" mode when switched "off" which will preserve this downloaded software thereby preventing the need to download the STB for each session (i.e. download is only needed when the STB is "cold started" or detects the need to download new software, e.g. software update). However, a downloaded STB is not a requirement.

- The interface between the STB and the NT is to be standardized (refer to RP1 in Figures 2 and 3). However, it is open at this time what functions will remain in the STB and what will be implemented in the NT. Therefore, for the purpose of these functional interactions, there is no distinction between the STB and the NT and will be referred to as, simply, the "STB."

- An ATM broadband network (B-ISDN) is used in both the transport and access network.

- The Access Network (AN) is transparent to the communications and signalling. In other words, any messages (signalling or control) which are sent or received by the STB are "transparently" transferred to their destination. For example, any signalling done by the STB to set up a network connection is passed through the AN to the ATM Node/B-SSP.

As far as possible, existing signalling messages should be used to realize the functional relationships. The definition and standardization of signalling and control messages, e.g. between the STB and the Video Server, to control the delivery of video is outside the scope of this Recommendation. In Table 3, the performance of the functional interactions by Signalling Messages will be indicated with ***SM*** and by Control Messages will be indicated with ***CM***.



AN	Access Network
ATM BSN	ATM Broadband Switching Network functional area
AU	Access Unit
B-SSP	Broadband Service Switching Point
CS	Content Selection
IP	Intelligent Peripheral
Ln	Logical Interrelation
NT	Network Termination
Pn	Physical Interface
RPn	Reference Point
SCP	Service Control Point
SMP	Service Management Point
STB	Set Top Box
TE	Terminal Equipment

NOTE 1 – TMN-Telecommunications Management Network L7 may go either via P8, the ATM Node, and P5, or via an interface that may be defined associated with RP11.

NOTE 2 – The ATM BSN is to be viewed as part of the ATM CORE network functional area.

Figure 5/I.375.2 – Logical interrelations in the VOD system

Table 2/I.375.2 – Mapping between logical interrelations and interfaces

Logical interrelations / Interfaces	L1	L2	L3	L4	L5	L6	L7	L8	L9	(Mn)
P1	x		x		x			x		
P2	x		x		x			x		
P3		x								
P4			x						x	
P5							x	x		
P6					x			x	x	
P7				x						
P8					x	x	x		x	x
P9 (Note 1)										x
(RP9.3, RP9.4) (Note 1)										x
(RP10.1, RP10.2) (Note 1)										x
(RP11)							x (Note 2)			

NOTE 1 – For completeness, Table 2 contains besides the logical interrelations Ln also the logical interrelations Mn between the TMN and ATM Nodes, Access Network, and Service Management of Service Provider Selection and Content Selection via P9, RP9.3, RP9.4, and RP10.1, RP10.2 (Figures 2 and 3).

NOTE 2 – L7 may go either via P8, the ATM Node, and P5, or via an interface that may be defined associated with RP11.

Table 3/I.375.2 – Communication phases and information flows

Logical interrelations Ln	Communication phases	Information flows
EVENT 1: Set Top Box initial download		
L1	1.1	**Boot Request: Set Top Box (STB) ⇒ B-SSP *SM*** When the STB is activated (cold start or reset), it will send an initial download request to the network. This request will be trapped by the B-SSP at a trigger point causing a query to the Service Control Point (SCP) which determines the address of the Intelligent Peripheral (IP)/STB server for download of the specific STB type.
L2	1.2	**IP/STB-Server Query: B-SSP ⇒ SCP *SM*** The B-SSP queries the SCP for the address of the appropriate IP/STB-Server to which the STB should be connected.
L2	1.3	**Resolved IP/STB-Server Address: SCP ⇒ B-SSP *SM*** The SCP will instruct the B-SSP to switch the STB to the IP/STB server.
L3	1.4	**STB server downloads STB: STB ⇔ IP *CM*** IP/STB server downloads the Operating System and base application software needed to interact with the Gateway Service Provider Selection.
EVENT 2: Video-on-demand session		
L1	2.1	**Request interactive session: STB ⇒ B-SSP *SM*** The STB will send a VOD session request. This request will activate a trigger point in the B-SSP causing a query to the SCP (within the Service Provider Selection).
L2	2.2	**IP Query: B-SSP ⇒ SCP *SM*** The B-SSP queries the SCP for the address of the appropriate IP (within the Service Provider Selection) for the subscriber. The SCP will determine what available IP can serve the request.

Table 3/I.375.2 – Communication phases and information flows *(end)*

Logical interre-lations Ln	Commu-nication phases	Information flows
EVENT 2: Video-on-demand session *(cont.)*		
L2	2.3	**Resolved IP address: SCP ⇒ B-SSP *SM*** Routing information is returned to the B-SSP which sets up the SVC (Switched Virtual Connection) between the STB and IP.
L3	2.4	**Selection of service provider: STB ⇔ IP *CM*** The user interacts through the STB with the IP to select the desired service provider. The IP may set up a broadband channel to the STB to send information (e.g. Audio/Visual clips) to the user as part of the selection process.
L9	2.5	**User related data: IP ⇒ GCS *CM*** If the IP does not have all user verification data, the IP may signal to the Content Selection (GCS) user related data in order to make the GCS verify user's access permission and succeed user status (e.g. user's STB type) to the GCS.
L9	2.6	**User verification: GCS ⇒ IP *CM*** In the case where user access verification is made by the GCS, the GCS reports the result of user access verification to the IP.
L4	2.7	**User's selection: IP ⇒ SCP *CM*** The IP signals to the SCP information about the selected service provider and possibly user verification data.
L2	2.8	**Resolved VOD Server System/GCS address: SCP ⇒ B-SSP *SM*** In the case that the SCP controls the set-up of the connection between the STB and the service provider, the SCP (after user access verification by the IP or the GCS) then signals the B-SSP to switch the STB through to the GCS. Routing information is given to the B-SSP which will transfer the control channel to the GCS of the VOD Server System.
L5	2.9	**Selection of content: STB ⇔ VOD Server System/GCS) *CM*** The user interacts, through the STB, with the GCS of the VOD Server System to select the desired content (i.e. which video to view). The VOD Server System may, in addition, set up a broadband channel to the STB to send information (e.g. Audio/Visual clips) to the user as part of the selection process.
L6	2.10	**Routing addresses: VOD Server System/GCS ⇔ B-SSP *SM*** Once the user has selected a video to watch, the GCS will request a broadband (1.5-8 Mbit/s depending on video quality) unidirectional channel from the Video (Content) Server to the subscriber's STB for the video and possibly a narrow-band channel for the user's control of the video.
L7	2.11	**Selected video: VOD Server System/GCS ⇒ Video Server *CM*** The GCS informs the Video (Content) Server about the selected video.
L8	2.12	**Delivery and control of video: VOD Server System/Video Server ⇔ STB *CM*** After the broadband channel is switched through, the Video Server sends the selected video to the user (via the STB). The video is sent using compression and communication standards (e.g. MPEG-2). The user interacts through the STB with the Video Server (either via an additional backward channel from the STB to the Video Server, or via the control channel from the STB to the GCS and the connection between GCS and Video Server).
L7, L6	2.13a, 2.13b	**Release request: Content Server ⇒ GCS ⇒ B-SSP *CM*, *SM*** The Video Server requests via the GCS that the B-SSP release the video channel to the STB at the end of the video (or as a result of user actions).
L5, L6	2.14a, 2.14b	**Termination of the service/additional selection:** **VOD Server System/GCS ⇔ STB, GCS ⇒ B-SSP *CM*, *SM*** The GCS interacts with the user through the STB to provide additional selection or termination of service. The GCS requests that the B-SSP release the control channel to the STB when the user has selected to termination of the VOD session.

Figures 6 and 7 provide a graphical representation of the functional interactions flows described above. Please note that the figures only represent the main functional relationships and do not specify exact messages or protocols. Additionally, all signalling relations are expected to be realized by standard signalling messages that are not service-dependent.

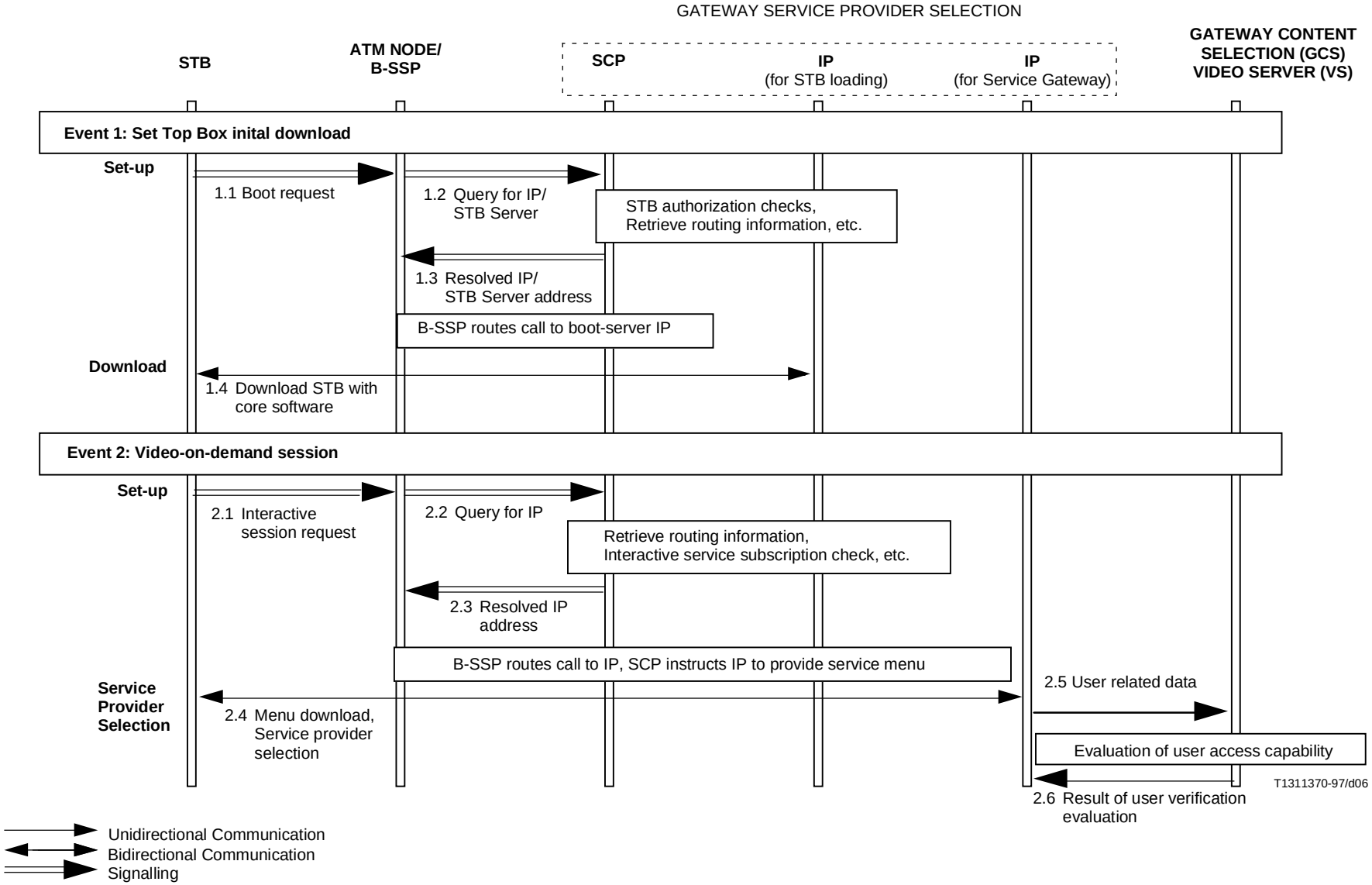


Figure 6/I.375.2 – Message flows for VOD (part 1)

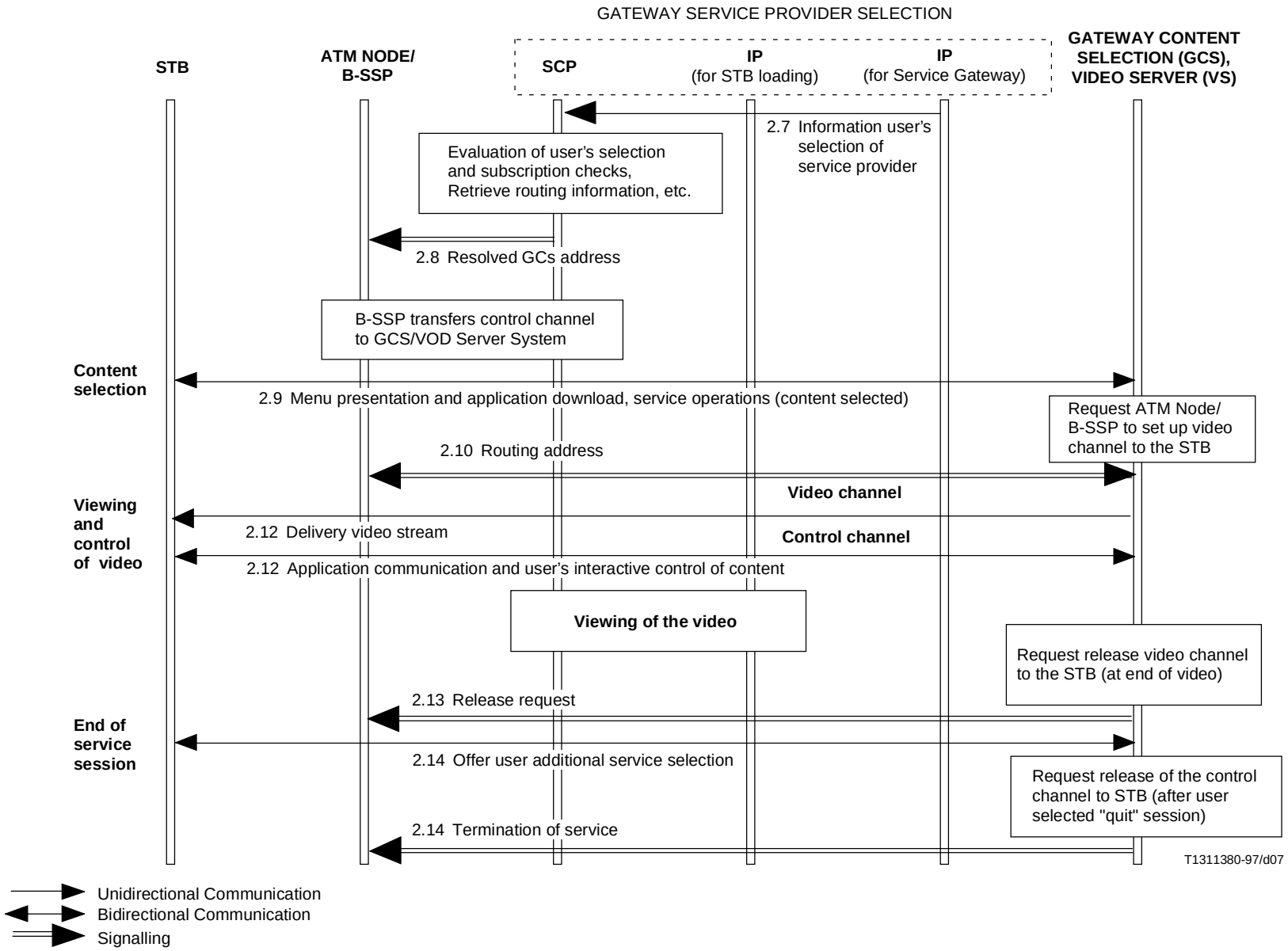
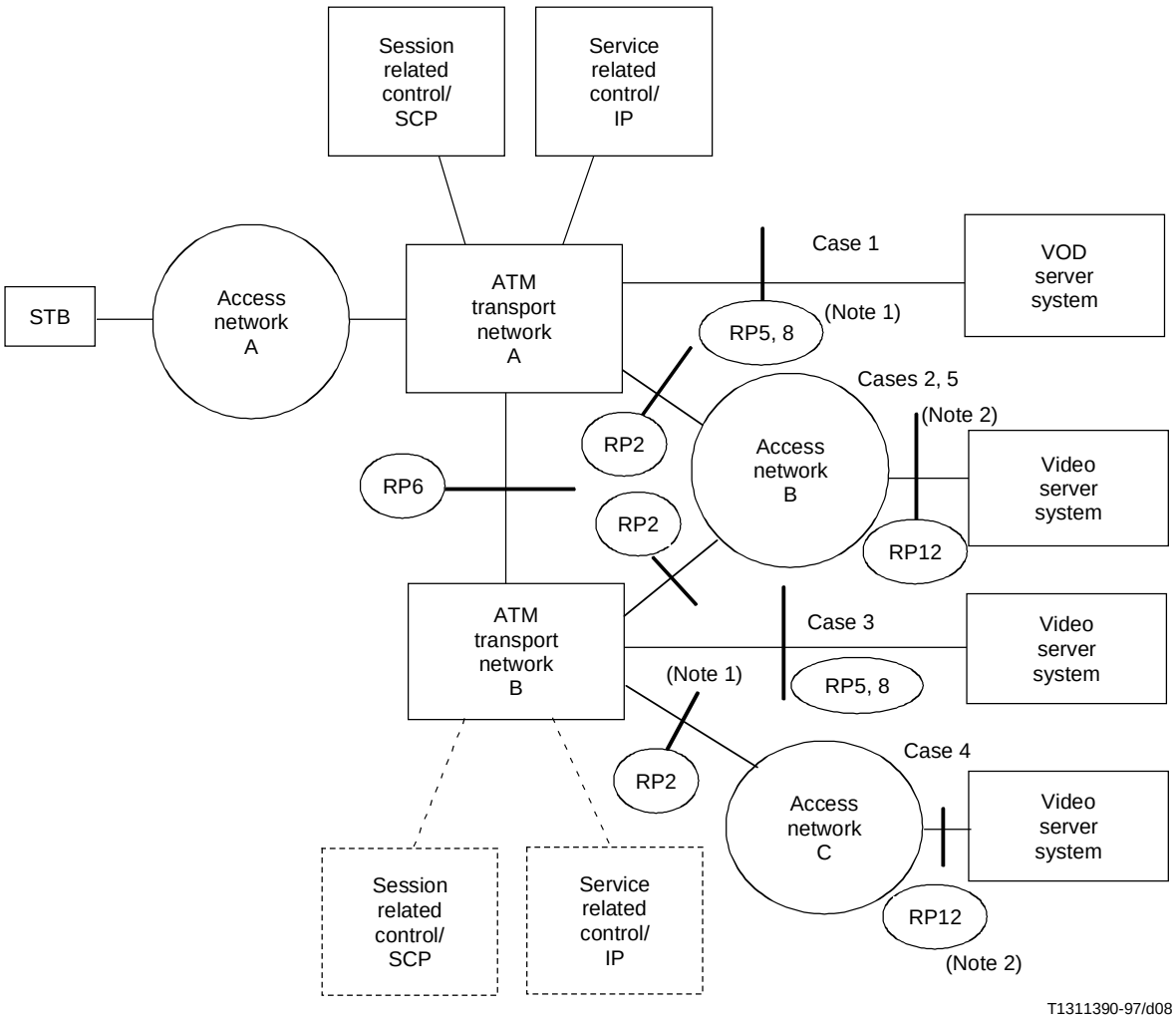


Figure 7/I.375.2 – Message flows for VOD (part 2)

8 VOD server system connection alternatives

Since VOD service might be provided through multiple network operators, several alternatives for connecting VOD Server System Function are illustrated in Figure 8. Case 1 depicts the case where the VOD Server System Function is connected via a single ATM transport network. Case 2 depicts the case where the VOD Server System Function is connected via an access network (Access Network B) in addition to the ATM Transport network A. Case 3 depicts the case where the VOD Server System Function is connected via two ATM transport networks (ATM Transport Networks A and B). Case 4 depicts the case where the VOD Server System Function is connected via Access Network C in addition to two ATM transport networks. Case 5 is similar to Case 4, but in this case the connection is provided through Access Network B instead of Access Network C.

Interworking scenarios between multiple networks and required functions for the reference points shown are for further study.



NOTE 1 – It has to be studied whether the Video Server System can be connected via a UNI at RP5, 8 to the ATM Transport Networks A, B directly or only via an access network in between.

NOTE 2 – The interface at RP12 is a UNI.

NOTE 3 – The examples shown are not exhaustive.

Figure 8/I.375.2 – VOD server system connection alternatives

Annex A

Description of the IN functional entities realized in the functional elements of the VOD delivery system

A.1 ATM-Node, Broadband Service Switching Point (B-SSP)

A.1.1 Broadband Call Control Function (B-CCF)

The Broadband Call Control Function (B-CCF) performs call and connection handling for a broadband call in an environment where IN treatment of a call is possible.

- The B-CCF is responsible for establishing and controlling the connection related aspects of an IN service under the control of the SCF.
- The B-CCF is service independent but is programmed to recognize that a B-IN service request has taken place or needs to be continued.
- The B-CCF also detects certain events which may be used to collect statistics and billing data.
- In a physical deployment of the broadband IN-architecture, the B-CCF will reside together with the B-SSF in a Broadband Service Switching Point (B-SSP).

A.1.2 Broadband Service Switching Function (B-SSF)

The Broadband Service Switching Function interfaces with B-CCF and SCF. It allows the B-CCF to be directed, from a service control point of view, by the SCF in order to realize a service in the IN network. It is assumed that the B-SSF will be based on current Capability Set 2 (CS-2) IN standards with some extensions to accommodate a Broadband call state model.

- The B-SSF communicates with the SCF via the Intelligent Network Application Protocol (INAP) amended for broadband IN by specific broadband issues such as bandwidth and grade of service.
- The B-SSF interprets the service request and call state information. For example, for an IN call set-up, it builds a standardized query and sends the query via the INAP protocol to the SCF.
- B-SSF receives, decodes and interprets the SCF response. It then provides explicit instructions to the B-CCF on how to complete the call set-up process.
- Instructions for charging and billing the service user (i.e. originator of call), as well as for collecting statistics data, are transferred via the B-SSF from the SCF to the B-CCF. The B-SSF, like the B-CCF, is service independent.
- In a physical deployment of the broadband IN-architecture, the B-SSF will reside together with the B-CCF in a Broadband Service Switching Point (B-SSP).

A.2 Service Provider Selection

A.2.1 Service Control Point (SCP): SCF Service Control and Service Data Functions

A.2.1.1 SCF Service Control Function

Real-time call related IN support of Interactive Multimedia Services such as Video-on-demand (VOD) is provided via the Service Control Function (SCF) and the Service Data Function (SDF). Typical IN functions of the SCF/SDF are at the network level, and include functions such as call routing (e.g. to the nearest Video Server), screening of service users, billing functions, and support of user procedures such as the selection of Service Provider.

It is assumed that the SCF amended for broadband IN will be based on the Capability Set 2 (CS-2) IN standards with some extensions to accommodate a Broadband call state model as well as the handling of the ATM interface. For example, capabilities such as origination of sessions from the SCF to the underlying B-SSF are not defined in current narrow-band standards and will need to be implemented to support broadband services.

- The SCF communicates to the B-SSF via standard Signalling System 7 (SS7). A B-INAP must be defined and standardized for this interface.

- The SCF processes incoming requests and access of the necessary service logic in real time. The SCF determines whether an incoming request is valid based on information such as STB identification, STB origin or other parameters.

- Service data related to the STB subscriber profile can reside at the SDF. This type of data includes information related to a particular Set Top Box (e.g. physical characteristics).

- The SCF collects and generates call processing and other statistical information if defined in the service logic.

- The SCF detects overload events and initiates suitable congestion control measures (e.g. automatic call gapping) to protect the IN against overload and to correct against this overload.

- The SCF may request billing data from the SSF and transmit call related billing data and statistical data to the SMF based on the specified billing method.

- The SCF will process irregular (e.g. "no navigation input from STB") events and act accordingly as defined by the service logic (e.g. "try to provide navigation data again").

- If the service requires it, the SCF may originate a broadband session (or call).

In a physical deployment of the broadband IN-architecture, the SCF and SDF may reside together in a Service Control Point (SCP).

A.2.1.2 Service Data Function (SDF)

The Service Data Function (SDF) contains user and network data necessary for the provision and operation of IN services. This information is available for real-time access by the SCF.

There are two types of data: Service data and Operational data.

Service data are the data held by the SDF and existing beyond the lifetime of the service request. They include subscriber profiles, service provider agreements, data used to authenticate a user wishing to access the database through the SCF (like PIN code), access rights, etc.

Operational data are those used in the B-SSF and SCF for the control and execution of the requested service.

The SDF provides the following functions:

a) Interfaces and interactions with the SCF for secured data acquisition and management.

b) Storing, managing and accessing data functionality.

c) Data exchange functionalities. They are needed to exchange information with the SCF.

d) Authentication functionalities and security access to Service data.

The SDF is able to authenticate users, assign user’s access rights, control user’s right to access specific data types held in the SDF, block data access, etc.

A.2.2 Intelligent Peripheral (IP): Specialized Resource Function (SRF)

The Specialized Resource Function (SRF) provides a pool of resources for access by other network entities. For example, the SRF provides the core Navigation service function for the Level 1 selection functionality.

- These resources include, but are not restricted to, the sending of data (e.g. files) needed to enable the user to navigate and select a Service Gateway for the service provider selection (Level 2 selection). The SRF downloads the navigation data related to a particular server to the STB during this type of user interactive dialogue.

- Another function of the SRF is the storage and downloading of software/loadware to a STB during service initialization.

- The communication between B-CCF/SSF and the SRF for establishing a connection follows an extended ATM UNI (DSS 2-based enhanced) protocol.

- During a user interactive session where the SCF is instructing the SRF to collect input from a user, collected information is returned by the SRF to SCF.

- In configurations where the SCF is directly connected to the SRF, the communication protocol between SCF and SRF is via a subset of INAP. Both communication methods (i.e. direct B-SCF⇔B-SRF and B-SCF⇔SSF⇔B-SRF) are possible.

- In a physical deployment of the broadband IN-architecture, the B-SRF may reside in an Intelligent Peripheral (IP).

- In a Service Node (B-SN) configuration, both the SCF/SDF and the SRF may reside in the same physical location.

- The SRF resources (e.g. navigation data) may be administered either locally or from the SMP.

- The SRF is capable of collecting its own traffic statistics and billing data and storing it locally and/or sending it to a TMN centre or to the SMF if required.

- The SRF provides notification of billing related events (e.g. End of Level 1 selection) to the SCF to ensure proper billing.

A.2.3 Service Management, Service Management Point (SMP): Service Management Functions (SMF)

The SMF provides a point where the IN service data can be administered. The SMF provides service management functions to the SCF, the SRF, and the B-SSF. In relation to the SCF, service portability of application programs in a network of SCP shall also be supported. The SMF is not a real-time function.

In addition to service management functions, the SMF may also collect billing and traffic statistics; data is collected from the SCF, the SRF and the B-SSF/CCF.

The SMF:

- provides service management capabilities for the SCF. This includes administration of all SCP data and large file management (e.g. routing addresses, feature interworking restrictions, etc.);

- supports the transmission of Service Logic program to the SCF;

- formulates and sends commands to activate/deactivate service logic programs to the SCF;

- receives, stores and processes statistics and billing data from the SCF. This also includes storing "on-line" statistical information;

- receives error or alarm messages from the SCF. Note that this function may alternatively reside in a TMN centre;

- provides access to configure the B-CCF/B-SSF trigger detection data;

- provides access to control the content of the SRF navigation content. A content provider will be capable of updating the navigation video data via the SMF;

- provides network security (e.g. password setting, access, etc.) function to ensure secure access of the functional entities (i.e. SCF, SRF, B-CCF/B-SSF) it is required to manage;
- in a physical deployment of the broadband IN-architecture, resides in the Service Management Point (SMP).

Appendix I

Set top box features

Functions for provision of the VOD application/service platform:

Control of Service Provider selection.

Control of video selection (Service Platform).

Support of video and audio stream downward and control stream bidirectional.

Interactive control of video play (e.g. PLAY, PAUSE, etc.).

MPEG decoding.

Audio decoding.

Provision of user interface platform.

Infrared user control.

Transmission termination.

Encryption (upstream).

Decryption (downstream).

Downloadable software (if necessary).

Video and hi-fi stereo outputs.

Video text decoding.

Cable tuner.

Smart Card reader/interface.

Expansion I/O.

General graphics and audio.

Sophisticated input devices (e.g. joystick).

Sophisticated output devices (e.g. VCR, home control, video game console, etc.).

ATM termination (if ATM is provided via the AN up to the STB).

Graphics adaptation.

ATM adaptation for signalling and video services.

UNI interface (UNI or a limited subset).

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