ETSI TECHNICAL REPORT

ETR 089

August 1993

Source: ETSI TC-NA

Reference: DTR/NA-052714

ICS: 33.080

Key words: Signalling, B-ISDN

Broadband Integrated Services Digital Network (B-ISDN) Principles and requirements for signalling and management information transfer

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Foreword

This ETSI Technical Report (ETR) has been prepared 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 application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

This ETR defines the Broadband Integrated Services Digital Network (B-ISDN) signalling requirements, signalling transfer functions, Virtual Path/Virtual Channel (VP/VC) network element configurations at user access and some call and connection control aspects.

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1 Scope

The ETSI Technical Report (ETR) defines the Broadband Integrated Services Digital Network (B-ISDN) signalling requirements, signalling transfer functions, Virtual Path/Virtual Channel (VP/VC) network element configurations at user access and some call and connection control aspects.

2 References

For the purposes of this ETR, the following references apply.

[1] ITU-T Recommendation I.150: "B-ISDN ATM functional characteristics".

[2] ITU-T Recommendation I.311: "B-ISDN general network aspects".

[3] ITU-T Recommendation I.327: "B-ISDN functional architecture".

[4] ITU-T Recommendation I.361: "B-ISDN ATM layer specification".

[5] ITU-T Recommendation Q.142x: "B-ISDN meta-signalling".

[6] ITU-T Recommendation I.37x: "Network Capabilities to Support Multimedia Services".

[7] ITU-T Recommendation Q.700: "Introduction to CCITT Signalling System No 7".

[8] CCITT Recommendation Q.767: "Application of the ISDN user part of CCITT signalling system No. 7 for international ISDN connections".

[9] ITU-T Recommendation X.25: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

3 Definitions

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

Call: a call is a logical association between two or more endpoints, offering the possibility to make use of a telecommunication service.

Connection: the association of network resources providing the capability of transferring information between endpoints.

Simple call: two party call supported by one connection. The connection can be unidirectional or bidirectional.

Two party call: a call in which exactly two users are involved.

Multiparty call: a call in which three or more users are involved.

Multiconnection call: a call, which is supported by two or more point-to-point connections between the users.

Multiparty/Multiconnection call: a call that has both multiparty and multiconnection characteristics.

Multimedia call: a call which offers a multimedia service.

Medium (plural media): a means by which information is perceived, expressed, stored or transmitted.

The multimedia service, as defined in ITU-T Recommendation I.37x [6], is a service in which the interchanged information consists of more than one type, such as text, graphics, sound, image and video. Precise definition for the information type and party are required. Also the relationship between user, party and signalling endpoint should be further investigated.

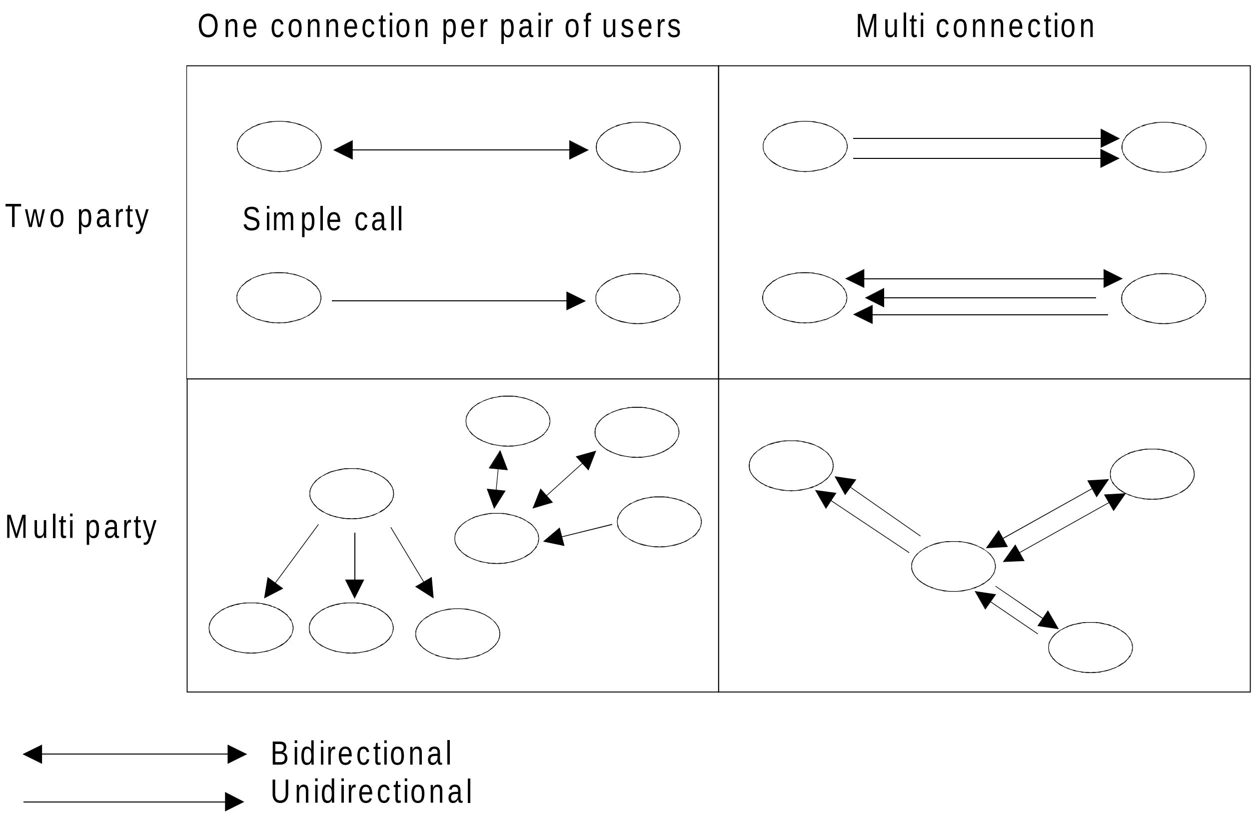


Figure 1: Examples of types of calls

Figure 1 illustrates different types of calls.

VP cross-connect: a VP cross-connect is a network element which connects VP links; it translates Virtual Path Identifier (VPI) (not Virtual Channel Identifier (VCI)) values and is directed by management plane functions and not by control plane functions.

VC cross-connect: a VC cross-connect is a network element which connects VC links, it terminates Virtual Path Connections (VPCs) and translates VPI/VCI values and is directed by management plane functions and not by control plane functions.

VP switch: a VP switch is a network element that connects VP links; it translates VPI (not VCI) values and is directed by control plane functions.

VC switch: a VC switch is a network element that connects VC links; it terminates VPCs and translates VPI/VCI values and is directed by control plane functions.

NOTE: Different configurations of network elements are possible.

4 Symbols and abbreviations

For the purposes of this ETR, the following symbols and abbreviations apply.

AAL	ATM Adaptation Layer
ABC	Access Bearer Control
AC	Access Control
ATM	Asynchronous Transfer Mode
BC	(Bearer) Connection Control
B-ISDN	Broadband ISDN
B-SP	B-ISDN Signalling Point
B-STP	B-ISDN Signalling Transfer Point
C-plane	Control Plane
CAS	Channel Associated Signalling
CC	Call Control
CCS	Common Channel Signalling
CEQ	Customer Equipment
CLS	Connectionless Server
CRF	Connection Related Function
FE	Functional Entity
GBSVC	General Broadcast Signalling Virtual Channel
IN	Intelligent Network
ISDN	Integrated Service Digital Network
LAN	Local Area Network
LEX	Local Exchange
MAN	Metropolitan Area Network
MOU	Memorandum of Understanding
NA	Network Adapter
N-ISDN	Narrowband ISDN
NBC	Network Bearer Control
NL	Network Layer
NMC	Network Management Centre
NNI	Network Node Interface
NT	Network Termination
OAM	Operation And Maintenance
OBC	Originating Connection Control
OBCA	Originating Connection Control Agent
OCC	Originating Call Control
OCCA	Originating Call Control Agent
OSI	Open System Interconnection
PL	Physical Layer
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RBC	Relaying Connection Control
SAP	Service Access Point
SBSVC	Selective Broadcast Signalling Virtual Channel
SCA	Service Control Agent
SCP	Service Control Point
SPID	Service Profile Identifier
SSP	Service Switching Point
SVC	Signalling Virtual Channel
SVCI	Signalling Virtual Channel Identifier
TBC	Terminating Connection Control
TBCA	Terminating Connection Control Agent
TCC	Terminating Call Control
TCCA	Terminating Call Control Agent
TE	Terminal Equipment
TEX	Transit Exchange
TNBC	Transit Network Bearer Control
U-plane	User-plane

UNI	User Network Interface
UPT	Universal Personal Telecommunications
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier
VP-XC	Virtual Path Cross Connect

5 Signalling principles and requirements

5.1 B-ISDN signalling requirements

5.1.1 Introduction

In B-ISDN, the use of Asynchronous Transfer Mode (ATM) allows for a multiplicity of service types/characteristics and for the logical separation of signalling from user information streams. A user may have multiple signalling entities connected to the network call control via separate ATM virtual channel connections. The following subclauses identify the signalling capabilities needed in B-ISDN and the requirements for establishing signalling communication paths.

5.1.2 Capabilities required for B-ISDN signalling

5.1.2.1 Capability to support simple, multiparty and multiconnection call

a) Support of symmetric and asymmetric simple calls (e.g. low or zero bandwidths in one direction and high bandwidths in the other).

b) Negotiate the characteristics of the call at call establishment.

c) Simultaneous establishment and removal of multiple connections associated with a call.

NOTE: The simultaneous establishment of multiple connections should not be significantly slower than the establishment of a single connection.

d) Add and remove connection to and from an existing call.

e) Add and remove a party to and from a multiparty call.

f) Capability to correlate when requested connections composing a multiconnection call.

NOTE: This correlation is handled by the origination and destination B-ISDN switches, which may be public or private.

g) Reconfigure a multiparty call including an already existing call or splitting the original multiparty call into more calls.

5.1.2.2 Capabilities to control ATM virtual channel connections and virtual path connections for information transfer

a) Establish, maintain and release ATM VCCs and VPCs for information transfer. The establishment can be on-demand, semi-permanent or permanent, and should comply with the requested connection characteristics (e.g. bandwidth, Quality of Service (QoS)).

b) Support of communication configurations on a point-to-point, multipoint and broadcast basis.

c) Negotiate the traffic characteristics of a connection at connection establishment.

d) Ability to renegotiate source traffic characteristics of an already established connection.

5.1.2.3 Capabilities to support semi-permanent connections

Semi-permanent connections can be set up by either control plane communication, supported by signalling or by management plane communication.

Semi-permanent connections can be used as follows:

- end-to-end semi-permanent connection;
- semi-permanent connections to specialised network elements (i.e. Connectionless Server (CLS) or Network Adapter (NA));
- backbone network configuration at Network Node Interface (NNI).

The following management functions will be required to be supported for the provision of reliable semi-permanent connection:

- failure indication by network or by user;
- automatic re-establishment of semi-permanent connections in case of failure.

5.1.2.4 Others

a) Capability to reconfigure an already established connection, for instance, to pass through some intermediate processing entity such as a conference bridge.

b) Support interworking between different coding schemes.

c) Support interworking with non B-ISDN services, e.g. services supported by Public Switched Telephone Network (PSTN) or Narrowband ISDN (N-ISDN).

Further signalling requirements may be possible and are for further study.

5.2 Signalling method

The signalling method to be used in the B-ISDN will be Common Channel Signalling (CCS). CCS is a method of signalling in which the signalling information relating to a multiplicity of channels or functions or for network management, is conveyed over a single channel by addressed messages.

CCS will be able to operate in two modes:

1) associated mode (i.e. signalling points, that are the origin and destination points of the messages are directly interconnected by a link);

2) quasi-associated mode (i.e. messages pass through one or more signalling points other than those which are the origin or destination of the messages. The path is pre-determined).

The use of Channel Associated Signalling (CAS) for specific purposes, such as sporadic sources needs further study.

5.3 Signalling transport functions

At the user access, multiple VPs may be used to carry Signalling VCs (SVCs). These VPs may connect the user to one or more local exchanges (allowing the users to be connected to more than one network), or other users. B-ISDN signalling configurations are classified as either point-to-multipoint or point-to-point.

A point-to-multipoint signalling configuration exists when a signalling entity ("point") interacts with multiple signalling entities ("multipoints"). In a point-to-multipoint signalling configuration, meta-signalling procedures shall be used to request allocation of individual point-to-point SVCs.

A point-to-point signalling configuration exists when a signalling entity interacts with another signalling entity.

When the signalling configuration is unknown, a point-to-multipoint signalling configuration shall be assumed. A signalling configuration can become known either by subscription or by a dynamic procedure.

5.3.1 Signalling virtual channels

5.3.1.1 Signalling virtual channels at the user-network interface

The requirements for SVCs at the user access are as follows:

a) Point-to-point signalling virtual channels:

for point-to-point signalling, one virtual channel connection in each direction is allocated to each signalling endpoint. The same VPI/VCI value is used in both directions of communication.

In general, a signalling endpoint in a Customer Equipment (CEQ) can control, by means of associated point-to-point SVCs, user VCs belonging to any of the VPs at the associated interface.

As a network option, the user VCs controlled by a signalling endpoint can be constrained such that the point-to-point SVCs can only control user VCs in the same VP;

NOTE: Whether there is one signalling endpoint per terminal or whether there are multiple endpoints per terminal requires further study.

b) General Broadcast Signalling Virtual Channel (GBSVC):

the GBSVC may be used for call offering in all cases. In cases where the network does not implement service profiles, or where terminals do not support service profile identification, then the GBSVC should be used for call offering.

A specific VCI value for general broadcast signalling is reserved per VP at the User-Network Interface (UNI). Only where meta-signalling (see subclause 5.3.2) is used in this VP will the GBSVC be activated;

c) Selective Broadcast Signalling Virtual Channels (SBSVC):

instead of GBSVC, a virtual channel connection for selective broadcast signalling can be used for call offering, in cases where a specific service profile is used. No other uses of the selective broadcast signalling virtual channels are foreseen.

The concept of service profiles is related to basic services as well as supplementary services (see subclause 5.3.2.1.2).

5.3.1.2 Signalling virtual channels at the NNI

Only the point-to-point signalling configuration is used at the NNI. A standardised VCI value is dedicated in each VP. In case additional VCs are required for signalling, the additional VCI values are pre-established.

The method for pre-establishment is for further study.

5.3.2 Meta-signalling

5.3.2.1 Meta-signalling functions at the UNI

In order to establish, check and release the point-to-point SVC connections and SBSVC connections, that are needed across an interface, meta-signalling procedures are provided. For each direction, meta-signalling is carried in a permanent Virtual Channel Connection (VCC) having a standardised VCI value. This channel is called the meta-signalling virtual channel. It may be necessary to support meta-signalling on any VP. A meta-signalling channel can only control signalling VCs within its own VP. Meta-signalling protocol is terminated in the ATM layer management entity.

The meta-signalling function will be required to:

- manage the allocation of capacity to signalling channels;
- establish, release and check the status of signalling channels;
- release point-to-point signalling virtual channels;
- resolve the possible contention for particular signalling virtual channels identifiers;
- manage the allocation of capacity to signalling virtual channels;
- provide a means to associate a signalling end-point with a service profile if provided;
- provide the means to distinguish between simultaneous requests.

5.3.2.1.1 Relationship between meta-signalling and the user access signalling configurations

A point-to-multipoint user access signalling configuration exists when the network supports more than one signalling entity at the user side. In this configuration, terminals need to use the meta-signalling protocol to request allocation of their individual point-to-point SVCs.

A point-to-point user access signalling configuration exists when the network supports only one signalling entity at the user side. In this configurations, terminals will use a pre-established VC with a standardised VCI value (see ITU-T Recommendation I.361 [4], table 2) as the point-to-point SVC. In this case, no general broadcast signalling virtual channel will be provided.

In a user-to-user signalling configuration the meta-signalling protocol can optionally be used over a user-to-user VPC to manage a user-to-user SVC. It is recommended (but it is a user choice) to use the standardised VCI value as the user-to-user meta-signalling channel. In this case, meta-signalling will not have an impact on the network.

The meta-signalling protocol can be used to manage SVCs between a user and another network over the same user access. In this case VPIs other than the default one are used and the VCI value is the standardised one.

5.3.2.1.2 Meta-signalling procedures for handling the service profile identifier and the allocation of broadcast channels

The objective of the procedures is to support maximum flexibility in the network architecture at minimum cost for the terminal configurations.

The procedures also supports terminal portability by hiding the internal architecture of the network from the terminal and by not requiring pre-set or pre-programmed information for network access in the terminal with the exception of default value service profile identifier.

The procedures also require that the implementation of the selective broadcast procedure is optional in the user configuration and in the network.

The association between a signalling entity and a service profile is accomplished via a Service Profile Identifier (SPID), that is conveyed in the appropriate meta-signalling message(s). Definition and scope of service profile is given in Annex A.

5.3.2.2 Meta-signalling functions at the NNI

No meta-signalling is used on the NNI.

5.3.2.3 Meta-signalling requirements

a) Scope of meta-signalling:

a meta-signalling VC is able to manage SVCs only within its own VP. In VPI=0 the meta-signalling VC is always present and has VCI value equal to 1. A standardised VCI value equal to 1 for meta-signalling is reserved per VP at the UNI.

b) Activation of meta-signalling VC:

only when meta-signalling is required to be used in a given VP will the meta-signalling VC be activated.

This can be done at VP establishment or later. In this case the mechanisms are for further study.

For a VP with point-to-multipoint signalling configuration, meta-signalling is required and the meta-signalling VC within this VP will be activated. For a VP in point-to-point signalling configuration, the use of meta-signalling is for further study.

c) Initiation of meta-signalling procedure:

meta-signalling procedure for assignment and removal of the SVC should be activated when necessary.

d) Meta-signalling VC bandwidth:

there will be a standardised default value for the meta-signalling VC bandwidth. The bandwidth can be changed by mutual agreement between network operator and user.

The default value is for further study.

e) SVC bandwidth:

the user should have the possibility to negotiate the bandwidth parameter value.

The bandwidth parameter values are for further study.

5.4 Call and connection control aspects

5.4.1 Introduction

In present signalling systems of the N-ISDN, Call Control (CC) and Bearer Connection Control (BC) are integrated in one monolithic system. One (bidirectional) connection is being established as a part of the call setup procedure. A call is, therefore, supported by exactly one connection. In future, this may no longer be the case, for the following reasons:

- the growing need for multimedia services requires a flexible and efficient control of these services. This could be achieved if a call is supported by multiple connections and each connection supports a service component;
- the introduction of multiparty calls often requires that a call is supported by more than one connection;
- in near future, the number of mobile calls will grow rapidly. In addition, Universal Personal Telecommunications (UPT) will be introduced. These services demand the exchange of signalling, without the need for establishing a user data connection, e.g. database access. The same is valid for signalling in networks based on the Intelligent Network (IN) architecture. The separation between call control and connection control offers this possibility.

In order to be able to support future services, it is necessary that CC and BC are separated in terms of signalling protocols and control systems.

5.4.2 Separation between call control and connection control

5.4.2.1 Concept of CC/BC separation

The concepts of CC and BC separation includes two different aspects:

- the functions of CC and BC (see subclause 5.4.2.3) are logically separated in the specification and in the implementation of the network control system (although CC and BC may be located in the same physical place);
- there is a distinction between CC information and BC information. CC and BC information can be routed differently (although this may not necessarily be the case).

5.4.2.2 Advantages of CC/BC separation

The CC/BC separation offers the following advantages:

- not all nodes in the network need to be equipped with CC. Intermediate switching nodes can be equipped with BC only;
- multimedia services can be controlled in a flexible way, i.e. within an existing call, connections can be added or released, without releasing the call;
- multiparty calls can be controlled in a flexible way: within an existing call, parties can be added or removed without releasing the call. Multiparty calls can be reconfigured including an already existing call or splitting the original call into more calls;
- the establishment and release of connections and the call can be done simultaneously and sequentially;
- the sequential establishment of a call and its supporting connection(s) offers the possibility to negotiate first about call acceptance (e.g. compatibility check, status check), before the connections have been set up. This avoids wasting of network resources, e.g. in case of unsuccessful call acceptance negotiation;

- signalling information can be exchanged without the simultaneous establishment of a connection, which is very useful for mobile and UPT calls, as well as for IN services;
- charging and tariffing, which are more and more complicated functions in future services, can be dealt with in a more flexible way, because they can be based on call parameters and connection parameters;
- the direction of connection establishment can be different from the direction of call establishment;
- control systems have a modular structure;
- it allows an easier introduction of new services.

5.4.2.3 Functions of call control and connection control

The functions of CC and BC can be summarised as follows:

1) **Functions of CC:**

overall control of the call:

- accepting service requests;
- service discrimination;
- end-to-end QoS negotiations;
- end-to-end QoS renegotiation;
- compatibility checking;
- call/connection admission control;
- user status checking and monitoring;
- routing CC information (selecting next CC-node);
- routing of User-plande (U-plane) connections;
- request allocation of identifiers;
- provide charging information;
- control of supplementary services;

control of BC:

- coordination between CC and BC;
- grouping of bearers;
- instruct the BC to setup/release a connection;
- coordination between BC`s;

information transfer capability:

- user-to-user signalling;

2) Functions of BC

control of each connection:

- reservation and allocation of network resources;
- request allocation of identifiers;
- through-connecting;
- disconnect and release resources;
- collection of charging information;
- routing BC information (selecting next BC-node);
- QoS negotiation;
- QoS renegotiation.

5.4.3 Requirements for signalling procedures

The following requirements need to be considered for the development of B-ISDN signalling protocols:

- the enhanced protocols should support user equipment for the new B-ISDN services and for existing N-ISDN service at the same User-Network Interface (UNI);
- the support of several protocols at the UNI should be avoided;
- the receipt of modified existing information elements or introduction of new ones, respectively, should result in regular protocol actions rather than in an invocation of error procedures;
- a network should only evaluate the information which it needs to perform screening, to determine the network resources and to perform the routing for the service requested by the user;
- the specific features inherent to the ATM technique should be taken into account when defining specific signalling procedures.

The general requirements apply to both the initial and the target solution.

In addition, the target solution should aim at commonality between UNI and NNI.

5.5 Evolution of the signalling requirements

In order to evolve to the target B-ISDN signalling system, a timetable is shown in table 1, that identifies three subsequent releases. The intention of this table is to clarify the services, network capabilities and network architectures in order to define signalling capabilities, procedures and protocols.

Table 1: Timetable of the different releases

Release 1 (NOTE 1)	by 92 (release 2) (NOTE 2)	by 94 (release 3)
1 B-ISDN bearer services (NOTE 2)	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
BCOB-A (CBR, CO, end-to-end timing) peak traffic parameter, emulation (speech, 3,1 kHz audio & 64 kbit/s unrestricted and higher rates)	BCOB-B (VBR, CO, with end-to-end timing)	Multi-media
BCLB (VBR, CLS, no end-to-end timing) peak traffic parameter	BCOB-C (VBR, CO, no end-to-end timing)	Distributive services
BCOB-X (unrestricted, proprietary AAL) peak traffic parameter	Bandwidth allocated on basis of traffic characteristics for all classes	
Information transfer capability: unrestricted	Relationship of CLP to QoS & Indication of QoS by user	Negociation of QoS class by user from QoS classes
2 Network architecture (refer ITU-T Recommendation I.311, § 2)	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
For both UNI and NNI	Connnectionless servers (switched access)	
VPC cross connect only	VP resource management systems	
VCC switching (ATM switching) Non-intelligent multiplexing	Service control point (IN) access	
Connectionless servers interconnected with semi-permanent VCC/VPC Access to connectionless services with semi-permanent VCC/VPC (at UNI) (NOTE 3)		

(continued)

Table 1 (continued): Timetable of the different releases

Release 1 (NOTE 1)	by 92 (release 2) (NOTE 2)	by 94 (release 3)
3 Network capabilities	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
VC switching (point-to-point)	Simple Multi-point VC & VP connections	Broadcast connections
VP cross connect (point-to-point) (NOTE 8)	VP configuration with standard OAM	VP configuration with integrated OAM and switching
VP establishment with OAM system (NOTES 4, 5) VCC, within a user-user VPC, establishment on demand	CLP use	
Indication of VPC and VCC peak bit-rate during establishment (NOTE 6)	Negotiation of VPC and VCC bandwidth during establishment	
	Renegotiation of VPC/VCC bandwidth during active phase	
	Indication of QoS	
3.1 Traffic characteristics	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
Peak allocated VCC and VPC (NOTE 6)	Bandwidth allocated to VCC and VPC on basis of traffic characteristics including additional parameters e.g. average, burstiness, peak duration (NOTE 4)	
Circuit emulation, including 64 kbit/s	N-ISDN interworking	
3.2 Connection configurations (user bearer services)	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
Unidirectional, point-to-point	Simple point-to-point ATM bearers. Limited topologies, including add/drop features (NOTE 5)	
Bi-directional, point-to-point symmetrical and asymmetrical		
Single connection, simultaneous establishment	Multi-connection, delayed establishment	

(continued)

Table 1 (concluded): Timetable of the different releases

Release 1 (NOTE 1)	by 92 (release 2) (NOTE 2)	by 94 (release 3)
3.3 Connection configurations (signalling)	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
Uni-directional, point-to-multipoint, broadcast		
Bi-directional, point-to-point, symmetrical		
3.4 Interworking	**< -as for 90 with additions:**	**<- as for 90 and 92 with additions:**
To narrowband ISDN using BCOB-A	For further study in release 2 & 3	For further study in release 2 & 3
To other connectionless networks using BCLB (NOTE 3)		
4 Other attributes	**<- as for 90 with additions:**	**<- as for 90 and 92 with additions:**
Common channel signalling transfer mode		
Meta-signalling channel		
Initial guidance on charging	Broadband aspects of charging and relationship to resource allocation	
Limited supplementary services as per CCITT Recommendation Q.767 [8] (NOTE 7)	Supplementary services	

NOTE 1: Mandatory for 1992 signalling recommendations.

NOTE 2: This includes the support of narrowband ISDN services identified in the Memorandum of Understanding (MOU) and specified by NA1.

NOTE 3: No signalling impact expected, as the ATM bearer connections will be semi-permanent.

NOTE 4: The Operation and Maintenance (OAM) procedures may not be standardised.

NOTE 5: Customer to VP service provider signalling relation to be considered in release 2.

NOTE 6: A peak rate traffic parameter will be specified as a data request rate at the ATM layer Service Access Point (SAP). An additional peak rate traffic parameter to be specified as a bit rate at the ATM Adaption Layer (AAL) SAP is for further study.

NOTE 7: Subject to minimal impact on connection configurations. Further study is required on the applicability of these supplementary services to B-ISDN services to be defined by NA1.

NOTE 8: No on-demand VP switching is required in release 1.

6 VP/VC network element configuration at user access

This Clause defines the VP/VC network elements involved in the user access management, control and information transfer, and describes the various communication scenarios applicable between the user and the network elements and typical VP/VC network element configurations of the user access to accommodate for VP/VC user information transfer capability.

6.1 Communications between user and network elements

The following five types of communications are identified for the provision of transport of U-plane information (see figure 2):

1) management plane communication type 1:

this is a communication taking place directly between the CEQ and the Network Management Centre (NMC) via two types of communication paths:

- a communication path connected with the NMC via an interface other than the interface through which the U-plane information is transferred (using a remote entry terminal at the CEQ); or

- via pre-defined VPC or VC between Terminal Equipment (TE) and the NMC through the same T-interface as that for user information transfer (via the VP/VC cross-connect).

In principle this communication exists of a request from the CEQ for a permanent or semi-permanent VPC or VC for user information transfer, and a notification from the NMC to the CEQ of the VPI and VCI values to be used for this user information transfer across TB interface.

At the CEQ the user can manually enter the request information either at the remote entry terminal or directory at the Terminal Equipment/Network Termination 2 (TE/NT2). In case of a remote entry terminal, an internal communication between this terminal and the TE/NT2 could be used;

2) management plane communication type 2:

the VPC/VCC link connections are established/released/maintained within the VP- or VC cross-connects via the management plane communication type 2.

Communicating entities of this communication are the NMC and VP- or VC cross-connects. Communication between them could be ATM - based or not ATM-based;

3) control plane communication (access):

in this communication a user manages (establishes/releases) a VPC/VCC by sending control plane messages through a signalling VC which is terminated at a VC switch;

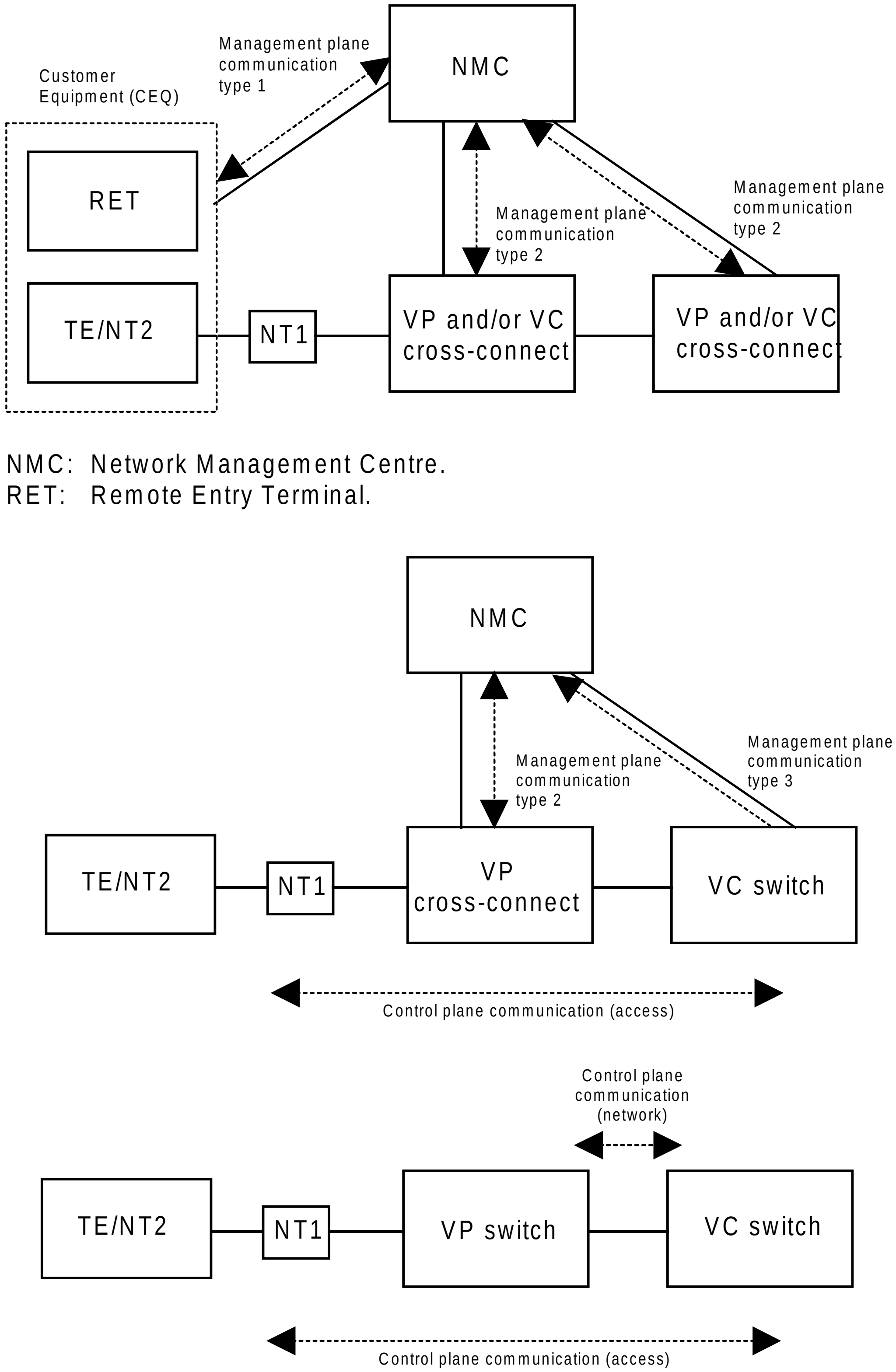
4) management plane communication type 3:

this communication is for a VC switch which accepts a request for connection management using control plane communication (access) to transfer the request information to the NMC by sending management plane messages;

5) control plane communication (network):

this communication is for a VC switch which accepts a request for connection management using control plane communication (access) to transfer the request to establish release/maintain VP links via the VP switch by sending control plane messages.

Figure 2 shows communicating entities of each communications without indicating any routes of communication paths.



NOTE: The solid line shows the physical link and the dashed line shows the information flows.

Figure 2: Communication used for management information transfer

6.2 Possible communication scenarios for typical configurations at the user access

This subclause describes several possible configurations which are subsets of the general configurations shown in figure B.1 and figure B.2 of Annex B. These configurations address the specific situation in which there is a VP cross-connect or switch in the access network.

Case A1 in figure 3 shows (semi-)permanent/reserved VPC/VCC assignments (reserved is a semi-permanent communication with a repetitive or not time factor).

In this case a customer requests the NMC to establish/release a VPC/VCC by the management plane communications type 1 which is performed by a remote entry terminal which is connected to NMC via another interface than through which user plane information is transferred.

After indication by the NMC the VPI or VCI values to be used, the TE/NT2 will be connected to the semi-permanent communication. The VPC/VCC link connection are established/released within the cross-connects via management plane communication type 2.

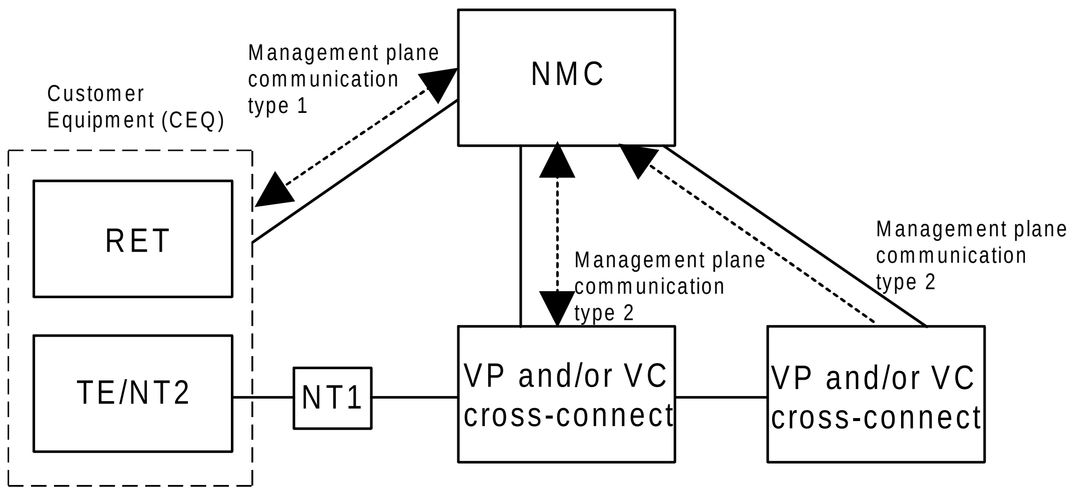
Case A2 in figure 3 shows another kind of (semi-)permanent/reserved VPC/VCC assignment. In this case management plane communication type 1 takes places via pre-defined VPC/VCC between TE/NT2 and NMC trough a VP or VC cross-connect.

Case A in figure 4 shows on-demand VPC/VCC assignments in which NMC is involved. In this case, a user sets up a signalling VC using the meta-signalling VC in the VPC where VPI is zero at the UNI. Then the user establish/release a VPC/VCC by sending control plane messages through that signalling VC.

The meta-signalling and signalling messages are conveyed transparently through VP cross-connect located between the user and the VC switch where the meta-signalling VC and the signalling VC are terminated.

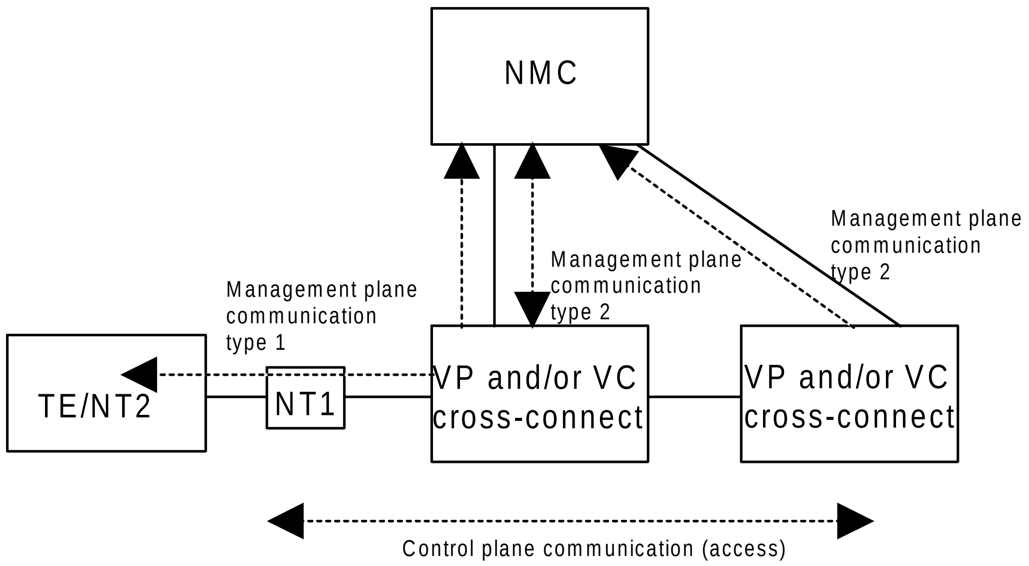
The VC switch communicates to the NMC via management plane communication type 3 and then the NMC orders the VP cross-connect to establish/release the required VPC by management plane communication type 2.

Case B in figure 4 is another kind of on-demand VPC/VCC request in which the NMC is not involved, using a VP switch. The user controls the VP switch by access signalling to a VC switch. This one then controls the VP switch by means of network signalling.



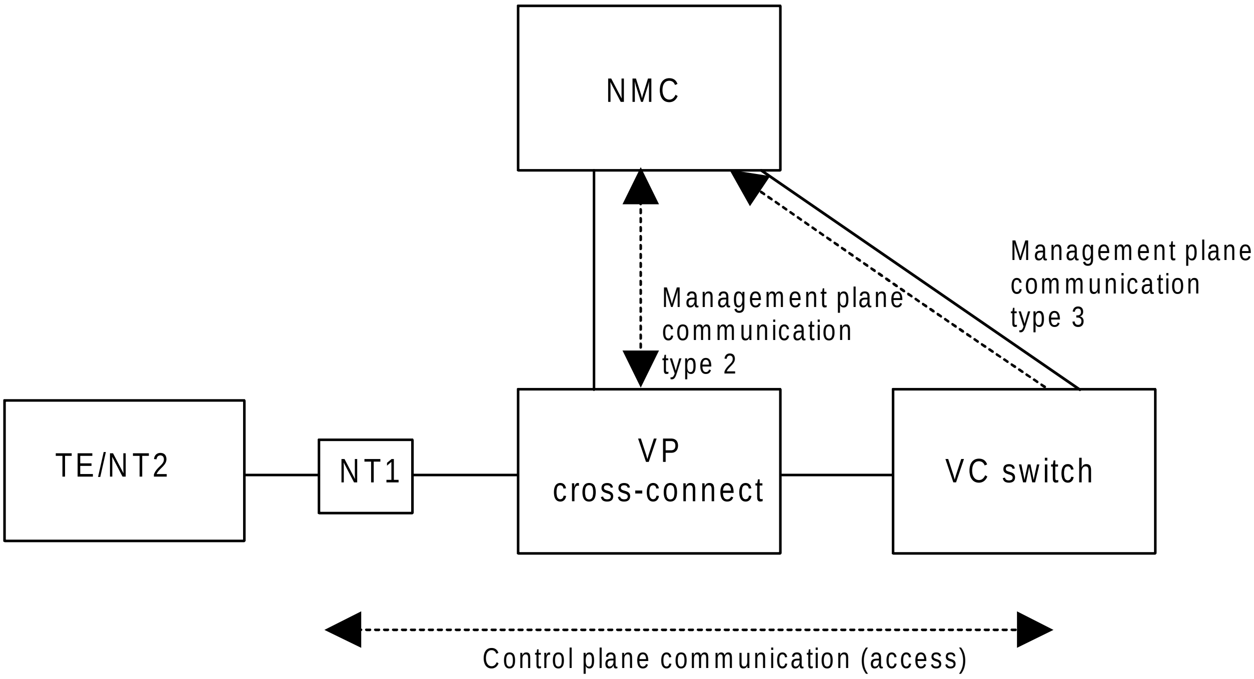
NMC: Network Management Centre.
RET: Remote Entry Terminal.

A1: (semi-)permanent/reserved VPC/VCC request

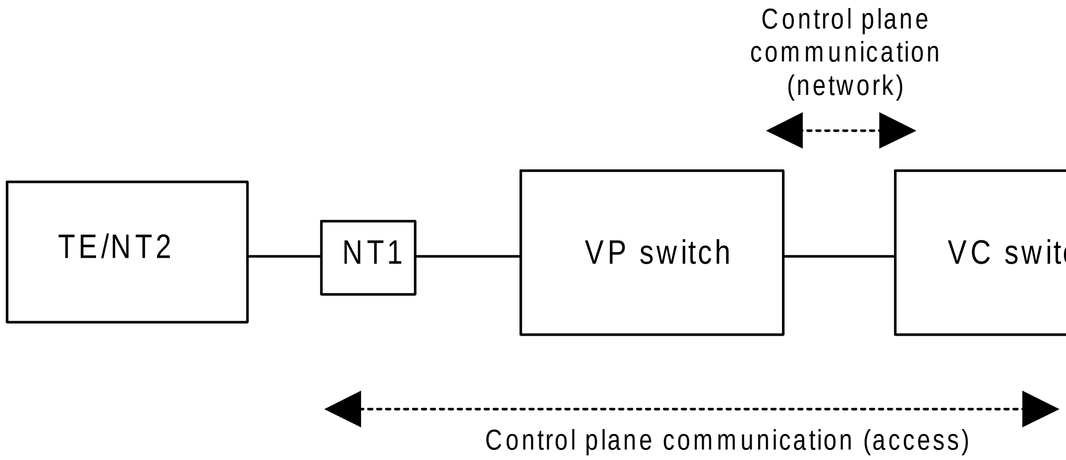


A2: (semi-)permanent/reserved VPC/VCC request

Figure 3: Possible VP/VC network element configurations (1/2) when a VP and/or VC cross-connect is in the access network



A: On-demand VPC/VCC request (1)



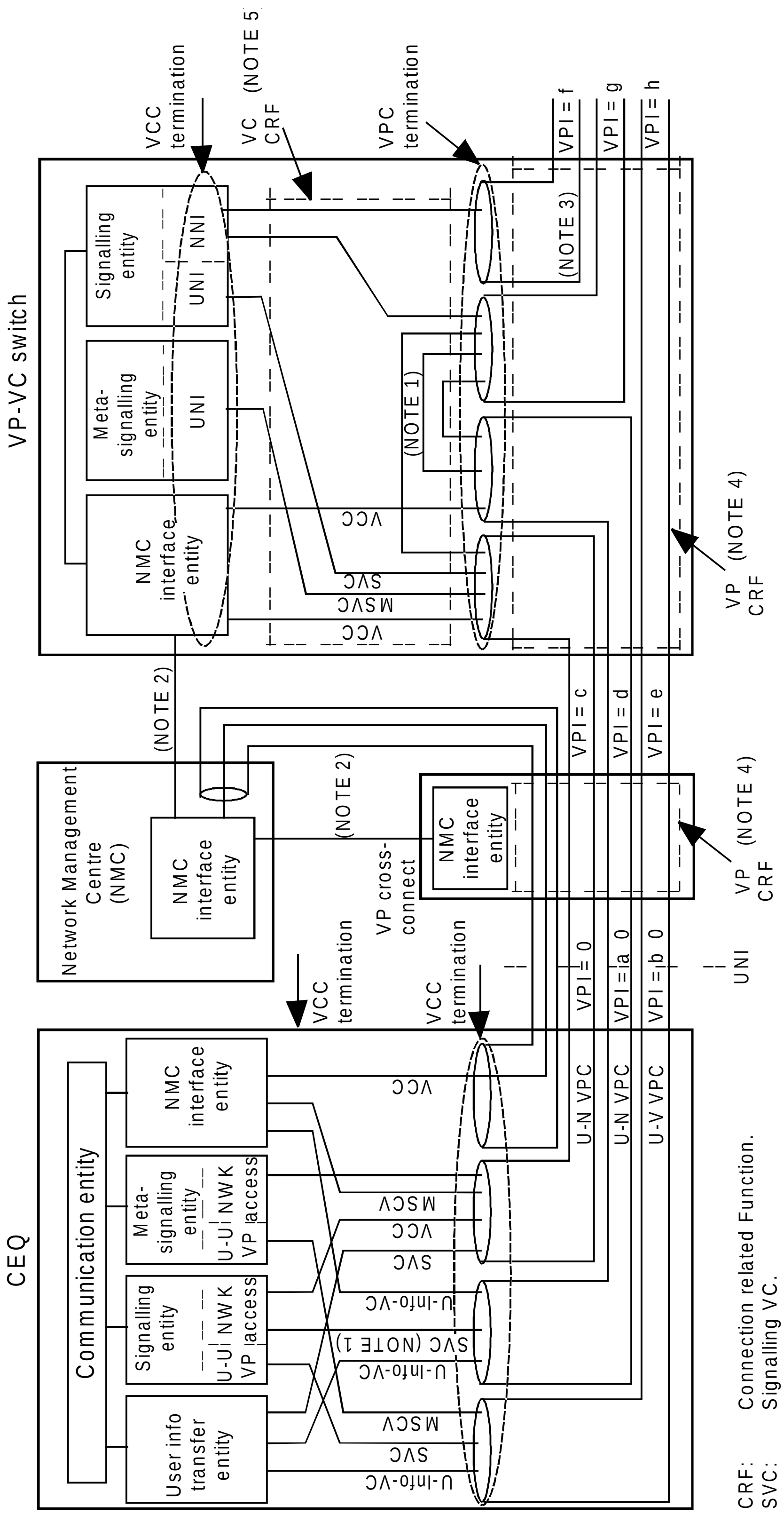
B: On-demand VPC/VCC request (2)

Figure 4: Possible VP/VC network element configurations when a VP cross-connect or switch element is in the access network

The above configurations are illustration of some of the possible configurations.

6.3 Network element functions

Figure 5 illustrates the functions in the CEQ, cross-connect, switch, VP, VC network elements and control and management entities.



CRF: Connection related Function.
SVC: Signalling VC.
MSCV: Meta-signalling VC.

NOTE 1: Signalling VCs for out-band control of user-to-user VPC are for further study.

NOTE 2: Those links may also be ATM connections.

NOTE 3: Network-network VP containing only signalling VCs. Additional VCI values for signalling in this VP are pre-established. The method of pre-establishment is for further study.

NOTE 4: VPI translation takes place in VP CRF.

NOTE 5: VCI translation takes place in VC CRF.

Figure 5: Examples of VP and network element functions

7 Control and management transport network

From a logical view point the B-ISDN control, and management transport has to provide the capability to transfer the following signalling information:

- control information for U-plane;
- control information between Service Switching Points (SSPs) and Service Control Points (SCPs) in the context of IN;
- user-to-user signalling information (for further study);
- user-to-service management system signalling information;
- management information for OAM.

This Clause describes the requirements and possible network architectures for the B-ISDN control and management function. Although the use of ATM transport is outlined in this Clause, this does not preclude the use of other transport networks (e.g. Signalling System No. 7, ITU-T Recommendation X.25 [9]).

7.1 General objectives and requirements

The B-ISDN control and management transport network should be an infrastructure for service control and OAM capabilities.

1) reliability:

high reliability of the transport network should be achieved to protect a network against failure and overload. Protection mechanisms such as protection switching, self-healing and rerouting are envisaged;

2) flexibility:

the transport function should be flexible enough to allow frequent changes in service requirements associated with the introduction of new functions and data bases for service control and OAM in the network. It should be suitable for the future distributed processing environment;

3) performance:

by using the ATM capabilities, it is expected that the performance of ATM transport networks will be at least as good as transport networks used to support Signalling System No.7 signalling.

4) commonality of interface:

it is desirable that the interfaces of the various nodes, including transport nodes, service control nodes and OAM nodes to the control and management information transport network should be common through the ATM layer.

The signalling transport protocol at UNI and NNI should be common;

5) **interworking with N-ISDN signalling transport network:**

the B-ISDN control and management transport function may provide access to existing Signalling System No. 7 transport networks.

This interworking allows the B-ISDN to have access to resources on the N-ISDN environment, e.g. SCPs, and on the other hand will also allow existing network nodes to have access to high speed capabilities provided by the ATM network;

6) **modes of operation:**

the transport network should allow two modes of operation-associated mode and the quasi-associated mode.

The definition of associated and quasi-associated mode in ITU-T Recommendation Q.700 [7] is applicable in B-ISDN control and management transport network.

In associated mode two possibilities are foreseen:

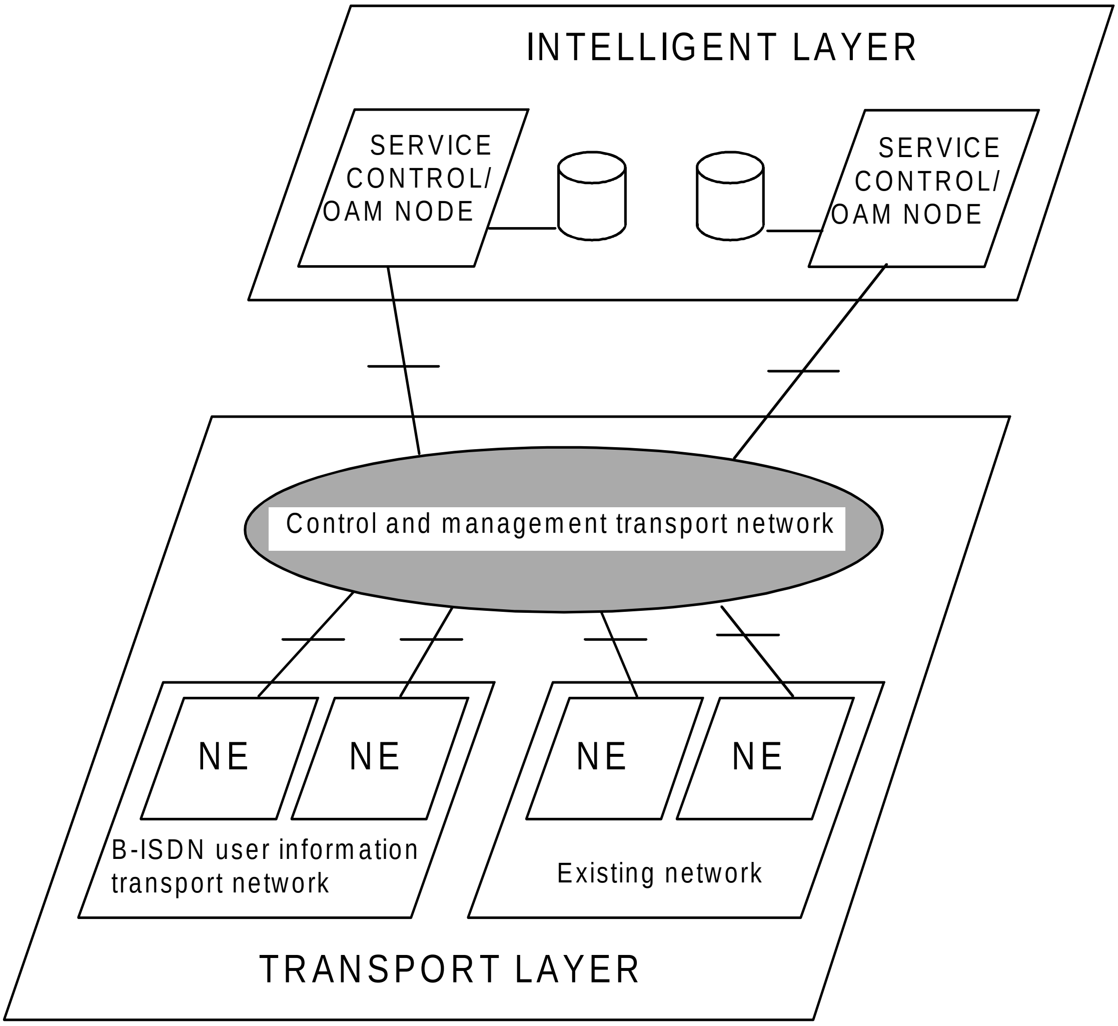
a) carrying in the same VP the control and management and user information VCs;

b) carrying in one VP the control and management information VCs and in other VPs user information VCs. The VPs may be on the same or on separate physical links.

In quasi-associated mode, messages relating to a particular relation are conveyed over two or more ATM VC/VPs in tandem, passing through one or more B-ISDN Signalling Transfer Points (B-STPs) operating in a connectionless messaging mode.

7.2 Network structure

Figure 6 shows a generic structure for the control and management information transport network.



NOTE: At the introductive stage, other transports, e.g. Signalling System No. 7 or ITU-T Recommendation X.25 [9], may be applicable.

Figure 6: Control and management information transport network

It is assumed that this network is logically separated from the B-ISDN user information transport network.

The B-ISDN control and management information transport network may also be used by existing N-ISDN nodes, enhancing their capability of exchanging this type of information.

The control and management information transport network shall provide access to the intelligent layer nodes.

7.2.1 Possible network architectures

Possible architectures of B-ISDN control and management transport network are described.

1) VP cross-connect backbone:

Figure 7 illustrates a possible transport network architecture.

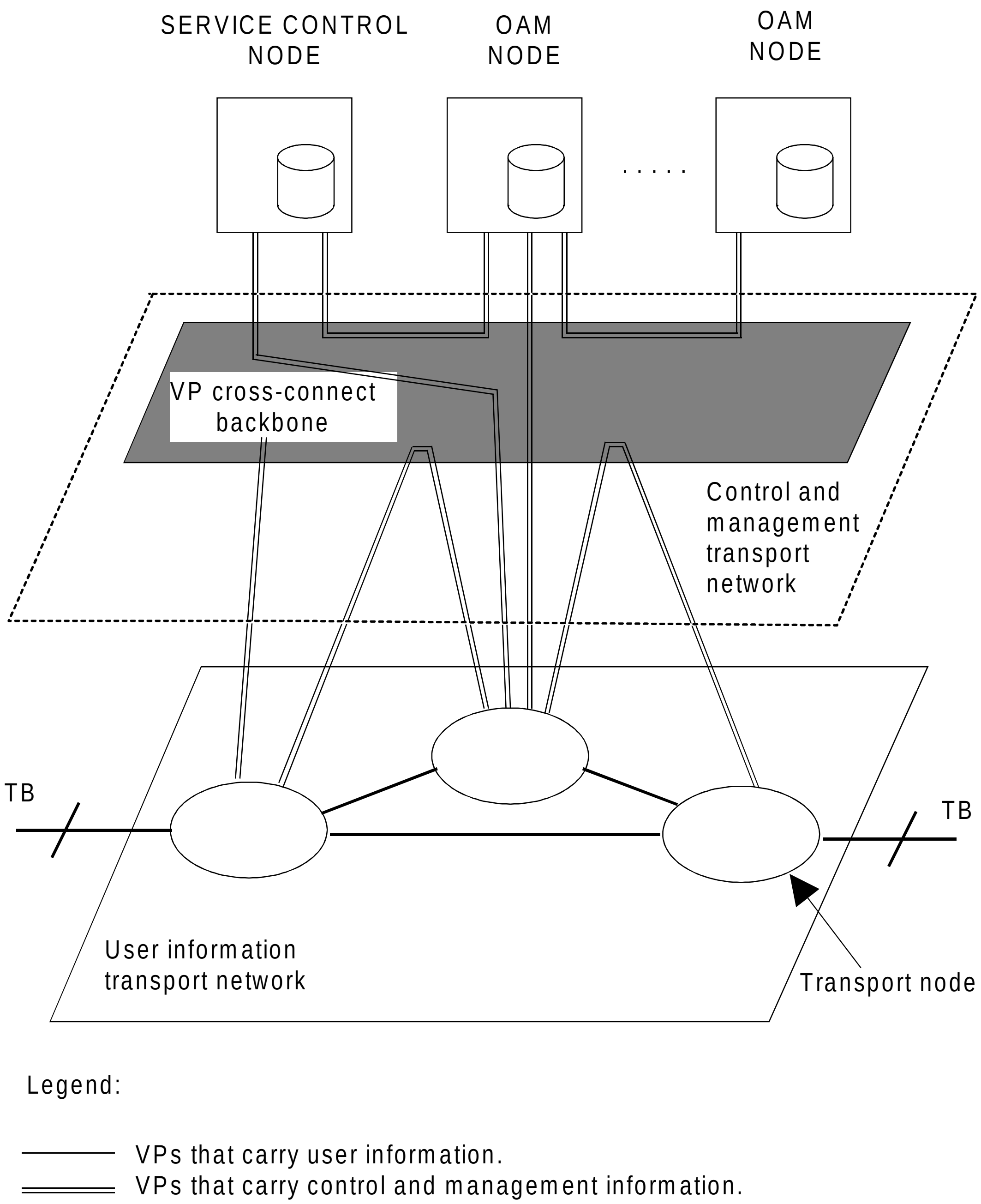


Figure 7: Control and management transport network architecture using a VP cross connect backbone

In this example, VPs are used for interconnecting various nodes in a pre-assigned basis. A VP cross-connect backbone serves as a control and management transport network.

Different types of control or management flows within a VP are segregated by different VCs. This allows the distribution of functions at the ATM layer instead of at higher layers.

In this configuration two options are foreseen:

a) segregation of the control and management information from the user information at the VP level. In this case the total VP capacity in a transmission line can be dynamically re-allocated among the VPs for signalling and the VPs for user information, according to the traffic variations and/or failure situations;

b) no segregation at the VP level. The VPs will carry both control and management information and user information.

The support of the signalling information in a VP cross-connect backbone structure could allow:

- simplification of the existing protocols for control and management transport;

- better performance, mainly by the reduction of the control and management messages delay;

- to take advantage of a possible self-healing capability at the VP level.

2) VC cross-connect backbone

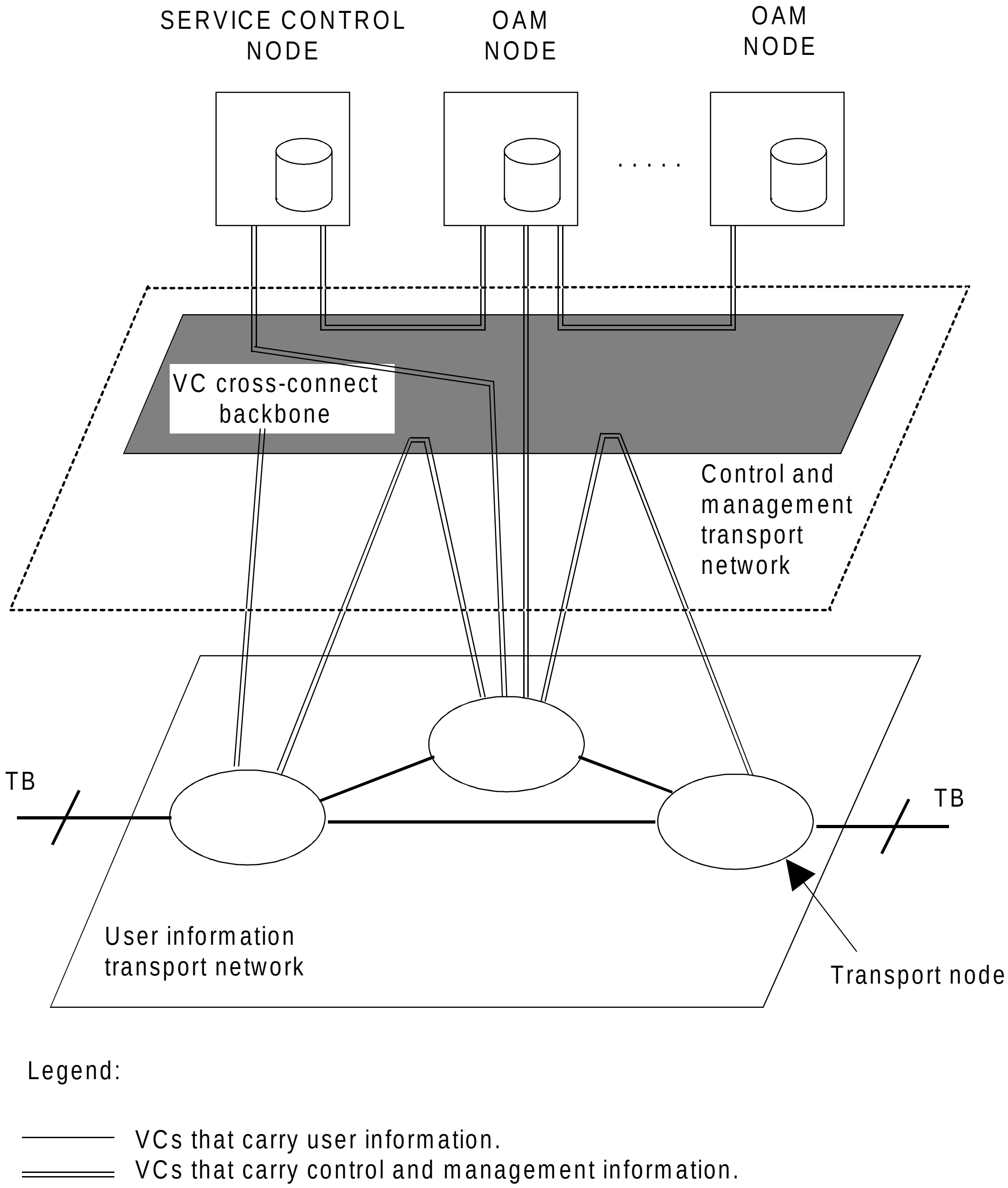


Figure 8: Control and management transport network architecture using a VC cross-connect backbone

In this example VCs are used for interconnecting various nodes in a pre-assigned basis. The difference from the previous example is that the management function of the network is at the VC level.

3) **VP/VC cross-connect backbone with B-STP functionality**

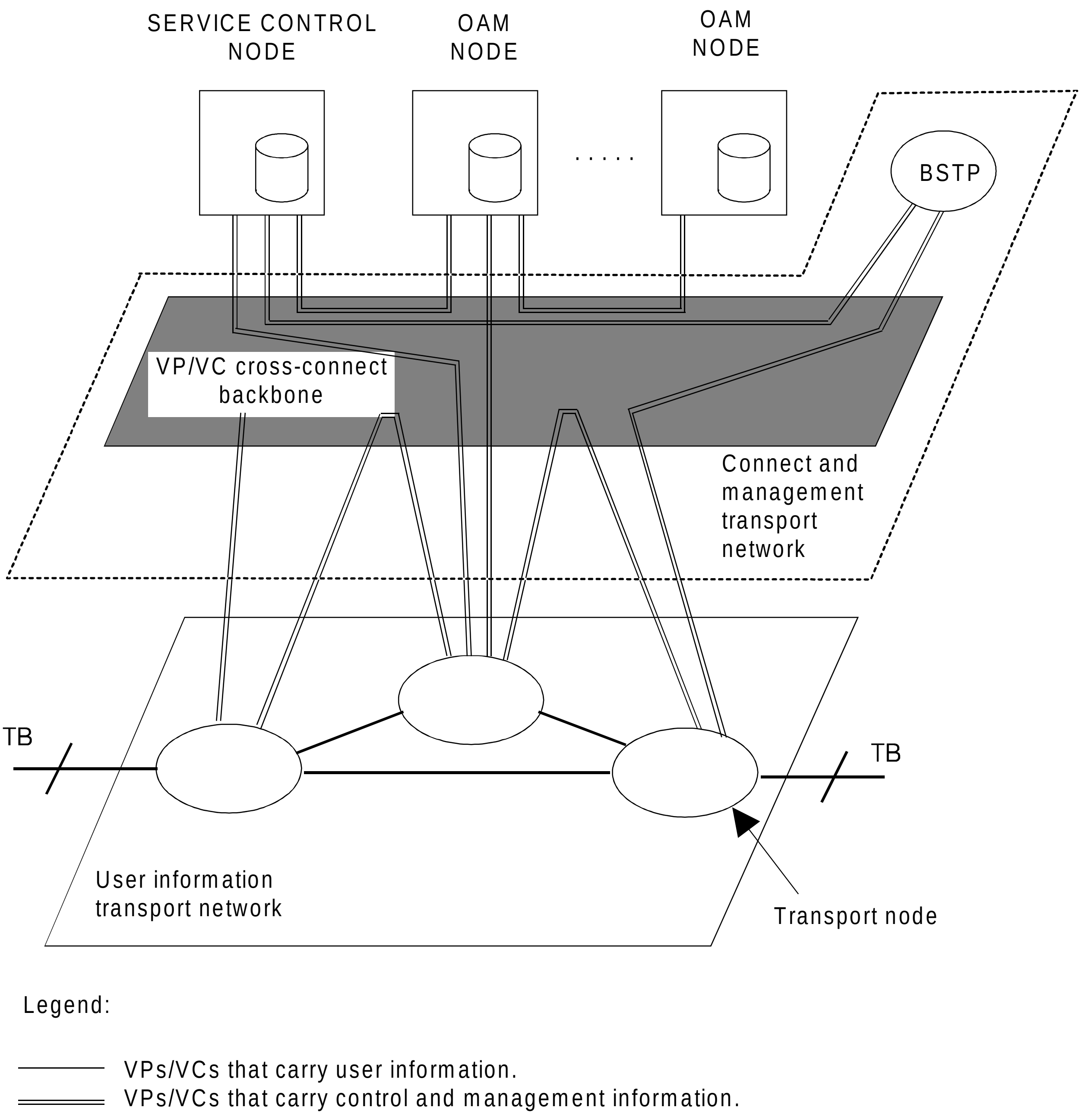


Figure 9: Example of control and management transport network architecture with B-STP functionality

The B-STP may be used in situations where the traffic volume is low between two signalling points or between SSPs and SCPs.

In this case, control and management network consists of VP-VC backbone and B-STP functions. Annex D illustrates an example of this architecture.

Annex A: Definition and scope of service profiles

A.1 Definition of service profiles

A service profile is a collection of information maintained by the network, characterising a set of services provided by the network to the user.

The provision of service profile is a network option.

A service profile contains information necessary to provide both basic services and supplementary services.

A.2 Scope of service profiles

The support of service profile allows:

- a B-TE or a group of B-TE to identify a set of services as characterised by a specific service profile provided by the network;

- the use of selective broadcast SVCs for call offering.

The association between a signalling entity and a service profile is accomplished via the SPID, that is conveyed in the appropriate meta-signalling message(s).

In order to ensure terminal portability and service compatibility in all cases where network and/or terminals do or do not support service profiles, the following cases are identified:

- **a terminal not implementing the SPID:**

  the terminal shall indicate the default SPID value in the meta-signalling assignment procedure and shall monitor the general broadcast SVC for incoming call offering;

- **a terminal implementing the SPID:**

  meta-signalling procedures must allow the user to indicate a SPID value to be carried in the assign request message and must be able to accept the broadcast general or selective SVCI value in the assignment response message;

- **a network not implementing the SPID:**

  meta-signalling procedures shall respond with a general broadcast SVCI value in the assignment response message as the incoming call offering channel, irrespective of the SPID value in the assignment request message;

- **a network implementing the SPID:**

  meta-signalling procedures must respond to the indicated SPID value with the associated broadcast general or selective SVCI value during the assignment procedures, allowing different standardised levels of service for a user or an interface. If a terminal enters an unknown SPID, then the default SPID value shall be assumed by the network and general broadcast SVCI value shall be returned.

A.3 Service profile configuration

The following service profile configurations have been identified and require further study:

- only one service profile on an interface;
- only one service profile for all signalling endpoints using the same service on an interface;
- a default service profile to be used by all signalling endpoints that do not specify a service profile identifier as part of their signalling VCI request (i.e. the support of service profile could be optional for a signalling endpoint);
- one service profile per signalling endpoint;
- one service profile for all signalling endpoints of one terminal.

Annex B: Examples of signalling configurations

Figure B.1 illustrates three possible signalling configurations:

Case A: the customer uses signalling procedures to establish Virtual Channel Connections (VCCs) to other customers. The meta-signalling channel is used to establish a signalling channel (or channels) between the CEQ and the local Connection Related Function (CRF). The local CRF provides an interconnects function, based on using the VPI and VCI in the ATM cell header;

Case B: the customer has VPCs through the Local CRF to another CEQ. These VPCs could be established:

a) without using signalling procedures (e.g. by subscription);

b) using signalling procedures on a demand basis.

When a VP connection is established by using signalling procedures, the CEQ uses the meta-signalling channel to the local CRF to establish a signalling channel (or channels) which may be used to establish the VPCs. This possibility is for further study. Virtual channel links within a VPC are established by using signalling procedures between a CEQ and a node terminating the VPC.

The procedures for establishing a signalling channel or channel between the nodes terminating the VPC (e.g. the CEQs) are for further study. Optionally the meta-signalling protocol can be used. The local CRF provides an interconnects function based on using only the VPI portion of the ATM cell header for those VPCs that do not terminate at the local CRF.

Case C: The customer has VPCs through the local CRF to another CEQ and additional VPCs that terminate at the local CRF. In this case, the CEQ uses the meta-signalling channel to the local CRF to establish signalling VCCs to other nodes. The local CRF provides an interconnects function based on using only the VPI portion of the ATM cell header for those VPCs that do not terminate at the local CRF, and based on both the VPI and VCI for those VPCs that do terminate at the local CRF.

NOTE: The procedures for establishing a signalling channel(s) for CEQ to CEQ signalling communication are for further study. Optionally, the meta-signalling protocol can be used.

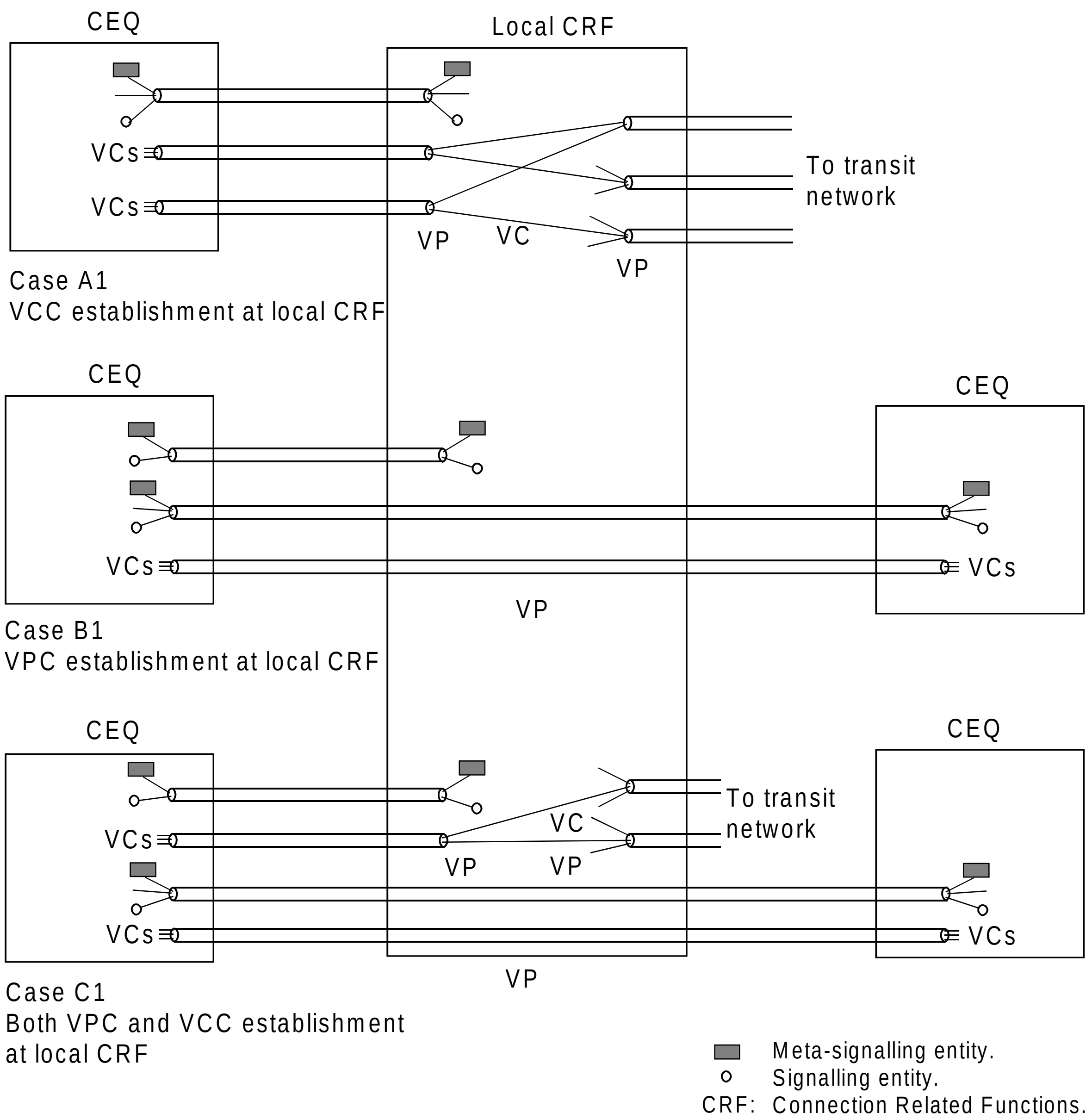
Figure B.2 illustrates an example of a VCC and a VPC and the relationship of user-network and internodal signalling procedures. In this example, user-network signalling is carried on one VPC designated as the VPC for carrying meta-signalling. Other signalling channels on this VPC are established using procedures over the meta-signalling channel.

Internodal signalling messages may be carried between network nodes over Virtual Channel Connections designated for internodal signalling. The procedures for allocating these VCCs are for further study.

In some cases, signalling may be required over VPCs established between the CEQ and another CEQ, as shown in Case B and in Case C, figure B.1, in order to establish user VCCs within those VPCs. The procedure for establishing these signalling channels is for further study. Optionally the meta-signalling protocol can be used.

In the upper portion of figure B.2 a VCC is illustrated between the CEQ on the left and the CEQ on the right side. This VCC is established by using user-network and internodal signalling procedures.

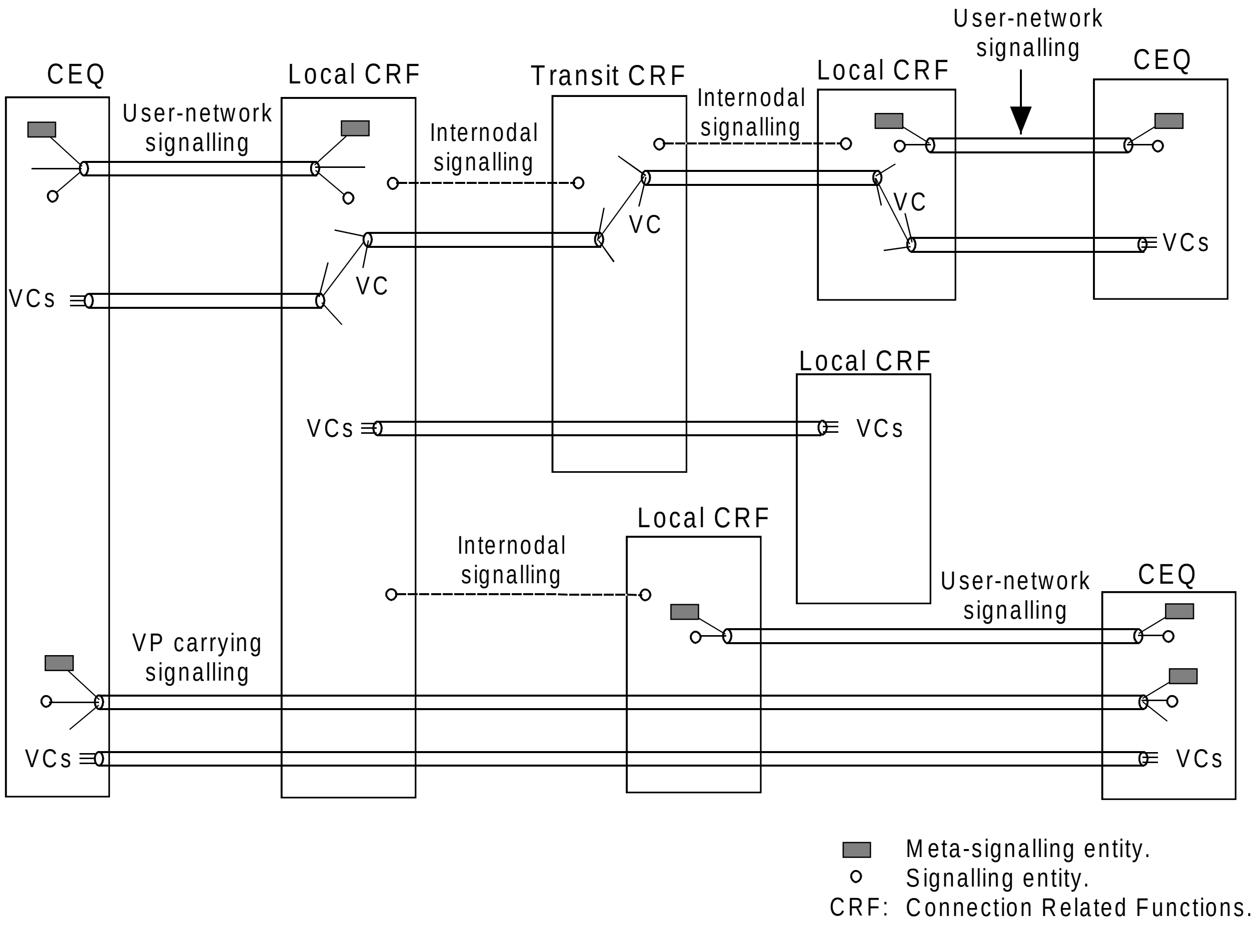
Two Virtual Path Connections (VPCs) are illustrated in the lower portion of figure B.2 between the CEQ on the left and the CEQ on the right. One VPC contains a meta-signalling channel, which is used to establish additional signalling channels within that VPC. This VPC between the two CEQs may carry other non-signalling traffic. After signalling channels are established, signalling procedures are used to establish VCCs within VPCs between the two CEQs.



NOTE 1: The implementation of local and transit CRF is not subject to standardisation. The CRF provides interconnection of ATM cells using information in the VPI and/or VCI.

NOTE 2: The procedures for establishing a signalling channel, or signalling channels, for CEQ to CEQ signalling communication are for further study. Optionally, the meta-signalling protocol can be used.

Figure B.1: Possible VPC/VCC establishment and signalling configurations



NOTE 1: The implementation of local and transit CRF is not subject to standardisation. The CRF provides interconnection of ATM cells using information in the VPI and/or VCI.

NOTE 2: The procedures for establishing a signalling channel, or signalling channels, for CEQ to CEQ signalling communication are for further study. Optionally, the meta-signalling protocol can be used.

Figure B.2: Relationship of VP/VC connections to user-network and internodal signalling

Annex C: Functional model for B-ISDN

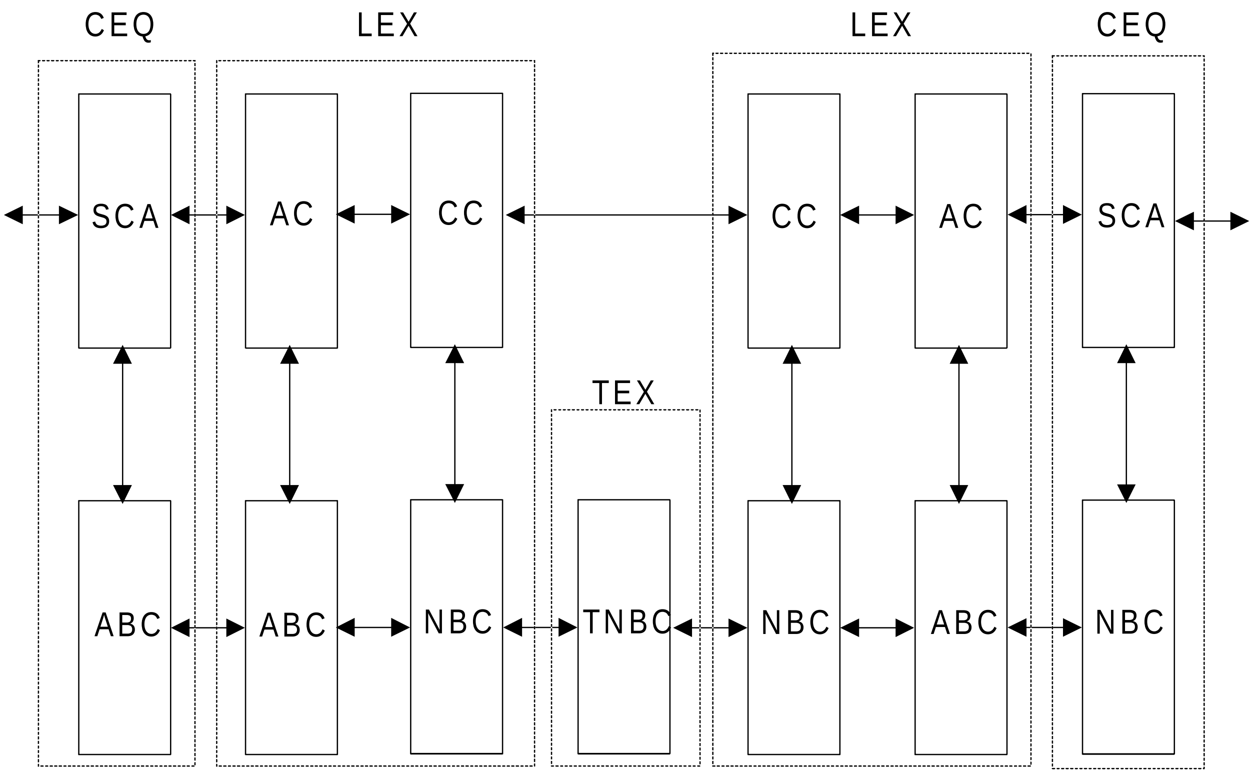
C.1 Description of the functional model

The basic assumption is the distinction between two different levels, for call control and connection control.

NOTE: These levels are not layers in the OSI sense, and that two sets of messages, performing a peer-to-peer relationship, are to be defined.

Figure C.1 shows the functional model for B-ISDN simple services. The following Functional Entities (FEs) have been identified:

SCA: Service Control Agent.
AC: Access Control.
CC: Call Control.
ABC: Access Bearer Control.
NBC: Network Bearer Control.
TNBC: Transit Network Bearer Control.



LEX: Local Exchange

Figure C.1: Functional model for a simple call in B-ISDN, based on CC/BC separation

The following functions have been allocated to be identified FEs:

SCA:

- control access side of call and maintain access side call states (in co-operation with AC);
- interact with corresponding ABCs, and coordinate their logical and physical relationships;
- formulate service request and address information;
- reserve access side bearer resources to the call (call reference, connection identifier);

AC:

- evaluate and screen service request and address information from SCA;
- control access side of call and maintain access side call states;
- interact with corresponding ABCs for the management of the access bearer connection elements;
- coordinate the addition/deletion of a connection (access side) to/from an existing call;
- coordinate the logical relationships between ABCs;
- reserve access bearer resources for the call (call reference, connection identifiers);
- provide charging information to management plane;

CC:

- process service request as received from AC;
- control network side of call and maintain network side call states;
- interact with corresponding NBCs for the management of the network bearer connection elements;
- coordinate the addition/deletion of a connection (network side) to/from an existing call;
- coordinate the logical relationships between NBCs;
- reserve network side bearer resources for the call (e.g. during call establishment phase);
- handle address information for call destination(s);
- provide charging information to management plane;

ABC:

- manage access side bearer resources (VPI/VCI, bandwidth);
- allocate and deallocate access side bearer resources;
- connect and disconnect access side bearer resources;
- control access side connection and manage access side connection states;
- manage access side resource configuration related to a connection;
- provide information to AC or SCA for charging;

NBC:

- interact with CC;
- interact with TBNC which handles transit network resource configuration;
- allocate and deallocate network side bearer resources (VPI/VCI, bandwidth) in cooperation with TNBC;
- connect and disconnect network side bearer resources;
- manage network side resource configuration related to a connection;
- control network side connection and manage network side connection states;
- provide information to CC for charging;

TNBC:

- interact with NBCs and TNBCs for network side resource configuration;
- allocate and deallocate network side bearer resources;
- pass network side bearer resource and configuration information between corresponding NBCs;
- connect and disconnect network side bearer resources;
- manage network side resource configuration related to a connection;
- control network side connection and manage network side connection states.

The functional model according to figure C.1 should be sufficient for simple calls in the B-ISDN symmetric bidirectional, asymmetric bidirectional and unidirectional). The model is insufficient to describe multiparty calls, supplementary services etc. In this case, additional FEs and relationships will be needed.

At present, no explicit reference to calling and called party is considered necessary; in the future this may be included.

In figure C.1 the mapping of the FEs on the physical location is shown by the dotted boxes. For the user side, the figure shows a generic CEQ, which can be either the TE, in case of a "non-intelligent" NT2, or NT2 + TE, if the NT2 is an "intelligent equipment". In the latter case, the FEs foreseen for the CEQ should be distributed. The question whether to join certain FEs, e.g. AC and CC in a LEX, into another FE is for further study. The model in figure C.1 has the advantage of showing the different FEs both at UNI and NNI.

A second model, which is more oriented to signalling is shown in figure C.2.

This figure shows only the relationships that need to be standardised. This model also highlights the calling and called parties: this has indeed relevance as far as signalling is concerned. The FEs in figure C.2 are a superset of the FEs in figure C.1. The following FEs are distinguished in figure C.2.

OCCA: Originating Call Control Agent.
OCC: Originating Call Control.
TCCA: Terminating Call Control Agent.
TCC: Terminating Call Control.
OBCA: Originating Connection Control Agent.
OBC: Originating Connection Control.
RBC: Relaying Connection Control.
TBCA: Terminating Connection Control Agent.
TBC: Terminating Connection Control.

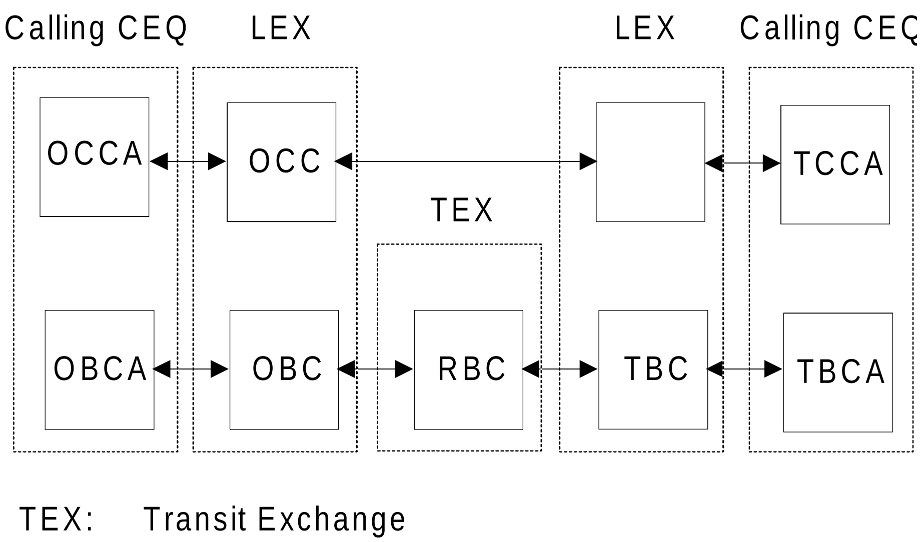


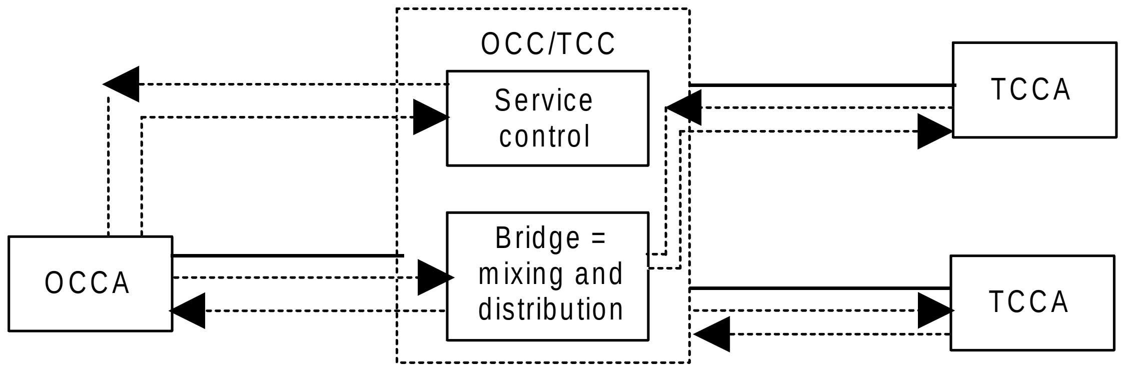
Figure C.2: Functional model for B-ISDN signalling

C.2 Allocation of FEs to physical location

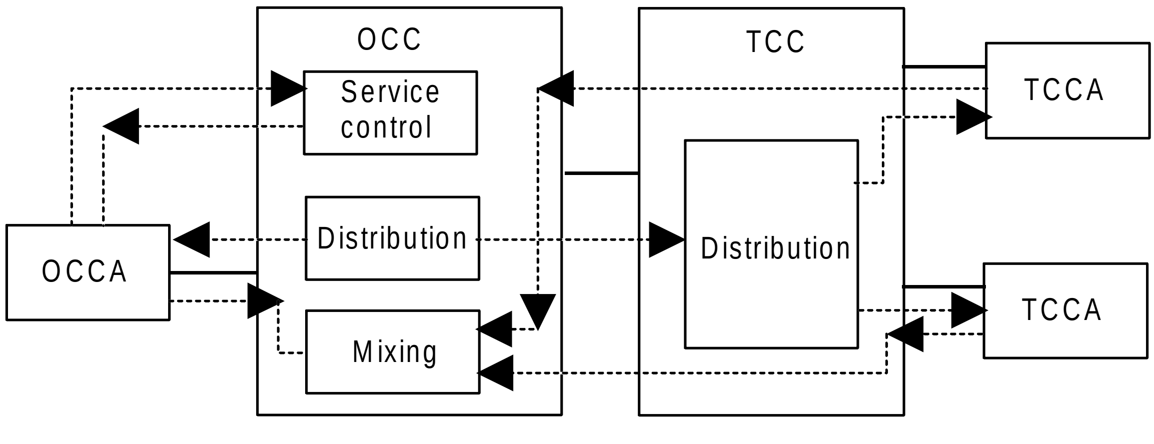
The physical location of the FEs is strongly related with the type of connection element.

EXAMPLE: For the three party call, additional FEs can be defined: mixing, distribution and service control FE. Figure C.3 illustrates two different locations of these FEs, resulting in other connection element types. In figure C.3 A, all FEs are located within the same exchange in the network. In this case we need a point-to-point duplex, single medium connection element type for the U-plane connection. In figure C.3 B, the distribution FE is located in the originating and terminating exchange. The other FEs are located only in the originating exchange. As a result, the connection element type for the U-plane are:

- a point-to-point, simplex, single medium connection element;
- a point-to-multipoint, simplex, single medium connection element.



A: Service control, mixing and distribution functions located in one network node.



B: Service control and mixing functions are located in one network node while the distribution function is spread over various network nodes.

Figure C.3: Allocation of FEs to physical locations affects the connection types

Annex D: Example

This example takes into consideration the following three network elements:

- B-ISDN Signalling Point (B-SP). These nodes have signalling functions. They generate and process signalling messages;

- B-ISDN Signalling Transfer Point (B-STP). These nodes receive, route and forward signalling messages;

- Virtual Path cross-connect (VP-XC).

In figure D.1 there is an example of a path dedicated to signalling transport, which extends between two different TEs. This example can be regarded as a specific case of the general architecture of figure 9.

The VPs in the figure (thick black lines) carry signalling VCs only. In this way, the signalling transport network is logically separated from the user data transport network at the NNI. Although logically separated from user data, signalling information and user data could be transported by the same physical links.

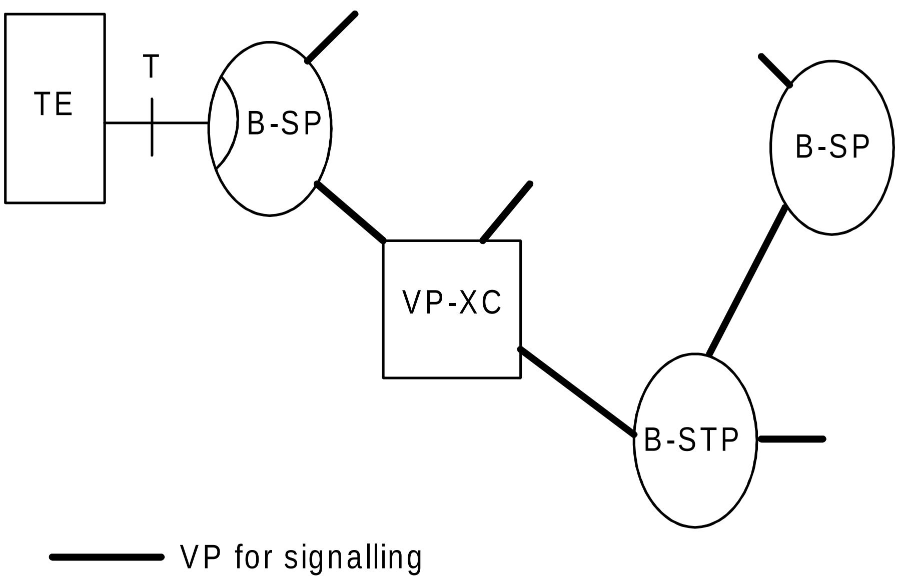
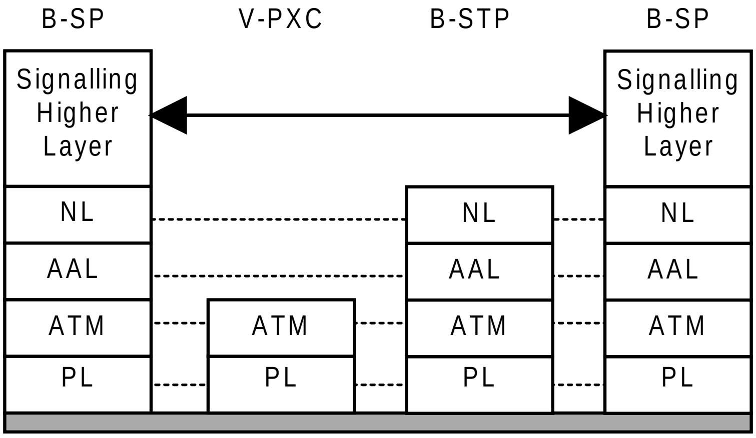


Figure D.1: Example of a path within the B-ISDN signalling network

Figure D.2 shows, in terms of protocol stacks, the path drawn in figure D.1. Apart from the Physical Layer (PL), ATM layer and AAL, the stacks shows a Network Layer (NL) and a "signalling higher layer".

It is shown that B-STPs have functions up to and including the Open System Interconnection (OSI) network layer (such as routing) and B-ISDN Signalling Points (B-SPs) have functions up to and including the OSI application layer.



B-SP:	B-ISDN Signalling Point.
B-STP:	B-ISDN Signalling Transfer Point.
VP-XC:	Virtual Path Cross Connect.
PL:	Physical Layer.
ATM:	ATM Layer.
AAL:	ATM Adaptation Layer.
NL:	Network Layer.

Figure D.2: Protocol stacks of network elements involved in the signalling transport

History

Document history	
August 1993	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)