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INTERNATIONAL TELECOMMUNICATION UNION

CCITT **I.150**

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

GENERAL STRUCTURE AND SERVICE CAPABILITIES

B-ISDN ASYNCHRONOUS TRANSFER MODE FUNCTIONAL CHARACTERISTICS

Recommendation I.150

§

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FOREWORD

permanent organ of the International Telecommunication Union (ITU). CCITT 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 Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation I.150 was prepared by Study Group XVIII and was approved under the Resolution No. 2 procedure on the 5 of April 1991.

CCITT NOTES

1)
indicate both a telecommunication Administration and a recognized private operating agency.

2) A list of abbreviations used in this Recommendation can be found in Annex A.

Preamble to B-ISDN Recommendations

In 1990, CCITT SG XVIII approved a first set of Recommendations on B-ISDN. These are:

I.113 — Vocabulary of terms for broadband aspects of ISDN

I.121 — Broadband aspects of ISDN

I.150 — B-ISDN asynchronous transfer mode functional characteristics

I.211 — B-ISDN service aspects

I.311 — B-ISDN general network aspects

I.321 — B-ISDN Protocol Reference Model and its application

I.327 — B-ISDN functional architecture

I.361 — B-ISDN ATM Layer specification

I.362 — B-ISDN ATM Adaptation Layer (AAL) functional description

I.363 — B-ISDN ATM Adaptation Layer (AAL) specification

I.413 — B-ISDN user-network interface

I.432 — B-ISDN user-network interface — Physical Layer specification

I.610 — Operation and maintenance principles of B-ISDN access

These Recommendations address general B-ISDN aspects as well as specific service- and network-oriented issues, the fundamental characteristics of the asynchronous transfer mode (ATM), a first set of relevant ATM oriented parameters and their application at the user-network interface as well as impact on operation and maintenance of the B-ISDN access. They are an integral part of the well established I-Series Recommendations. The set of Recommendations are intended to serve as a consolidated basis for ongoing work relative to B-ISDN both within CCITT and in other organizations. They may also be used as a first basis towards the development of network elements.

CCITT will continue to further develop and complete these Recommendations in areas where there are unresolved issues and develop additional Recommendations on B-ISDN in the I-Series and other series in the future.

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B-ISDN ASYNCHRONOUS TRANSFER MODE FUNCTIONAL CHARACTERISTICS

1 Introduction

This Recommendation addresses specifically the functions of the ATM Layer. This Layer is common to all services including signalling and OAM.

2 Basic principles of ATM

ATM is the transfer mode solution for implementing a B-ISDN. It influences the standardization of digital hierarchies, multiplexing structures, switching and interfaces for broadband signals.

ATM is used in this Recommendation for addressing a specific packet-oriented transfer mode which uses asynchronous time division multiplexing techniques. The multiplexed information flow is organized into blocks of a fixed size called cells. A cell consists of an information field and a header. The primary role of the header is to identify cells belonging to the same virtual channel within the asynchronous time division multiplex. Transfer capacity is assigned by negotiation and is based on the source requirements and the available capacity. Cell sequence integrity on a virtual channel connection is preserved by the ATM Layer.

ATM is a connection-oriented technique. Connection identifiers are assigned to each link of a connection when required and released when no longer needed. In general, signalling and user information are carried on separate ATM Layer connections.

ATM offers a flexible transfer capability common to all services, including connectionless services. Additional functionalities on top of the ATM Layer (e.g. in the ATM Adaptation Layer (AAL)) are provided to accommodate various services. The boundary between the ATM Layer and the AAL corresponds to the boundary between functions supported by the contents of the cell header and functions supported by AAL-specific information. The AAL-specific information is contained in the information field of the ATM cell.

The information field is transported transparently by the ATM Layer. No processing, e.g. error control, is performed on the information field at the ATM Layer.

The header and information field each consists of a fixed integer number of octets. The header size (5 octets) and the information field size (48 octets) remain constant at all reference points, including the User-network interface (UNI) and the Network-node interface (NNI), where the ATM technique is applied.

3 ATM Layer

3.1 *ATM Layer connections*

3.1.1 *Connection definition*

An ATM Layer connection consists of the concatenation of ATM Layer links in order to provide an end-to-end transfer capability to access points.

3.1.2 *Connection identifiers*

3.1.2.1 *Virtual path identifiers (VPIs) and virtual channel identifiers (VCIs)*

At a given interface, in a given direction, the different virtual path (VP) links multiplexed at the ATM Layer into the same Physical Layer connection are distinguished by the VPI. The different virtual channel (VC) links in a virtual path connection (VPC) are distinguished by the VCI as indicated in Figure 1/I.150.
FIGURE 1/I.150 = cm

3.1.2.2 *VPI-VCI relationships*

Two different VCs belonging to two different VPs at a given interface may have the same VCI value. Therefore, a VC is only fully identified at an interface by both VPI and VCI values.

A specific value of VCI has no end-to-end significance if the virtual channel connection (VCC) is switched. VPIs may be changed wherever VP links are terminated (e.g. cross-connects, concentrators and switches). VCIs may only be changed where VC links are terminated. As a consequence, VCI values are preserved within a VPC.

3.1.2.3 *Number of active connections at the UNI*

At the UNI, 24 bits are available in the VPI/VCI field for connection identification. The actual number of routing bits in the VPI and VCI fields used for routing is negotiated between the user and the network, e.g. on a subscription basis. This number is determined on the basis of the lower requirement of the user or the network. The rules to determine the position of the routing bits used within the VPI/VCI field are given in § 2.2.3 of Recommendation I.361.

3.1.3 *Aspects of virtual channel connections (VCCs)*

3.1.3.1 *General characteristics of VCCs*

The definition of a VCC is given in Recommendation I.113. This section provides additional explanations to facilitate the understanding of the following topics:

a) *Quality of service:* a user of a VCC is provided with a Quality of Service specified by parameters such as cell loss ratio and cell delay variation;

b) *Switched and (semi-) permanent VCCs:* VCCs can be provided on a switched or (semi-) permanent basis;

c) *Cell sequence integrity:* cell sequence integrity is preserved within a VCC;

d) *Traffic parameter negotiation and usage monitoring:* traffic parameters shall be negotiated between a user and a network for each VCC at VCC establishment and may be subsequently renegotiated. Input cells from the user to the network will be monitored to ensure that the negotiated traffic parameters are not violated.

3.1.3.2 *Establishment and release of a VCC*

3.1.3.2.1*Establishment/release at the UNI*

VCCs may be established/released using one or more of the following four methods:

a) without using signalling procedures, e.g. by subscription [(semi-)permanent connections];

b) meta-signalling procedures (see Recommendation I.311), e.g. by using a meta-signalling VCC to establish/release a VCC used for signalling;

c) user-to-network signalling procedures, e.g. using a signalling VCC to establish/release a VCC used for end-to-end communications;

d) user-to-user signalling procedures, e.g. using a signalling VCC to establish/release a VCC within a pre-established VPC between two UNIs.

The value assigned to a VCI at a UNI using the methods listed above could be assigned by one of the following:

a) the network;

b) the user;

c) negotiation between the user and the network;

d) standardization.

The specific value assigned to a VCI at a UNI is, in general, independent of the service provided over that VC. For terminal interchangeability and initialization it is desirable to use the same value for certain functions on all UNIs. For example, the same VCI value for the meta-signalling VC will be used on all UNIs in order to simplify initialization of the terminal equipment.

3.1.3.2.2 *Establishment/release at the NNI*

ATM network elements (e.g. ATM switches, cross-connects and concentrators) process the ATM cell header and may provide VCI and/or VPI translation. Thus, whenever a VCC is established/released across the ATM network, VC links may need to be established/released at one or more NNIs. VC links are established/released between ATM network elements using inter- and intra-network signalling procedures; other methods are also possible.

3.1.3.3 *Pre-assigned VCIs*

Pre-assigned VCI values are reserved for:

a) unassigned cell identification;

b) meta-signalling VC identification;

c) general broadcast signalling VC identification;

d) physical layer cell identification;

e) other uses are for further study.

Additional information concerning the use of these values in combination with VPI values can be found in § 3.1.4.3.

3.1.3.4 *Signalling VCs*

Refer to Recommendation I.311.

3.1.3.5 *OAM VCs*

Refer to Recommendation I.610.

3.1.4 *Aspects of Virtual Path Connections (VPCs)*

3.1.4.1 *General characteristics of VPCs*

The definition of a VPC is given in Recommendation I.113. This section gives additional explanations concerning VPCs to facilitate the understanding of the following topics:

a) *Quality of service*

A user of a VPC is provided with a quality of service specified by parameters such as cell loss ratio and cell delay variation.

b) *Switched and (semi-) permanent VPCs*

VPCs can be established on a switched or (semi-) permanent basis.

c) *Cell sequence integrity*

Cell sequence integrity is preserved for each VCC within a VPC.

d) *Traffic parameters negotiation and usage monitoring*

Traffic parameters will be negotiated between a user and the network for each VPC at VPC establishment and may be subsequently renegotiated. Input cells from the user to the network will be monitored to ensure that the negotiated traffic parameters are not violated.

e) *VCI restrictions within a VPC*

One or more VCIs within a VPC may not be available to the user of the VPC. The number and values of these VCIs are for further study.

3.1.4.2 *Establishment and release of a VPC*

A VPC may be established/released between VPC endpoints by one of the following methods. These methods are for further study.

a) Establishment/release without using signalling procedures. In this case the VPC is established/released on a subscription basis.

b) Establishment/release on demand:

—
be performed by the user invoking signalling or network management procedures.

—
signalling procedures.

3.1.4.3 *Pre-assigned VPIs*

Pre-assigned VPI values are used for:

a) unassigned cell identification and physical layer cell identification;

Note — For the unassigned cell identification and cells reserved for use by the physical layer, a pre-assigned value of VPI/VCI combination is reserved.

b) meta-signalling VC identification;

c) general broadcast signalling VC identification;

d) other uses are for further study.

3.1.5 *Pre-assigned cell header values*

Cells reserved for the use of the physical layer have pre-assigned values reserved for the whole header; these values are not to be used by the ATM layer.

3.2 *Service characteristics*

3.2.1 *Services expected from the physical layer*

For further study.

3.2.2 *Services provided to the higher layer*

For further study.

3.3 *Management plane interactions*

For further study.

3.4 *Functions of the ATM layer*

3.4.1 *Cell multiplexing and switching*

The basic ATM routing entity for switched services is the VC. It is handled in VC multiplexers/demultiplexers and switches. VCs are aggregated in VPCs which are routed as such through VP multiplexers/demultiplexers and VP switches (see Figure 2/I.150).
FIGURE 2/150 = cm

3.4.2 *Quality of service (QOS) provided by the ATM layer*

3.4.2.1 *QOS related to VCCs*

A user of a VCC is provided with one of a number of QOS classes supported by the network. Specific QOS classes and the quality provided by each QOS class require further study. Requested QOS classes are indicated to networks at call/connection establishment. The QOS class associated with a given connection within a call will not change for the duration of the connection. Renegotiation of the QOS class may require the establishment of a new connection.

3.4.2.2 *QOS related to VPCs*

A user of a VPC is provided with one of a number of QOS classes supported by the network. Specific QOS classes and the quality provided by each class require further study. Requested QOS classes are indicated to networks at call/connection establishment. The QOS classes associated with a VPC will not change for the duration of the VPC.

It should be noted that a VPC will carry VC links of various QOS classes. The QOS of the VPC must meet the most demanding QOS of the VC links carried.

3.4.2.3 *QOS related to cell loss priority (CLP)*

3.4.2.3.1*General*

Many variable bit rate (VBR) services will require a guarantee of some minimum capacity as well as a peak capacity. In times of network congestion, the network will need to know which cells can be discarded without violating the negotiated QOS parameters (for example, the guaranteed minimum capacity).

Some VBR services will benefit if the user or service provider (e.g. layered coding video provider) can select which cells have the higher loss sensitivity.

3.4.2.3.2*CLP indicator*

One bit in the cell header is used for explicit cell loss priority indication. This bit may be set by the user or service provider to indicate lower priority cells. Cells with the CLP bit set are subject to discard depending on network conditions. Cells with the CLP bit not set have higher priority as capacity for them has been allocated within the network.

The network will monitor the connection in accordance with mechanisms described in Recommen-dation I.311 in order to protect the QOS of other users.

The rate of higher priority cells will be determined at call establishment and may be subsequently renegotiated. Cells arriving at the network in excess of this rate will be subject to network usage parameter control. Cells arriving at the network in excess of other agreed parameters for the call will also be subject to normal usage parameter control.

Note — The cell loss priority mechanism would not normally be used for constant bit

rate (CBR) services, i.e. cells belonging to a CBR service would not normally have the CLP indicator set.

3.4.3 *Payload type functions*

The payload type field is used to provide an indication of whether the cell payload (i.e. information field) contains user information or network information. In user information cells the payload consists of user information and service adaptation function information. In network information cells the payload does not form part of the user's information transfer.

When the payload type field does not indicate user information, further information concerning the type of network control will be found in the information field of the cell.

It is envisaged that network information cells would be generated within the network but might cross the UNI. Use of network information cells by users is for further study.

The use of the payload type field for additional functions related to usage parameter control is for further study.

3.4.4 *Generic flow control (GFC) at the UNI*

The GFC mechanism assists in the control of the flow of traffic from ATM connections of various QOS classes (related to the ATM Layer). More specifically, the GFC mechanism is used to control traffic flow in order to alleviate short-term overload conditions that may occur.

In situations where flow control is unnecessary, the impact of the implementation of the GFC mechanism on the terminal is for further study.

The specification of the GFC mechanism is for further study. However, the mechanism is expected to conform to the following:

a) The flow control at the UNI is supported by the ATM cell header. The GFC field is used to provide this function.

b) The GFC mechanism may assist the customer network in providing various QOS within the customer network.

c) The GFC mechanism should not perform flow control of traffic from the network. The use of GFC at SB and TB is as follows:

i)

interface.

The GFC mechanism should provide flow control of information generated locally by terminals within a customer's premises. This traffic may occur in directions to and from the terminal across the interface at the SB reference point and the I* interface. Operation of the GFC mechanism within the B-NT2 to control the traffic in the B-NT2 to terminal direction is for further study. The specific mechanism at the interface at the SB reference point and I* interface is for further study.

ii) GFC at TB

The GFC field is present at the interface at the TB reference point. It may be used to provide flow control of information transfer in a direction from the B-TE to the network; however, this and the specific mechanism at TB is for further study.

d) The GFC mechanism resides in the ATM Layer and is independent of the Physical Layer.

e) The GFC mechanism applies at B-UNIs and should support the configurations of § 2.2 of Recommendation I.413.

f) The GFC mechanism must allow a terminal to achieve an assured capacity or

bandwidth allocated by the network to both CBR and VBR calls. In the case of VBR services, the GFC mechanism must be able to partition fairly and efficiently the capacity above that guaranteed for all active connections.

g) The GFC mechanism should not compromise terminal interchangeability.

ANNEX A

(to Recommendation I.150)

Alphabetical list of abbreviations contained in this Recommendation

AAL

CBR Constant bit rate

CLP Cell loss priority

GFC Generic flow control

NNI Network-node interface

QOS Quality of service

UNI User-network interface

VBR Variable bit rate

VC Virtual channel

VCC Virtual channel connection

VCI Virtual channel identifier

VP Virtual path

VPC Virtual path connection

VPI Virtual path identifier