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Amendment 1

(06/2000)

SERIES Q: SWITCHING AND SIGNALLING

Digital subscriber Signalling System No. 1 – Data link layer

ISDN user-network interface – Data link layer specification

Amendment 1

ITU-T Recommendation Q.921 – Amendment 1

(Formerly CCITT Recommendation)

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ITU-T Recommendation Q.921

ISDN USER-NETWORL INTERFACE – DATA LINK LAYER SPECIFICATION

AMENDMENT 1

Summary

This Recommendation specifies the Link Access Procedures on the D-channel (LAPD) of an ISDN customer access. Implementations of this Recommendation are in use in existing networks.

This Recommendation has been amended in order to add a new Annex J and a new Appendix V to describe in general terms the link access procedure for use in a symmetrical application between two Private Integrated Network Exchanges (PINXs) at the Q reference point.

Source

Amendment 1 to ITU-T Recommendation Q.921 was prepared by ITU-T Study Group 11 (1997-2000) and approved under the WTSC Resolution 1 procedure on 15 June 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 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.

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As of the date of approval of this Recommendation, ITU had 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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ISDN USER-NETWORK INTERFACE – DATA LINK LAYER SPECIFICATION

AMENDMENT 1

1) Clause 1

Add a new paragraph to the scope as follows:

Annex J of this Recommendation describes in general terms the link access procedure for use in a symmetrical application between two Private Integrated Network Exchanges (PINXs) at the Q reference point (see ISO/IEC 11579-1 [8]).

2) Clause 1.2 – References

Add a new reference [8] as follows:

[8] ISO/IEC 11579-1:1994, *Information technology – Telecommunications and information exchange between systems – Private integrated services network – Part 1: Reference configuration for PISN Exchanges (PINX)*.

3) New Annex J

Add the following new Annex J:

ANNEX J

Inter-exchange signalling data link layer protocol in Private Integrated Services Networks (PISNs) – Applicability and additions to frame structure, elements of procedures, formats of fields, elements for layer-to-layer communication, peer-to-peer procedures to accommodate PISN inter-exchange requirements

This annex applies to the procedures for LAPD defined in clauses 1 through 5. This annex also applies to the SET MODE (SM) command, the Selective Reject (SREJ) response, and the procedures used to support multi-selective reject option in LAPD, defined in E.1 through E.5 – "Provision of Multi-Selective Reject Option". The optional procedures in E.1 through E.5 are referred to hereafter as the SM/SREJ option.

The criteria pertaining to the use of the SM/SREJ option is specified in E.1. Clause E.1 applies to this annex with the following modifications:

1) The use of Annex E requires bilateral agreement between peer PINX users.

2) This bilateral agreement is applicable on a link-by-link basis.

Clause E.1, as modified above, is reproduced below:

Annex E defines the SET MODE (SM) command, the Selective Reject (SREJ) response, and the procedures used to support multi-selective reject option in LAPD. The multi-selective reject option of LAPD reduces the sensitivity of the throughput of the Data-link layer to degradations in the Bit Error Ratio of the underlying transmission media.

The procedures defined in Annex E are recommended for use on applications where there is a significant probability of having more than one outstanding unacknowledged I-frame. In the absence of such probability, the procedures of the main body of ITU-T Q.921 shall apply as amended by this annex.

The procedures defined in Annex E are optional, and their use requires bilateral agreement between peer PINX users. These bilateral agreements are on a link-by-link basis. In the context of this annex, in the absence of provision of the procedures defined in Annex E, the procedures of the remainder of this Annex J to Q.921 shall apply.

J.1 Frame structure for peer-to-peer communication

J.1.1 General

Clause 2.1 shall apply.

J.1.2 Flag sequence

Clause 2.2 shall apply.

J.1.3 Address field

The address field shall consist of two octets as illustrated in Figure 1/Q.921. The format of the address field is defined in J.2.2.

Networks conforming to this specification do not support the LAPB data link connection within the D-channel.

J.1.4 Control field

Clause 2.4 shall apply.

J.1.5 Information field

Clause 2.5 shall apply.

J.1.6 Transparency

Clause 2.6 shall apply.

J.1.7 Frame Check Sequence (FCS) field

Clause 2.7 shall apply with the changes as given above.

J.1.8 Format convention

Clause 2.8 and its clauses shall apply.

J.1.9 Invalid frames

Clause 2.9 shall apply.

J.1.10 Frame abort

Clause 2.10 shall apply.

J.2 Elements of procedures and formats of fields for data link layer peer-to-peer communication

J.2.1 General

Clause 3.1 shall apply.

J.2.2 Address field format

Clause 3.2 shall apply.

J.2.3 Address field variables

J.2.3.1 Address field Extension Bit (EA)

Clause 3.3.1 shall apply.

J.2.3.2 Command Response field bit (C/R)

The C/R bit identifies a frame as either a command or response. In the case of the interconnection of two PINXs, the setting of the C/R bit for a particular data link depends on the assignment of "master" and "slave" sides of the inter-PINX signalling channel. The coding of the C/R bit is shown in Table J.1 below.

Table J.1/Q.921 – C/R field bit usage

Command/Response	Direction	C/R Value
Command	master side to slave side	1
	slave side to master side	0
Response	master side to slave side	0
	slave side to master side	1

J.2.3.3 Service Access Point Identifier (SAPI)

Clause 3.3.3 shall apply with the exception that the use of any SAPI value other than 0 (e.g. 16 for X.25 packet mode) is beyond the scope of this annex.

J.2.3.4 Terminal Endpoint Identifier (TEI)

A TEI is associated with a specific point-to-point data link between two PINXs. The TEI value used by equipment conforming to this annex shall be the value ZERO. The use of TEI values other than 0 are beyond the scope of this annex.

PINXs conforming to this annex shall assign the value TEI = 0 independently at each end of a particular inter-PINX signalling channel.

J.2.4 Control field format

Clause 3.4 and its clauses shall apply.

J.2.5 Control field parameters and associated state variables

Clause 3.5 and its clauses shall apply if the SM/SREJ option is not implemented, and E.3.5 and its clauses shall apply if the SM/SREJ option is implemented.

J.2.6 Frame types

J.2.6.1 Commands and responses

Clause 3.6.1 shall apply with the changes as given above if the SM/SREJ option is not implemented, and E.3.6.1 shall apply with the changes given above if the SM/SREJ option is implemented.

J.2.6.2 Information (I) command

Clause 3.6.2 shall apply.

J.2.6.3 Set Asynchronous Balanced Mode Extended (SABME) command

Clause 3.6.3 shall apply if the SM/SREJ option is not implemented, and E.3.6.3 shall apply if the SM/SREJ option is implemented.

J.2.6.4 Disconnect (DISC) command

Clause 3.6.4 shall apply.

J.2.6.5 Unnumbered Information (UI) command

Clause 3.6.5 shall apply.

J.2.6.6 Receive Ready (RR) command/response

Clause 3.6.6 shall apply.

J.2.6.7 Reject (REJ) command/response

Clause 3.6.7 shall apply with the changes as given above if the SM/SREJ option is not implemented, and E.3.6.7 shall apply with the changes as given above if the SM/SREJ option is implemented.

J.2.6.8 Receive Not Ready (RNR) command/response

Clause 3.6.8 shall apply.

J.2.6.9 Unnumbered Acknowledgement (UA) response

Clause 3.6.9 shall apply if the SM/SREJ option is not implemented, and E.3.6.9 shall apply if the SM/SREJ option is implemented.

J.2.6.10 Disconnected Mode (DM) response

Clause 3.6.10 shall apply.

J.2.6.11 Frame Reject (FRMR) response

Clause 3.6.11 shall apply if the SM/SREJ option is not implemented, and E.3.6.11 shall apply if the SM/SREJ option is implemented.

J.2.6.12 Exchange Identification (XID) command/response

Clause 3.6.12 shall apply.

J.3 Elements for layer-to-layer communication

J.3.1 General

Clause 4.1 shall apply with the changes as given above and the following exceptions:

a) the following generic primitive types are not part of this annex:

MPH-ACTIVATE	not applicable to the Data Link Layer;
MPH-DEACTIVATE	not applicable to the Data Link Layer;
MPH-INFORMATION	not applicable to the Data Link Layer;

b) the following primitives are not part of this annex due to the fact that the layer 2 user does not implement the functionality which is making use of the layer 2 services associated with these primitives:

DL-UNIT DATA.request	unacknowledged information transfer invoked by layer 3;
MDL-UNIT DATA.request	unacknowledged information transfer invoked by layer management.

NOTE – Layer 3 and layer management, if receiving a DL-UNIT DATA.indication or a MDL-UNIT DATA.indication primitive, will discard its contents and not take any further action.

J.3.2 Primitive procedures

J.3.2.1 General

Clause 4.2.1 shall apply.

J.3.2.2 Layer 3 – Data link layer interactions

Clause 4.2.2 shall apply with the exception that the Data Link Connection Identifier (DLCI) state "information transfer" defined in support of broadcast data link procedures is not part of this annex.

Figure 8/Q.921 shall apply, with the exception of the state transitions as a result of the receipt of the DL-UNIT DATA.request primitive.

J.3.2.3 Data link layer – physical layer interactions

Subclause 4.2.3 items d) and e) shall apply.

The mechanism to detect loss of layer 1 capability is implementation dependent.

J.4 Definition of the peer-to-peer procedures of the data link layer

Clause 5 shall apply with the changes as given above if the SM/SREJ option is not implemented, and E.5 shall apply with the changes as given above if the SM/SREJ option is implemented.

J.4.1 Procedures for the use of the P/F bit

Clause 5.1 shall apply if the SM/SREJ option is not implemented, and E.5.1 shall apply if the SM/SREJ option is implemented.

J.4.2 Procedures for unacknowledged information transfer

Clause 5.2.1 shall apply with the changes as given above.

Clause 5.2.2 shall apply with the exception that the generation of the UI frame may not be implemented due to the fact that the layer 2 users do not implement the functionality which requires the transmission of this frame.

Clause 5.2.3 shall apply.

J.4.3 Terminal Endpoint Identifier (TEI) management procedures

J.4.3.1 General

PINXs conforming to this annex shall implement non-automatic TEI assignment procedures. The TEI Management procedures defined in the following clauses are defined internally to the PINX as no peer-to-peer management information transfer procedures are part of this annex.

The applicability of automatic TEI assignment procedures and peer-to-peer management information transfer to PINX interconnection scenarios shall not be used by equipment conforming to this annex. The layer management, if receiving a MDL-UNIT DATA.indication primitive, shall discard its contents and take no further action.

J.4.3.2 TEI assignment procedures

The TEI value to be used for a particular data link shall be delivered by the Layer Management Entity (LME) to the Data Link Layer entity via the MDL-ASSIGN.request primitive.

J.4.3.3 TEI check procedures

The procedures defined in 5.3.3 to enable checking of a TEI value are not part of this annex.

Since equipment conforming to this annex implements non-automatic TEI assignment procedures only, using the fixed TEI value 0 for the single data link connection on the D-channel, duplicate TEI assignment cannot occur.

J.4.3.4 TEI removal procedures

The procedures defined in 5.3.4 to enable removal of a TEI value are not part of this annex. Equipment conforming to this annex may initiate TEI removal procedures internally.

J.4.3.5 TEI identity verify procedures

The procedures defined in 5.3.5 to enable checking of a TEI value are not part of this annex.

J.4.3.6 Formats and codes

The format and codes defined in 5.3.6 are not part of this annex, as no peer-to-peer messages are defined for the support of management procedures.

J.4.4 Initialization of data link layer parameters

Clause 5.4 shall apply with the changes as given above.

J.4.5 Procedures for establishment and release of multiple frame operation

The provision of extended multiple frame operation (modulo 128 sequencing) shall be supported by equipment conforming to this annex.

J.4.5.1 Establishment of multiple frame operation

Clause 5.5.1 shall apply if the SM/SREJ option is not implemented, and E.5.5.1 shall apply if the SM/SREJ option is implemented.

J.4.5.2 Information transfer

Clause 5.5.2 shall apply if the SM/SREJ option is not implemented, and E.5.5.2 shall apply if the SM/SREJ option is implemented.

J.4.5.3 Termination of multiple frame operation

Clause 5.5.3 shall apply if the SM/SREJ option is not implemented, and E.5.5.3 shall apply if the SM/SREJ option is implemented.

J.4.5.4 TEI-assigned state

Clause 5.5.4 shall apply if the SM/SREJ option is not implemented, and E.5.5.4 shall apply if the SM/SREJ option is implemented.

J.4.5.5 Collision of unnumbered commands and responses

Clause 5.5.5 shall apply if the SM/SREJ option is not implemented, and E.5.5.5 shall apply if the SM/SREJ option is implemented.

J.4.5.6 Unsolicited DM response and SABME or DISC command

Clause 5.5.6 shall apply with the exception that equipment supporting LAPB protocol procedures on the D-channel is beyond the scope of this annex if the SM/SREJ option is not implemented, and is not applicable if the SM/SREJ option is implemented.

J.4.6 Procedures for information transfer in multiple frame operation

Clause 5.6 shall apply if the SM/SREJ option is not implemented, and E.5.6 shall apply if the SM/SREJ option is implemented.

J.4.6.1 Transmitting I frames

Clause 5.6.1 shall apply if the SM/SREJ option is not implemented, and E.5.6.1 shall apply if the SM/SREJ option is implemented.

J.4.6.2 Receiving I frames

Clause 5.6.2 shall apply if the SM/SREJ option is not implemented, and E.5.6.2 shall apply if the SM/SREJ option is implemented.

J.4.6.3 Sending and receiving acknowledgements

Clause 5.6.3 shall apply if the SM/SREJ option is not implemented, and E.5.6.3 shall apply if the SM/SREJ option is implemented.

J.4.6.4 Receiving REJ frames

Clause 5.6.4 shall apply if the SM/SREJ option is not implemented, and E.5.6.4 shall apply if the SM/SREJ option is implemented.

J.4.6.5 Receiving RNR frames

Clause 5.6.5 shall apply if the SM/SREJ option is not implemented, and E.5.6.5 shall apply if the SM/SREJ option is implemented.

J.4.6.6 Data link layer own receiver busy condition

Clause 5.6.6 shall apply if the SM/SREJ option is not implemented, and E.5.6.6 shall apply if the SM/SREJ option is implemented.

J.4.6.7 Waiting acknowledgement

Clause 5.6.7 shall apply if the SM/SREJ option is not implemented, and E.5.6.7 shall apply if the SM/SREJ option is implemented.

J.4.7 Re-establishment of multiple frame operation

J.4.7.1 Criteria for re-establishment

Clause 5.7.1 shall apply if the SM/SREJ option is not implemented, and 3.6.3 shall apply with all references to "SABME" replaced by "SM", if the SM/SREJ option is implemented.

J.4.7.2 Procedures

Clause 5.7.2 shall apply if the SM/SREJ option is not implemented, and E.5.7.2 shall apply if the SM/SREJ option is implemented.

J.4.8 Exception conditions reporting and recovery

Clause 5.8 shall apply with the exception that the actions to be taken by the connection management entity on receipt of a MDL-ERROR.indication primitive are defined in Appendix V, if the SM/SREJ option is not implemented. Clause E.5.8 shall apply with the exception that the actions to be taken by the connection management entity on receipt of a MDL-ERROR.indication primitive are defined in Appendix V, if the SM/SREJ option is implemented.

J.4.8.1 N(S) sequence error

Clause 5.8.1 shall apply with the changes as given above if the SM/SREJ option is not implemented, and E.5.8.1 shall apply if the SM/SREJ option is implemented.

J.4.8.2 N(R) sequence error

Clause 5.8.2 shall apply if the SM/SREJ option is not implemented, and E.5.8.2 shall apply if the SM/SREJ option is implemented.

J.4.8.3 Timer recovery condition

Clause 5.8.3 shall apply if the SM/SREJ option is not implemented, and E.5.8.3 shall apply if the SM/SREJ option is implemented.

J.4.8.4 Invalid frame condition

Clause 5.8.4 shall apply if the SM/SREJ option is not implemented, and E.5.8.4 shall apply if the SM/SREJ option is implemented.

J.4.8.5 Frame rejection condition

Clause 5.8.5 shall apply if the SM/SREJ option is not implemented, and E.5.8.5 shall apply if the SM/SREJ option is implemented.

J.4.8.6 Receipt of an FRMR response frame

Clause 5.8.6 shall apply if the SM/SREJ option is not implemented, and E.5.8.6 shall apply if the SM/SREJ option is implemented.

J.4.8.7 Unsolicited response frames

Clause 5.8.7 shall apply if the SM/SREJ option is not implemented, and E.5.8.7 shall apply if the SM/SREJ option is implemented.

J.4.8.8 Duplicate assignment of a TEI value

Clause 5.8.8 shall apply.

NOTE – As equipment conforming to this annex will only implement a single data link connection, duplicate TEI assignment cannot occur.

J.4.9 List of system parameters

Clause 5.9 shall apply with the changes as given above and with the following exceptions:

– N202 and timers T201 and T202 are not part of this annex;

– the maximum number of outstanding I frames (k) shall have a value of 7 where a signalling channel of greater than or equal to 64 kbit/s is used and shall have a value of 3 where a signalling channel of less than 64 kbit/s is used.

  Additional values of k may be used on particular inter-PINX links by special arrangement between the two PINXs.

J.4.10 Data link layer monitor function

The procedures described in 5.10 with the changes as given above are mandatory for equipment conforming to this annex.

4) New Appendix V

Add the following new Appendix V:

APPENDIX V

Inter-exchange signalling data link layer protocol in PISNs – Occurrence of the MDL-ERROR.indication primitive in the data link layer protocol for the support of Inter-exchange signalling in PISNs

This appendix applies to the procedures for LAPD defined in clauses 1 through 5. This appendix also applies to the SET MODE (SM) command, the Selective Reject (SREJ) response, and the procedures used to support multi-selective reject option in LAPD, defined in E.1 through E.5 – "Provision of Multi-Selective Reject Option". The optional procedures in clauses E.1 through E.5, are referred to hereafter as the SM/SREJ option.

The criteria pertaining to the use of the SM/SREJ option is specified in E.1. Clause E.1 applies to this annex with the following modifications:

1) The use of Annex E requires bilateral agreement between peer PINX users.

2) This bilateral agreement is applicable on a link-by-link basis.

Clause E.1, as modified above, is reproduced below:

Annex E defines the SET MODE (SM) command, the Selective Reject (SREJ) response, and the procedures used to support multi-selective reject option in LAPD. The multi-selective reject option of LAPD reduces the sensitivity of the throughput of the Data-link layer to degradations in the Bit Error Ratio of the underlying transmission media.

The procedures defined in Annex E are recommended for use on applications where there is a significant probability of having more than one outstanding unacknowledged I-frame. In the absence of such probability, the procedures of the main body of ITU-T Q.921 shall apply as amended by this annex.

The procedures defined in Annex E are optional, and their use requires bilateral agreement between peer PINX users. These bilateral agreements are on a link-by-link basis. In the context of this appendix, in the absence of provision of the procedures defined in Annex E, the procedures of the remainder of this Appendix V to Q.921 shall apply.

V.1 Introduction

Table V.1 (derived from Appendix II, Table II.1/Q.921) describes the error situations in which the MDL-ERROR.indication primitive will be generated. This primitive notifies the Data Link Layer's connection management entity of the occurred error situation. The table has been adapted from Table II.1/Q.921 to reflect the peer-to-peer nature of the configuration of PINXs conforming to this appendix. If the SM/SREJ option is not implemented, then Table V.1 shall apply. If the SM/SREJ option is implemented, then Table V.1 shall apply with all references to "SABME" replaced by "SM".

V.2 Layout of Table V.1

The entries in the various columns of Table V.1 should be interpreted as indicated here.

The "Error code" column gives the identification value of each error condition which will be included as a parameter with the MDL-ERROR.indication primitive.

The "Error condition" column, in conjunction with the "Affected states" column, describes unique protocol error events and the basic state of the Data Link entity at the point that the MDL-ERROR.indication primitive will be generated.

The columns entitled "Master management action" and "Slave management action" indicate the preferred action to be taken within the PINX concerned. The actions for Master and Slave Data Link configurations are identical.

V.3 Preferred management actions

In general, the "Error log" described in Table V.1 to be undertaken on receipt of the MDL-ERROR.indication primitive is an implementation option.

Table V.1/Q.921 – Master and slave management actions for MDL-ERROR.indications

Error type	Error code	Error condition	Affected states	Master management action	Slave management action
Receipt of unsolicited Response	A	Supervisory (F = 1)	7	Error log	Error log
	B	DM (F = 1)	7, 8	Error log	Error log
	C	UA (F = 1)	4, 7, 8	Error log	Error log
	D	UA (F = 0)	4, 5, 6, 7, 8	Error log	Error log
	E	DM (F = 0)	7, 8	Error log	Error log
Peer initiated Establishment	F	SABME	7, 8	Error log	Error log
Unsuccessful retransmission (N200 times)	G	SABME	7, 8	Indication that maintenance action is required since layer 2 is unable to provide services	Indication that maintenance action is required since layer 2 is unable to provide services
	H	SABME	6		
	I	Status Enquiry	8		
Other	J	N(R) Error	7, 8	Error log	Error log
	K (Note 1)	Receipt of FRMR response	7, 8	Error log	Error log
	L	Receipt of frame with undefined control field	4, 5, 6, 7, 8	Error log	Error log
	M	Receipt of I field not permitted	4, 5, 6, 7, 8	(Note 2)	(Note 2)
	N	Receipt of frame with wrong size	4, 5, 6, 7, 8	Error log	Error log
	O	N201 Error	4, 5, 6, 7, 8	Error log	Error log

NOTE 1 – The FRMR response will not be transmitted by a Data Link Layer entity conforming to this appendix.

NOTE 2 – According to 5.8.5, this error code will never be generated.

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