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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – B-ISDN application protocols for the network signalling

## Switched virtual path capability

ITU-T Recommendation Q.2766.1

(Previously CCITT Recommendation)

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**ITU-T RECOMMENDATION Q.2766.1**

# SWITCHED VIRTUAL PATH CAPABILITY


## Summary

This Recommendation specifies extensions to the Broadband ISDN User Part (B-ISUP) protocol to support Switched Virtual Path (SVP) service in a point-to-point configuration. This Recommendation allows for the use of parameters already specified by Recommendations Q.2761, Q.2762, Q.2763, and Q.2764 for the B-ISDN basic call at the NNI, in order to support the Switched Virtual Path capability.



## Source

ITU-T Recommendation Q.2766.1 was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 15th of May 1998.

## FOREWORD

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

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

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## NOTE

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

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

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**Recommendation Q.2766.1**

# SWITCHED VIRTUAL PATH CAPABILITY

*(Geneva, 1998)*

## 1 Overview

### 1.1 Scope

This Recommendation specifies extensions to the Broadband ISDN User Part protocol to support Switched Virtual Path (SVP) service in a point-to-point configuration. This Recommendation allows for the use of parameters already specified by Recommendations Q.2761 to Q.2764 for the B-ISDN basic call at the NNI, in order to support the Switched Virtual Path capability.

It defines:

– parameter coding needed;

– enhancements to the application process procedures; and

– enhancements to the maintenance control, application process functions.

### 1.2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation I.610 (1993), *B-ISDN operation and maintenance principles and functions.*

– ITU-T Recommendation Q.2610 (1995), *Usage of cause and location in B-ISDN user part and DSS 2.*

– ITU-T Recommendation Q.2650 (1995), *Interworking between Signalling System No. 7 Broadband ISDN User Part (B-ISUP) and Digital Subscriber Signalling System No. 2 (DSS 2).*

– ITU-T Recommendation Q.2723.1 (1996), *B-ISDN user part – Support of additional traffic parameters for sustainable cell rate and quality of service.*

– ITU-T Recommendation Q.2723.3 (1997), *Extensions to the B-ISDN user part – Signalling capabilities to support traffic parameters for the Available Bit Rate (ABR) ATM transfer capability.*

– ITU-T Recommendation Q.2723.4 (1997), *Extensions to the B-ISDN user part – Signalling capabilities to support traffic parameters for the ATM Block Transfer ATM transfer capability.*

– ITU-T Recommendation Q.2723.6 (1998), *Extensions to the Signalling System No. 7 B-ISDN user part (B-ISUP) – Signalling capabilities to support the Indication of the Statistical Bit Rate Configuration 2 (SBR 2) and 3 (SBR 3) ATM transfer capabilities.*

– ITU-T Recommendation Q.2724.1 (1996), *B-ISDN user part – Look-ahead without state change for the network node interface.*

– ITU-T Recommendation Q.2725.1 (1996), *B-ISDN user part – Support of negotiation during connection setup.*

– ITU-T Recommendation Q.2725.2 (1996), *B-ISDN user part – Modification procedures.*

– ITU-T Recommendation Q.2725.3 (1997), *Extensions to the B-ISDN user part – Modification procedures for sustainable cell rate parameters.*

– ITU-T Recommendation Q.2725.4 (1998), *Extensions to the Signalling System No. 7 B-ISDN user part – Modification procedures with negotiation.*

– ITU-T Recommendation Q.2726.1 (1996), *B-ISDN user part – ATM end system address.*

– ITU-T Recommendation Q.2726.2 (1996), *B-ISDN user part – Call priority.*

– ITU-T Recommendation Q.2726.3 (1996), *B-ISDN user part – Network generated session identifier.*

– ITU-T Recommendation Q.2762 (1995), *General functions of messages and signals of the B-ISDN User Part (B-ISUP) of Signalling System No. 7.*

– ITU-T Recommendation Q.2763 (1995), *Signalling System No. 7 B-ISDN user part (B-ISUP) – Format and codes.*

– ITU-T Recommendation Q.2764 (1995), *Signalling System No. 7 B-ISDN user part (B-ISUP) – Basic call procedures.*

– ITU-T Recommendation Q.2934 (1998), *Digital Subscriber Signalling System No. 2 – Switched virtual path capability.*

### 1.3 Abbreviations

This Recommendation uses the following abbreviations:

AEI Application Entity Instance

QoS Quality of Service

SVP Switched Virtual Path

VPC Virtual Path Connection

VPCI Virtual Path Connection Identifier

## 2 B-ISDN User Part messages and parameters

### 2.1 Messages

In general, the message types defined in Recommendation Q.2763 are used to support SVP call/connection control. The following messages are not used for the SVP capability, but are passed without treatment if received.

- Forward Transfer message (FOT);
- Suspend;
- Resume.

## 2.2 Parameters and parameter subfields

In general, the parameters and parameter subfields defined in Recommendation Q.2763 are used to support SVP call/connection control. The following parameters and parameter subfields are affected in B-ISUP.

### 2.2.1 Broadband bearer capability

The format of the Broadband bearer capability parameter defined in Recommendation Q.2763 is modified as shown in Recommendation Q.2934.

The coding of subfields for SVP service is defined in the Broadband bearer capability information element in Recommendation Q.2934.

NOTE – A new codepoint is added to the bearer class field for SVP service.

### 2.2.2 Connection element identifier

As specified in Recommendation Q.2763, the octets 3 and 4 of the Connection element identifier parameter field shall be omitted.

### 2.2.3 OAM traffic descriptor

The format of the OAM traffic descriptor parameter defined in Recommendation Q.2763 is modified as shown in Recommendation Q.2934.

The coding of subfields for SVP service is defined in the OAM traffic descriptor information element in Recommendation Q.2934.

### 2.2.4 Resource identifier

Coding "010 – CEI: VPCI/VCI" in Resource indicator subfield is not supported.

Note 2 to Figure 47/Q.2763 is not required.

Coding "100 – VPC Pool: VPCI". A new codepoint in the Resource indicator subfield for SVP service.

The following parameters and parameter subfields defined in Recommendation Q.2763 are not used for the SVP capability, but are passed without treatment if received.

- AAL parameters;
- Backward narrow-band interworking indicator;
- Broadband high layer information;
- Broadband low layer information;
- Echo control information;
- Forward narrow-band interworking indicator;
- In-band information indicator;
- Narrow-band bearer capability;
- Narrow-band high layer compatibility;
- Narrow-band low layer compatibility;
- Progress indicator.

# 3 Call control, application process functions

## 3.1 Introduction

### 3.1.1 Assignment procedure of VPCI and bandwidth

The one side selection of bandwidth and VPCI values, which allows one exchange to be assigning exchange for both outgoing and incoming call/connections, on a VPCI basis, is adopted to prevent dual seizure completely.

#### 3.1.1.1 Management of VPCI value and bandwidth of each VPC pool

Before a route between two exchanges can be put into service, the following is necessary:

- the VPCIs to be used must be assigned unambiguously and identically at both exchanges;
- VPC pools must be defined on a physical interface basis identically at both exchanges; each VPC pool consists of a continuous range of VPCIs;
- a bandwidth pool must be allocated to each VPC pool identically at both exchanges;
- for every VPC pool it must be defined which exchange controls this VPC pool, i.e. which is responsible for assigning bandwidth for this VPC pool.

NOTE – In some cases the VPCI values that may be used for SVP may be restricted, e.g. by management action.

The following default mechanism is defined for determining this designation.

If an exchange has to set up a call/connection (also in the case of an automatic repeat attempt), it shall first use a VPCI which it is controlling, i.e. a Set-Up request including the Connection Element Identifier parameter is issued. Only if there is no available bandwidth or VPCI values which the exchange is controlling, the exchange issues a Set-Up request without the Connection Element Identifier parameter.

Bandwidth is allocated from the available bandwidth for SVP connections under allocation control of the assigning exchange.

#### 3.1.1.2 Assignment procedure of VPCI and bandwidth

The assigning exchange assigns both VPCI and bandwidth for outgoing and incoming call/connections. The non-assigning exchange does not assign but asks the assigning exchange to assign both VPCI and bandwidth.

a) *Outgoing call/connections from the assigning exchange to the non-assigning exchange*

The assigning exchange performs the following actions:

- selection of one VPCI from the set of VPCI values that the assigning exchange controls;
- assigning bandwidth to the call/connection;
- updating the available bandwidth pool that the switch controls.

b) *Outgoing call/connections from the non-assigning exchange to the assigning exchange*

- The non-assigning exchange performs no assignment actions.
- The assigning exchange performs the actions as in a).

c) *Simultaneous call/connection request from the assigning exchange and the non-assigning exchange*

- As the assigning exchange assigns bandwidth at the time of call/connection acceptance at the assigning exchange, a dual seizure of bandwidth cannot occur.

#### 3.1.1.3 Abnormal procedure

For abnormal conditions of the one-side selection principle, the following procedures shall apply:

- If a Set_Up indication primitive with VPCI is received at the assigning exchange for that virtual path, an Incoming_Resources_Rejected request primitive shall be returned with cause "VPCI/VCI assignment failure". The event shall be reported to management.
- If a Set_Up indication primitive without VPCI is received at an exchange which is non-assigning for all virtual paths between the sending and receiving exchanges, an Incoming_Resources_Rejected request primitive shall be returned with cause "VPCI/VCI assignment failure". The event shall be reported to management.
- If an Incoming_Resources_Accepted indication primitive with VPCI is received at the assigning exchange for that virtual path, the event shall be reported to management. The call/connection shall be released using cause "VPCI/VCI assignment failure".
- If an Incoming_Resources_Accepted indication primitive without VPCI is received at an exchange which sent a Set-Up request without the Connection Element Identifier parameter, the event shall be reported to management, and the call/connection shall be released using cause "VPCI/VCI assignment failure".

### 3.2 Successful call/connection Set-Up

### 3.2.1 Forward address signalling – *en bloc*

#### 3.2.1.1 Actions required at the originating exchange

a) *VPCI selection – Assigning exchange*

When the originating exchange has received the complete information from the calling party and has determined that the call/connection is to be routed to another exchange, route and VPCI selection take place.

Appropriate routing information is either stored at the originating exchange or at a remote database to which a request is made.

The selection of the route will depend on the Called Party Number, Broadband Bearer Capability, ATM Cell Rate, and the outcome of the assignment procedure; see 3.1.1.2 a). Additionally, if the Maximum End-to-end Transit Delay parameter is present, this is used together with the Propagation Delay Counter. The selection process may be performed at the exchange or with the assistance of the remote database.

The exchange shall create an instance of the B-ISUP AE and issue the Set_Up request primitive to it.

The information used to determine the routing of the call/connection by the originating exchange will be included in the Set_Up request primitive to enable the correct routing at intermediate exchanges. The Set_Up request primitive implicitly confirms that performance parameter objectives have been met. It indicates the reservation of ATM connection elements.

b) *VPCI selection – Non-assigning exchange*

As for the assigning exchange except that the assignment procedure is according to 3.1.1.2 b).

c) *Address information sending sequence*

Procedures of Recommendation Q.2764 apply.

d) *Set_Up request primitive – Issued by the assigning exchange*

The Set_Up request primitive in principle contains all the information that is required to route the call/connection to the destination exchange and connect the call/connection to the called party. The originating exchange shall at a minimum include in the Set_Up request primitive the mandatory parameters listed in Table 2.2/Q.2764 and the Connection Element Identifier parameter.

After issuing the Set_Up request primitive, a response, i.e. the Incoming_Resources_Accepted indication primitive or Incoming_Resources_Rejected indication primitive, is awaited.

e) *Set_Up request primitive – Issued by the non-assigning exchange*

Procedures of Recommendation Q.2764 apply.

f) *Completion of transmission path*

For all VP connections, through connection in both directions shall be completed not later than on receipt of an Answer indication. Through connect shall not occur before receipt of Incoming_Resources_Accepted indication primitive.

### 3.2.1.2 Actions required at an intermediate national exchange

#### 3.2.1.2.1 Incoming side of the exchange

a) *Assigning exchange*

After receiving a Set_Up indication primitive, an assigning exchange shall perform the assignment procedure for VPCI and bandwidth as described in 3.1.1.2 b). If this is successful, the Incoming_Resources_Accepted request primitive shall be issued immediately. The Incoming_Resources_Accepted request primitive shall at a minimum include the mandatory parameters listed in Table 2.4/Q.2764, including the Connection Element Identifier parameter.

b) *Non-assigning exchange*

Procedures of Recommendation Q.2764 apply.

#### 3.2.1.2.2 Other actions at the exchange

a) *VPCI selection*

After the issuing of the Incoming_Resources_Accepted request primitive, an intermediate national exchange will analyse the called party number and the other routing information (see 3.2.1.1) to determine the routing of the call/connection. If the intermediate national exchange can route the call/connection, it shall create an instance of the B-ISUP AE and issue a Set_Up request primitive to it. The exchange shall follow the assignment procedure for VPCI and bandwidth as described in 3.1.1.2.

b) *Parameters in the Set_Up request primitive issued by the assigning exchange*

Procedures of Recommendation Q.2764 apply.

c) *Set_Up Request primitive – Issued by the non-assigning exchange*

Procedures of Recommendation Q.2764 apply.

d) *Completion of transmission path*

For all VP connections, through connection in both directions shall be completed not later than on receipt of an Answer indication. Through connect shall not occur before receipt of Incoming_Resources_Accepted indication primitive.

#### 3.2.1.3 Actions required at an outgoing international exchange

##### 3.2.1.3.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.1.3.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.1.2.2 a).

b) *Parameters in the Set_Up request primitive – Issued by the assigning exchange*

Procedures of Recommendation Q.2764 apply with the exception of A-law/μ-law conversion.

c) *Parameters in the Set_Up request primitive – Issued by the non-assigning exchange*

See 3.2.1.2.2 c) with the addition in 3.2.1.3.2 b).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.1.4 Actions required at an intermediate international exchange

##### 3.2.1.4.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.1.4.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.1.2.2 a).

b) *Parameters in the Set_Up request primitive – Issued by the assigning exchange*

See 3.2.1.2.2 b), with the addition of Recommendation Q.2764.

c) *Parameters in the Set_Up request primitive – Issued by the non-assigning exchange*

See 3.2.1.2.2 c), with the addition in 3.2.1.4.2 b).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.1.5 Actions required at an incoming international exchange

##### 3.2.1.5.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.1.5.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.1.2.2 a).

b) *Parameters in the Set_Up request primitive – Issued by the assigning exchange*

See 3.2.1.2.2 b) with the following additions:

The incoming international gateway exchange shall delete the Origination ISC Point Code parameter from the Set-Up indication primitive and set up a call/connection to the national network. This information is used for statistical purposes, e.g. accumulation of the number of incoming call/connections on an originating international switching centre basis.

c) *Parameters in the Set_Up request primitive – Issued by the non-assigning exchange*

See 3.2.1.2.2 c) with the addition in 3.2.1.5.2 b).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.1.6 Actions required at the destination exchange

After the issuing of the Incoming_Resources_Accepted request primitive, (see 3.2.1.2.1) the destination exchange will analyse the called party number to determine to which party the call/connection should be connected. It will also check the called party's access condition and perform various checks to verify whether or not the connection is allowed.

If the connection is allowed, the destination exchange will proceed to offer the call/connection to the called party.

If the Set-Up indication primitive contains information from the access carried in the parameters mentioned in 3.2.1.1, it is transferred unaltered in the indication sent to the called user, as specified in Recommendation Q.2650.

#### 3.2.1.7 Called party number for operator calls

Not applicable.

#### 3.2.1.8 Called number for calls to testing and measuring devices

Not applicable.

### 3.2.2 Forward address signalling – Overlap operation

#### 3.2.2.1 Actions required at the originating exchange

a) *VPCI selection – Assigning exchange*

As in 3.2.1.1 a).

b) *VPCI selection – Non-assigning exchange*

As in 3.2.1.1 b).

c) *Address information sending sequence*

As in 3.2.1.1 c).

d) *Content of Set_Up, and Subsequent_Address request primitives issued by the assigning exchange*

The Set_Up, and Subsequent_Address request primitives contain all the information that is required to route the call/connection to the destination exchange and connect the call/connection to the called party. The contents of the Set_Up request primitive is the same as described in 3.2.1.1 d). The only purpose of the Subsequent_Address request primitive is to carry further digits.

Within national networks the address information contained within the Set_Up request primitive may vary depending on the routing requirement within the network.

The remaining digits of the number may be sent in Subsequent_Address request primitives containing one or several digits as they are received. Efficiency can be gained by grouping together as many digits as possible. However, to prevent an increase in post sending delay in those cases where overlap operation with subscribers' dialling is used, it may be desirable to send the last few digits individually. The first Subsequent_Address request primitive must not be issued before the receipt of the Incoming_Resources_Accepted indication primitive.

The Subsequent_Address request primitive shall include the mandatory parameters included in Table 2.6/Q.2764.

The end-of-pulsing (ST) signal is always sent in the following situations:

- semi-automatic calls; and
- when the end-of-pulsing (ST) signal is received.

In automatic working, the end-of-pulsing (ST) signal is sent whenever the originating exchange is in a position to know, by digit analysis, that the final digit has been sent. Digit analysis may consist of an examination of the country code and counting the maximum (or fixed) number of digits of the national number. In other cases, the end-of-pulsing signal is not sent and the end-of-address information is determined by the receipt of the Address_Complete or Answer indication primitive.

e) *Content of Set_Up, and Subsequent_Address request primitives issued by the non-assigning exchange*

As in 3.2.1.1 e).

f) *Completion of transmission path*

As in 3.2.1.1 f).

#### 3.2.2.2 Actions required at an intermediate national exchange

##### 3.2.2.2.1 Incoming side of the exchange

a) *Assigning exchange*

After receiving a Set_Up indication primitive, an assigning exchange shall perform the assignment procedure for VPCI and bandwidth as described in 3.2.1.2 b). If this is successful the Incoming_Resources_Accepted request primitive shall be issued immediately. The Incoming_Resources_Accepted request primitive shall include the mandatory parameters listed in Table 2.4/Q.2764, and include the Connection Element Identifier parameter.

b) *Non-assigning exchange*

Procedures of Recommendation Q.2764 apply.

##### 3.2.2.2.2 Other actions at the exchange

a) *VPCI selection*

After the issuing of the Incoming_Resources_Accepted request primitive, an intermediate national exchange will analyse the called party number and the other routing information [(See 3.2.1.1 a)] to determine the routing of the call/connection. If the intermediate national exchange can route the call/connection, it shall create an instance of the B-ISUP AE and issue a Set_Up request primitive to it. The exchange shall follow the assignment procedure for VPCI and bandwidth as described in 3.1.2.2.

If the number of the digits in the called party number are not sufficient to route the call/connection, the routing will be carried out when the intermediate national exchange has received additional digits in Subsequent_Address indication primitive(s). Any address digits received in Subsequent_Address indication primitives during the *VPCI selection* process may be included in this Set_Up request primitive. Any Subsequent_Address indication primitives received after the Set_Up request primitive has been sent are forwarded as Subsequent_Address request primitive(s), after the Incoming_Resources_Accepted indication primitive has been received.

b) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the assigning exchange*

See 3.2.2.1 d).

c) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the non-assigning exchange*

See 3.2.2.1 e).

d) *Completion of transmission path*

See 3.2.2.1 f).

#### 3.2.2.3 Actions required at an outgoing international exchange

##### 3.2.2.3.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.2.3.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.2.2.2 a).

b) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the assigning exchange*

See 3.2.2.1 d), with the additions as in Recommendation Q.2764.

c) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the non-assigning exchange*

See 3.2.2.1 e).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.2.4 Actions required at an intermediate international exchange

##### 3.2.2.4.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.2.4.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.2.2.2 a).

b) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the assigning exchange*

See 3.2.2.1 d), with the addition of Recommendation Q.2764.

c) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the non-assigning exchange*

See 3.2.2.1 e).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.2.5 Actions required at an incoming international exchange

##### 3.2.2.5.1 Incoming side of the exchange

See 3.2.1.2.1.

##### 3.2.2.5.2 Other actions at the exchange

a) *VPCI selection*

See 3.2.2.2.2 a).

b) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the assigning exchange*

See 3.2.2.1 d).

c) *Parameters in the Set_Up, and Subsequent_Address request primitives issued by the non-assigning exchange*

See 3.2.2.1 e).

d) *Completion of transmission path*

See 3.2.1.2.2 d).

#### 3.2.2.6 Actions required at the destination exchange

See 3.2.1.6.

#### 3.2.2.7 Called party number for operator calls

Not applicable.

#### 3.2.2.8 Called number for calls to testing and measuring devices

Not applicable.

### 3.2.3 Address_Complete request primitive

#### 3.2.3.1 Actions required at the destination exchange

An Address_Complete request primitive will be sent from the destination exchange as soon as it has been determined that the complete called party number has been received, and to convey indications on the called party's status. The Called Line Status indicator will be set appropriately.

a) If an indication that the address is complete or no status indication has been received from the ISDN access prior to the destination exchange determining that the complete called party number has been received, the indicators in the Address_Complete request primitive will be set as follows:

- called party's status: "No indication".

In this case the indication that the destination user is being alerted is transferred in a Progress primitive (See 3.2.4).

b) The destination exchange concludes from the receipt of an indication from the ISDN access that the complete called party number has been received. In this case the indicators in the Address_Complete request primitive will be set as follows:

- called party's status: "alerting".

The Address_Complete request primitive shall include the mandatory parameters listed in Table 2.3/Q.2764.

If an answer indication is received immediately from the called ISDN access, the Answer request primitive may be issued without having previously issued an Address_Complete request primitive.

#### 3.2.3.2 Actions required at an intermediate national exchange

Procedures of Recommendation Q.2764 apply.

#### 3.2.3.3 Actions required at an outgoing international exchange

Procedures of Recommendation Q.2764 apply.

#### 3.2.3.4 Actions required at an intermediate international exchange

See 3.2.3.2.

#### 3.2.3.5 Actions required at an incoming international exchange

See 3.2.3.2.

#### 3.2.3.6 Actions required at the originating exchange

a) On receipt of an Address_Complete indication primitive with the called party's status indicator set to "alerting", an alerting indication is passed to the calling party.

b) On receipt of the Address_Complete indication primitive, the "Awaiting Answer" timer is started. If timer "Await Answer" expires, the connection is released (Cause = "No answer from user (user alerted)") and an indication is sent to the calling subscriber.

c) If the Address Complete indication primitive contains information from the access carried in the parameters mentioned in 3.2.3.1, it is transferred unaltered in the indication returned to the calling user.

#### 3.2.3.7 Through connection at the destination exchange

The destination exchange will through connect after the reception of the connection indication from the called party and before issuing the Answer request primitive.

The through connection of the virtual path at answer, at other exchange types, is covered in 3.2.5.

#### 3.2.3.8 Access delivery indication

Procedures of Recommendation Q.2764 apply.

### 3.2.4 Progress

The Progress request primitive is sent only after the Address_Complete indication primitive. The Progress request primitive is sent from an exchange in the backward direction indicating that an event has occurred during call/connection set-up which should be relayed to the calling party.

#### 3.2.4.1 Actions required at the destination exchange

The Progress request primitive is sent from the destination exchange if the Address_Complete request primitive has been sent and subsequently:

- An indication is received that the called party is being alerted. The Progress request primitive contains a Called Party's Indicators parameter with the Called Party's Status set to "alerting".

The Progress request primitive shall include the mandatory parameters listed in Table 2.10/Q.2764.

#### 3.2.4.2 Actions required at an intermediate exchange

Procedures of Recommendation Q.2764 apply.

#### 3.2.4.3 Actions required at the originating exchange

On receipt of a Progress indication primitive at the originating exchange, no state change occurs, and the appropriate indication is sent to the calling user.

### 3.2.5 Answer primitive

#### 3.2.5.1 Actions required at the destination exchange

When the called party answers, the destination exchange shall:

- allocate the requested quality of service;
- issue an Answer request primitive. The Answer request primitive shall include the mandatory parameters listed in Table 2.9/Q.2764.

Through connection: See 3.2.3.7.

The Answer request primitive can be issued without having issued a previous Address_Complete request, e.g. in the case of an automatic answering terminal.

#### 3.2.5.2 Actions required at an intermediate national exchange

Upon receipt of an Answer indication primitive, the intermediate national exchange through connects the virtual path in both directions if not already connected and issues the corresponding Answer request primitive towards the preceding exchange.

If this is a national controlling exchange, and the Answer indication is received subsequent to an Address Complete indication, timer "Await Answer" is stopped.

#### 3.2.5.3 Actions required at an outgoing international exchange

See 3.2.5.2. Additionally, if the Answer indication is received subsequent to an Address Complete indication timer, "Await Answer" is stopped.

#### 3.2.5.4 Actions required at an intermediate or incoming international exchange

See 3.2.5.2.

#### 3.2.5.5 Actions required at the originating exchange

When the originating exchange receives an Answer indication primitive indicating the required call and connection have been completed, the "Awaiting Answer" timer is stopped, (if the Answer indication is received subsequent to an Address Complete indication). The virtual path is connected through in both directions, if not already connected, and a connect indication is sent to the calling subscriber.

### 3.2.6 Forward_Transfer primitive

Not supported.

### 3.2.7 Transit network selection (national option)

Procedures as in Recommendation Q.2764 apply.

### 3.2.8 Storage and release of information

Procedures as in Recommendation Q.2764 apply.

### 3.2.9 Simple segmentation (national option)

Procedures as in Recommendation Q.2764 apply.

### 3.3 Unsuccessful call/connection set-up

#### 3.3.1 Lack of resources at the incoming side

If at any time a call/connection leg cannot be completed due to lack of resources at the incoming side (e.g. SIDs, VPCI or bandwidth), the exchange will immediately start the release of the call/connection and issue an Incoming_Resources_Rejected request primitive towards the preceding exchange. The Incoming_Resources_Rejected request primitive shall contain the mandatory parameters listed in Table 2.5/Q.2764. Cause value "resource unavailable – unspecified" is included, if no SIDs were available, cause value "no VPCI/VCI available" in case no VPCI is available, and cause value "user cell rate not available" in the case of lack of bandwidth. The incoming signalling association (AEI) is deleted.

#### 3.3.2 Lack of resources at the outgoing side

If at any time a call/connection leg cannot be completed due to lack of resources at the outgoing side (e.g. SIDs or bandwidth) or if the maximum end-to-end transit delay is exceeded, the exchange will immediately start the release of the call/connection and issue a Release request primitive towards the preceding exchange. The Release primitive shall contain the mandatory parameters listed in Table 2.7/Q.2764. Cause value "resource unavailable – unspecified" is included, if no SIDs were available, or if the maximum end-to-end transit delay is exceeded, cause value "no VPCI/VCI available" in the case of lack of VPCI, and cause value "user cell rate not available" in the case of lack of bandwidth. Procedures continue as in 3.4.

#### 3.3.3 Actions at an exchange receiving an Incoming_Resources_Rejected Primitive

On receipt of an Incoming_Resources_Rejected indication primitive, an exchange shall release the VPCI (if applicable) and the bandwidth, and shall terminate the outgoing signalling association, i.e. the associated AEI is deleted. The exchange may attempt to re-route the call/connection.

If all attempts to re-route the call/connection have failed:

a) The exchange shall immediately start the release of the call/connection.

b) An intermediate exchange will issue a Release request primitive with the received cause value towards the preceding exchange. Procedures continue as in 3.4.

c) An originating exchange will send an indication to the calling user.

#### 3.3.4 Actions at an exchange receiving a Release message

On receipt of a Release indication primitive from the succeeding exchange after the Incoming_Resources_Accepted indication and before the Address_Complete indication, the exchange shall release the VPCI (if applicable) and the bandwidth, and shall issue a Release response primitive. The outgoing signalling association is terminated, i.e. the associated AEI is deleted:

a) If it is the controlling exchange (i.e. the exchange controlling the call), the exchange may attempt to re-route the call/connection.

b) If it is not the controlling exchange or if all attempts to re-route the call/connection have failed:

   1) An intermediate exchange will issue a Release request primitive with the received cause value towards the preceding exchange. Procedures continue as in 3.4.3.

   2) An originating exchange will send an indication to the calling user.

#### 3.3.5 Address incomplete

The determination that the proper number of digits has not been received can be made at once if the end-of-pulsing signal is received.

When overlap working is used the "Address Incomplete" timer is started on receipt of the latest address message if the minimum or fixed number of digits for forward routing of the call/connection have not yet been received.

If the end of pulsing has not been received, the Release request primitive with cause "address incomplete" will be sent towards the preceding exchange on expiry of the "Address Incomplete" timer. Procedures continue as in 3.4

### 3.3.6 Tones and announcements

Not supported.

## 3.4 Normal call/connection release

### 3.4.1 General

The release procedure is a confirmed operation whereby the Release request/indication initiates release of the call and virtual path, and the response/confirmation signifies completion of the release. The same procedures are used in the network irrespective whether they are initiated by the calling party, the called party or the network.

The following actions will be performed by any exchange receiving a Release indication primitive:

- the associated VPCI will be made available for new traffic;
- the bandwidth will be made available for new traffic;
- and after that the appropriate Release response primitive is returned;
- the signalling association is terminated, i.e. the associated AEI is deleted.

An exchange that has initiated the release procedure by issuing a Release request primitive shall perform the following actions on receipt of the Release confirmation primitive:

- the associated VPCI will be made available for new traffic;
- the bandwidth will be made available for new traffic;
- the signalling association is terminated, i.e. the associated AEI is deleted.

The following subclauses describe additional required actions.

### 3.4.2 Release Initiated by a calling party

Procedures of Recommendation Q.2764 apply.

### 3.4.3 Release initiated by a called party

Procedures of Recommendation Q.2764 apply.

### 3.4.4 Release initiated by the network

Procedures of Recommendation Q.2764 apply.

## 3.5 Suspend, Resume (network initiated)

Not supported.

## 3.6 Propagation delay determination

The procedure provides means to determine the total propagation delay for a connection.

A propagation delay value must be defined for each VPC pool going out of every exchange, for which the exchange is the assigning exchange.

The propagation delay information is accumulated during call/connection set-up in the forward direction. The result is sent in the backward direction as call history information before the active phase of a call/connection.

### 3.6.1 Procedure

Procedures as in Recommendation Q.2764 apply.

#### 3.6.1.1 Actions at the initiating exchange

Procedures as in Recommendation Q.2764 apply.

##### 3.6.1.1.1 Actions referring to the propagation delay counter

In the case of an assigning exchange: The propagation delay counter shall be set to a value defined for the selected VPC pool to the succeeding exchange, plus an access delay value (if available).

In the case of a non-assigning exchange: The propagation delay counter shall be set to the access delay value, or zero if the access delay value is unknown.

##### 3.6.1.1.2 Actions referring to the call history information

Procedures as in Recommendation Q.2764 apply.

#### 3.6.1.2 Actions at an intermediate exchange

Procedures as in Recommendation Q.2764 apply.

##### 3.6.1.2.1 Actions referring to the propagation delay counter

a) *Incoming side of the exchange*

In the case of an assigning exchange: After choosing a VPC pool, the propagation delay counter shall be increased by the corresponding delay value.

In the case of a non-assigning exchange, the propagation delay counter is unchanged.

b) *Outgoing side of the exchange*

In the case of an assigning exchange: After choosing a VPC pool, the propagation delay counter shall be increased by the corresponding delay value.

In the case of a non-assigning exchange, the propagation delay counter is unchanged.

The Set_Up request primitive is issued towards the succeeding exchange containing the new value of the propagation delay counter.

##### 3.6.1.2.2 Actions referring to the call history information

Procedures as in Recommendation Q.2764 apply.

#### 3.6.1.3 Actions at the terminating exchange

Procedures as in Recommendation Q.2764 apply.

##### 3.6.1.3.1 Actions referring to the propagation delay counter

a) *Incoming side of the exchange*

In the case of an assigning exchange: After choosing a VPC pool, the propagation delay counter shall be increased by the corresponding delay value.

b) *Other actions at the exchange*

The destination exchange shall increase the value by the delay value of the terminating access (if available) and store it until the call/connection is released.

#### 3.6.1.3.2 Actions referring to the call history information

Procedures as in Recommendation Q.2764 apply.

### 3.7 Error indication primitive

The Error indication primitive can be received as a result of various protocol errors detected by the ASEs. The following errors and their corresponding actions are identified:

a) Timer "Await Address Complete" expiry, detected by CC ASE: If this error occurs, the call/connection should be released, in both the forward and backward directions, using Cause "Address Incomplete".

b) Unexpected message received while awaiting the IAM Acknowledge message, detected by BCC ASE: This will initiate an automatic repeat attempt. The existing outgoing signalling association is terminated, i.e. the associated AEI is deleted *(Reset initiated by the Maintenance Application Process).*

c) Unexpected message received while awaiting the Address Complete message, detected by CC ASE: This will initiate an automatic repeat attempt. The existing outgoing signalling association is terminated, i.e. the associated AEI is deleted *(Reset initiated by the Maintenance Application Process).*

d) Timer "Await Release Complete" expiry, detected by BCC ASE: If this error occurs, the VPCI and the bandwidth shall be removed from service, and the signalling association is terminated, i.e. the associated AEI is deleted *(Reset initiated by the Maintenance Application Process).*

e) Timer "Await IAM Acknowledge" expiry, detected by BCC ASE: If this error occurs, the VPCI and the bandwidth shall be removed from service, and the signalling association is terminated, i.e. the associated AEI is deleted *(Reset initiated by the Maintenance Application Process).*

f) Unexpected Release Complete message received after the reception, or sending, of the IAM Acknowledge message, detected by BCC ASE: This will initiate the release of the call/connection, using cause value "protocol error – unspecified".

If an Error indication primitive is received indicating any other error has occurred, it is discarded, with no action.

### 3.8 Primitive contents

See Recommendation Q.2764.

## 4 Maintenance control, application process functions

### 4.1 Introduction

Procedures of Recommendation Q.2764 apply.

### 4.2 Reset

The reset procedure is used to return signalling identifiers and connection elements (virtual path link/VPC pool) to the idle condition. The procedure is invoked under abnormal conditions: when the current status of the Signalling Identifiers (SIDs) or the Connection Element Identifiers (CEIs) are unknown or ambiguous. For example, a switching system that has suffered memory mutilation will not know the status of Signalling Identifiers (SIDs) and virtual path connections, e.g. idle, busy

incoming, busy outgoing, etc.; the identifiers and virtual path link/VPC pool (and any associated bandwidth) between the two adjacent nodes should therefore be reset to the idle condition. The resources are therefore made available for new traffic.

In order to indicate what resource is to be reset, the Reset_Resource request contains a Resource Identifier parameter. If the resource indicator is set to "remote SID" the resource value will indicate the local SID reference at the sending node (the remote reference at the receiving node). If the resource indicator is set to "local SID" then the resource value will indicate the remote SID reference at the sending node (the local reference at the receiving node). If the resource indicator is set to "VPC pool: VPCI" or "CEI VPCI", the resource value will indicate the virtual path link/VPC pool common to both the sending and receiving nodes.

The reset procedure should be initiated for:

a) signalling anomalies detected by the B-ISUP signalling system. The following anomalies are detected by the protocol procedures, reported to the exchange management functions, and thus initiate the reset procedure:

   1) Unexpected message received while awaiting the IAM Acknowledge message, (detected by BCC ASE). Action: Reset remote SID.

   2) Unexpected message received while awaiting the Address Complete message, (detected by CC ASE). Action: Reset local SID.

   3) Timer "Await Release Complete" expiry, (detected by BCC ASE). Action: Reset VPCI.

   4) Unexpected message received relating to an unallocated SID, (detected by BCC ASE). Action: Reset remote SID.

   5) Timer "Await IAM Acknowledge" expiry, (detected by BCC ASE). Action: Assigning exchange: Reset VPCI and remove the VPCI and bandwidth from service. Non-assigning exchange: Reset remote SID.

   6) Call Control Application Process detects a missing mandatory parameter in a received primitive. Action: Reset local SID.

b) maintenance action due to memory mutilation such as losing of the association information between a signalling ID and a Connection Element identifier; and

c) maintenance action involving start-up and restart of an exchange and/or a signalling system: Reset of each affected VPC pool.

### 4.2.1 Actions at Reset initiating exchange

To initiate reset a Reset_Resource request primitive is issued. The primitive will contain the resource identifier.

On issuing the Reset_Resource request primitive, the exchange should (if applicable) stop sending ATM cells on the connection.

On issuing the Reset_Resource request primitive, the exchange shall start timer "Repeat Reset".

On receiving the Reset_Resource confirmation primitive, the exchange shall stop timer "Repeat Reset".

On receiving the Reset_Resource confirmation primitive, the affected exchange will place the referenced resource it controls in the "idle" state, and return all associated bandwidth on the VPC pool which the exchange controls to the "available" state (i.e. send indication to resource control mechanism).

If the resource reset was "VPC pool: VPCI", the exchange shall idle all associated signalling identifiers, i.e. delete all signalling associations related to that VPC pool.

The VPC pool blocking conditions are affected by reset of VPC pool: VPCI as follows:

a) Any local blocking condition related to the reset VPC pool is removed when the Reset_Resource confirmation primitive is received.

b) Any remote blocking condition related to the reset VPC pool is removed when the Reset_Resource confirmation primitive is received, unless a Block_Resource indication has been received, since the sending of the Reset_Resource, relating to the concerned VPC pool; in such a case the remote blocking condition is (re-)instated.

The blocking conditions are unaffected by other types of reset.

The exchange should notify the maintenance system of the outcome of the procedure.

### 4.2.2 Actions at Reset responding exchange

On receiving a Reset_Resource indication primitive, the receiving (unaffected) exchange will:

a) If it is the incoming or outgoing exchange on a connection in any call/connection state, the exchange should accept the message as a request to idle resources it controls. It responds by sending a Reset_Resource response primitive after the indicated resource, the bandwidth if it is the controlling exchange for the VPC pool affected and all associated identifiers (SIDs, VPCIs, where applicable) on the concerned link, have been made available for new traffic.

   If it is a VPC pool: The VPCI is reset then all associated VPCIs and SIDs on the VPC pool should be released.

b) If the received resource (SID, VPC pool: VPCI, VPCI) is not allocated (idle condition), accept the primitive as a release request and therefore respond by sending a Reset_Resource response.

c) Any interconnected virtual path links/VPC pool and all associated resources, will be released by an appropriate method (e.g. Release) except in the case of call/connections that are currently awaiting the Incoming_Resources_Accepted indication: in this case an automatic repeat attempt is applicable.

d) If the primitive is received after having sent a Reset_Resource request primitive, respond by a Reset_Resource response primitive. The associated identifiers and the bandwidth if applicable should be made available for service.

e) If the Resource indicator is set to "VPC pool: VPCI" and if the affected VPC pool is in a locally blocked state, the Reset_Resource indication shall be accepted as a request to idle all resources (signalling identifiers, VPC pool: VPCI, VPCI). The affected VPC pool is returned to the locally blocked state. A Block_Resource request with a Resource indicator set to "VPC pool: VPCI" indicating the affected VPC pool shall be sent. A Reset_Resource response shall be issued following the Block_Resource request primitive.

f) If the Resource indicator is set to "VPC pool: VPCI" and if the affected VPC pool is in a remotely blocked state, the remotely blocked state shall be removed.

### 4.2.3 Abnormal reset procedures

a) If a Reset_Resource confirmation is received which is not a correct response to a sent Reset_Resource request, it is discarded.

b) If a Reset_Resource indication is received requesting reset of a resource (e.g. connection element identifier) that is not controlled by the B-ISDN User Part, it is discarded.

c) If an Error indication primitive is received indicating that timer "Await Reset Acknowledgement" has expired in the MC ASE, and if timer "Repeat Reset" has not yet expired for the first time, the Reset procedure is repeated as described in 4.2.1.

If timer "Repeat Reset" expires the "Repeat Reset" timer shall be started again, and the Reset procedure is repeated as described in 4.2.1. The maintenance system shall be informed on the first expiry of timer "Repeat Reset", and this procedure shall continue until the Reset_Resource confirmation primitive is received, or until maintenance intervention occurs.

## 4.3 Blocking and unblocking of VPC pool

The VPC pool blocking procedure is provided to prevent a VPC pool from being selected for carrying new non-test call/connections. This procedure can be initiated automatically, e.g. under fault conditions, or manually, to permit testing or other exchange management functions.

Blocking can be initiated by the exchange at either end of a VPC pool. At both ends the VPC pool is put into a blocked state and the bandwidth becomes unavailable. A blocked VPC pool cannot be selected for new non-test traffic by either exchange; however, test call/connections can be completed in either direction independent of the blocking state. Test call/connections must not return a VPC pool to service.

An acknowledgement is required for each blocking and unblocking request. The acknowledgement is not sent until the appropriate action – blocking or unblocking – has been taken.

Unblocking can only be initiated by the same exchange which initiated the blocking procedures sending an Unblocking, or Reset (VPC pool: VPCI), request, (see also 4.2.2). At either end, the blocked state is removed and the bandwidth becomes available again.

### 4.3.1 Initiating blocking

When the exchange initiates the blocking procedure, it issues the Block_Resource request primitive, with the Resource identifier set to "VPC pool: VPCI", and indicating the affected VPC pool. The VPC pool is put into the locally blocked state, and so no new non-test call/connections can be completed over this VPC pool, in either direction.

When the Block_Resource confirmation primitive is received, the maintenance system is informed of the completion of the blocking.

### 4.3.2 Initiating unblocking

When the exchange initiates the unblocking procedure, it issues the Unblock_Resource request primitive, with the Resource identifier set to "VPC pool: VPCI", and indicating the affected VPC pool.

When the Unblock_Resource confirmation primitive is received, the local blocking condition for the VPC pool is removed. The maintenance system is informed.

### 4.3.3 Receiving blocking

When the exchange receives the Block_Resource indication primitive, indicating the affected VPC pool, the virtual path is put into the remotely blocked state, the bandwidth becomes unavailable, and so no new non-test call/connections can be completed over this virtual path, in either direction. A Block_Resource response primitive is then issued.

### 4.3.4 Receiving unblocking

When the exchange receives the Unblock_Resource indication primitive, indicating the affected VPC pool, the remotely blocked state for the VPC pool is removed, the bandwidth becomes available again for traffic, and the Unblock_Resource response primitive is issued.

### 4.3.5 Abnormal procedures

a) If a Block_Resource indication is received for a VPC pool which is already in a remotely blocked state, a Blocking Acknowledgement message shall be sent.

b) If an Unblock_Resource indication is received for a VPC pool which is not in a remotely blocked state, an Unblocking Acknowledgement message shall be sent.

c) If an Error indication primitive is received indicating that an error has been detected in the MC blocking protocol state machines, the maintenance system shall be informed.

d) If a Block_Resource indication is received for a VPC pool which is not under the control of the B-ISDN User Part, it is discarded.

e) If a Block_Resource indication or Unblock_Resource indication is received with the Resource identifier set to "CEI: VPCI" and the indicated VPCI is under control of a VPC Pool, it is discarded.

## 4.4 User Part availability procedure

### 4.4.1 Inaccessible User Part

On receipt of a Remote_Status indication primitive with the cause "User Part unavailability – inaccessible remote user" the B-ISDN User Part shall:

a) mark the concerned User Part unavailable.

b) inform the management/overload function, and all VPC pools to that destination are blocked for new call/connections. Call/connections in progress need not be released even though signalling messages cannot be sent to the affected exchange. (While it may not be technically necessary to release call/connections in progress, network providers may choose to release such call/connections, perhaps after some time interval, if there is a concern about overcharging due to the exchange's inability to completely clear the call/connection when either the calling or called party disconnects.)

c) start the availability test procedure by issuing a User_Part_Available request primitive.

On receipt of a User_Part_Available confirmation primitive, or any other primitive relating to the far User Part, the B-ISDN User Part shall:

a) mark the concerned User Part available.

b) inform the management/overload function, and the VPC pools will be unblocked, and any of them in the idle state can be used for call/connections immediately. Normal call/connection release procedures that may have started during the period of signalling isolation continue and as such will ensure that affected VPC pools are returned to idle state.

c) delete the associated Maintenance AEI.

If a User_Part_Available indication primitive is received, the B-ISDN User Part will respond by sending a User_Part_Available response primitive, if it is available. If it is not available, no action shall be taken.

### 4.4.2 Unequipped User Part

On receipt of a Remote_Status indication primitive with the cause "User Part unavailability – unequipped remote user" the B-ISDN User Part should inform the management system and all VPC pools to that destination are blocked for new call/connections. Call/connections in progress need not be released even though signalling messages cannot be sent to the affected exchange. (While it may not be technically necessary to release call/connections in progress, network providers may choose to release such call/connections, perhaps after some time interval, if there is a concern about

over-charging due to the exchange's inability to completely clear the call/connection when either the calling or called party disconnects.)

### 4.5 Transmission alarm handling

Procedures of Recommendation Q.2764 apply.

### 4.6 Automatic congestion control

Procedures of Recommendation Q.2764 apply.

### 4.7 B-ISUP signalling congestion control

Procedures of Recommendation Q.2764 apply.

### 4.8 Destination availability

On the reception of a Destination_Unavailable indication primitive, the B-ISDN User Part takes the following action:

If the affected destination is not a destination (Signalling Point) known by the B-ISDN User Part (not connected by VPC pool/virtual paths to the exchange), no action takes place.

If the affected destination is a destination (Signalling Point) known by the B-ISDN User Part, all VPC pools to that destination are blocked for new call/connections.

Call/connections in progress need not be released even though signalling messages cannot be sent to the affected exchange. (While it may not be technically necessary to release call/connections in progress, network providers may choose to release such call/connections, perhaps after some time interval, if there is a concern about overcharging due to the exchange's inability to completely clear the call/connection when either the calling or called party disconnects.)

On the reception of a Destination_Available indication primitive, the B-ISDN User Part takes the following action:

If the affected destination is not a destination (Signalling Point) known by the B-ISDN User Part (not connected by VPC pool/virtual paths to the exchange), no action takes place.

If the affected destination is a destination (Signalling Point) known by the B-ISDN User Part, the VPC pools will be unblocked, and any of them in the idle state can be used for call/connections immediately. Normal call/connection release procedures that may have started during the period of signalling isolation continue and as such will ensure that affected VPC pools are returned to idle state.

### 4.9 VPC pool Consistency Check

The VPC pool Consistency Check is provided to verify the consistent and correct allocation of all logical Virtual Path Connection Identifiers of a VPC pool to a Virtual Path Identifier on an interface in both connected exchanges. The check is performed to guarantee that a user plane information flow is possible between the two adjacent exchanges using the bilaterally agreed logical Virtual Path Connection Identifiers. This is done using the Loopback Capability of Recommendation I.610 that operates on the Virtual Path Level. The consistency of the logical Virtual Path Connection Identifiers is checked at the adjacent node by monitoring the receipt of a user plane test flow in a Virtual Path Connection at a particular interface that is indicated by the Virtual Path Connection Identifier. After the performance of the check, the result of the Loopback test (continuity at the Virtual Path level) is available in the initiating node. The result of the monitoring function (receipt of Loopback cells at

the Virtual Path Connection level) is available at the adjacent node and is sent back to the initiating exchange. The procedure can be initiated automatically or manually. The consistency check should be initiated for only one Virtual Path Connection to any adjacent node at a time.

The VPC Pool Consistency Check can be initiated by an exchange at either end of a Virtual Path Connection Pool. The Virtual Path Connection Pool to be tested must be blocked when the procedure is initiated. The procedures below are applied for each VPCI of the VPC Pool sequentially, i.e. the consistency of each VPCI and VPI is checked.

Consistency Check Begin and Consistency Check End are confirmed operations. The acknowledgement is not sent until the appropriate action – start or stop of the user plane test flow supervision procedure – has been taken.

The end of the consistency check can only be initiated by the same exchange which initiated the procedure by sending a Consistency Check End request.

### 4.9.1 Initiating Consistency Check Request

When an exchange initiates the consistency check, it issues the Check_Resource_Begin request primitive. The Resource Identifier is set to "Connection element identifier: VPCI" and the affected Virtual Path Connection Identifier is included. A Virtual Path Connection endpoint is established for the VP to be tested. The standardized Virtual Channel Identifier for F4 flows is used (see Recommendation I.610).

When the Check_Resource_Begin confirmation primitive is received, the maintenance system is informed about the completion of the VPCI Consistency Check connection set-up and the user plane test flow is initiated.

### 4.9.2 Receiving Consistency Check Request

When the exchange receives the Check_Resource_Begin indication primitive, indicating the affected Virtual Path Connection, the primitive is accepted as a request for a VPCI Consistency Check connection set-up and the maintenance system is informed. A Virtual Path Connection end point is established for the VP to be tested. The user plane test flow monitoring function is connected to the standardized Virtual Channel for F4 flows (see Recommendation I.610) in the indicated Virtual Path Connection. A Check_Resource_Begin response primitive is issued.

### 4.9.3 Initiating Consistency Check End

When an exchange initiates the end of the Consistency Check procedure, the user plane test flow is stopped and the Check_Resource_End request primitive is issued.

When the Check_Resource_End confirmation primitive is received, it contains the Consistency Check Result Information. The VPCI Check Result Indicator is set to the result of the user plane test flow monitoring function at the logical Virtual Path Connection level. The maintenance system is informed about the completion and the result of the check and the VPCI Consistency Check connection is released. The Virtual Path Connection end point is deleted.

### 4.9.4 Receiving Consistency Check End

When the exchange receives the Check_Resource_End indication primitive, the user plane test flow monitoring function is disconnected. The maintenance system is informed about the completion of the test. The VPCI Consistency Check connection is released, the Virtual Path Connection end point is deleted and the Check_Resource_End response primitive is issued. The Check_Resource_End response primitive contains the Consistency Check Result Information. The VPCI Check Result Indicator is set to the result of the user plane test flow monitoring function at the logical Virtual Path Connection level. If, due to any reason, the monitoring function could not be performed properly, the VPCI Check Result Indicator shall be set to "Virtual Path Connection Identifier check not performed".

### 4.9.5 Abnormal procedures

a) If a Check_Resource_Begin confirmation primitive is received which is not a correct response to a sent Check_Resource_Begin request, it is discarded.

b) If a Check_Resource_End confirmation primitive is received which is not a correct response to a sent Check_Resource_End request, it is discarded.

c) If a Check_Resource_Begin indication primitive is received requesting a VPCI Consistency Check for a Virtual Path Connection that is not controlled by the B-ISDN User Part, it is discarded.

d) If an Error indication primitive is received indicating that timer "Await Consistency Check Request Acknowledgement" has expired in the MC ASE, the maintenance system shall be informed.

e) If an Error indication primitive is received indicating that timer "Await Consistency Check End Acknowledgement" has expired in the MC ASE, the maintenance system shall be informed.

f) If a Check_Resource_Begin indication primitive is received requesting a VPCI Consistency Check for a Virtual Path Connection for which a Check_Resource_Begin request primitive has been issued, it is discarded.

## 4.10 Primitive contents

See Recommendation Q.2764.

# 5 Compatibility, application process functions

Procedures of Recommendation Q.2764 apply.

# 6 Interworking

## 6.1 Interworking with nodes not supporting this feature

As the SVP service makes use of a new codepoint in the Bearer class field – which is routing relevant – it shall not be routed to an exchange not supporting that service, unless there is an error in routing. If such error occurs, the following applies.

Nodes not supporting the service do not support the SVP specific parameter values defined in this Recommendation and the procedures for the handling of unrecognized signalling information apply. The instruction indicators for these parameters shall be set so as to release the connection.

NOTE – The instruction indicators should be set as shown in Appendix II/Q.2764 for the Broadband bearer capability parameter in order to support the correct behaviour.

## 6.2 Interworking with ISUP

These call/connections are not supported in ISUP and are released at the B-ISUP/ISUP interworking point, with the cause "service not supported".

## 6.3 Interworking with DSS 2

The mapping of DSS 2 information elements to B-ISUP parameters is supported as defined in Recommendation Q.2650.

# 7 Interaction

## 7.1 Interaction with other capabilities

### 7.1.1 Point-to-multipoint

Not supported.

### 7.1.2 Traffic parameters

The procedures of Recommendations Q.2723.1, Q.2723.3, Q.2723.4, and Q.2723.6 can be used with SVP capability. The allowed combinations of traffic parameters and ATM Transfer Capabilities (ATCs) are specified in Recommendation Q.2934.

### 7.1.3 Look-ahead

The procedures of Recommendation Q.2724.1 can be used with SVP capability.

### 7.1.4 Negotiation of traffic characteristics during call set-up

The procedures of Recommendation Q.2725.1 can be used with SVP capability.

### 7.1.5 Modification of traffic characteristics during the active phase of the call

The procedures of Recommendations Q.2725.2, Q.2725.3, and Q.2725.4 can be used with SVP capability.

### 7.1.6 ATM End System Address

The procedures of Recommendation Q.2726.1 can be used with SVP capability.

### 7.1.7 Call priority

The procedures of Recommendation Q.2726.2 can be used with SVP capability.

### 7.1.8 Network generated session ID

The procedures of Recommendation Q.2726.3 can be used with SVP capability.

### 7.1.9 Frame relay

Not supported.

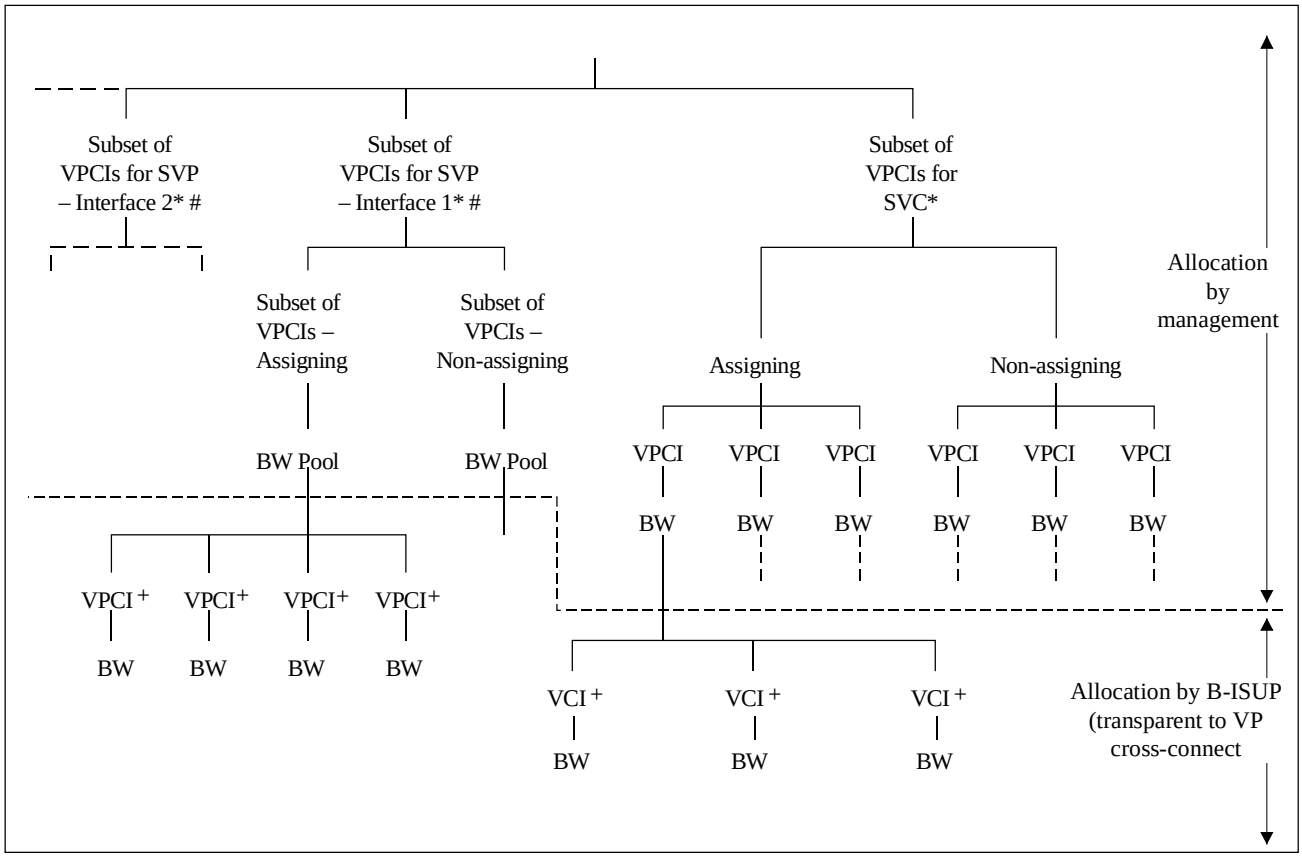
APPENDIX I

## Guidelines for the management of VPCI and bandwidth

## I.1 Management of VPCI and bandwidth

Figure I.1 shows management of VPCI and bandwidth resources between a pair of exchanges. At the highest level, mutually exclusive subsets of VPCIs need to be defined for Switched Virtual Channel (SVC) connections and Switched Virtual Path (SVP) connections. For SVPs, subsets should be defined on a physical interface basis. Each (per interface) VPCI subset for SVP should be further subdivided into two mutually exclusive subsets for which the exchange functions as the assigning and non-assigning exchange. A bandwidth pool is allocated to each of these two subsets. Any of the VPCI subset described can be a null set (with 0 associated bandwidth). Configuration up to this level is accomplished via network management system.

To route an outgoing SVP connection request, the exchange would first try to select a VPCI it controls from the subset(s) of VPCIs allocated for SVPs. Based on the connection request, bandwidth will be assigned to this VPCI from the pool of bandwidth associated with the VPCI subset the selected VPCI belongs to. The selected VPCI will be signalled in the Connection Element Identifier together with other parameters in the IAM. If there is no available VPCI belonging to the subset(s) of VPCIs allocated for SVPs and controlled by the exchange, or the available bandwidth the exchange controls is insufficient to satisfy the connection request, the exchange will request the far-end exchange to allocate VPCI and bandwidth, i.e. the IAM will be sent without the Connection Element Identifier.




BW Bandwidth
* Subsets of VPCIs for SVP and SVC are mutually exclusive.
\+ A mixture of traffic with different characteristics is allowed within each subset.
\# Other VPCIs on the same interface may be used to connect to other exchanges.

**Figure I.1/Q.2766.1 – Management of VPCIs and bandwidth resources between a pair of exchanges**

## I.2 Configuration of VP cross-connect

It is important to emphasize that for SVPs, a bandwidth pool is allocated to each of two subsets of VPCIs on a per interface basis for which the exchange functions as an assigning and a non-assigning exchange. Further selection of a VPCI and bandwidth allocation to that VPCI take place dynamically based on connection request via signalling. Because signalling is transparent to a VP cross-connect, an entire subset of VPCI and the associated bandwidth used for SVPs must be connected through the VP cross-connect via management between the same pair of input and output ports. This provisioning in the VP cross-connect must take place before SVP service is turned on. No bandwidth

will be allocated to an individual VPCI; instead a pool of bandwidth will be allocated to a subset of VPCIs between a pair of exchanges through an intermediate VP cross-connect. Selection of a VPCI and allocation of bandwidth to it in response to a connection request will take place via signalling between two exchanges, completely transparent to the intermediate VP cross-connect. The VP cross-connect must not do traffic management (e.g. policing and smoothing) at the VP level for the VPCs designated for SVPs.

This subclause is for further study.

## APPENDIX II

## VPCIs, VPIs, bandwidth pools and interfaces possible relationships

### II.1 Default mechanism

Figure II.1 shows possible relationships between VPCIs, VPIs, bandwidth pools and interfaces.

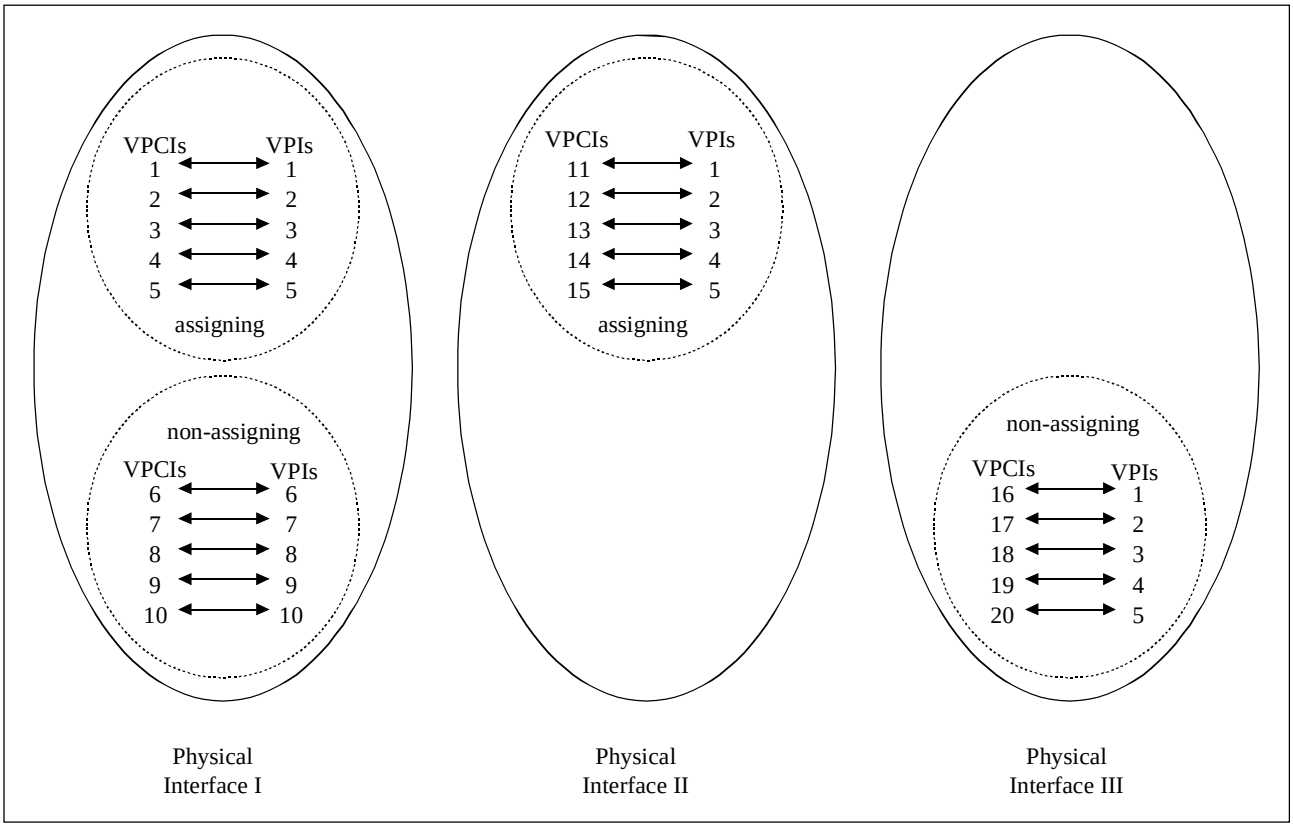



**Figure II.1/Q.2766.1 – Possible relationships between VPCIs, VPIs, bandwidth pools and interfaces**

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