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Contents

Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

This ETR focuses on Asynchronous Transfer Mode (ATM) end-to-end solutions for Video On Demand (VOD) services and the support of the evolution from today's networks to Broadband Integrated Services Digital Network (B-ISDN).

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1 Scope

This ETSI Technical Report (ETR) focuses on Asynchronous Transfer Mode (ATM) end-to-end solutions for Video On Demand (VOD) services and the support of the evolution from today's networks to Broadband Integrated Services Digital Network (B-ISDN). Related to the control aspects (clause 8) the main text covers the general aspects, as well as specific solutions without making use of IN. The use of IN solutions for the implementation of the service control functionalities is given in annex A.

This ETR addresses those networks delivering VOD services between servers operated by service providers and the end customers “consuming” the services. It does not address those networks used for transferring the produced programs from the content servers to the video servers operated by the service providers.

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ANSI T1/4/94-007R8: "Asymmetric Digital Subscriber Loop specification".

[2] DAVIC 1.0: "The Digital Audio-Visual Council - DAVIC 1.0 Specifications, Revision 4.1 (September 1995)".

[3] ETR 228: "Terminal Equipment (TE); Broadband Multimedia Information Retrieval Services".

[4] ETR 257: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); Applicability of existing protocol specifications for a Vb interface in an access arrangement with Access Networks (AN)".

[5] ISO/IEC 13818-1: "Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems".

[6] ISO/IEC 13818-6: "Information technology - Generic coding of moving pictures and associated audio information - Part 6:DSM-CC User-Network signalling".

[7] ITU-T Recommendation G.652: "Characteristics of a single-mode optical fibre cable".

[8] ITU-T Recommendation G.707: "Synchronous digital hierarchy bit rates".

[9] ITU-T Recommendation G.708: "Network node interface for the synchronous digital hierarchy".

[10] ITU-T Recommendation G.709: "Synchronous multiplexing structure".

[11] ITU-T Recommendation G.902: "ITU- T - Framework recommendation on functional access networks (AN) - Architecture and functions, access types, management and service node aspects".

[12] ITU-T Recommendation I.432: "B-ISDN user-network interface - Physical layer specification".

[13] ITU-T Recommendation Q.2931: "Broadband integrated services digital network (B-ISDN) - Digital subscriber signalling system No. 2 (DSS 2) - User-network interface (UNI) layer 3 specification for basic call/connection control".

[14] ISO/IEC/JTC1/SC29/WG11 N0673 (MPEG94/March1994): "Results of MP@ML video quality verification tests".

[15] RFC 768: "Internet Society - User Datagram Protocol (UDP)".

[16] RFC 791: "Internet Society - The Internet Protocol (IP)".

[17] RFC 793: "Internet Society - The Tranmission Control Protocol (TCP)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

Video On Demand (VOD): A VOD application provides residential users with the ability to select among a catalogue of pre-recorded programmes (films, news bulletins, sport events, music clips, documentaries, previews, etc.) to receive the chosen programme on a TV set and navigate through it, using control commands (ETR 228 [3]).

When considering services such as VOD, a number of roles can be identified:

customer: Customers may rent or own the device that allows access to the different services: typically the device will consist of a television set and a set-top-box, or a Personal Computer (PC), or a work-station. Customers may get access to a service either by subscription, or on per call basis, or even by means of a combination of the two.

service provider: Service providers own and control a number of video servers from which the programmes are distributed to the customers. Service providers may be contacted by the customers directly, or through a broker. Service providers are related to content providers from which they buy the rights to distribute a certain programme. Service providers also have the responsibility of updating the video servers. Service providers may have relationship with one or more brokers.

brokers: Brokers offer a customer an access service to different service providers with which they have an agreement. They allow the Customer to choose among different service providers based on the specific user request on a call by call basis. Brokers have no direct relationship with the content providers.

content provider: Content providers own certain programmes and are able to sell the rights of distribution to one or more service providers.

network provider: The network provider offers the communication support (infrastructure) to all the parties mentioned above. It is assumed that communication will always take place through the network. It is important to note that the role of the network provider is infrastructural in the information service provision, while the other roles are of structural type. This implies that the network provider is not part of the direct chain that links the information producer (referred to as "content provider") to the information consumer (referred to as "customer"). It is expected that the network provider will provide fair and equal access to all services providers.

Some of the roles identified above can be played by the same actor. In fact a service provider may also be a broker in an area where the number of service providers is small, and a network operator may also be a broker, when the brokerage service is offered by the network.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

ADSL	Asymmetric Digital Subscriber Loop
ATM	Asynchronous Transfer Mode
BCC	Bearer Channel Connection
CAP	Carrierless Amplitude modulation/Phase modulation
CATV	Cable Television
CDV	Cell Delay Variation
DSM-CC	Digital Storage Medium Commands and Control
DVB	Digital Video Broadcasting
EDTV	Enhanced quality Digital Television

FTTB	Fibre To The Building
FTTC	Fibre To The Curb
FTTH	Fibre to the Home
HFC	Hybrid Fibre Coaxial cable
IN	Intelligent Network
IP	Intelligent Peripheral
LDTV	Low quality Digital Television
MP@ML	Main Profile at Main Level (MPEG-2)
MPEG	Moving Pictures Experts Group (ISO/IEC JTC1/WG29)
MPEG-1	(first set of standards for moving pictures from MPEG)
MPEG-2	(second set of standards for moving pictures from MPEG)
MPEG-2 TS	MPEG-2 Transport Stream
PC	Personal Computer
PES	Packetized Elementary Stream
PON	Passive Optical Network
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
SDTV	Standard quality Digital Television
SMF	Service Management Functions
SMP	Service Management Point
STB	Set-Top Box
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TE	Terminal Equipment
UDP	User Datagram Protocol
UTP	Unshielded Twisted (copper) Pair
VCR	Video Cassette Recorder
VOD	Video on Demand

4 Reference architecture

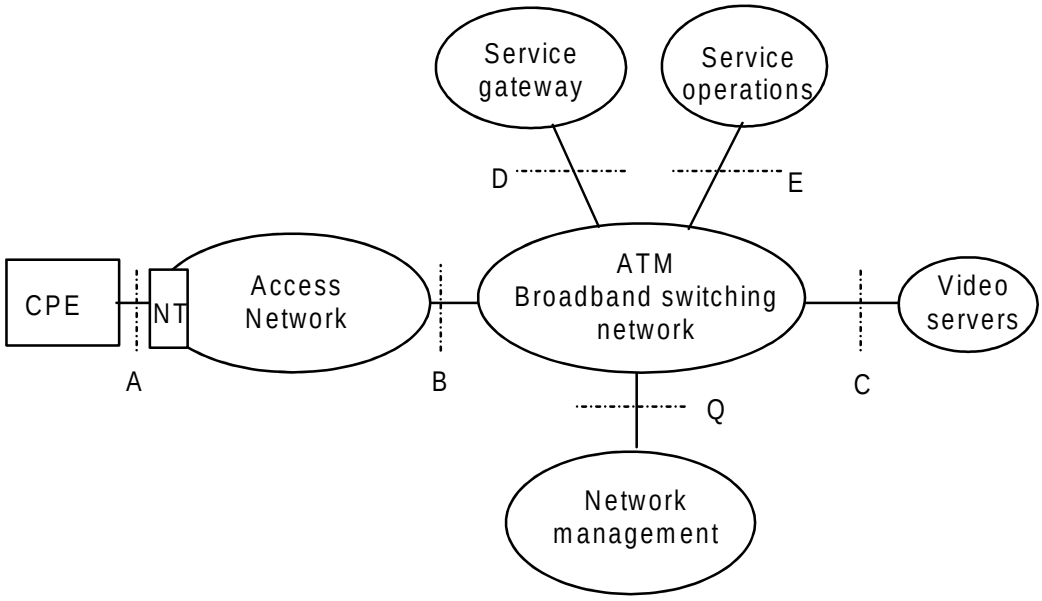


Figure 1: VOD system architecture

The architecture and the subsystems of a VOD system are shown in figure 1. The system includes video server(s), broadband switching network elements, access arrangements and customer premises equipment. It should be noted that these systems could be owned by different organizations.

4.1 Video servers

The video servers contain the source of the video programs and provide an on-demand copy of the requested video signal via the network to the user. The video server or a set of servers can be owned by a service provider, where multiple service providers can operate within the same network. Video servers can also be owned by network operators. There might be a need to have some storage facilities closer to the user.

4.2 Broadband switching network

The broadband switching network provides the interconnection between the various network subsystems in the VOD architecture. It provides functions such as signalling and program data transfer. If Asynchronous Transfer Mode (ATM) is used end-to-end a high degree of flexibility can be provided in the transfer of program data between the servers and between the servers and the users.

4.3 Network management

The network management performs management functions (e.g. fault configuration, performance monitoring, security) related to the complete system and management functions related to the network resources and parameters (operation and maintenance information flows).

4.4 Service gateway

The service gateway provides the interface with the VOD system for the users in identifying and connecting the appropriate service provider. A service gateway serves a group of customers. Additional gateways are added as the number of customers increases. The service gateway may be provided by the network operator or by a separate, public or private service provider or service broker.

Possible functions of the service gateway are listed below:

a) First level navigation.

The end-user will be allowed to select different service providers, on the basis of an interactive menu listing the available ones and, as an option, their updated content and other relevant information (e.g. tariffing);

b) End-user's profile customization.

The end-user will be able to negotiate and define his own subscriber profile by direct interaction with the service gateway. Profile customization will allow the end-user to administratively define a default service provider and to enable/disable reacheability to a specified set of service providers (e.g.: based on time of the day or other criteria);

c) Set-Top Box (STB) software download.

Optionally the S.G should be able to download to the STB the software needed for communications to the network over assigned channels;

d) Service provider’s broker.

It allows the selection of one service provider from a list of many.

4.5 Service operations

The service operations enable the service provider to operate the service he offers to his customers, such as billing, subscriber management and promotion trailers and to manage his set of program material onto a set of video servers.

Possible functions of the service operations are listed below:

a) service interworking.

As an option, the end-user should be offered the capability to interact with a particular program server, whose service signalling protocol (i.e. the set of messages/primitives exchanged between the server and the STB) is not compatible with his own STB. To this extent, service interworking functions should be provided by the service operations;

b) STB software download.

As an option, the service operations should be able to download to the STB:

- the software needed for the interaction with the requested server;

- the software applications requested by the user.

c) third party connection set-up.

As an option, the service operations may be able to request the setting up of a connection (e.g. video connection) between the video server and the STB and to verify whether the required QoS and bandwidth can be offered by the network. Connection set-up by service operations is performed between video servers and the STB only as a result of an appropriate VOD service request from the user/STB and after an appropriate handling of charging and authorization.

4.6 Access network

The access network comprises the various access arrangements from the switching broadband network to customer premises equipment. It includes access multiplexing arrangements and network terminations.

The Network Termination (NT) terminates the network at the user site.

4.7 Customer premises equipment

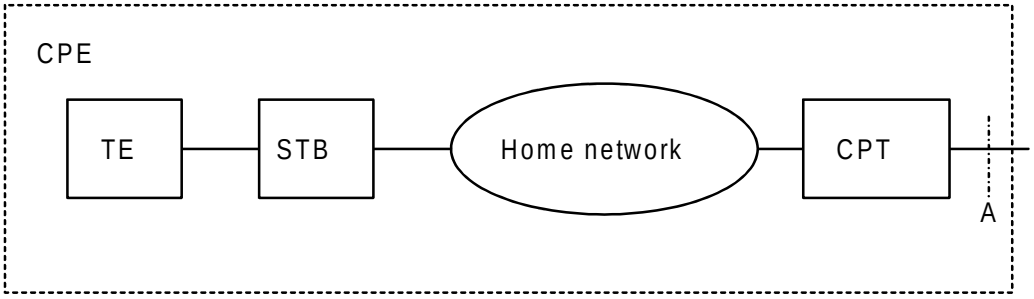
The customer premises equipment is the set of equipment under the customer's control and comprises the home network, one or more STBs connecting different TV sets, PCs, game consoles, etc. It does not include the equipment located at the customer premises which are controlled by the network operator (e.g. network termination). The reference point A marks the limit of the responsibility between network provider and customer. An interface needs to be defined to leave the customer a free choice of the access network provider and of the Terminal Equipment (TE):

a) The home network.

It terminates in-house the access network and allows the user to connect multiple terminals to the delivery system. Two main configurations are possible:

- point to multipoint with star, tree or bus configuration;

- point to point with star or daisy chain configuration



CPT: Customer Premises Termination.

Figure 2: Customer premises equipment

b) Customer premises termination.

In house a further functional block called CPT (Customer Premises Termination) is introduced.

The CPT is used to decouple the physical and the protocol layers used in the access network from the transmission technology used in house.

The CPT block can be empty. In that case the transmission technology used in the access network is terminated in the TE.

c) TE.

The real terminals, such as a TV set, a PC or a game console.

d) STB.

The functionality of the STB include the following minimum set of functions:

- to interface with the currently existing TV set;
- to support the remote control of video play (e.g. PLAY, PAUSE, etc.);
- to decode the Moving Pictures Experts Group (MPEG) video and audio stream;
- to support the human interface (basic graphical capabilities);
- to interface to the network;
- to support the conditional access functions (encryption, user authentication).

As an option, the STB may include the following features:

- to support the protocols necessary to communicate with a program server (e.g. virtual Video Cassette Recorder (VCR) control) and with a service gateway;
- to offer inputs such as smart card, credit card readers and joysticks;
- to support O&M functions;
- to support the capability to be downloaded.

5 Network related issues

5.1 Access networks

The access network is connected to the switching broadband ATM network through an interface at reference point B. This interface supports bi-directional communication.

The access node within the access network performs the following functions:

a) **Interface to the ATM switching broadband network** (at reference point B) terminates the physical layer of the transmission system used in the switching broadband network.

The interface to the switching broadband network is VB5 compliant as described in ETR 257 [4];

b) **Multiplexing, concentration and/or grooming.**

The access node performs multiplexing, and possibly concentration and grooming as defined in ETR 257 [4];

c) **Generation of the physical layer used in the access network.**

The transmission technique used in the access network is linked to:

- the level of fibre deployment: Fibre only in the switching broadband network, Fibre To The Curb/Fibre To The Building (FTTC/FTTB), Fibre To The Home (FTTH);
- the physical medium used in the access network (Unshielded Twisted (copper) Pair (UTP), coaxial cable, hybrid solutions).

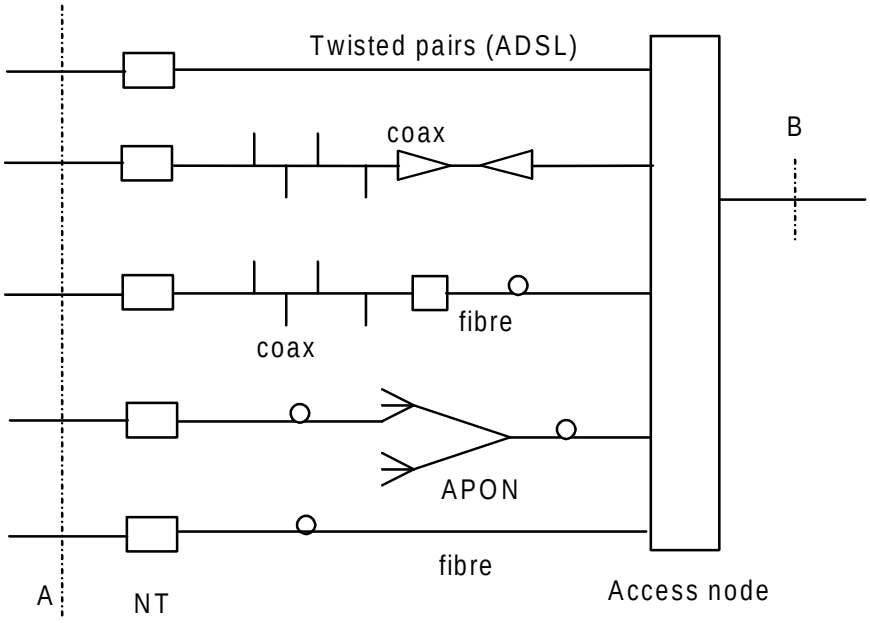


Figure 3: Access network reference architecture

Some examples of possible access solutions are:

- twisted copper pairs using Asymmetric Digital Subscriber Loop (ADSL) technique as physical layer for the transmission;

- coaxial cable using Digital Video Broadcasting (DVB) standard as physical layer;

- Hybrid Fibre Coaxial cable (HFC) with different level of deployment of the fibre (typically the fibre is terminated in a node that serves a few hundreds of subscribers);

- FTTB/FTTC using UTP or coax to cover the last part to the TE;

- fibre to the home with a point-to-point or a point-to-multipoint configurations (Passive Optical Network (PON));

- 155 Mbit/s B-ISDN fibre access links (UNI) standardized for the target network.

The ATM transfer mode can be used on top of all the presented physical solutions for the access network.

5.2 Switched broadband network

The switched broadband network is ATM based and makes use of the available standards defined by ITU-T and ETSI for the user to network interfaces and the network to network interfaces.

The VOD service can be supported over both switched and (semi-)permanent virtual connection. The target solution for the provision of the service is via a fully switched B-ISDN ATM based network, however initial solutions may provide the service using Permanent Virtual Connections (PVCs) through the backbone ATM network. It is recognized that Switched Virtual Connections (SVCs) allow a more efficient use of network resources than PVC. In view of the current B-ISDN signalling capabilities which do not support features such as third party connection set-up, multiconnection and multiparty, it is also recognized that a PVC approach is attractive for the short term.

For the upper layers the use of ITU-T Recommendation Q.2931 [13] is recommended for call and connection control.

6 Interfaces

The interfaces at reference points between the functional blocks shown in figure 1 need to be specified. The standardization is required for the following reasons:

- to allow interoperability between equipment provided by different vendors;

- to use a common set of protocols for all the services provided by the full service network.

As far as possible existing standards should be used.

Below the interfaces at reference points A, B, C, D, E are defined referring to an ATM solution end-to-end. The interfaces A, B and C form the direct chain between the VOD service provider and the user.

It is proposed that the interfaces at reference points D and E have the same protocol stacks.

At reference point B, VB compliant interface shall be adopted as currently under specification in ETR 257 [4] and ITU-T Recommendation G.902 [11].

Table 1: Protocol stack at reference point A

<table>
<tr><td>Non-delay sensitive data</td><td>Delay-sensitive data</td><td>Session control</td><td>Call and connection control</td></tr>
<tr><td colspan="4">Application layer</td></tr>
<tr><td rowspan="2">User data</td><td>Audio data
Video data
User data</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Au-Vi-Data PES</td><td>DSM-CC U-N</td><td>ITU-T Recommendation Q.2931 [13]</td></tr>
<tr><td>TCP/UDP</td><td>MPEG2-TS</td><td>TCP/UDP</td><td rowspan="2"></td></tr>
<tr><td>IP
AAL5
ATM</td><td>AAL1/5
ATM</td><td>IP
AAL5
ATM</td><td>SAAL
AAL5
ATM</td></tr>
<tr><td>Downstream
Upstream</td><td colspan="3">e.g. STS1, DVB, ADSL (DMT) or HFC (QAM) or FTTC (CAP)
QPSK or DQPSK (TDMA),
ITU-T Recommendation I.432 [12].</td></tr>
<tr><td colspan="4">CAP: Carrierless Amplitude modulation/Phase modulation.
DSM-CC: Digital Storage Medium Commands and Control.
IP: Intelligent Peripheral.
MPEG2-TS: MPEG-2 Transport Stream.
PES: Packetized Elementary Stream.
QAM: Quadrature Amplitude Modulation.
QPSK: Quadrature Phase Shift Keying.
TCP: Transmission Control Protocol.
TDMA: Time Division Multiple Access.
UDP: User Datagram Protocol.</td></tr>
</table>

Table 2: Protocol stack at reference point B

Resources control	**Connection control**
BCC	Q.2931
SAAL AAL5 ATM	SAAL AAL5 ATM
SDH STM1, STM4 or STM16 (G.707,G.708, G.709)	SDH STM1, STM4 or STM16 (G.707, G.708, G.709)
G.652	G.652
BCC: Bearer Channel Connection. G.652: ITU-T Recommendation G.652 [7]. G.707: ITU-T Recommendation G.707 [8]. G.708: ITU-T Recommendation G.708 [9]. G.709: ITU-T Recommendation G.709 [10]. Q.2931: ITU-T Recommendation Q.2931 [13].	

Table 3: Protocol stack at reference points C

<table>
<tr><th>Non-delay sensitive data</th><th>Delay-sensitive data</th><th>Session control</th><th>Call and connection control</th></tr>
<tr><td colspan="4">Application Layer</td></tr>
<tr><td rowspan="2">User Data</td><td>Audio data
Video data
User data</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Au-Vi-Data PES</td><td>DSM-CC U-N</td><td>Q.2931</td></tr>
<tr><td>TCP/UDP</td><td>MPEG2-TS</td><td>TCP/UDP</td><td rowspan="2"></td></tr>
<tr><td>IP
AAL5
ATM</td><td>
AAL1/5
ATM</td><td>IP
AAL5
ATM</td><td>SAAL
AAL5
ATM</td></tr>
<tr><td colspan="4">SDH STM1, STM4 or STM16 (G.707,G.708 and G.709).
PDH (specifications numbers).</td></tr>
<tr><td colspan="4">G.707: ITU-T Recommendation G.707 [8].
G.708: ITU-T Recommendation G.708 [9].
G.709: ITU-T Recommendation G.709 [10].
Q.2931: ITU-T Recommendation Q.2931 [13].</td></tr>
</table>

Table 4: Protocol stack at reference point D and E

<table>
<tr><th>Session control</th><th>Call and connection control</th></tr>
<tr><td>DSM-CC U-N</td><td>Q.2931</td></tr>
<tr><td>TCP/UDP</td><td rowspan="2"></td></tr>
<tr><td>IP
AAL5
ATM</td><td>SAAL
AAL5
ATM</td></tr>
<tr><td colspan="2">SDH STM1, STM4 or STM16 (G.707,G.708 and G.709)</td></tr>
<tr><td colspan="2">G.707: ITU-T Recommendation G.707 [8].
G.708: ITU-T Recommendation G.708 [9].
G.709: ITU-T Recommendation G.709 [10].
Q.2931: ITU-T Recommendation Q.2931 [13].</td></tr>
</table>

7 Network management

For the management of switching broadband and access networks, it is proposed to adopt the common framework of ISO and ITU-T relative to the management of open systems where interoperability between managing systems and managed systems is achieved by open interfaces.

Recommendation M.3010 defines the “Telecommunications Management Network” (TMN).

The network is divided into network elements that are the components of the network (located at a single physical place or distributed) managed through a standard interface (Q interface). The ITU-T allows for any physical implementation of the TMN, however from functional point of view the TMN follows a logical layered architecture, which is composed by these layers:

- the element layer that performs the functions of the elements of the telecommunication network itself. This layer includes the control functions for transporting user traffic and handling calls;
- the element management layer that manages the network elements individually not considering the relations between them;
- the network management layer that handles the relations between the network elements;
- the service management layer that is concerned with users and service issues;
- the business management layer that is mainly related to the development of business applications and is not considered by the standardization world.

8 Control aspects

8.1 General considerations

This subclause covers six scenarios indicating the interactions between the functional blocks of the VOD system architecture. It should be considered as a first step leading to the identification of the signalling requirements and definition of related protocols, as well as the service related interactions.

Three levels of control have been identified in the provision of the VOD service as shown in figures 4 and 5. The figure also shows the hierarchy between the three levels of control.

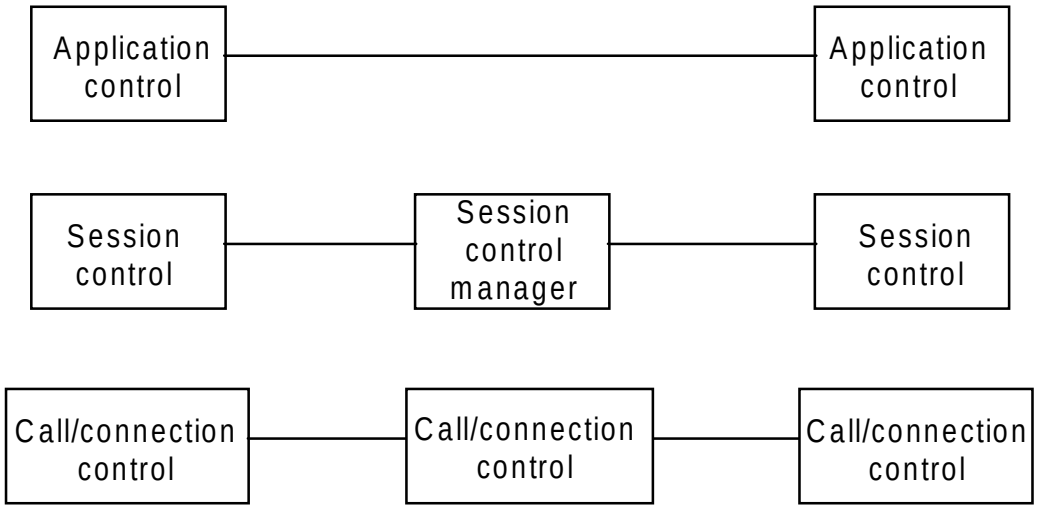


Figure 4: Levels of control

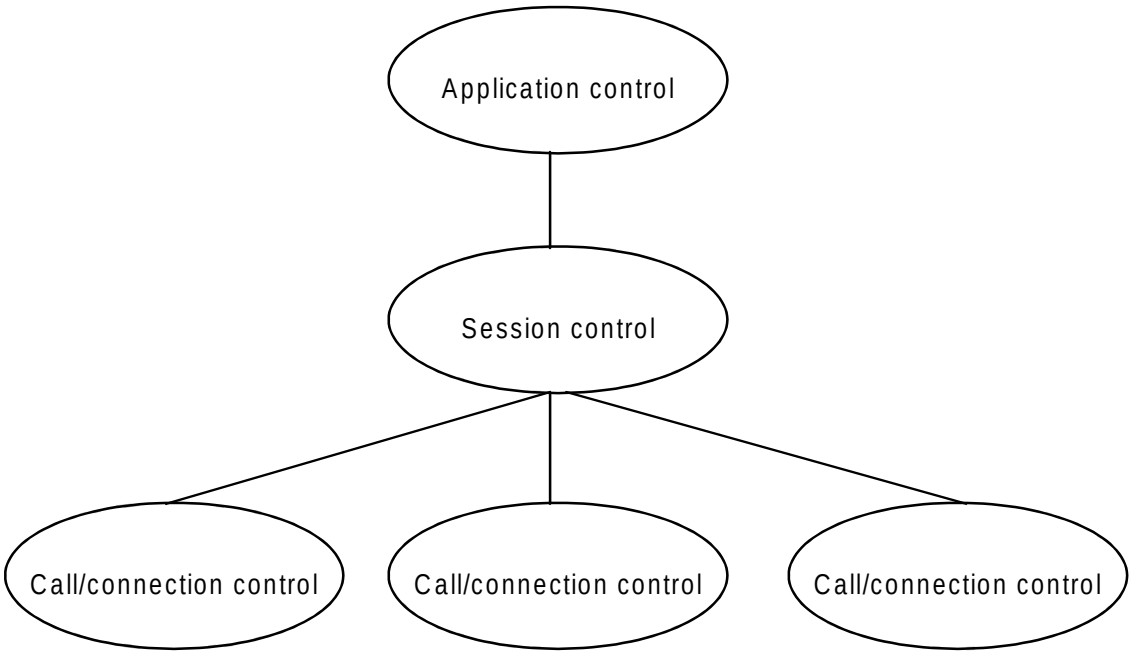


Figure 5: Mapping of control levels

Call/connection control: This level of control is defined as the basic control capabilities provided by the broadband switched network switched network in order to establish a single connection between two end-points. This level of control is always located in the control-plane of the network.

Session control: This level of control is defined as the enhanced control capabilities required to handle several control resources, i.e. the capability to co-ordinate in a single session more calls/connections. This level of control may be located in the control-plane of the network when the capabilities are integrated within the signalling system of the network. In all the other cases this level of control is located in the user-plane of the network.

Application control: This level of control is defined as the end-to-end control capabilities to control the service. This type of control is always located in the user-plane of the network.

The level of integration of the call/connection control and the session control capabilities within the signalling system of the network may vary depending on which capabilities actually migrate to the network. To give an example the present B-ISDN signalling capabilities (SCS-1) offer only the call/connection control as defined above. As the signalling capabilities are upgraded, the B-ISDN signalling will be able to handle not only point-to-point monoconnection calls but also (e.g.) point-to-point multiconnection calls. This means that some session control capabilities may be integrated in the network and that the session control outside the network is required only for the missing functions. It is expected that with the target B-ISDN signalling there will be no need for session control outside the network.

Table 5 gives an overview of the possible degrees of integration of the call/connection control and session control capabilities and shows the possible location of the session control capabilities for each of the cases.

Table 5: Levels of integration between session control and call/connection control

Level of integration	Location of session control	Comments
Non integrated	Broadband switched network Service gateway Service operation	In this case the location in the broadband switched network implies that the session control is offered as a value added function within the domain of the network operator. The flow required for session control is in the user-plane of the network.
Partly integrated	Broadband switched network Service gateway Service operation	In this case the location in the broadband switched network implies that the part of session control that is not integrated in the signalling system of the network is offered as a value added function within the domain of the network operator. The flow required for session control is in the user-plane of the network.
Fully integrated	Broadband switched network	In this case the session control capabilities are offered by the signalling system of the network and the required flow is part of the control-plane of the network.

A two step selection mechanism is used in order to identify and retrieve the VOD information content. The first step allows to identify and select the service provider. The second step allows the user to actually select and retrieve the VOD content itself, i.e. the video program. Alternatively the user may directly access the service provider (via the service operations); in this case the second step only is performed.

8.2 Assumptions

The following assumptions have been made in the development of the proposed scenarios:

1) broadband switched network, service gateway, and service operations belong in principle to different domains (e.g. broadband switched network belonging to the network provider, service gateway belonging to the service broker, service operation belonging to the service provider);

2) all the communication required between the different entities takes place over switched connection, set-up by signalling (i.e. UNI signalling). NNI signalling is assumed to be used within the broadband switched network;

3) the first scenario covers a short term solution with non-integrated session and call/connection control functionalities. The remaining five scenarios assume fully integrated session and connection control capabilities;

4) the first four scenarios assume a two-step selection mechanism, while the last two scenarios assume direct communication with the service provider;

5) it is never shown, however it may be possible for the service gateway to remain active throughout the duration of the whole session (i.e. after the first navigation phase is terminated), e.g. in order to allow the possibility to return to the service gateway after the viewing of a program without the need to establish a new session.

8.3 Scenarios covered

The first scenario gives an example of flows for the case of non-integrated session and call/connection control capabilities. No assumptions are made as to the location of the session control manager.

For the remaining five scenarios, two main cases are distinguished:

1) the service gateway is involved in the service interactions (two step selection);

2) the user requests direct access to service provider (one step selection).

These two main scenarios are then organized in different sub-scenarios, depending on:

- the possibility to involve service operations in the session set-up phase;

- the availability of third party call/connection set-up capability.

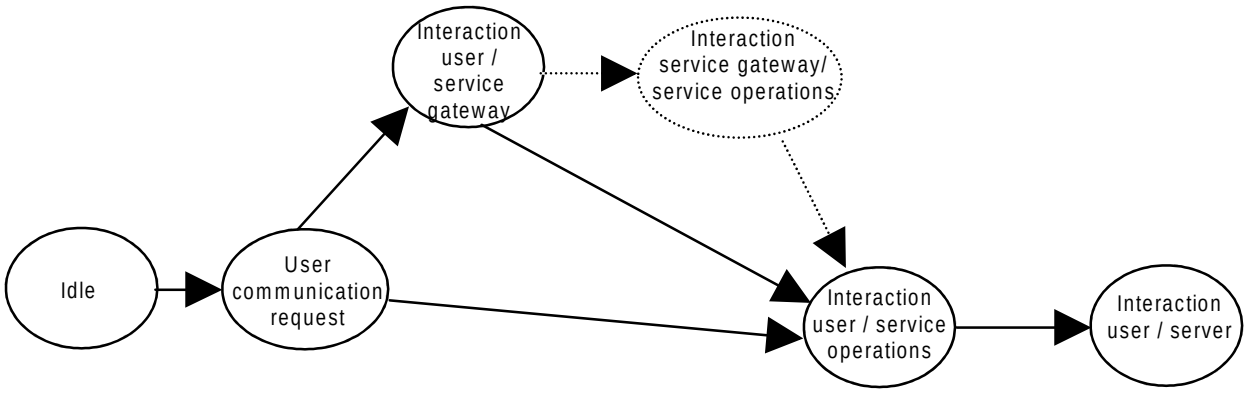


Figure 6: Overview of control phases

The different scenarios identified are presented hereafter.

8.4 Short term scenario with separated session control and call/connection control phases

For the purpose of this scenario, in order to show the different levels of control, the functions of some of the entities have been exploded, showing specifically the session control and the call/connection control blocks. In particular, it has to be noted that, although not explicitly shown in the drawings, the functions of the service gateway can also be further split showing explicitly session and call/connection control.

In this scenario it has been assumed that the session manager is either located in the service gateway or in the broadband switching network (shown by the dotted lines). It is important to stress the fact that the session manager controls the session throughout its duration and therefore it remains active for the entire duration of the session itself. Also it has to noted that when the session manager is located in the service gateway, the pair of flows indicated with dotted lines is internal to the service gateway

Connection establishment is further assumed to be initiated from the STB. The session manager can therefore be a stand alone function in this case.

Each session or service offering starts with a service request at the session level.

The session confirmation gives the STB all the information needed to establish a connection between STB and service gateway for the navigation step 1, through which a service provider is selected.

To establish the communication with a service provider (service operations), the signalling sequence may be equivalent to the sequence described above. Starting with a request to set-up a session to the selected service provider from the STB at the session control level and completed with a connection confirmation at the call/connection control level.

The new connection may now be used for the navigation step 2 which gives the user with the possibility to select a specific program.

The following flow sequence is also equivalent to the sequences described above, starting with the request for a session with the video server where the selected programme is located at session level and ending with a new or modified connection for the program content delivery.

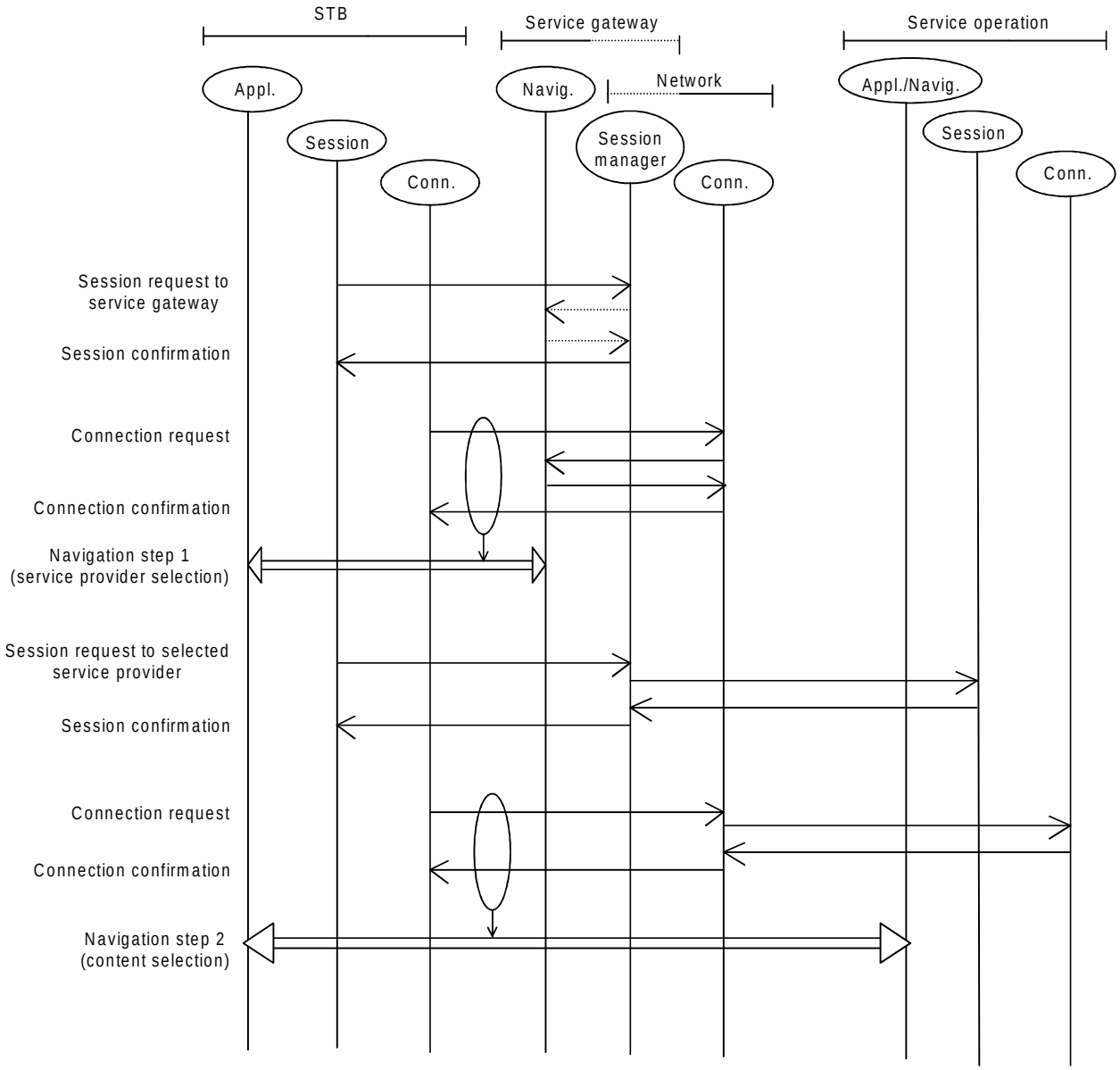


Figure 7: Scenario 1 (part 1)

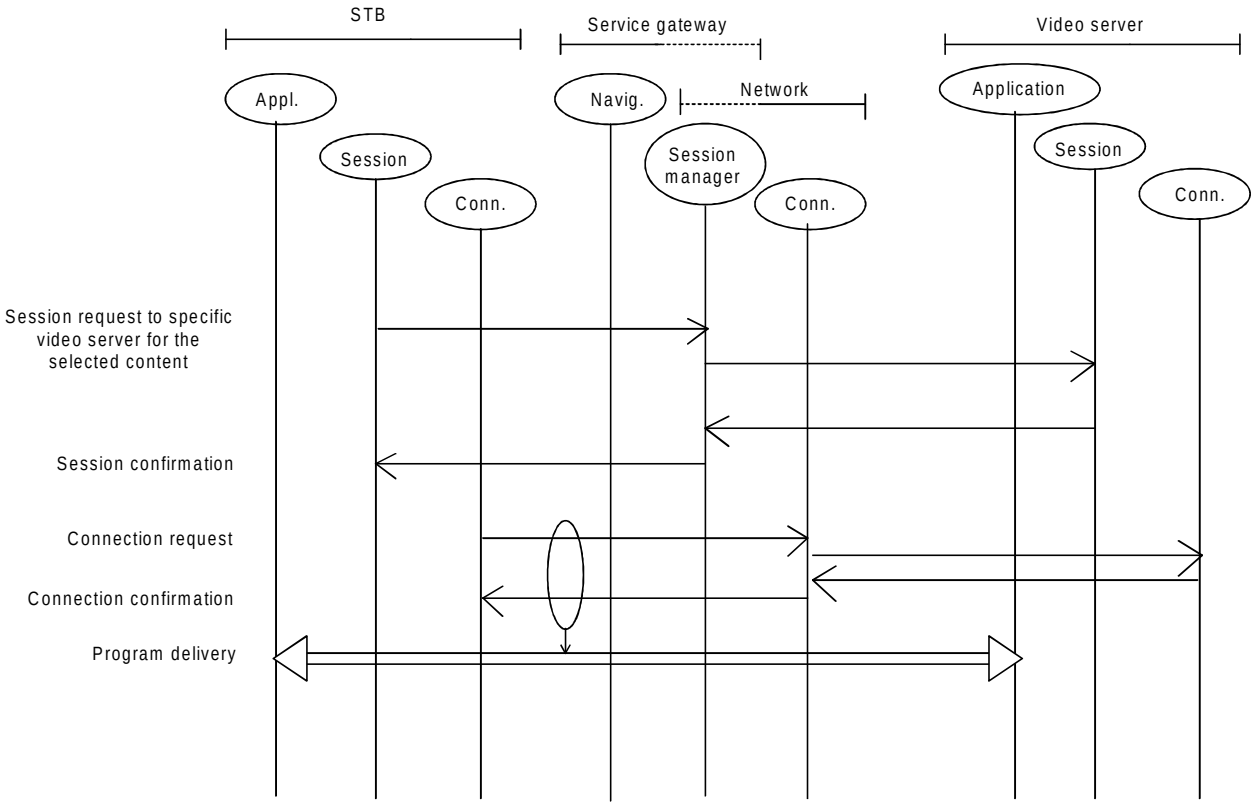
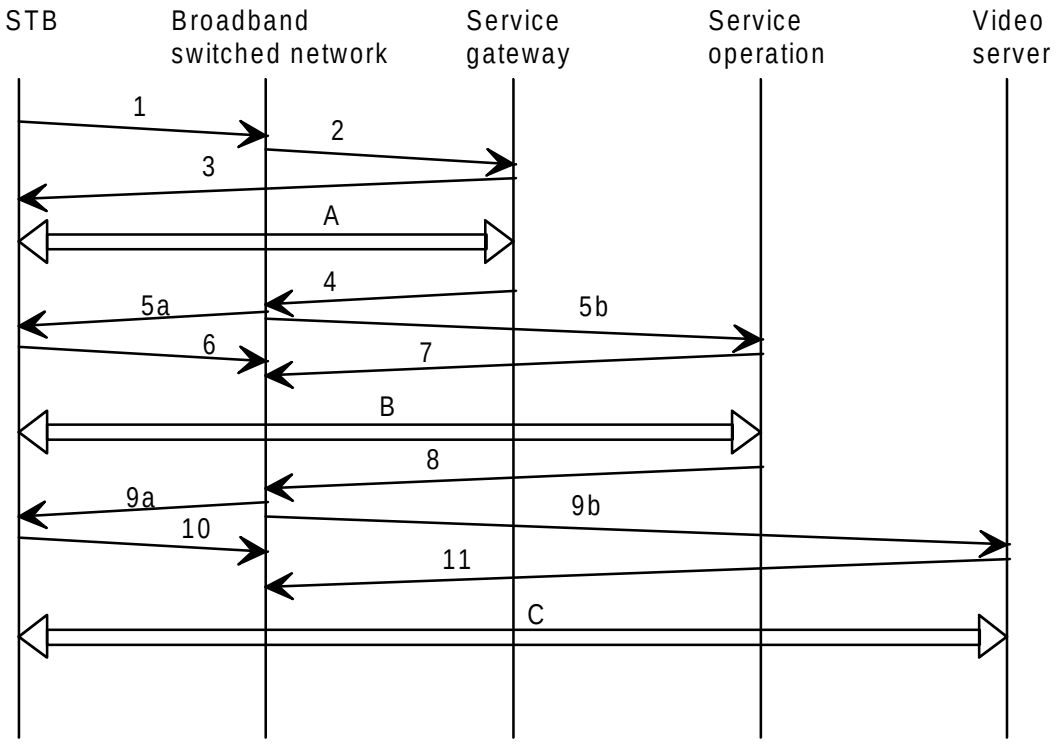


Figure 8: Scenario 1 (part 2)

8.5 Scenarios with service gateway

8.5.1 Scenarios without service operation involvement in the session set up phase

8.5.1.1 Scenario with third party call/connection set-up capability (scenario 2A)



1 This flow is the request to the network to set up a call for the VOD service. As a two-step selection mechanism is used, the called entity in this flow is the service gateway.

2 Flow 2 is the connection set-up request made by the network to the proper service gateway to be involved in the service.

3 Flow 3 is the confirmation from the service gateway to actually set-up the communication, which is passed to the STB through the network.

A This flow represents the navigation protocol between the service gateway and the STB. User verification may be performed as well within this communication. The STB identifies a service provider.

4 The service gateway requests from the network the setting up of a communication between the STB and the service operation of the chosen service provider. The address of the selected service provider (i.e. the address of the service operation) is passed to the network by the service gateway.

5a Flow 5a represents the communication request from the network towards the STB for the second navigation phase within the domain of the selected service provider.

5b Flow 5b represents the communication request from the network towards the service operation for the second navigation phase within the domain of the selected service provider.

6 Flow 6 represents the confirmation and acceptance of the connection given by the STB to the network.

Figure 9: Scenario 2A (sheet 1 of 2)

7 Flow 7 represents the confirmation and acceptance of the connection given by the service operation to the network.

At this point in time the connection related to flow A may be released.

B This flow represents the navigation protocol between the STB and the selected service provider. The information exchange is concluded with the choice of a specific programme. A further user verification may be performed within this communication.

8 The third party call/connection set-up capability is used and the service operation passes on to the network the address of the video server where the selected programme is stored and requests the setting up of a communication between the server and the STB.

9 Flows 9a and 9b are analogous to flow 5a and 5b.

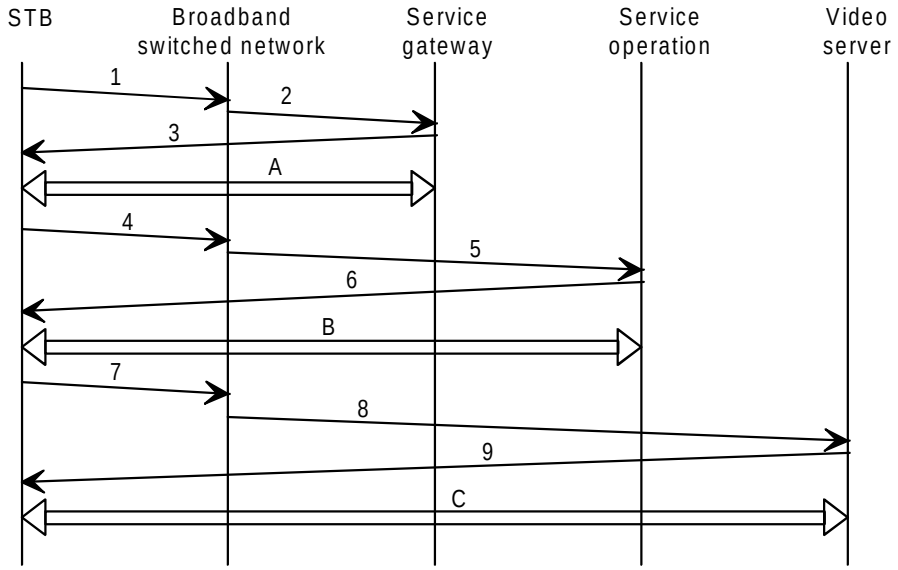
10 Flow 10 is analogous to flow 6.

11 Flow 11 is analogous to flow 7.

C This flow represents both the actual delivery of the selected programme, as well as the related control information. For VOD this flow represent the MPEG flow from the server to the STB, and the VCR commands to control the presentation of the programme. If allowed by the service definition, commands to allow the resuming of a communication between the STB and the service operation are also included.

Figure 9: Scenario 2A (sheet 2 of 2)

8.5.1.2 Scenario without third party call/connection set-up capability (scenario 2B)



1 This flow is the request to the network to set up a call for the VOD service. As a two-step selection mechanism is used, the called entity in this flow is the service gateway.

2 Flow 2 is the connection set-up request made by the network to the proper service gateway to be involved in the service.

3 Flow 3 is the confirmation from the service gateway to actually set-up the communication, which is passed to the STB through the network.

A This flow represents the navigation protocol between the service gateway and the STB. User verification may be performed as well within this communication. The STB identifies a service provider, and the service gateway communicates the address of the selected service provider to the STB, in order to be used for the further proceeding of the service.

4 The STB requests from the network the setting up of a communication with the chosen service provider (represented by the service operation).

5 Flow 5 represents the further action from the network to the service operation.

6 Flow 6 represents the relevant confirmation from the service operation.

At this point in time the connection related to flow A may be released.

B This flow represents the navigation protocol between the STB and the selected service provider. The information exchange is concluded with the choice of a specific programme, the address of the specific server storing the selected programme is passed to the STB. A further user verification may be performed within this communication.

7 The STB requests from the network the setting up of a communication with a specific video server.

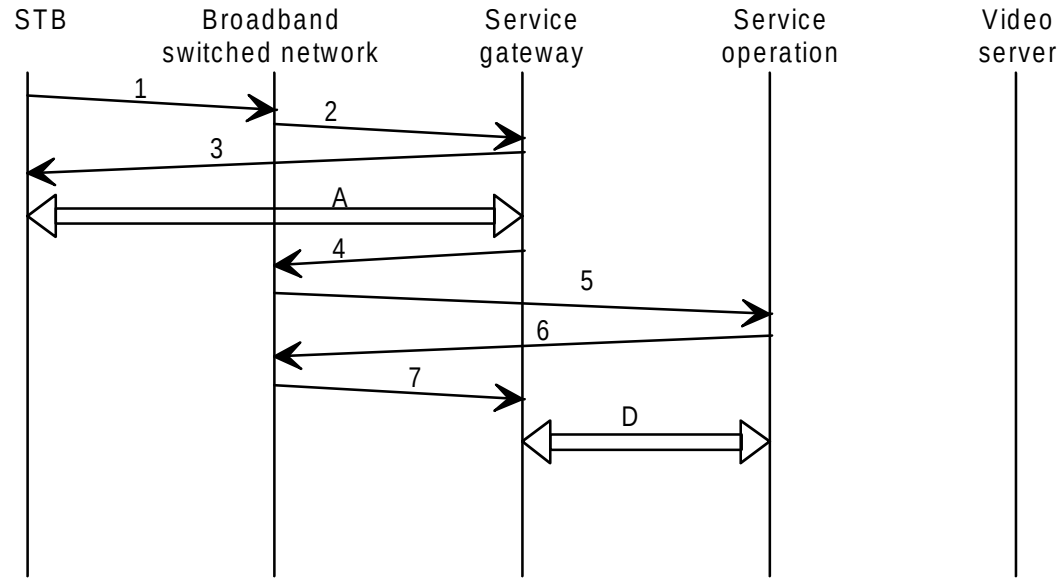
8 Flow 8 is analogous to flow 5 from the network towards the video server.

9 Flow 9 is analogous to flow 6 from the network towards the STB.

C This flows represents both the actual delivery of the selected programme, as well as the related control information. For VOD this flow represent the MPEG flow from the server to the STB, and the VCR commands to control the presentation of the programme.

Figure 10: Scenario 2B

8.5.2 Scenarios with service operations involvement in the call/connection set-up capability (scenario 2C)



1 This flow is the request to the network to set up a call for the VOD service. As a two-step selection mechanism is used, the called entity in this flow is the service gateway.

2 Flow 2 is the connection set-up request made by the network to the proper service gateway to be involved in the service.

3 Flow 3 is the confirmation from the service gateway to actually set-up the communication, which is passed to the STB through the network.

A This flow represents the navigation protocol between the service gateway and the STB. User verification may be performed as well within this communication. The STB identifies a service provider.

4 The service gateway requests from the network the setting up of a communication between the service gateway and the service operation of the chosen service provider. The network address of the selected service provider (i.e. the network address of the service operation) is passed to the network by the service gateway.

5 Flow 5 represents the request from the network to the service operation to set up a communication between the service gateway and the service operation. confirmation from the service gateway to the network.

6 Flow 6 represents the relevant confirmation given by the service operation to the network.

7 Flow 7 represents the confirmation given by the network to the service gateway in response to the flow 4 request.

D This flow represents the communication between the service gateway and the service operations, which may be required in specific cases of service provision, e.g. for checking user profile and access rights to a specific service provider.

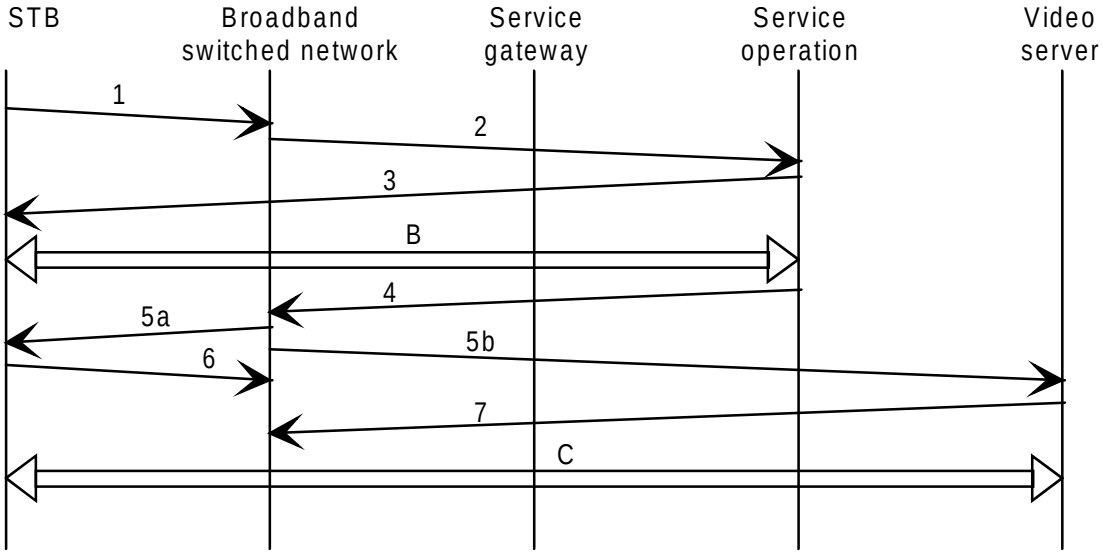
The flows exchanged after this phase will continue according to scenario 2A (starting from flow 4) in the case with third party call/connection set-up capability or scenario 2B (starting from flow 4) in the case without third party call/connection set-up capability. The connection used for flow D may be cleared.

Figure 11: Scenario 2C

The flows presented in all of the three scenarios can be applied also when the connection with the service gateway is not released after the choice of the service provider.

8.6 Scenarios without service gateway

8.6.1 Scenario with third party call/connection set-up capability (scenario 3A)



1 This flow is the request to the network to set up a call for the VOD service. In this scenario the called address passed to the network identifies a specific service provider to which the STB intend to be connected.

2 Flow 2 represents the request done by the network to the specific service provider to accept the STB communication request.

3 Flow 3 represents the confirmation given by the service provider to the STB.

B This flow represents the navigation protocol between the STB and the service provider. The information exchange is concluded with the choice of a specific programme. User verification may be performed within this communication.

4 Third party call/connection set-up capability is used and the service operation passes on to the network the address of the server where the selected programme is stored and requests the setting up of a communication between the server and the STB.

5 Flows 5a and 5b represent the communication request from the networks towards the two end-parties that will be involved in the communication, i.e. the STB and the video server.

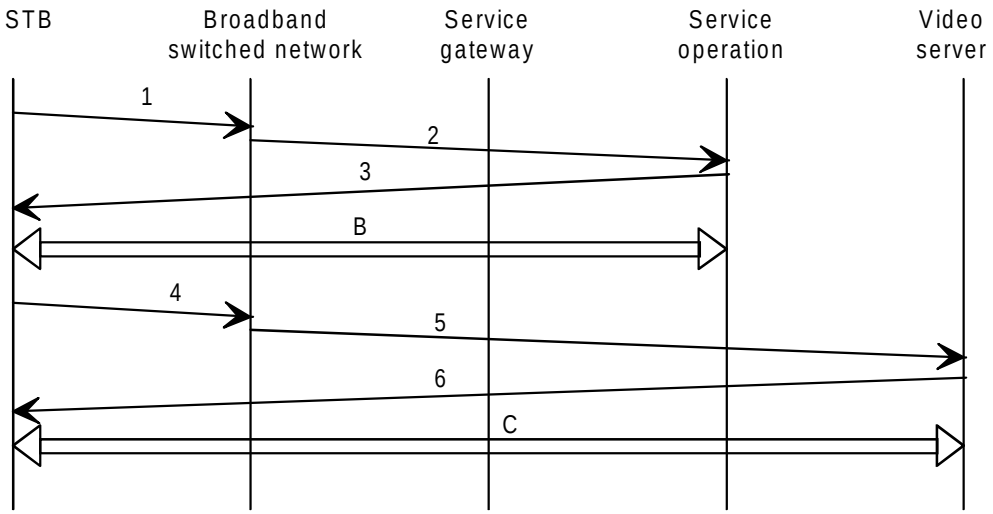
6 Flows 6 represent the confirmation and acceptance of the connection given by the STB to the network.

7 Flows 7 represent the confirmation and acceptance of the connection given by the video server to the network.

C This flows represents both the actual delivery of the selected programme, as well as the related control information. For VOD this flow represent the MPEG flow from the server to the STB, and the VCR commands to control the presentation of the programme. If allowed by the service definition, commands to allow the resuming of a communication between the STB and the service operation are also included.

Figure 12: Scenario 3A

8.6.2 Scenario without third party call/connection set-up capability (scenario 3B)



1 This flow is the request to the network to set up a call for the VOD service. In this scenario the called address passed to the network identifies a specific service provider to which the STB intend to be connected.

2 Flow 2 represents the further action request from the network to the service provider.

3 Flow 3 represents the confirmation given by the service operation to the STB.

B This flow represents the navigation protocol between the STB and the service provider. The information exchange is concluded with the choice of a specific programme, the address of the server storing the selected programme is passed to the STB, which will take care of requesting the network for the setting up of the connection between STB and server. User verification may be performed within this communication.

4 The STB requests from the network the setting up of a communication with a specific server.

5 Flow 5 represents the further action from the network to the program.

6 Flow 6 represents the further response from program server to the STB.

C This flows represents both the actual delivery of the selected programme, as well as the related control information. For VOD this flow represent the MPEG flow from the server to the STB, and the VCR commands to control the presentation of the programme.

Figure 13: scenario 3B

9 Charging

Charging functions in multiprovider environment is the key topic when studying the economies of services and revenues for operators and service providers.

The network operator should be able to send network usage info to a billing system. The network operator can compose these network billing data out of his local data base containing the session and connection related information.

Two possible scenarios for the compilation of the session bill are:

- the network operator provides the session billing service based on the data received by all the actors involved in the session (service provider, network provider, etc);

- a third party provides the session billing service based on the data received by all the actors involved in the session (service provider, network provider, etc).

10 Quality of service

The most common quality of service parameters needed for a connection through the ATM network (or switch) are: peak cell rate, average cell rate , bit error rate, cell loss ratio, allowed delay and allowed delay variation. These are used to determine if the requested connection can be accepted.

If the video program has several service components (e.g. audio, different levels of video coding) and these components have their own connections for transportation, each component must have their own quality of service descriptors. However, at an early stage only one connection is used for the transport of all service components.

10.1 Requirements of the presentation layer for digital video/information downstream

Video decoding conforming to the MPEG-2 standards with main profile and main level support (recommendation 601 with a ratio of 4:2:0), pictures with 4:3 and 16:9 aspect ratios will have bit rates of up to 15 Mbit/s with totally flexible video signals. The required bit rate for a certain quality depends on the source material. Some general guidelines, based on ISO/IEC/JTC1/SC29/WG11 N0673 [14], are provided in table 6.

Table 6: Video quality and required bit rate

Service	Quality	Bit Rate
16:9 EDTV	Near studio (enhanced)	12 Mbit/s
16:9 SDTV	Standard	8 Mbit/s
4:3 SDTV	Standard	5-6 Mbit/s
4:3 LDTV	"VCR-quality" (low)	2-4 Mbit/s

EDTV: Enhanced quality Digital Television.
LDTV: Low quality Digital Television.
SDTV: Standard quality Digital Television.

Audio encoding conforms to MPEG-layers I coding (128..360 kbit/s, 2 stereo channels) and MPEG-2 (360 kbit/s) for five channels and a subwoofer.

10.2 Requirements set by MPEG-2

The error performance target on the Cable Television (CATV) network is less than one uncorrected bit error in a program in one transmission hour. As a result, the maximum bit error rate (BER) is 10^{-10}... 10^{-11} depending on the bit rate of the program. (1 mistake/hour DVB).

Similar requirements have been given in the document IVS baseline document (March 1994) of ITU-T SG13. The requirements relevant to VOD range from 15 minutes of error free operation for 4 Mbit/s VCR quality, to 30 minutes of error free operation for 10 Mbit/s TV quality.

10.3 Network performance

Considering the network performance at physical layer, the bit error rate could be in the order of 10^{-10}. On the other hand, bit error rate in the access network consisting of copper cables could be as high as 10^{-5}, and consequently error correction is needed.

It is required that the Cell Delay Variation (CDV) caused by the ATM network has to be compensated before passing the Transport Streams to the MPEG-2 decoder. As estimated by the experts group of SG 15 of ITU-T (AVC-635), the maximum CDV (UNI-UNI) generated by the ATM network could be as high as 3 milliseconds peak-to-peak in rare cases.

Annex A: IN-based solution for VOD

A.1 General

In this annex, solutions using Intelligent Network (IN) functionality to support VOD are described. The reference configuration given in figure 1 is expanded by IN functional groups and elements. Additional reference points and interfaces are identified between the functional groups/elements of the VOD delivery system. Specific information flows during communication phases of an IN-based VOD session between those functional elements are described.

A.2 Additional functions required for an IN-based VOD solution

In the following, supplements to the VOD reference configuration when using IN are shown in figure A.1, and the functions of its major elements for VOD are described.

These IN functions encompassing B-ISDN requirements provide rapid and cost-effective introduction, control and management of new communication services such as VOD, and new features.

IN supports functions within the ATM broadband switching network, and the service gateway. Also the service operations and the video server may be supported by IN functions, that therefore are shown in figure A.1.

In figure A.1, the network management system functions (TMN) are also shown because of the close link between TMN and IN.

In the following description, the 2-step selection mechanism is used (see subclause 8.1).

A.2.1 Support of download by IN

If the STB functions does not contain the procedures needed for control of, e.g. selection processes and applications, the relevant software may be downloaded by the Intelligent Peripheral (IP) in the service gateway and/or the service operations (see figure A.1).

A.2.2 ATM Broadband Switching Network (ATM BSN)

The Broadband Service Switching Point **(B-SSP)** contains VOD specific triggers to access the service gateway and service operations functions.

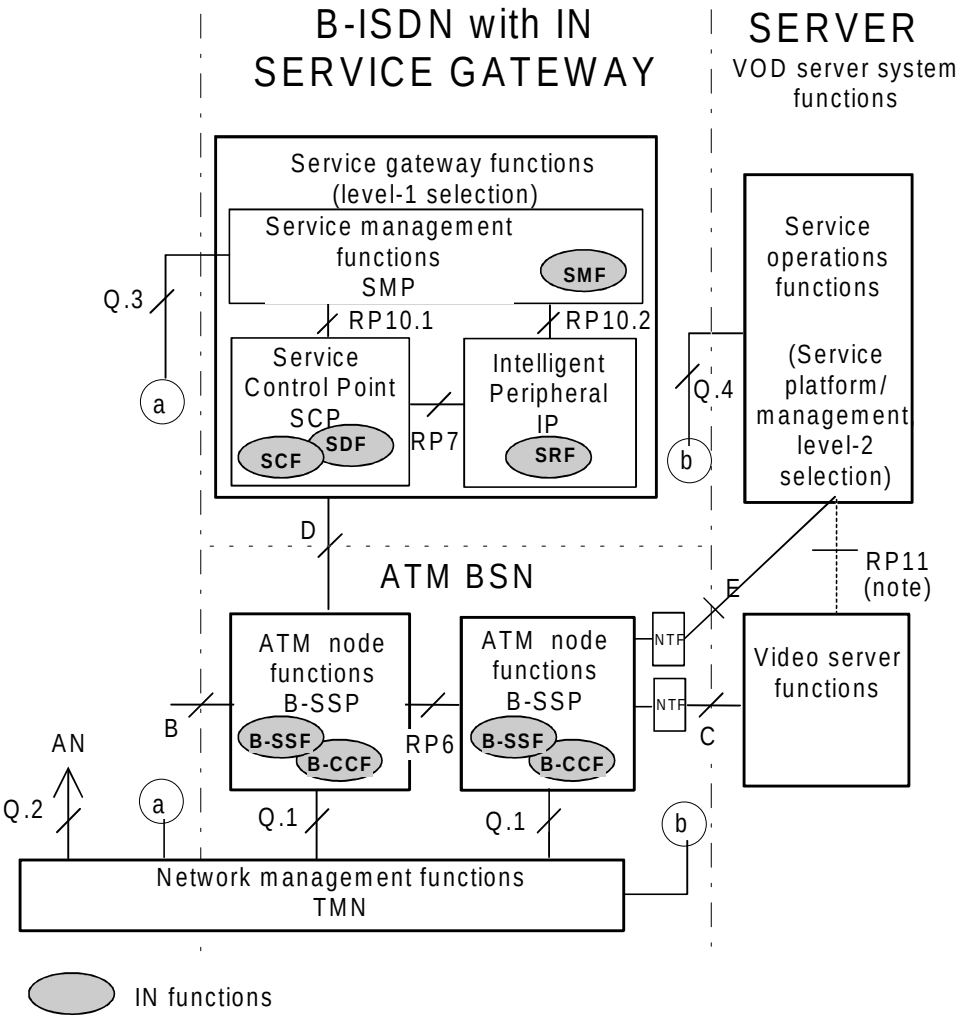
A.2.3 Service gateway

The service gateway area contains the **service gateway functions** that are realized in figure A.1 by IN functions. In the IN-based reference configuration the service gateway contains the **Service Control Point (SCP)** with its functional elements **Service Control Functions (SCF)** and **Service Data Functions (SDF),**and the **Intelligent Peripheral (IP)** with its functional element **Specialized Resource Functions (SRF)**. In general, the service gateway belongs to the broadband network, i.e. the B-ISDN, and will be provided by the ATM BSN operator, e.g. as level-1-gateway offering equal access to all services and brokers. In special cases, the service gateway may be provided by a public or private service providers' broker (not shown in figure A.1).

The SCF provides connection and call control, and depending on the realization of the SCP also VOD session control. The SCF may either control the VOD session during a special phase only, e.g. the first step of the selection mechanism, or during the whole VOD (user-to-user) application using the DSM-CC user-to-network protocol or other session control protocols to be defined.

The functions of the SCP and IP provide control and management functions for the selection of the service provider by the user. This selection is step 1 of the two-step selection mechanism (see subclause 8.1).

The SCP 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. The SCP is able to communicate with every B-SSP using INAP (see reference point D). The SCP determines the IP unit which can serve the user's request, and initiates the connection between the STB and the IP. This may be done either by informing the STB about the logical address (IN number) of the IP, and then the STB requests from the B-SSP the set-up of this connection, or the SCP directly instructs the B-SSP to route the connection to IP (third party call control). After information from the IP about the user's selection of the service provider (RP 7), the SCP initiates the set-up of a control channel between the STB and the service operations (see below) as part of the VOD server system. This may also be done either via a set-up request of the STB, or by direct instruction of the B-SSP by the SCP as described before.



Legend:

AN	Access Network	SCF	Service Control Function
ATM BSN	ATM Broadband Switching Network	SCP	Service Control Point
B-	Broadband	SDF	Service Data Functions
CCF	Call Control Function	SMF	Service Management Functions
IN	Intelligent Network	SMP	Service Management Point
IP	Intelligent Peripheral	SRF	Specialized Resource Function
OSF	Operations System Function	SSF	Service Switching Function
RP	Reference Point	SSP	Service Switching Point
		TMN	Telecommunication Management Network

NOTE: At RP11 it has to be studied whether and what type of interface should be standardized. The service operations and the video 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 elements will be connected via a transport network, e.g. ATM BSN.

Figure A.1: Supplement of VOD reference configuration when using IN

The IP acts as the communication partner to the STB during user-interactive dialogue for the selection of the service provider (RP D). It receives and sends control information and may also send audio-visual 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 SCP (RP7) in order to initiate the set-up of the relevant connection.

In the case of IN, the **service management** functional element as part of the functions of the service gateway (IN element **SMP**) provides SMF for the SCP and the IP, such as collection, administration and update of SCP and IP data, e.g. routeing addresses, traffic statistics, billing data, video content navigation data. It provides features supporting the VOD service, such as:

- routeing and address screening 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.

A.2.4 VOD server system

The **VOD server system** functions consist of 2 functional groups: the **service operations** functions and the **video server(s)** functions which may be realized separately in different systems (figure A.1) or also together in one system. When realized in different systems they may be connected via the ATM BSN (RP E and C) or directly (RP 11). The functions of the service operations (or gateway for the second step of the selection mechanism) support and perform content selection. These gateway functions act as a service platform and contain functions for content management.

It should be noted, that the service platform and management functions in the service operations and the video server control functions may also be supported by the IN (not indicated in figure A.1).

A.2.5 IN functional entities to support VOD

In the following, the IN functional entities within the functional elements of the part of the VOD delivery system presented in figure A.1 are described.

A.2.5.1 ATM-Node, Broadband Service Switching Point B-SSP:

A.2.5.1.1 Broadband Call Control Function (B-CCF)

The 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 Switching Point (B-SSP).

A.2.5.1.2 Broadband Service Switching Function (B-SSF)

The B-SSF interfaces with B-CCF, SCF and SRF. 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 the current CS2 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 Switching Point (B-SSP).

A.2.5.2 Service gateway

A.2.5.2.1 SCP: SCF/SDF

Real time call related IN support of advanced interactive multimedia services such as 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 routeing (e.g. to the nearest service provider), screening of service users, billing functions and support of user procedures.

It is assumed that the SCF amended for broadband IN will be based on the current Capability Set 2 (CS2) IN standards with some extensions to accommodate a Broadband call state model as well as the handling of the ATM interface:

- the SCF communicates to the B-SSF via standard Signaling System No.7 (SS7) and the application part INAP. A standardized B-INAP for this interface is under standardization;

- 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 necessary to process a service request;

- service data related to the STB subscriber profile can reside at the SDF. This type of data includes information related to a particular STB (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 initiate suitable congestion control measures (e.g. automatic call gapping) to protect against overload and to correct against this overload;

- the SCF may control billing and charging via the B-SSF, and may request billing data from the B-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 an Service Control Point (SCP).

A.2.5.2.2 IP: SRF

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

- the SRF may include the sending of data (e.g. files) which is needed to enable the user to select a service provider;

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

- the communication between B-CCF/B-SSF and the SRF for establishing a connection follows an extended ATM UNI (DSS2-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 possibly via the B-CCF/B-SSF;

- 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 SCF↔RF and SCF↔B-SSF↔SRF) are possible;

- in a physical deployment of the broadband IN-architecture, the 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 store it locally and/or send 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 or B-SSF to insure proper billing.

A.2.5.2.3 Service management, SMP: 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/B-CCF. 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 which is collected from the SCF, the SRF and the B-SSF/B-CCF.

The SMF provides the following functions:

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

- the SMF will support the transmission of service logic program to the SCF (e.g. for service creation);

- 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 for IN support;

- optionally, a content provider will be capable of updating the navigation video data via the SMF, e.g. as additional information for the service provider selection;

- provides access to control the content of the SRF navigation content;

- the SMF will provide network security (e.g. password setting, access etc.) function to insure 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 the SMF resides in the SMP.

A.3 Reference points and interfaces

Based on the VOD Reference Configuration described above, table A.1 contains the proposed interfaces so far identified between the network elements. The reference points are those shown in figure A.1.

Table A.1: Reference points and interfaces

Reference point	Between		Type of interface	Comments
B	Access network	ATM node	VB5	Under study by ITU-T
D	ATM node	Service Control Point (SCP)	TBD	(using INAP)
D	ATM node	Intelligent Peripheral (IP)	UNI	Standard interface defined by ITU-T Recommendation I.432 [12]
RP6	ATM node	ATM node	NNI	Standard interface defined by ITU-T
RP7	Service Control Point (SCP)	Intelligent Peripheral (IP)	TBD	(using INAP)
E	ATM node	Service operations	UNI (note 1)	Standard interface defined by ITU-T Recommendation I.432 [12]
C	ATM node	Video server	UNI	Standard interface defined by ITU-T Recommendation I.432 [12]
RP11	Service operations	Video server	(note 5)	
Q.1 Q.2	Network management	ATM nodes, access network (note 2)	TMN interfaces	Under study by ITU-T
Q.3 Q.4	Network management	Management functions of service gateway, service operations	- (note 3)	
RP10.1 RP10.2	Service Management Functions (SMF)	Service control point/intelligent peripheral	(note 4)	

NOTE 1: At E, an interface has to be defined in the case that the service operations and the video (content) server will be realized in separate systems, and has to be standardized when connected via a transport network, e.g. B-ISDN (figure A.1). Both functional groups may also be directly connected via a proprietary interface. No physical interface between those functional groups is necessary when they are realized in one system.

NOTE 2: At Q.1 and Q.2, it has to be studied whether the same interface is appropriate for both the ATM node and the access network.

NOTE 3: It has to be studied whether at Q.3, Q.4 (figure A.1) interfaces are to be standardized or TMN messages will be carried via interfaces at RPs Q.1, D, and 10.1, or at RPs Q.1 and E (note 1) respectively.

NOTE 4: No interfaces are identified yet (requires further study).

NOTE 5: At RP11, it has to be studied whether and what type of interface should be standardized.

A.4 Communication phases and information flows of IN-based VOD solutions

The description of the communication phases by information flows, and the graphical presentation of information flows of one example of an IN-based VOD session are described in subclause A.4.1, table A.2, and figure A.2. A second example of an IN-based VOD session using DSM-CC session protocols is described in subclause A.4.2, table A.3, and figure A.3.

A.4.1 Example 1 of information flows of an IN-based VOD solution

This subclause provides the description of one example of an IN-based VOD session (defined by the user-to-user VOD application) by means of the communication phases and their information flows (table A.2 and figure A.2) between various elements of the VOD delivery system (based on the VOD reference configuration (using IN) given in figure A.1). Additionally, the order presented here indicates the rough form of chronological order of communication during a VOD session.

The two-step selection mechanism used in this description for the selection of information to be retrieved by the user as described in subclause 8.1.

In this example of IN-based VOD session, the SCP may perform the VOD session, at least during step 1 of the selection mechanism, using as far as possible existing (user-to-network) signalling messages. The use of a particular session protocol in this scenario is for further study.

The STB may contain all control and communication procedures needed for control of, e.g. the selection of the service provider. If the STB does not contain the necessary procedures, it may be downloaded by an Intelligent Peripheral (IN) in the service gateway.

As far as possible, existing signaling messages should be used to realize the functional relationships. Additional signaling messages may need to be standardized. In the following, functional interactions via network signaling messages will be indicated with **SM** and service control messages will be indicated with **CM**.

Table A.2: Communication phases and information flows example 1

Communication phases	Information flows
EVENT 1: Set-Top-Box initial download	
1.1	**Set-Top-Box (STB) ⇒ B-SSP (boot request)** ***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 SCP who determines the address of the STB server for the specific STB type.
1.2	**B-SSP ⇒ SCP (IP/STB-server query)** ***SM*** The B-SSP queries the SCP for the address of the appropriate IP/STB-server to which the STB should be connected.
1.3	**SCP ⇒ B-SSP (resolved STB-server address)** ***SM*** The SCP will instruct the B-SSP to switch the STB to the IP/STB server.
1.4	**STB ⇔ IP (STB server downloads STB)** ***CM*** IP/STB server downloads the operating system and base application software needed to interact with the service gateway.
(continued)	

Table A.2: Communication phases and information flows - example 1 (concluded)

EVENT 2: VOD session	
2.1	**STB ⇒ B-SSP (request interactive session) *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 gateway).
2.2	**B-SSP ⇒ SCP (service related control query) *SM*** The B-SSP queries the SCP for the address of the appropriate IP for the subscriber. The SCP will determine what available IP can serve the request.
2.3	**SCP ⇒ B-SSP (resolved service related control address) *SM*** Routeing information is returned to the B-SSP who sets up the SVC (switched virtual connection) between the STB and IP.
2.4	**STB ⇔ IP (selection of service provider) *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.
2.5	**IP ⇒ SO (user related data) *CM*** If the IP does not have all user verification data, the IP may signal to the Service Operations (SO) within the VOD server system user related data in order to make the SO verify user's access permission and succeed user status (e.g. user's STB type) to the SO.
2.6	**SO ⇒ IP (user verification) *CM*** In the case where user access verification is made by the SO, the SO reports the result of user access verification to the IP.
2.7	**IP ⇒ SCP (user's selection) *CM*** The IP signals to the SCP information about the selected service provider and possibly user verification data.
2.8	**SCP ⇒ B-SSP (resolved VOD server system/SO address) *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 SO) then signals the B-SSP to switch the STB through to the SO. Routeing information is given to the B-SSP who will transfer the control channel to the SO.
2.9	**STB ⇔ VOD server system/SO (selection of content) *CM*** The user interacts, through the STB, with the SO 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.
2.10	**VOD server system/SO ⇒ B-SSP (routeing addresses) *SM*** Once the user has selected a video to watch, the SO 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 narrowband channel for the user's control of the video.
2.11	**VOD server system/SO ⇒ video server (selected video) *CM*** The SO informs the video (content) server about the selected video
2.12	**VOD server system/video server ⇔ STB (delivery and control of video) *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 SO and the connection between SO and video server).
2.13	**Video server ⇒ SO ⇒ B-SSP (release request) *CM, SM*** The video server requests via the SO that the B-SSP release the video channel to the STB at the end of the video (or as a result of user actions).
2.14	**VOD server system/SO ⇔ STB, SO ⇒ B-SSP (termination of the service/additional selection) *CM, SM*** The SO interacts with the user through the STB to provide additional selection or termination of service. The SO requests that the B-SSP release the control channel to the STB when the user has selected to terminate the VOD session.

Figure A.2 provides a graphical representation of the information flows described above.

NOTE: The figures only represent the main functional relationships and do not specify exact messages or protocols. Additionally, all signaling relations are expected to be realized by standard signaling messages that are not service-dependent.

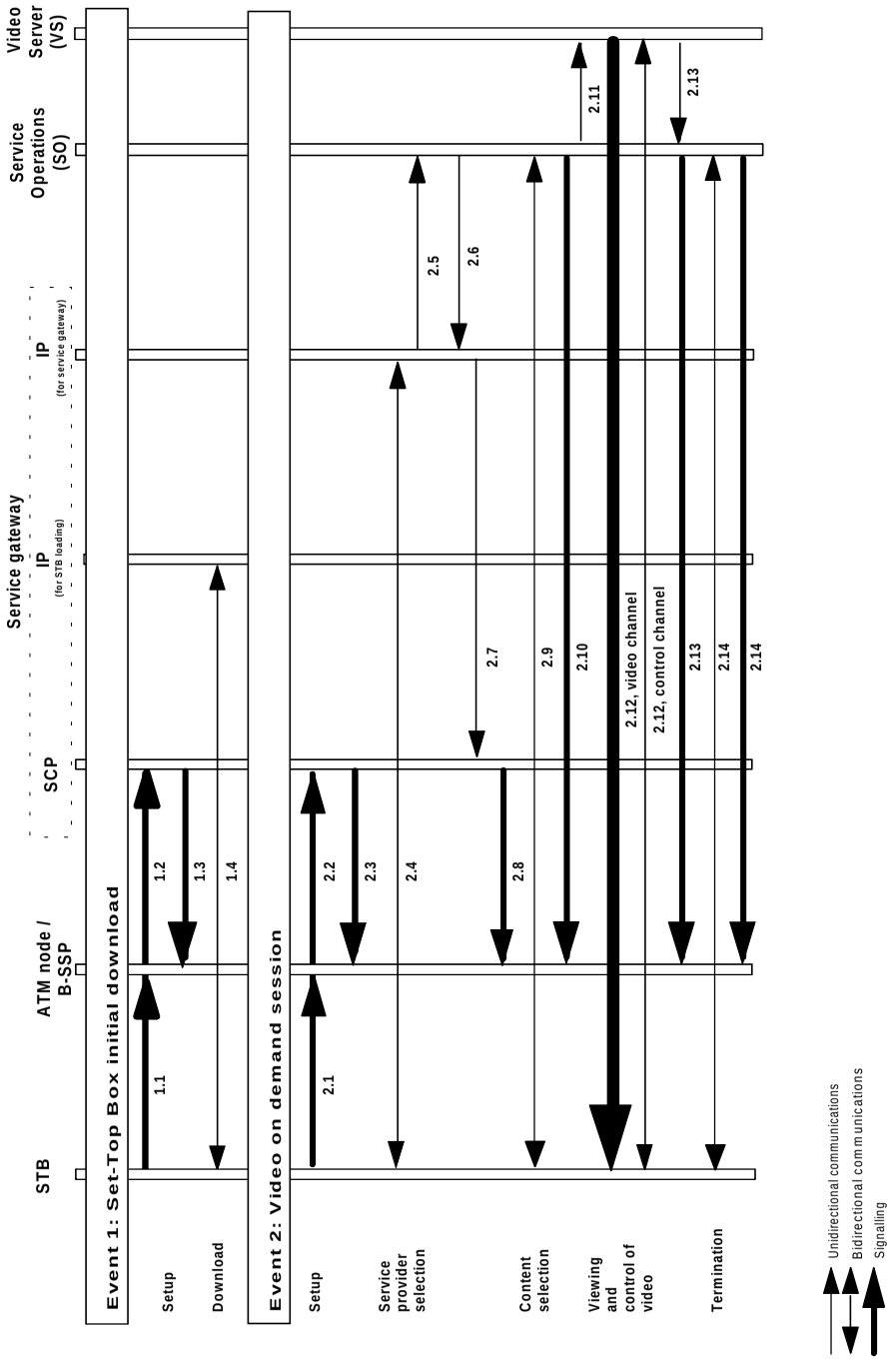


Figure A.2: Information flows for VOD (example 1)

A.4.2 Example 2 of information flows of an IN-based VOD solution using DSM-CC session management

This subclause provides the description of one example of an IN-based VOD session by means of the communication phases and their information flows (table A.3 and figure A.3) between elements of the VOD delivery system (based on the VOD reference configuration (using IN) given in figure A.1). Additionally, the order presented here indicates the rough form of chronological order of communication during a VOD session.

The two-step selection mechanism used in this description for the selection of information to be retrieved by the user is described in subclause 8.1.

In this example an IN-based VOD session controlled by a VOD session manager in the network using DSM-CC session protocols is described.

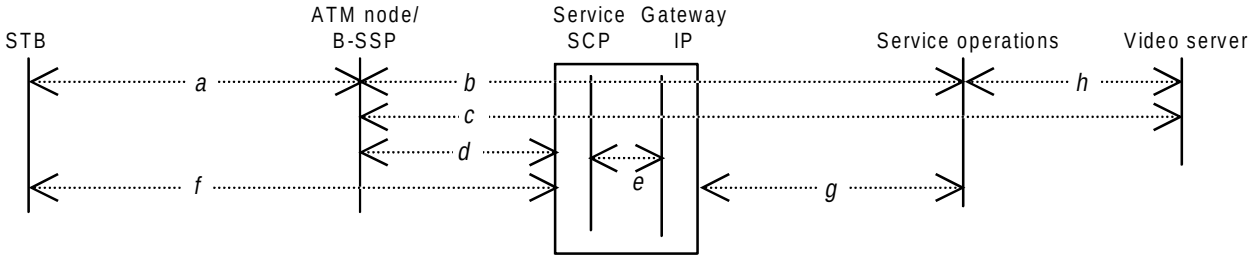
Table A.3: Communication phases and information flows - example 2

Communication phases	Information flows
EVENT: VOD session	
1	**Set-Top-Box (STB) ⇔ service gateway** After request of the user via the STB, session management performs session set-up and resource negotiation/assignment.
2	**STB ⇒ B-SSP** The STB requests connection set-up using IN-number.
3	**B-SSP ⇒ service gateway** The B-SSP queries the service gateway/SCP for routeing address of the IP.
4	**Service gateway ⇒ B-SSP** After SCP has executed IN features (screening, charging, etc.) and after retrieval of routeing information, the service gateway (SCP) sends the resolved IP address to B-SSP.
5	**Service gateway ⇔ STB** After B-SSP has routed the call to IP, after B-SSP has informed SCP of connection set-up, and after SCP has instructed IP to perform navigator function, session management performs assignment confirmation.
6	**Service gateway ⇔ STB** Navigator function: menu is downloaded to the STB, and the service provider (indirectly the service operations) is selected by the user via the STB.
7	**STB ⇒ B-SSP** After service operation selection, STB requests from the B-SSP the release of the connection between STB and IP.
8	**Service gateway ⇔ STB** After B-SSP has released connection with IP,and B-SSP has informed SCP about the ATM connection release, session management performs release of VOD session step 1 between service gateway and STB.
9a, 9b	**Service gateway ⇔ STB, service gateway ⇔ service operations** Service gateway sets up VOD session step 2 between and service operations (controlled by service gateway), and performs resource negotiation/assignment.
10	**STB ⇒ B-SSP** STB requests setup of connection of service operations using IN number.
11	**B-SSP ⇒ service gateway/SCP** B-SSP queries the SCP for the routeing address of the service operations.
12	**Service gateway ⇒ B-SSP** After SCP has executed IN features (screening, charging, subscription checks, etc.) and after retrieval of routeing information, the SeRvice gateway/SCP sends the resolved service operations server address to B-SSP.
13a, 13b	**Service gateway ⇔ STB, service gateway ⇔ service operations** After B-SSP has routed the call to the service operations server and after B-SSP has informed the ATM connection setup, resource assignment is confirmed between service gateway and STB, and between service gateway and service operations by session management.

Table A.3: Communication phases and information flows - example 2 (concluded)

Communication phases	Information flows
EVENT: VOD session	
14	**Service operations ⇔ STB** Navigator function: menu is downloaded from service operations to STB, and the video content (indirectly the video server) is selected by the user via the STB.
15a, 15b	**Service gateway ⇔ STB, service gateway ⇔ service operations** Session management performs resource negotiation/assignment for video channel between video server and STB.
16	**STB ⇒ B-SSP** STB requests (by using IN number) the setup of a video channel from the video server to the STB.
17	**B-SSP ⇒ service gateway/SCP** The B-SSPqueries the SCP for routeing address of the video server.
18	**Service gateway/SCP ⇒ B-SSP** After SCP has executed IN features (screening, charging, etc.) and after retrieval of routeing information, the SCP sends the resolved video server address to the B-SSP.
19a, 19b	**Service gateway ⇔ STB, service gateway ⇔ service operations** After the B-SSP has routed the call to the video server and after B-SSP has informed the SCP about the setup, resource assignment is confirmedbetween service gateway and STB and between service gateway and service operations by session management.
20	**Video server ⇒ STB** Delivery of video stream.
21a, 21b	**Service operations ⇔ STB** The user communicates via the STB with the service operations and interactively controls the presentation of the video. Service operations forward the control information to the video server
22a, 22b	**STB ⇔ service operations** After finalization of the video, the user (STB) communicates with the service operations about termination of the VOD session, or the retrieval of an additional video respectively. Service operations informs the video server about the result

A.4.3 Use of protocols



a **STB - ATM node/B-SSP.**

b **ATM node/B-SSP - service operations.**

c **ATM node/B-SSP - video server.**

Type of protocol: UNI, i.e. DSS2 according ITU-T Recommendation Q.2931 [13].
Purpose: provision of ATM connections.

d **ATM node/B-SSP - service gateway.**

d1 **ATM node/B-SSP - SCP.**

Type of protocol: Broadband Intelligent Network Aplication Protocol (B-INAP), enhanced INAP compared to current ITU-T INAP recommendation.
Purpose: ATM connections will be controlled by the SCP.

d2 **ATM node/B-SSP - IP.**

Type of protocol: UNI, i.e. DSS2 according to ITU-T Recommendation Q.2931 [13].
Purpose: provision of ATM connections.

e **SCP - IP.**

Type of protocol: The service gateway internal protocol interface, i.e. between SCP and IP, is not described. This interface depends on the chosen function split between SCP and IP.

f **STB - service gateway.**

g **Service operations - service gateway.**

Type of protocol: DSM-CC.

Possible options for transport:

1) specific PVC;
2) specific SVC, DSM-CC messages are transported as payload. The STB/server for service operations has to support two signalling entities, i.e. one entity for requesting ATM connections and one entity for transport of DSM-CC user-to-network messages;
3) signalling, DSM-CC messages are embedded in non-call associated DSS2 signalling messages, e.g. facility.

Purpose: Transport of DSM-CC user-to-network messages for session management, i.e session setup, resource negotiation and assignment, session release.

h **Service operations - video server.**

Type of protocol: Proprietary protocol (note).

NOTE: Interface is proprietary. Service operations and video server may be realized in different systems or together in one system and may belong to one service/content provider or to different service providers and content providers.

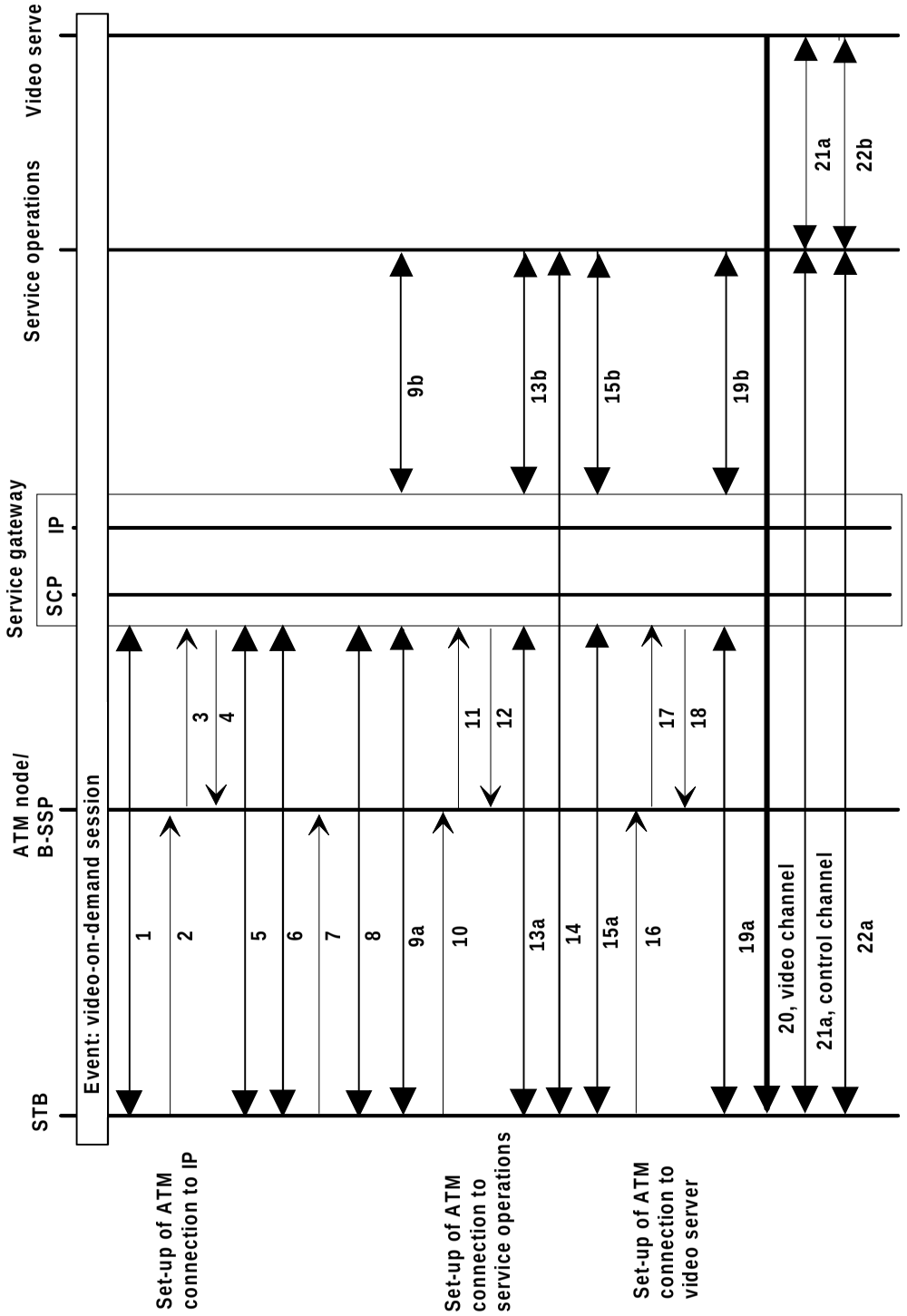


Figure A.3: Information flows for VOD (example 2)

History

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