INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

I.620

(10/96)

SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Maintenance principles

Frame relay operation and maintenance principles and functions

ITU-T Recommendation I.620

(Previously CCITT Recommendation)

ITU-T I-SERIES RECOMMENDATIONS

INTEGRATED SERVICES DIGITAL NETWORK

GENERAL STRUCTURE	I.100–I.199
Terminology	I.110–I.119
Description of ISDNs	I.120–I.129
General modelling methods	I.130–I.139
Telecommunication network and service attributes	I.140–I.149
General description of asynchronous transfer mode	I.150–I.199
SERVICE CAPABILITIES	I.200–I.299
Scope	I.200–I.209
General aspects of services in ISDN	I.210–I.219
Common aspects of services in the ISDN	I.220–I.229
Bearer services supported by an ISDN	I.230–I.239
Teleservices supported by an ISDN	I.240–I.249
Supplementary services in ISDN	I.250–I.299
OVERALL NETWORK ASPECTS AND FUNCTIONS	I.300–I.399
Network functional principles	I.310–I.319
Reference models	I.320–I.329
Numbering, addressing and routing	I.330–I.339
Connection types	I.340–I.349
Performance objectives	I.350–I.359
Protocol layer requirements	I.360–I.369
General network requirements and functions	I.370–I.399
ISDN USER-NETWORK INTERFACES	I.400–I.499
Application of I-series Recommendations to ISDN user-network interfaces	I.420–I.429
Layer 1 Recommendations	I.430–I.439
Layer 2 Recommendations	I.440–I.449
Layer 3 Recommendations	I.450–I.459
Multiplexing, rate adaption and support of existing interfaces	I.460–I.469
Aspects of ISDN affecting terminal requirements	I.470–I.499
INTERNETWORK INTERFACES	I.500–I.599
MAINTENANCE PRINCIPLES	**I.600–I.699**
B-ISDN EQUIPMENT ASPECTS	I.700–I.799
ATM equipment	I.730–I.749
Management of ATM equipment	I.750–I.799

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION I.620

FRAME RELAY OPERATION AND MAINTENANCE PRINCIPLES AND FUNCTIONS

Summary

This Recommendation provides the operation and maintenance principles and procedures for frame relay services at the user-to-network interface and network-to-network interface.

The OAM functions described in support of frame relaying are based on OAM specific frames and the associated procedures.

Source

ITU-T Recommendation I.620 was prepared by ITU-T Study Group 13 (1993-1996) and was approved by the WTSC (Geneva, 9-18 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.

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.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had/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.

CONTENTS

Recommendation I.620

FRAME RELAY OPERATION AND MAINTENANCE PRINCIPLES AND FUNCTIONS

(Geneva, 1996)

1 Scope

The scope of this Recommendation is to identify a minimum set of functions useful to operate and maintain the Frame Relaying (FR) Q.922 CORE Data Link Layer (DLL) and Frame Relaying Service Specific Convergence Sublayer (FR-SSCS) aspects of the frame relaying User-Network Interface (UNI) and Network-to-Network Interface (NNI) as well as the individual FR virtual connections that may be routed through the FR network, supported either by a circuit-based network or an ATM-based network.

The functions of the layers above or below the Q.922 CORE DLL or FR-SSCS are not considered in this document.

2 References

Considerations on Operations, Administration and Maintenance (OAM) functions take into account the following ITU-T Recommendations:

– CCITT Recommendation I.233.1 (1991), *Frame mode bearer services: ISDN frame relaying bearer service.*

– ITU-T Recommendation I.365.1 (1993), *B-ISDN ATM adaptation layer sublayers: Frame Relaying Service Specific Convergence Sublayer (FR-SSCS).*

– ITU-T Recommendation I.372 (1993), *Frame relaying bearer service network-to-network interface requirements.*

– ITU-T Recommendation I.555 (1993), *Frame relaying bearer service interworking.*

– ITU-T Recommendation I.610 (1995), *B-ISDN operation and maintenance principles and functions*.

– ITU-T Recommendation Q.921 (1993), *ISDN user network interface – Data link layer specification*.

– CCITT Recommendation Q.922 (1992), *ISDN data link layer specification for frame mode bearer services*.

– ITU-T Recommendation Q.933 (1995), *Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring*.

3 Definitions

This Recommendation uses terms which are defined in ITU-T Recommendations listed in clause 2.

4 OAM principles

The following functions are considered:

a) *Performance monitoring*

Normal functioning of the managed entity is monitored by continuous or periodic checking of functions. As a result, maintenance event information will be produced.

b) *Defect and failure detection*

Malfunctions or predicted malfunctions are detected by continuous or periodic checking. As a result, maintenance event information or various alarms will be produced.

c) *Fault localization*

Determination by internal or external test systems of a failed entity if failure information is insufficient.

d) *Status and failure information*

Notification of availability (active) or unavailability (inactive) as well as failure information is provided for configured FR connections among layer management entities. Response to status report requests will also be given.

e) *Transfer of accounting information*

The capability of transmitting billing and accounting data (for further study).

These functions result in a bidirectional information flow of the same type as the already defined F4 and F5 OAM flows for ATM layer OAM in Recommendation I.610. The flow will be referred to as the FR-OAM flow in this Recommendation.

During some period of time the I.620 frame relay OAM procedures may not be implemented in all parts of a network. In general, Recommendation I.620 uses specific OAM frames in its procedures. Because all existing FR networks or equipment may not be capable to distinguish these OAM frames from user frames, it shall be guaranteed that the OAM frames are extracted before they leave the part of the network supporting I.620 procedures.

5 Positioning in the Protocol Reference Model (PRM)

The OAM functions covered in this Recommendation belong to the Q.922 CORE DLL and FR-SSCS (AAL) layer management. The layered concept and the requirement of independence of the layers from each other lead to the following principles:

1) OAM functions related to OAM levels are independent from the OAM functions of other layers and have to be provided at each layer.

2) Each layer, where OAM functions are provided, is able to carry out its own processing to obtain OAM information necessary to perform the function. OAM functions are performed by the layer management. Higher layer functions are not necessary to support the OAM of the lower layer.

The functions of the layers above or below the Q.922 CORE DLL or the FR-SSCS are not considered in this Recommendation.

6 FR-OAM flow mechanisms

The FR-OAM flow is bidirectional. OAM frames carrying the FR-OAM flow have the same DLCI value as the user frames on the user FR connection. The same DLCI value is used for each direction of the FR user link and the FR-OAM flow. This ensures that the FR-OAM frames follow the same

path as the user data frames. This also ensures that fault and performance information can be correlated at each FR processing node.

The Administration/organization that controls the insertion of OAM frames in an FR management domain must ensure that those frames are extracted before they leave the span of control of that Administration/organization with the exception of those management domains that have been extended by bilateral agreements.

7 OAM functions of the Q.922 CORE DLL and FR-SSCS

7.1 OAM functions for the FR connection (FR-OAM flow)

7.1.1 Fault management functions

NOTE – A comprehensive set of fault management functions for ATM is described in Recommendation I.610. This Recommendation describes only a loopback function for FR. Other functions are for further study.

7.1.1.1 FR loopback capability

7.1.1.1.1 General description

The frame relay layer loopback capability allows for operations information to be inserted at one location along a frame relay connection and returned (or looped back) at a different location, without having to take the connection out of service. This capability is performed by non-intrusively inserting a loopback OAM frame at any participating point along the frame relay connection (i.e. at an endpoint or any connecting point). This frame may be looped back at any participating downstream point according to the information contained in its information field.

Examples of network applications of loopback are described in Annex A.

7.1.1.1.2 Principles of operation

It shall be possible to initiate a loopback without Operations System Function (OSF) intervention; e.g. a customer may initiate an end-to-end loopback. This does not preclude the reporting of loopback results to the OSF.

7.1.1.1.3 Loopback applications

The loopback mechanism provides the following OAM capabilities:

1) Continuity check;

2) Fault localization.

The following additional capabilities may be provided by the use of the optional fields:

3) Round Trip Delay (RTD) and delay variation measurements;

4) OAM information transfer;

5) Node fault condition detection.

7.1.2 FR performance management functions

Performance management functions are for further study.

8 Frame relay layer OAM frame format

The frame relay layer OAM frames contain fields common to all types of OAM frames (see Table 1) as well as specific fields for each type of OAM frame.

A received OAM frame with a reserved code point shall be passed transparently by a frame relay node.

Table 1/I.620 – Common OAM header code points

Coding	Function
0000 0001	Loopback
1111 1111	User specific (Note)
All other values	Reserved
NOTE – User-specific functions are not to be standardized by the ITU-T.	

8.1 Common OAM frame fields

All frame relay layer OAM frames will have the following common fields (see Figure 1):

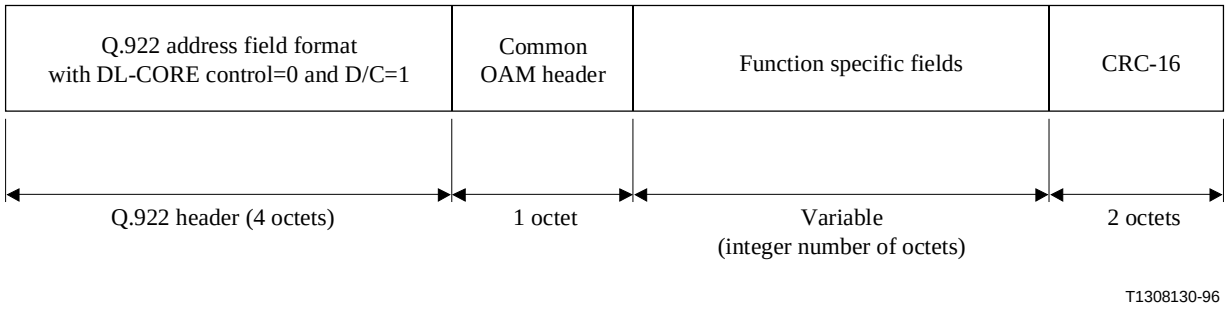

Figure 1/I.620 – Common OAM frame format

1) *Frame header* – This field consists of the address field as defined in Annex A/Q.922. Identification of OAM frames is described in 8.1.1.
2) *Common OAM header (8 bits)* – This field indicates the type of OAM function performed by this frame. Coding is accordance with Table 1.
3) *Function-specific fields (variable: integer multiple of 8 bits)* – These fields carry information specific to the OAM function being performed.
4) *Error detection code (16 bits)* – This field carries a CRC-16 error detection code as defined in Recommendation Q.921.

8.1.1 OAM frame identification

The following method is used to distinguish OAM frames from user frames.

The OAM frame uses the 4-octet address field format of Q.922 with D/C=1. The DL-CORE control field shall be encoded as 000000 in an OAM frame. The OAM frame has the same DLCI value as the user data frame for each link of the frame relay connection.

NOTE – User frames are described in Recommendation Q.922. OAM frames can co-exist with, and are distinguishable from, all types of user frames.

8.2 Loopback function

8.2.1 FR Loopback frame format

The Loopback (LB) frame format is shown in Figure 2.

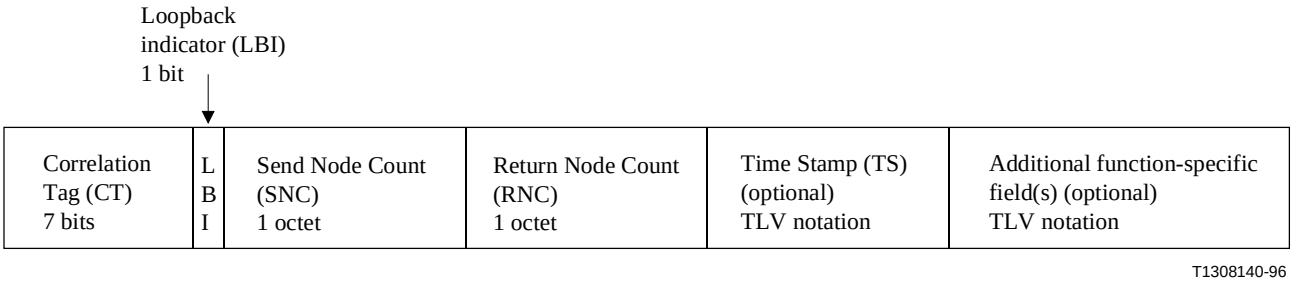

Figure 2/I.620 – Function-specific fields and format of FR-OAM loopback

Correlation Tag (CT): 7 bits

This field is used to correlate the transmitted LB frame with the received LB frame, in conjunction with the return node count value (see below).

Loopback Indicator (LBI): 1 bit

This field provides a Boolean indication as to whether or not the frame has been looped back (send or return direction indication). For a send frame, the LBI is set to 1. For a return frame, the LBI is set to 0.

A means to confirm that loopback is performed at the frame relay layer, rather than at the physical layer, is provided by requiring the loopback point to change the loopback indication field within the loopback frame payload. This principle is illustrated in Figure 3.

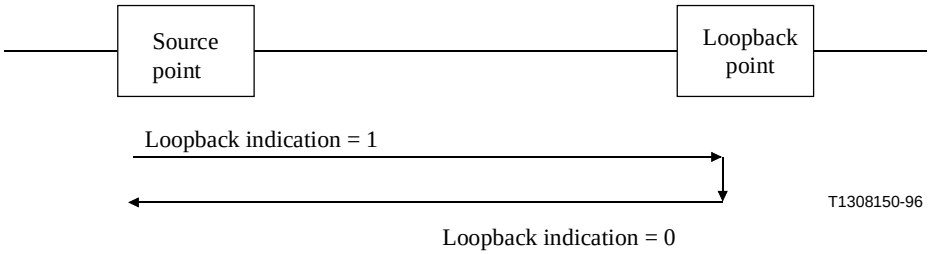

Figure 3/I.620 – The loopback indication function

Send Node Count (SNC): 1 octet

This field is set by the sending node to indicate the number of FR nodes to be traversed before loopback.

If the SNC is set to zero, the LB frame should be passed by every node to the connection end point for initialization purposes as described below.

If the SNC is set to all-ones, the LB frame should be passed by every node to the connection end point for the specific case of an end-to-end loopback.

Return Node Count (RNC): 1 octet

The RNC value is incremented by 1 by each FR node traversed if the LBI is set to 1.

The RNC value is decremented by 1 by each FR node traversed if the LBI is set to 0.

Time Stamp (TS): Optional. Variable length (integer number of octets)

This field may optionally be used to encode a time stamp for Round Trip Delay (RTD) measurements. The use of TS for single direction delay measurements is for further study.

The format and encoding of the TS field is in accordance with the ASN.1 notation for Type-Length-Value (TLV). Codepoints of type are given in Table 2.

Additional Function-Specific Field(s) (AFSF): Optional. Variable length (integer number of octets)

The format of this field is in accordance with the ASN.1 notation for TLV as for TS (see Table 2). This(ese) field(s) may optionally be used for enhancement of other OAM functions such as QOS monitoring, etc. and may be implementation specific. The use of this(ese) field(s) for additional OAM function is for further study.

An additional function-specific field with a reserved code point in a received OAM frame shall be ignored.

Table 2/I.620 – Codepoints of type for time stamp and additional function-specific fields

Coding	Type of function
0000 0001	Time stamp
1111 1111	User specific (Note)
All other values	Reserved
NOTE – User-specific functions are not to be standardized by the ITU-T.	

8.2.2 Initialization procedure

Any FR node may determine the number of nodes upstream and downstream for LB purposes by using the send and return node counts as follows.

The FR node sends the LB frame with SNC=0. LB Frames with SNC=0 are used for initialization purposes only and are called Initialization Loopback (ILB) frames. Every FR node must pass this frame after incrementing the value of the RNC field by 1 if the LBI is set to 1 (send direction).

The connection endpoint should copy the RNC value to the SNC field and set LBI to zero before looping back the ILB frame.

In the return direction, each node decrements the RNC value by 1 as per the normal procedures described below. The origination node extracts the ILB frame on the condition RNC=0. The value in the SNC field is then the number of nodes in the connection (for the given direction).

For the specific case of end-to-end loopback (SNC=all-ones), the initialization procedure need not be used.

8.2.3 Loopback procedures

Once the FR node has determined the number of participating nodes involved in the connection using the above procedure in each direction, LB procedures for either end-to-end or segment can proceed normally as follows.

The originating node sets the value of the SNC field to the required number of nodes to be traversed before loopback (the LB node). The LBI is set to 1 and a valid correlation tag value (e.g. sequence number) is inserted in the CT field. The RNC is set to 0.

Each node traversed increments the RNC by 1 when the LBI is set to 1.

The condition SNC=RNC determines the loopback point. The LB node sets the LBI to 0 before looping back the LB frame. The LB frame may be copied for subsequent processing of the function-specific fields by the management system.

In the return direction (LBI=0), each node decrements the RNC value by 1.

The condition RNC=0 identifies the originating node. The originating node extracts (or copies) the LB frame for processing by the management system.

For the specific case of end-to-end loopback, the originating endpoint sets the SNC to all-ones. Other procedures are the same as in the general case.

Loopback procedures can be initiated by management action on demand, or by end users as required.

Loopback frames may be sent periodically if required. The period is under management control and depends on service requirements.

8.2.4 Non-participating nodes

Any FR node may be configured by the management interface to be a participating or a non-participating node for the purposes of the FR-LB-OAM test. In the case that the node is considered to be non-participating in the LB test, it is required to pass transparently the LB-OAM frames.

Changes in configuration will require that the ILB frame be used to determine the new number of participating nodes in the connection.

8.2.5 LBI error condition

In the event that an LB point does not set the LBI=0 (e.g. as an error condition), the RNC values in the return direction will continue to be incremented, resulting in the originating point not extracting the LB frame. However, in this case, the downstream FR connection endpoint node should discard the LB frame when it detects the condition where LBI=1 and SNC is not equal to RNC.

ANNEX A

Network applications of loopback

The loopback capability supports the following network applications as shown in Figure A.1.

a) End-to-end loopback: An FR loopback frame is inserted by an FR endpoint, and looped back by the corresponding FR endpoint.

b) Access line loopback: An FR loopback frame is inserted by the customer or the network, and looped back by the first frame relay node in the network or customer equipment respectively.

c) Inter-domain loopback: An FR loopback frame is inserted by one network operator, and looped back by the first frame relay node (at the FR level) in an adjacent network operator domain.

d) Network-to-endpoint loopback: An FR frame is inserted by one network operator, and looped back by the FR endpoint in another domain.

e) Intra-domain loopback: An FR loopback frame is inserted by an FR connecting point, and looped back by another FR connecting point.

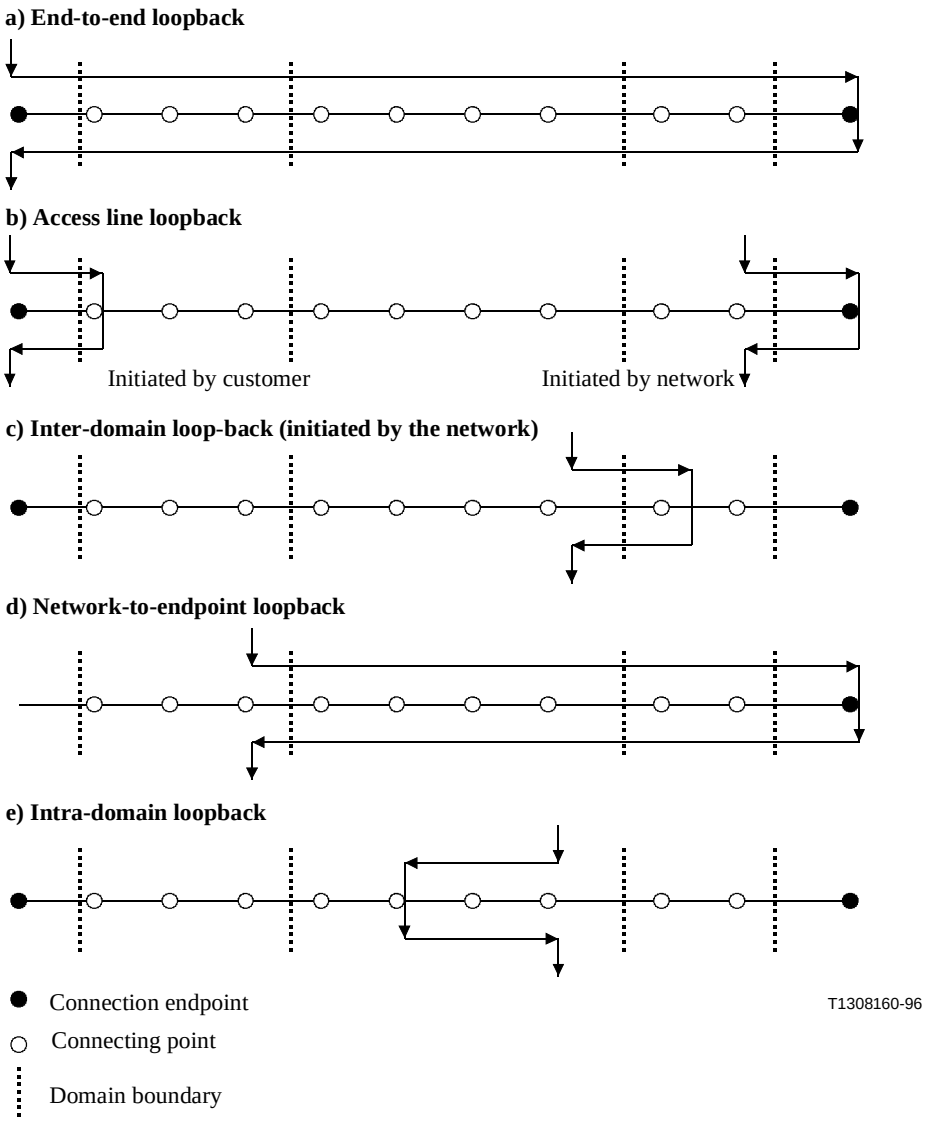

Figure A.1/I.620 – Loopback applications

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	**Integrated services digital network**
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communication
Series Z	Programming languages