INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

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(10/96)

SERIES E: TELEPHONE NETWORK AND ISDN

Operation, numbering, routing and mobile services – International operation – International routing plan

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B-ISDN routing

ITU-T Recommendation E.177

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION E.177

B-ISDN ROUTING

Summary

This Recommendation provides routing principles in B-ISDN, in particular, guidance on the incorporation of service requirements into the network routing process.

Source

ITU-T Recommendation E.177 was prepared by ITU-T Study Group 2 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 8th of October 1996.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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 (Helsinki, March 1-12, 1993).

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

NOTE

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

CONTENTS

Recommendation E.177

B-ISDN ROUTING

(Geneva, 1996)

1 Introduction

This Recommendation provides routing principles in B-ISDN, in particular, guidance on the incorporation of service requirements into the network routing process.

Contents of this Recommendation will be extended in order to satisfy operational needs which will arise according to the evolution of network/signalling capabilities.

2 Scope

The scope of this Recommendation is the routing of B-ISDN user information transport network supported by Signalling Capability Set 1 (SCS-1). Service capabilities supported in this Recommendation are as follows:

– routing principles for on-demand Virtual Channel Connection directed by signalling procedures to provide Broadband Connection Oriented Bearer service are specified. Routing principles for Broadband Connectionless Bearer Service are out of scope of this Recommendation;

– Virtual Path Connections to accommodate the Virtual Channel Connection are predefined, i.e. semi-permanent connection;

– one and only one connection is established per call in a point-to-point configuration;

– interworking with N-ISDN circuit mode service is considered; and

– no QOS indication/negotiation is performed between user and network.

Check marks on Table 1 show the service capabilities supported in this Recommendation.

TABLE 1/E.177

Service capabilities supported in this Recommendation

Configuration	✓Point-to-point	Point-to-multipoint	Broadcast
Number of connections per call	✓One and only one connection per call	Multiple connections per call	
Bandwidth	✓Symmetric	Asymmetric	
Bearer service	✓BCOB-A	BCOB-B, C	BCLB-D
Interworking with N-ISDN	✓Circuit mode	Packet mode	Frame mode
QOS class	✓No indication	Indication of QOS	
BCOB Broadband Connection Oriented Bearer service BCLB Broadband Connectionless Bearer service			

Routing principles for Virtual Path Connection is out of the scope of this Recommendation.

The following separation of concerns between transport function and OAM function should be taken into consideration:

– transport network control directed by service request from the user;
– policy making for efficient B-ISDN networking in OAM function.

Network topology and traffic routing methods are specified in Recommendation E.170.

3 References and related Recommendations

B-ISDN basic description		I.100-Series
B-ISDN interworking		I.500-Series
B-ISDN network capabilities		I.300-Series
B-ISDN signalling	– User-network interface	Q.2931
	– Network-node interface	Q.276X-Series
B-ISDN switching capabilities and interfaces		Q.2500-Series
B-ISDN telecommunication services		F.811
Network management controls		E.412
Numbering plans		E.191
Routing plans		E.170, E.171, E.172

4 Definitions

4.1 virtual path connection group: A group of Virtual Path Connections which have the same permanent characteristics between Virtual Channel switches, e.g. propagation delay. The following points should be taken into consideration on grouping VPCs and may consequently impact route selection:

– number of VP cross -connects on a connection;
– number of VP links on a connection;
– propagation delay of each VPC.

This current definition may evolve in the future taking account of future capability, e.g. traffic type.

5 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used.

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
B-BC	Broadband Bearer Capability
BCOB	Broadband Connection Oriented Bearer service
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	Broadband ISDN User Part
IAM	Initial Address Message
IN	Intelligent Network
N-ISDN	Narrow-band Integrated Services Digital Network

NPI Numbering Plan Identifier

OAM Operation Administration and Maintenance

OLVS Originating Local Virtual channel Switch

QOS Quality of Service

ROA Recognized Operating Agency

TLVS Terminating Local Virtual channel Switch

TON Type of Number

TVS Transit Virtual channel Switch

UNI User Network Interface

VC Virtual Channel

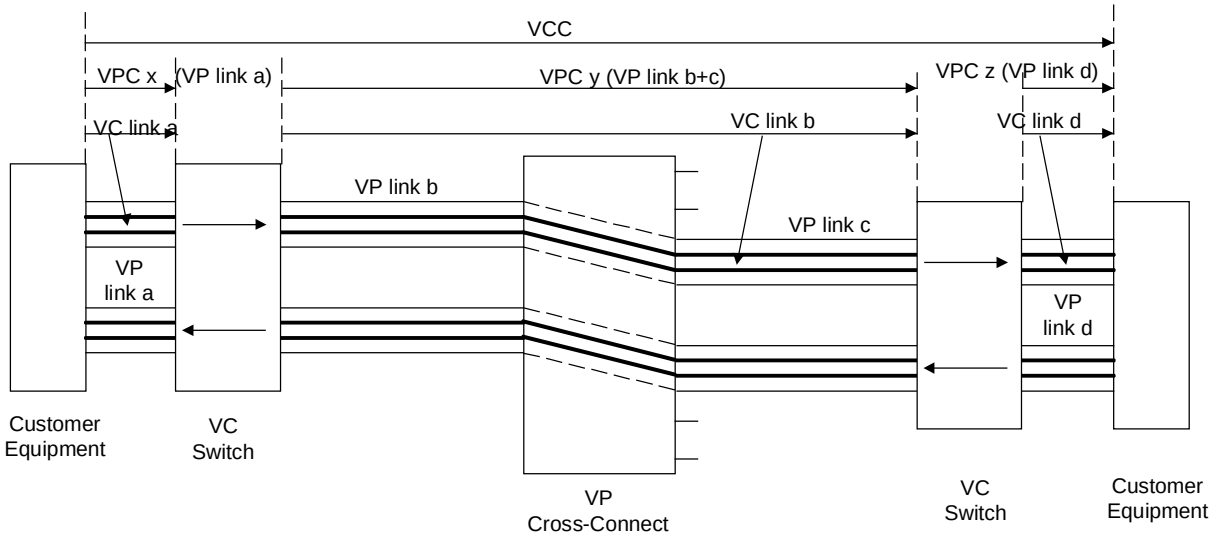
VCC Virtual Channel Connection

VP Virtual Path

VPC Virtual Path Connection

6 B-ISDN routing principles

6.1 Figure 1 shows representation of VPC and VCC between calling and called customer equipment.



VC Virtual Channel
VCC Virtual Channel Connection
VP Virtual Path
VPC Virtual Path Connection

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FIGURE 1/E.177

Representation of VPC and VCC

6.2 The concept of service defined network connections – the matching between the telecommunication service request and network component capability – would be applied to B-ISDN in order to ensure that B-ISDN services can be routed effectively and efficiently by various networks which support them.

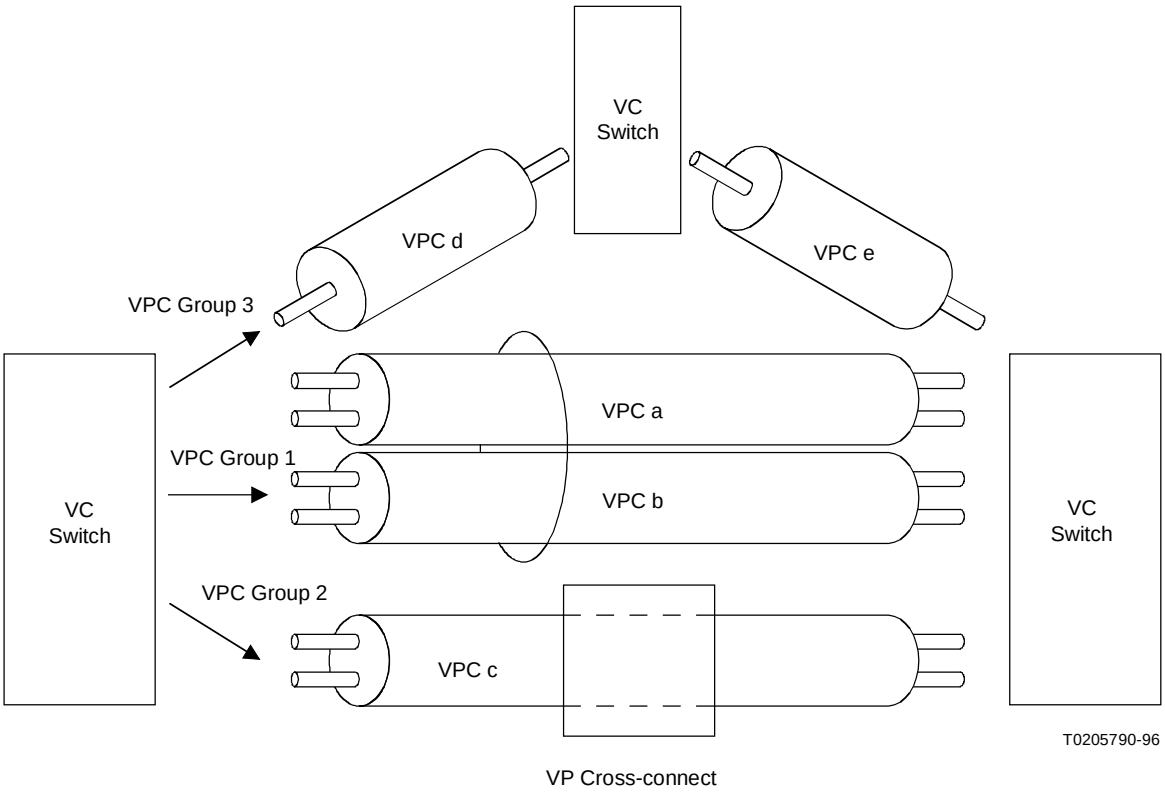
6.3 Routing of Virtual Channel Connection (VCC) is considered to be a function to select a Virtual Path Connection (VPC) Group from predefined VPC Groups between VC switches at the connection set-up phase.

Figure 2 shows the concept of VCC route selection. Translation of digits may be performed at the transit VC switch. Routing of VCC based on predefined VPC Group is similar to the routing of PSTN and circuit switched services of N-ISDN, i.e. selection of a circuit group between switches at the call set-up.

Appropriate VPC will then be selected from the route (VPC Group) based on the load and the requested traffic rate. According to Recommendation Q.2764, for every VPC it is defined which VC switch controls the assignment of bandwidth and identification of VC. A VC switch should first select the VPC which the switch is controlling. Figure 3 shows the concept of VPC selection between VC switches. No translation of digits will be performed at the VP cross-connect.

Route selection and VPC selection may be performed simultaneously.

It is necessary that predefined VPC can be identified unambiguously at both VC switches.



VPC Virtual Path Connection

FIGURE 2/E.177

Concept of route selection

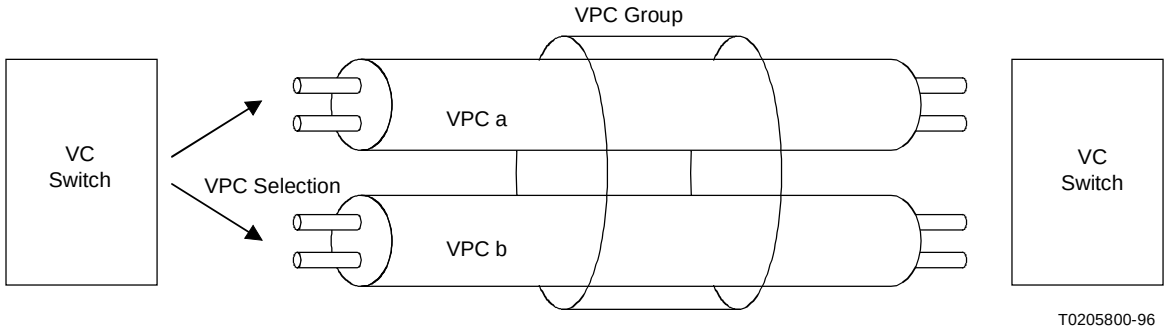


FIGURE 3/E.177

Concept of Virtual Path Connection (VPC) selection

6.4 Both directions of VCC are routed on the same route. Bandwidth of each direction may be different based on service request.

6.5 B-ISDN routing must be viewed from two perspectives:

– feature capabilities as seen by the customer;

– network, operational and commercial attributes as seen by the network operators.

6.6 From a network routing perspective, the physical requirements of a network connection may be determined through analysis of parameters (assessed in detail in clause 8). Bearer service definitions dictate the minimum capability for information transfer between ISDN access points. The service aspect of B-ISDN routing is based primarily on the bearer service requested by the customer. B-ISDN bearer services are defined in Recommendation F.811.

6.7 In order to support dynamic capabilities in new services, the following separation of concerns between transport function and OAM function should be taken into account:

– transport network control directed by service request from the user;

– policy making for efficient B-ISDN networking in OAM function.

7 Network structure

7.1 In the B-ISDN era it is suggested that:

a) the network structure should be non-hierarchical;

b) for connection routing purpose the network can be subdivided into national and international connection elements; the national element being subdivided into local and trunk if appropriate;

c) ROAs should be free to change their own connection routing arrangements providing they are still within the guidelines outlined in this plan.

7.2 International outgoing and incoming gateways should be VC switch to provide necessary interworking of routing methods and information analysis for routing purpose, e.g. digit analysis.

7.3 The routing concepts outlined in Recommendation E.170 can apply in any network elements (e.g. local, national or international) but only by agreements should they be used across a connection elements boundary (see Note). The following points should be taken into consideration and may impact route selection:

– number of VC switches and VP cross-connects on an end-to-end VCC;

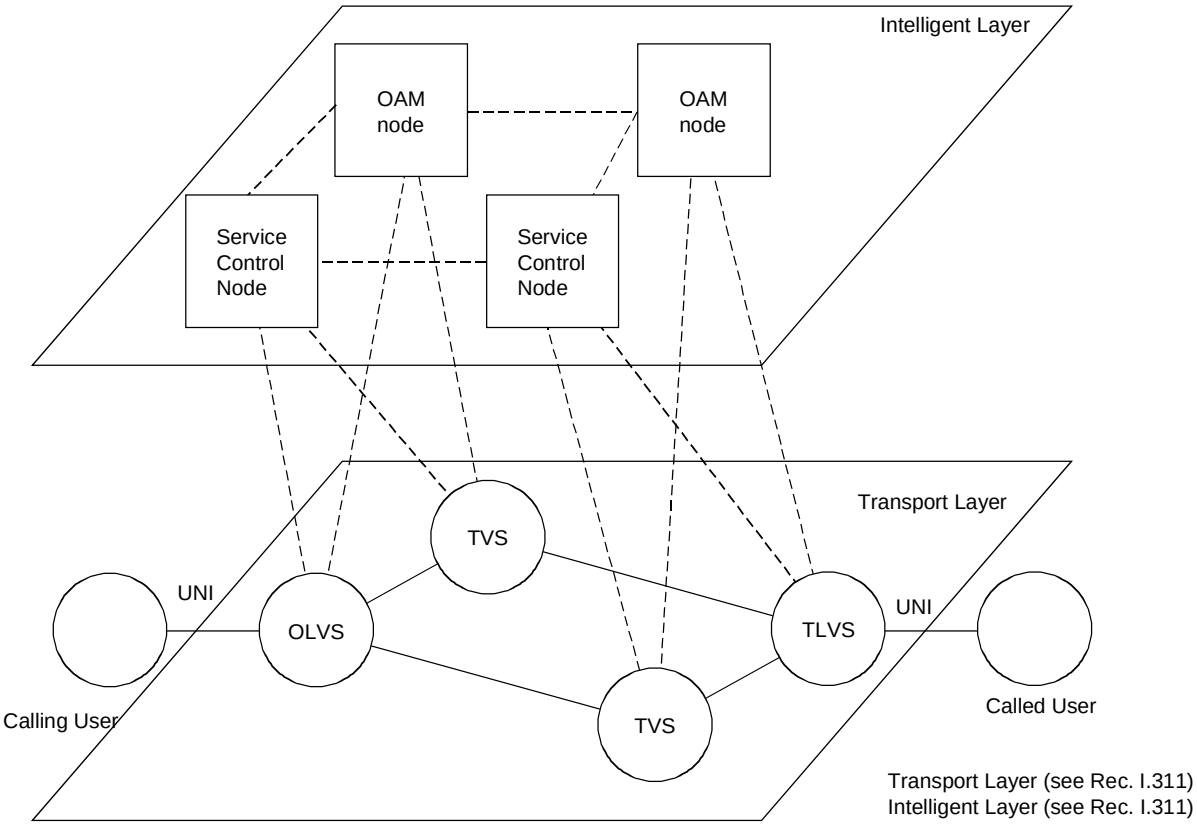
– number of VP links on an end-to-end VCC;

– propagation delay of an end-to-end VCC.

Maximum allocations of nodes and links allowed for each connection element are for further study.

NOTE – Dynamic routing as defined in Recommendation E.170 is for further study.

7.4 Figure 4 shows a generic B-ISDN network structure. Separation of transport function and OAM function will be realized either by the separation of physical nodes or integrated function in VC switches. Some of IN-supported services may require that service control node process impact routing on transport layer.



OLVS Originating Local Virtual Channel Switch
TVS Transit Virtual Channel Switch
TLVS Terminating Local Virtual Channel Switch
UNI User Network Interface

FIGURE 4/E.177

Generic B-ISDN network structure

8 Routing process

8.1 General

8.1.1 This subclause describes the B-ISDN routing process for both B-ISDN specific services and emulation of N-ISDN bearer services in B-ISDN. Information generated and processed from the originating terminal equipment, signalling links and switching nodes is discussed. The basic reference for the B-ISDN architecture is taken from Recommendation I.327.

8.1.2 The routing process is the sequence of functions required to establish a connection between the originating and the terminating terminal equipment or network service node.

8.2 User-network interface

8.2.1 The user initiates a request for service through B-ISDN capable terminal equipment. The user provides, through the terminal equipment, the following information:

– For B-ISDN specific services:
  - broadband service request details (including supplementary service);
  - called party number;
  - calling party number;
  - other information required for call set-up.

– For N-ISDN circuit mode bearer services:
  - narrow-band service request details (including supplementary service);
  - broadband service request details;
  - called party number;
  - calling party number.

– Other information required for call set-up (including supplementary service request).

8.2.2 The terminal equipment converts this information into a Q.2931 call set-up message which is transmitted to originating local VC switch.

8.3 Originating local VC switch

8.3.1 The originating local VC switch uses:

– call specific information provided in the Q.2931 call set-up message;

– customer subscription profile data in switch memory;

– routing related information stored either in switch memory or at a remote database to which a request is made;

– environmental and administrative conditions;

to establish:

– the route treatment of that specific connection (i.e. route selection, block, etc.);

– if necessary, the routing parameters which are associated with the call for use at subsequent VC switches in the connection.

8.3.2 The originating local VC switch therefore defines the minimum network resources (switching, signalling, transmission) which are needed to support the service request. These call/routing parameters are transported through the network via SS No. 7 B-ISUP.

8.3.3 Details of B-ISDN call routing parameters and their application and/or generation at various VC switches are contained in clause 9.

8.4 Transit VC switches (national and international)

8.4.1 Each transit VC switch in the route sequence will receive the routing parameters generated by the previous VC switch. These parameters will be used as the basis for selecting an appropriate outgoing route. In addition, routing parameters may be added to or modified to update such as connection history.

8.4.2 This process continues until either the terminating local VC switch is reached or the call is failed due to conditions encountered in the network.

8.4.3 The incoming and outgoing Initial Address Message (IAM) contains the following parameter fields which may be used for routing processes:

– For B-ISDN specific services:
  - called party number;
  - calling party's category;
  - broadband bearer capability;
  - ATM cell rate;
  - propagation delay counter.

– For N-ISDN circuit mode bearer services:
  - called party number;
  - calling party's category;
  - narrow-band bearer capability;
  - broadband bearer capability;
  - ATM cell rate;
  - propagation delay counter.

8.4.4 The IAM message may contain other parameters whose presence may influence the choice of route for the call. These parameters are:

– For B-ISDN specific services:
  - calling party number;
  - national/international call indicator;
  - maximum end-to-end transit delay;
  - transit network selection.

– For N-ISDN circuit mode bearer services:
  - calling party number;
  - national/international call indicator;
  - maximum end-to-end transit delay;
  - transit network selection.

8.4.5 The parameters listed within this subclause contain all the signalling information needed to perform routing in the international network.

8.4.6 In summary it should be noted that while many new parameters are potentially involved in selecting the B-ISDN route, most calls can be successfully completed by matching the service request with idle facilities which are capable of supporting it.

8.5 OAM nodes

8.5.1 In order to achieve cost effective allocation of network resources, OAM nodes may analyse network operation status information and react to the network operation status.

8.5.2 The following information may be used for routing management at OAM nodes:

– network management conditions, e.g. network congestion and network failure;

– time, event and state conditions.

9 Information analysis

The type of information that requires analysis for VC connection routing purposes will vary depending on the progress of the call through network. Consequently this will place different requirements on the network nodes as shown in Table 2.

9.1 Calling party

Depending on the calling party's service arrangement, a check of authorized and unauthorized service requests will be performed before the outgoing route is selected.

9.2 Incoming route

A match check may be required to ensure compatibility between incoming and outgoing VPCs.

9.3 Called number

The called number uniquely identifies a destination, on which an outgoing route choice is based. E.164 number is used for this purpose.

TABLE 2/E.177

Application of routing information at network nodes

Information for connection routing		Information to be taken into account (Note 1)				
		Originating VC switch	National transit VC switch	International VC switch	National transit VC switch	Terminating VC switch
a) Calling party		X	X	X	X	
b) Incoming route			X	X	X	X
c) Called number (Note 2)		X	X	X	X	X
d) Broadband bearer capability						
	Bearer class	X	X	X	X	
	Traffic type	(Note 3)	(Note 3)	(Note 3)	(Note 3)	
	Timing requirements	Further study	Further study	Further study	Further study	
e) ATM traffic descriptor (Note 4)		X				

f) ATM cell rate (Note 5)	Generated X	X	X	X	
g) End-to-end transit delay (Note 4)	X				
h) Maximum end-to-end transit delay	Generated X	X	X	X	
i) Propagation delay counter	Generated X	X	X	X	X
j) Transit network selection if permitted by operating agreement	Further study	Further study	Further study	Further study	
k) Network management conditions	X	X	X	X	
l) Time, event and state conditions	X	X	X	X	

NOTES

1 This Table identifies the data normally used to route VC connections in many fundamental circumstances. The use of data not marked with a cross is not precluded at any routing stage in special circumstances.

2 The called number includes Q.2931 NPI/TON information if present.

3 Signalling Capability Set 1 assumes peak resource allocation. Traffic type may not be used for routing.

4 This information appears only at user-network interface.

5 This includes OAM cells.

9.4 Broadband bearer capability

Broadband Bearer Capability (B-BC) is contained in the signalling information received from the calling party at the originating VC switch. B-BC contains bearer class information. That information will possibly be analysed at each VC switch to select appropriate route and allocate resources.

Route dependency of end-to-end timing functions needs further study.

9.5 ATM traffic descriptor

ATM traffic descriptor is contained in the signalling information received from the calling party at the originating VC switch. The ATM peak cell rate (see Recommendation I.371) values are indicated by the ATM traffic descriptor. They are analysed at the originating VC switch to set the ATM cell rate information (see 9.6 below).

9.6 ATM cell rate (encoded as ATM cell rate as SS No. 7 B-ISUP)

ATM cell rate indicates the number of cells per second that are required for the call. It is used for selecting appropriate route and allocating resources.

9.7 End-to-end transit delay

End-to-end transit delay is contained in the signalling information received from the calling party at the originating VC switch. This information includes the cumulative transit delay from the calling user to the network boundary, and maximum end-to-end transit delay requirements for the call. Those are set to separate parameters at the originating VC switch (see 9.8 and 9.9 below).

9.8 Maximum end-to-end transit delay

This parameter is generated from end-to-end transit delay information at the originating VC switch. In order to ensure that the end-to-end transit delay in the connection does not exceed the requirement

of the calling user, this parameter may be used for selecting an appropriate route together with propagation delay counter.

9.9 Propagation delay counter

This parameter is generated from end-to-end transit delay information at the originating VC switch. A propagation delay value is defined for each VP connection going out of every VC switch. The propagation delay information is accumulated during connection set-up.

9.10 Transit network selection

This is for further study.

9.11 Network management conditions

There will be cases where network management control activation will require modification to normal network routing decisions (see Recommendation E.412).

9.12 Time, event and state conditions

There will be cases where routing decisions will be updated periodically or aperiodically, predetermined, depending on the state of network or depending on whether calls succeed or fail (see Recommendation E.170).

10 Network capability

In order to route VC connections successfully, network must match the bearer service request to the switching and transmission capabilities.

For the emulation of N-ISDN services such as speech and 3.1 kHz audio, A/μ law conversion may be required at the international gateway.

Other network capabilities which may impact routing are for further study.

11 Signalling capability

In Signalling Capability Set 1 network, it is assumed that there is no difference between the signalling capability of different routes and that such signalling capability will therefore not be the basis for selecting a particular route.

12 History

This is the first issue of Recommendation E.177.

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