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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

OSI networking and system aspects – Efficiency

Information technology – Open systems interconnection – Network Fast Byte Protocol

ITU-T Recommendation X.633

(Previously "CCITT Recommendation")

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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. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

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. The text of ITU-T Recommendation X.633 was approved on 5th of October 1996. The identical text is also published as ISO/IEC International Standard 14700.

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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Summary

The Network Fast Byte Protocol applies to the provision of the OSI Connection-mode Network Service in end systems, and eliminates the round trip delay associated with the establishment and release of a network connection, and requires very low PCI overhead. The Network Fast Byte Protocol is intended for use in situations in which enhancements to the data link QOS are not required, and efficiency of operation (e.g. reduction of round trip delays on establishment and release) is of primary concern.

Introduction

This Recommendation | International Standard is one of a set of Recommendations | International Standards produced to facilitate the interconnection of information processing systems. This set of Recommendations | International Standards covers the services and protocols required to achieve such interconnection.

The Network Fast Byte Protocol Recommendation | International Standard is positioned with respect to other related Recommendations | International Standards by the layers defined in the Reference Model for Open Systems Interconnection (see ITU-T Rec. X.200 | ISO/IEC 7498-1). It is most closely related to, and lies within the field of application of the Network Service definition (ITU-T Rec. X.213 | ISO/IEC 8348). It also uses and makes reference to the Data Link Service definition (see ITU-T Rec. X212 | ISO/IEC 8886), whose provisions it assumes in order to accomplish Network Fast Byte's aims. The interrelationship of these Recommendations | International Standards is illustrated in Figure Intro. 1.

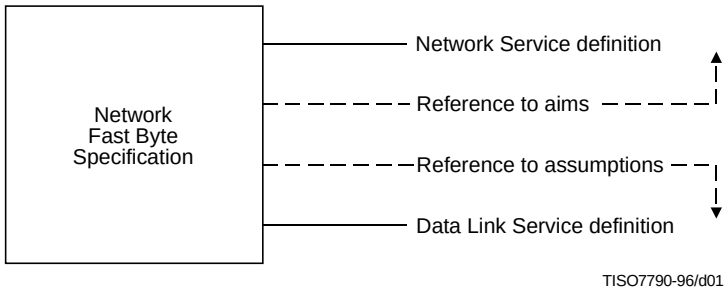

Figure Intro. 1 – Relationship between the Network Fast Byte Protocol and adjacent services

This Recommendation | International Standard specifies a common encoding and protocol procedures. It is intended that the Network Fast Byte should be simple and cater for a specific range of Data Link Service qualities possible. This Recommendation | International Standard does not define mechanisms that can be used to optimize or enhance the quality of the Data Link Service.

The primary aim of this Recommendation | International Standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer entities at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

a) as a guide for implementors and designers;

b) for use in the testing and procurement of equipment;

c) as part of an agreement for the admittance of systems into the open systems environment;

d) as a refinement of the understanding of OSI.

As it is expected that the initial users of this Recommendation | International Standard will be designers and implementors of equipment, this contains, in notes or in annexes, guidance on the implementation of the procedures defined herein.

This Recommendation | International Standard contains a clause on conformance of equipment claiming to implement the procedures in this Recommendation | International Standard (see clause 8). To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented for a given OSI protocol. Such a statement is called a Protocol Implementation Conformance Statement (PICS). A PICS proforma is provided in Annex A. Attention is drawn to the fact that this Recommendation | International Standard does not contain any tests to demonstrate this conformance.

It should be noted that it may not be possible with current technology to verify that an implementation will operate the protocol defined in this Recommendation | International Standard correctly under all circumstances. It is possible by means of testing to establish confidence that an implementation correctly operates the protocol in a representative sample of circumstances. It is, however, intended that this Recommendation | International Standard can be used in circumstances where two implementations fail to communicate in order to determine whether one or both have failed to operate the protocol correctly.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY OPEN SYSTEMS INTERCONNECTION – NETWORK FAST BYTE PROTOCOL

1 Scope

This Recommendation | International Standard specifies:

a) procedures when operating over the connection-mode data link service for the connection-mode transfer of data and control information from one network entity to a peer network entity;

b) the structure and encoding of the NPDUs used for the transfer of data and control information.

The procedures are defined in terms of:

a) the interactions between peer network entities through the exchange of NPDUs;

b) the interactions between a network entity and the network service user in the same system through the exchange of network service primitives;

c) the interactions between a network entity and the data link service provider through the exchange of data link service primitives.

These procedures are applicable to instances of communication between systems which support the Network Layer of the OSI Reference Model and wish to interconnect in the open systems environment using the Network Fast Byte Protocol.

This Recommendation | International Standard specifies, in clause 8, conformance requirements for systems implementing these procedures and provides the PICS proforma in compliance with the relevant requirements, and in accordance with the relevant guidance, given in ITU-T Rec. X.296 and ISO/IEC 9646-7. It does not contain tests which can be used to demonstrate this conformance.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and International Standards are subject to revision and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and International Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

– ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.

– ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.

– ITU-T Recommendation X.212 (1995) | ISO/IEC 8886:1996, *Information technology – Open Systems Interconnection – Data link service definition*.

- ITU-T Recommendation X.213 (1995) | ISO/IEC 8348:1996, *Information technology – Open Systems Interconnection – Network Service Definition*.
- ITU-T Recommendation X.233 (1993) | ISO/IEC 8473-1:1994, *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification.*
- ITU-T Recommendation X.263 (1995) | ISO/IEC TR 9577…[1], *Information technology – Protocol identification in the Network layer.*

2.2 Paired Recommendations | International Standards equivalent in technical contents

- ITU-T Recommendation X.223 (1993), *Use of X.25 to provide the OSI connection-mode network service for ITU-T applications*.

  ISO/IEC 8878:1992, *Information technology – Telecommunications and information exchange between systems – Use of X.25 to provide the OSI Connection-mode Network Service.*
- ITU-T Recommendation X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts*.

  ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts*.
- ITU-T Recommendation X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statements*.

  ISO/IEC 9646-7:1995, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements*.

3 Definitions

NOTE – The definitions contained in this clause make use of abbreviations defined in clause 4.

3.1 This Recommendation | International Standard is based on the concepts developed in ITU-T Rec. X.200 | ISO/IEC 7498-1 and makes use of the following terms defined in it:

a) concatenation and separation;

b) segmenting and reassembling;

c) multiplexing and demultiplexing;

d) splitting and recombining;

e) flow control;

f) connection-mode network service;

g) connection-mode data link service.

3.2 For the purposes of this Recommendation | International Standard, the following definitions apply:

3.2.1 equipment: Hardware or software or a combination of both; it need not be physically distinct within a computer system.

3.2.2 local matter: A decision made by a system concerning its behavior in the Network Layer that is not subject to the requirements of this protocol.

3.2.3 initiator: A network entity that acts on an N-CONNECT request from the NS-user.

3.2.4 responder: A network entity with whom an initiator wishes to establish a network connection.

3.2.5 sending network entity: A network entity that sends a given NPDU.

3.2.6 receiving network entity: A network entity that receives a given NPDU.

3.2.7 error indication: A DL-RESET indication that a network entity receives from the DLS-provider.

3.2.8 invalid NPDU: An NPDU that does not comply with the requirements of this Recommendation | International Standard for structure and encoding.

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[1] To be published.

3.2.9 **protocol error**: An NPDU whose use does not comply with the associated procedures.

3.2.10 **transparent (data)**: NS-user data that is transferred intact between network entities and which is unavailable for use by the network entities.

3.2.11 **calling**: A classification associated with the initiator (e.g. a calling address is the address of the initiator; a data transfer direction of calling-to-called is the direction of transfer which originates at the initiator and terminates at the responder).

3.2.12 **called**: A classification associated with the responder (e.g. a called address is the address of the responder; a data transfer direction of called-to-calling is the direction of transfer which originates at the responder and terminates at the initiator).

3.3 This Recommendation | International Standard uses the following terms defined in ITU-T Rec. X.290 and ISO/IEC 9646-1:

a) PICS proforma;

b) Protocol Implementation Conformance Statement (PICS).

3.4 This Recommendation | International Standard uses the following terms defined in ITU-T Rec. X.210 | ISO/IEC 10731:

a) network service user;

b) data link service provider.

4 Symbols and abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

4.1 Data units

NPDU	Network-protocol-data-unit
NSDU	Network-service-data-unit
DLSDU	Data-link-service-data-unit

4.2 NPDU types

FB-NPDU	Fast Byte NPDU

4.3 NPDU fields

EON	End of NSDU
Q	Q-bit parameter
NPCI	Network Layer Protocol Control Information
Null-PCI	Null PCI data transfer parameter

4.4 Miscellaneous

NS-user	Network-service user
NS-provider	Network-service provider
NSAP	Network-service-access-point
DLS-provider	Data link service provider
DLSAP	Data-link-service-access-point
QOS	Quality of Service
CODLS	Connection-mode Data Link Service

5 Overview of the Network Fast Byte Protocol

The Network Fast Byte Protocol applies to the provision of the OSI connection-mode network service in end systems, eliminates the round trip delay associated with the establishment and release of a network connection, and requires very low PCI overhead. The Network Fast Byte Protocol is required for use in situations in which enhancements to the data link QOS are not required, and efficiency of operation (e.g. reduction of round trip delays on establishment and release) is of primary concern. The protocol ensures an interoperable method for accomplishing this, by standardizing a "mapping" between the network and data link services.

Unlike traditional protocols, the Fast Byte protocol does not define different PDU types (e.g. connect, release, reset, etc.). The Fast Byte protocol defines a single PDU, and the semantics of this PDU are dependent on the service primitive in which the PDU is received.

5.1 Service provided by the Network Layer

The Network Fast Byte Protocol supports the OSI connection-mode network service defined in ITU-T Rec. X.213 | ISO/IEC 8348 with the following restrictions:

1) the optional receipt confirmation and optional expedited data services are not supported;
2) no enhancement of the data link service QOS is provided, so that the network service QOS approximates to the corresponding data link service QOS.

This protocol is intended to complement, as opposed to replace, the suite of existing protocols which supports the connection-mode network service (e.g. ITU-T Rec. X.223 and ISO/IEC 8878).

For support of the OSI connectionless-mode network service, ITU-T Rec. X.233 | ISO/IEC 8473-1 applies.

Information is transferred to and from the NS-user in the network service primitives listed in Table 1.

5.2 Service assumed from the Data Link Layer

The Network Fast Byte Protocol assumes the use of the OSI connection-mode data link service (CODLS) defined in ITU-T Rec. X.212 | ISO/IEC 8886.

When operating over CODLS, information is transferred to and from the DLS-provider in the data link service primitives listed in Table 2.

NOTES

1 The parameters listed in Table 2 are those in the data link service.

2 The way the primitives and parameters are exchanged between the network entity and the DLS-provider is a local matter.

5.3 Functions of the Network Layer

5.3.1 Overview of functions

The functions in the Network Layer are primarily concerned with the data transfer, routeing and relaying, and the enhancement of Quality of Service. The Network Fast Byte Protocol is intended for use in situations where enhancements are not required, and the efficiency of operation is of primary concern. The Network Fast Byte Protocol eliminates the round trip propagation delay associated with the establishment and release of a network connection, and requires very low PCI overhead. The following functions are therefore not supported:

a) multiplexing;
b) error detection;
c) error recovery;
d) flow control;
e) expedited data;
f) encryption;
g) accounting mechanisms;
h) status exchanges and monitoring of QOS;
i) temporary release of data link connections.

Table 1 – Network Service primitives

Primitives		Notes	Parameters	Notes
N-CONNECT indication	request		Called Address Calling Address Receipt Confirmation Selection Expedited Data Selection QOS-parameter Set NS-user-data	 1 1 2 3
N-CONNECT confirm	response		Responding Address Receipt Confirmation Selection Expedited Data Selection QOS-parameter Set NS-user-data	 1 1 2 3
N-DATA indication	request		NS-user-data Confirmation request	 4
N-DATA-ACKNOWLEDGE indication	request	4 4		
N-EXPEDITED DATA indication	request	4 4	NS-user-data	
N-RESET	request		Reason	
N-RESET	indication		Originator Reason	
N-RESET confirm	response			
N-DISCONNECT	request		Reason NS-user-data Responding Address	 3
N-DISCONNECT	indication		Originator Reason NS-user-data Responding Address	 3

NOTES

1 The NS-user may select the support of receipt confirmation and/or expedited data in a N-CONNECT request; however, the non-support of these services shall be indicated in the associated N-CONNECT confirm.

2 QOS parameter values, and QOS negotiation capabilities, are limited by those available from the underlying data link service provider. The Fast Byte protocol does not support enhancement of the QOS offered by the underlying service. Where the underlying service supports a range of QOS-parameter values, the Fast Byte protocol may use the corresponding negotiation facilities of the underlying service. A similar level of QOS service may be requested from the network service or, in the presence of local knowledge, a lower level may be requested. The actual level of QOS achieved may be lower than, similar to, or even higher than that requested.

3 Maximum length = maximum length of the user-data parameter of the underlying service minus the NPCI length.

4 Not supported.

5.3.2 Connection establishment

The purpose of connection establishment is to establish a network connection between two NS-users. The following functions of the network layer during this phase match the NS-users' requested Quality of Service with the services offered by the network layer:

a) map network addresses onto data link addresses;

b) transport of NS-user data (see 6.2).

5.3.3 Data transfer

The purpose of data transfer is to permit duplex transmission of NSDUs between the two NS-users connected by the network connection. This purpose is achieved by means of two-way simultaneous communication and by the use of segmenting and reassembly (see 6.7, 6.8 and 6.9).

Table 2 – Connection-Oriented Data link service primitives

Primitives		X	Parameters	X/Y/Z
DL-CONNECT indication	request	X X	Called Address Calling Address QOS parameter set DLS-user-data	X X Y X
DL-CONNECT confirm	response	X X	Responding Address QOS parameter set DLS-user-data	X Y X
DL-DATA indication	request	X X	DLS-user-data	X
DL-RESET	request	X	Reason	X
DL-RESET	indication	X	Originator Reason	Z Z
DL-RESET confirm	response	X X		
DL-DISCONNECT	request	X	Reason DLS-user-data	X X
DL-DISCONNECT	indication	X	Originator Reason DLS-user-data	Z Z X

X The Network Fast Byte Protocol assumes that this capability is provided by all DLS-providers.

Y The Network Fast Byte Protocol assumes that this facility is provided by all DLS-providers. The QOS-parameter values supported by the DLS-provider limit the corresponding values provided to the NS-user, since there are no mechanisms in the Network Fast Byte Protocol for enhancing the DLS-provided QOS.

Z Not used by the Network Fast Byte Protocol.

5.3.4 Release

The purpose of release (see 6.3, 6.4, 6.5, and 6.6) is to provide disconnection of the network connection, regardless of the current activity.

5.4 Operation over CODLS

It is assumed that each network entity is aware of the Quality of Service provided by particular data link connections. The Network Fast Byte Protocol has been designed to be used with data link connections with an acceptable residual error rate (for example, not signalled by disconnect or reset) and an acceptable rate of signalled errors.

5.5 Model of the Network Layer

A network entity communicates with its NS-users through one or more NSAPs by means of the service primitives as defined by the network service definition (see ITU-T Rec. X.213 | ISO/IEC 8348). Service primitives will cause or be the result of network protocol data unit exchanges between the peer network entities supporting a network connection. These protocol exchanges are effected using the services of the Data Link Layer as defined by the data link service definition (see ITU-T Rec. X.212 | ISO/IEC 8886) through one or more DLSAPs (see Figure 1).

Network connection endpoints are identified in end systems by an internal, implementation dependent, mechanism so that the NS-user and the network entity can refer to each network connection.

6 Network Fast Byte Protocol specification

This clause contains elements of procedure which comprise the Network Fast Byte Protocol specification.

In the specific case in which the Network Fast Byte Protocol is operated over a subnetwork employing out-of-band signalling which is listed in B.1, then the procedures which are applicable are specified in B.2, through appropriate references to the procedures in clause 6, and through references to other subnetwork specific Recommendations | International Standards. No modifications to the procedures in clause 6 are made in Annex B.

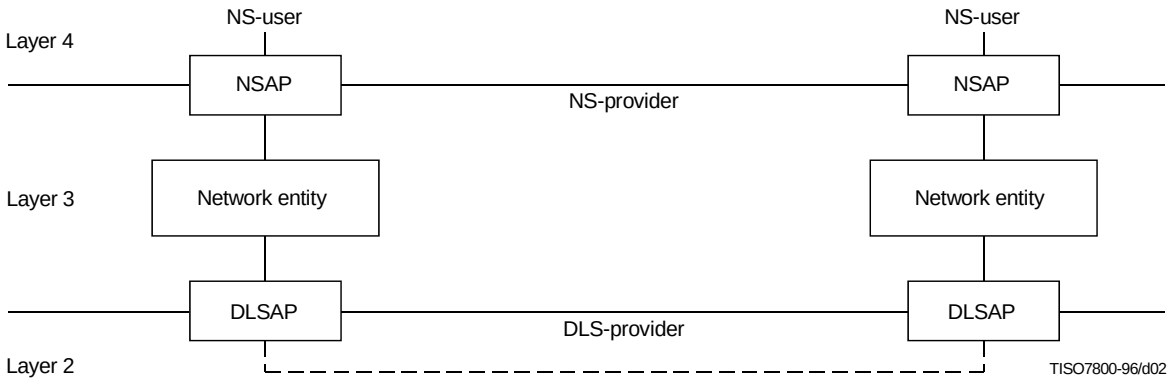


Figure 1 – Model of the network layer

When the Network Fast Byte Protocol is operated over a subnetwork which employs out-of-band signalling but the subnetwork is not listed in B.1, the network entities shall use the procedures listed below, and the Fast Byte protocol shall operate over the subnetwork User-plane. When the Network Fast Byte Protocol is not operated over a subnetwork employing out-of-band signalling, the network entities shall use the procedures listed below:

a) Network Protocol Data Unit (NPDU) transfer (see 6.1);

b) Connection establishment (see 6.2);

c) Connection refusal (see 6.3);

d) Normal release (see 6.4);

e) Error indication (see 6.5);

f) Abnormal release (see 6.6);

g) Data transfer (see 6.7);

h) Segmenting and reassembling (see 6.8);

i) Qualifier bit (see 6.9);

j) Invalid NPDU (see 6.10);

k) NS-user initiated reset (see 6.11);

The procedures define the transfer of NPDUs whose structure and coding is specified in clause 7. Network entities shall accept and respond to an NPDU received in a valid DLSDU and may issue NPDUs initiating specific elements of procedure specified in this clause.

6.1 Network Protocol Data Unit (NPDU) transfer

6.1.1 Purpose

The NPDU transfer procedure is used to convey network protocol data units in user data fields of data link service primitives.

6.1.2 Data link service primitives

The procedure uses the following data link service primitives when operating over CODLS:

a) DL-DATA;

b) DL-CONNECT;

c) DL-DISCONNECT.

6.1.3 Procedure

The network entities shall transmit and receive NPDUs as:

a) DLS-user data parameters of DL-DATA primitives;

b) DLS-user data parameters of DL-CONNECT primitives;

c) DLS-user-data parameters of DL-DISCONNECT primitives.

When an NPDU is put into a DLS-user data parameter, the significance of the bits within an octet and the order of octets within an NPDU shall be as defined in clause 7.

6.2 Connection establishment

6.2.1 Purpose

The procedure for connection establishment is used by network entities to create a new network connection.

6.2.2 Data link service primitives

The procedure uses the DL-CONNECT and DL-DISCONNECT data link service primitives.

6.2.3 Network service primitives

The procedure uses the N-CONNECT and N-DISCONNECT network service primitives.

6.2.4 NPDUs and parameters used

The procedure uses the FB NPDU and the NS-user data, called or responding address, calling address, called-to-calling Data NPDU size, calling-to-called Data NPDU size, Null-PCI, and Q-bit parameters.

6.2.5 Procedure

A network connection is established by means of one network entity (the initiator) transmitting an FB-NPDU to the other network entity (the responder), which replies with an FB-NPDU.

On receipt of an N-CONNECT request, the initiating network entity shall transmit an FB-NPDU as the DLS-user data parameter of a DL-CONNECT request, in order to establish a network connection.

On receipt of a DL-CONNECT indication containing an FB-NPDU, the responding network entity shall inform the NS-user by issuing an N-CONNECT indication.

On receipt of an N-CONNECT response, the responding network entity shall transmit an FB-NPDU as the DLS-user-data parameter of a DL-CONNECT response, in order to accept the network connection. If the network connection cannot be accepted by the responding NS-user (i.e. an N-DISCONNECT request is received from the NS-user) then 6.3 applies.

On receipt of a DL-CONNECT confirm containing an FB-NPDU, the initiating network entity shall consider the network connection accepted and inform the NS-user by issuing an N-CONNECT confirm.

On receipt of a DL-CONNECT confirm not containing an FB-NPDU, the initiating network entity shall consider the network connection not accepted and inform the NS-user by issuing an N-DISCONNECT indication. The reason parameter shall indicate “connection rejection-transient condition”. The initiating network entity shall issue a DL-DISCONNECT request. The originator and reason parameters shall indicate “undefined”.

NOTE 1 – There is a one-to-one correspondence of a network connection to a data link connection. Connection establishment occurs simultaneously.

NOTE 2 – The NS-user may select the support of receipt confirmation and/or expedited data in an N-CONNECT request; however, the non-support of these services shall be indicated in the associated N-CONNECT confirm and N-CONNECT indication.

During this exchange, all information and parameters needed for the network entities to operate shall be exchanged or negotiated.

The following information is exchanged:

a) Initiator: called and calling NSAP addresses, Null-PCI, Q bit, and NS-user data (if any).

b) Responder: responding NSAP address, Null-PCI, Q bit, and NS-user data (if any).

The following negotiations take place:

a) Initiator:

- Called-to-calling Data NPDU length, calling-to-called Data NPDU length. The initiator shall propose the maximum size for Data NPDUs in the called-to-calling, and calling-to-called directions. The values proposed by the initiator shall not exceed the maximum DLSDU size.

  NOTE 3 – Network entities may have knowledge, by some local means, of the maximum available DLSDU size.

- Q-bit support – The initiator shall set the Q bit to ONE to request Q-bit support from the responding network entity; otherwise, the Q bit shall be set to ZERO.

- Null PCI data transfer support – The initiator shall set the Null-PCI parameter to ONE to request null PCI during the data transfer phase; otherwise, the Null-PCI parameter shall be set to ZERO.

b) Responder:

- Called-to-calling Data NPDU length, calling-to-called Data NPDU length – The responder shall select the maximum size for Data NPDUs in the called-to-calling, and calling-to-called directions. The values selected by the responder shall be equal to or less than the values proposed by the initiator.

- Q-bit support – If the initiator set the Q bit to ONE, the responder shall indicate acceptance of Q-bit support by setting the Q bit to ONE, or shall decline Q-bit support by setting the Q bit to ZERO. If the initiator set the Q bit to ZERO, the responder shall indicate non-support by setting the Q bit to ZERO.

- Null PCI data transfer support – If the initiator set the Null-PCI parameter to ONE, the responder shall indicate acceptance of the request for null PCI during the data transfer phase by setting the Null-PCI parameter to ONE, or shall decline support by setting the Null-PCI parameter to ZERO. If the initiator set the Null-PCI parameter to ZERO, the responder shall indicate non-support by setting the Null-PCI parameter to ZERO

6.3 Connection refusal

6.3.1 Purpose

The connection refusal procedure is used when the NS-user or a network entity refuses a network connection in response to an FB-NPDU.

6.3.2 Data link service primitives

The procedure uses the DL-DISCONNECT data link service primitive.

6.3.3 Network service primitives

The procedure uses the N-DISCONNECT network service primitive.

6.3.4 NPDUs and parameters used

The procedure uses the FB NPDU, and NS-user data and responding address parameters.

6.3.5 Procedure

On receipt of an N-DISCONNECT request resulting from a previously issued N-CONNECT indication or if the responding network entity refuses the network connection, the responding network entity shall transmit an FB-NPDU as the DLS-user-data parameter of a DL-DISCONNECT request. The reason shall indicate “disconnection-abnormal condition”.

On receipt of a DL-DISCONNECT indication containing an FB-NPDU which is received as a result of a previously transmitted DL-CONNECT request, the initiating network entity shall consider the network connection not accepted and inform the NS-user by issuing an N-DISCONNECT indication. The originator parameter shall indicate “NS user”, and the reason parameter shall indicate “disconnection-abnormal condition”.

The following information is conveyed to the initiator:

- responding NSAP address;

- NS-user data, if any.

6.4 Normal release

6.4.1 Purpose

The release procedure is used by a network entity in order to terminate an existing network connection.

6.4.2 Data link service primitives

The procedure uses the DL-DISCONNECT data link service primitive.

6.4.3 Network service primitives

The procedure uses the N-DISCONNECT network service primitive.

6.4.4 NPDUs and parameters used

The procedure uses the FB-NPDU and NS-user data parameter.

6.4.5 Procedure

On receipt of an N-DISCONNECT request after a network connection has been established or after an originator has initiated a network connection but before its acceptance, a network entity shall transmit an FB-NPDU as the DLS-user-data parameter of a DL-DISCONNECT request, and shall consider the network connection to be released and so inform the NS-user. The reason parameter shall indicate “disconnection-normal condition”.

The following information is conveyed:

– NS-user data (if any).

A network entity receiving an FB-NPDU as the DLS-user data parameter of a DL-DISCONNECT indication after a network connection has been established or after an originator has initiated a network connection but before its acceptance, shall consider the network connection to be released and so inform the NS-user by issuing an N-DISCONNECT indication. The originator parameter shall indicate “NS user” and the reason parameter shall indicate “disconnection-normal condition”.

6.5 Error Indication

6.5.1 Purpose

This procedure is used on the receipt of a DL-RESET indication.

6.5.2 Data link service primitives

The procedure uses the DL-RESET data link service primitive.

6.5.3 Network service primitives

The procedure uses the N-RESET network service primitive.

6.5.4 NPDUs and parameters used

This procedure does not use an NPDU.

6.5.5 Procedure

A network entity receiving a DL-RESET indication shall signal the occurrence of the reset to the NS-user using an N-RESET indication with the originator parameter set to “NS provider” and the reason parameter set to “reason unspecified”.

A network entity receiving an N-RESET response shall issue a DL-RESET response primitive.

6.6 Abnormal release

6.6.1 Purpose

The release procedure is used by a network entity to release a network connection on the receipt of a DL-DISCONNECT indication which does not contain an FB-NPDU (i.e. resulting from a DLS-provider initiated disconnect).

6.6.2 Data link service primitives

The procedure uses the DL-DISCONNECT data link service primitive.

6.6.3 Network service primitives

The procedure uses the N-DISCONNECT network service primitive.

6.6.4 TPDUs and parameters used

None.

6.6.5 Procedure

If a network connection exists, and a DL-DISCONNECT indication which does not contain an FB-NPDU is received, then the network entity shall consider that the network connection is released and inform the NS-user by issuing an N-DISCONNECT indication. The originator parameter shall indicate “undefined” and the reason parameter shall indicate “undefined”.

If a network connection does not exist, and a DL-DISCONNECT indication which does not contain an FB-NPDU is received, then the network entity shall take no action.

6.7 Data transfer

6.7.1 Purpose

The transfer procedure is used to convey NS-user data of an N-DATA primitive.

6.7.2 Data link service primitives

The procedure uses the DL-DATA data link service primitive.

6.7.3 Network service primitives

The procedure uses the N-DATA network service primitive.

6.7.4 NPDUs and parameters used

The procedure uses the FB-NPDU and NS-user data parameter.

6.7.5 Procedure

The network entities shall transmit and receive an FB-NPDU as the DLS-user data parameter of a DL-DATA primitive. The NS-user data is contained within the NS-user data parameter of the FB-NPDU.

6.8 Segmenting and reassembling

6.8.1 Purpose

The segmenting and reassembling procedure is used to map an NSDU onto one or more NPDUs.

6.8.2 Data link service primitives

The procedure uses the DL-DATA data link service primitive.

6.8.3 Network service primitives

The procedure uses the N-DATA network service primitive.

6.8.4 NPDUs and parameters used

The procedure uses the FB-NPDU and End of NSDU (EON).

6.8.5 Procedure

A network entity shall map an NSDU onto an ordered sequence of one or more FB-NPDUs. This sequence shall not be interrupted by other NPDUs.

All FB-NPDUs except the last FB-NPDU in a sequence greater than one shall have a length of data greater than zero.

NOTES

1 The EON of an FB-NPDU indicates whether or not there are subsequent FB-NPDUs in the sequence.

2 There is no requirement that the FB-NPDUs shall be the maximum length available on the network connection.

6.9 Qualifier-bit

6.9.1 Purpose

The qualifier bit procedure is used to indicate that the data received is not to be passed transparently to the NS-user.

6.9.2 Data link service primitives

The procedure uses the DL-DATA and DL-DISCONNECT data link service primitives.

6.9.3 NPDUs and parameters used

The procedure uses the FB-NPDU and Q bit.

6.9.4 Procedure

The sending network entity shall use the Q bit to indicate whether the contents of the NS-user data field of an FB-NPDU is to be passed transparently to the receiving NS-user or to be processed by the receiving network entity.

The receiving network entity shall use the Q bit to determine whether the contents of the NS-user data field of the received FB-NPDU is to be passed transparently to the NS-user, or to be processed by the receiving network entity (for example, processed as control information associated with an X.29 PAD) and not passed transparently to the receiving NS-user.

6.9.4.1 Segmenting and reassembling

The network entity shall map Qualified Data onto an ordered sequence of one or more FB-NPDUs. This sequence shall not be interrupted by other NPDUs, and the value of the Q bit shall remain constant for each NPDU in the ordered sequence. An ordered sequence of FB-NPDUs in which the Q-bit value changes shall be discarded.

All FB-NPDUs except the last FB-NPDU in a sequence greater than one shall have a length of data greater than zero.

6.9.4.2 Non-support of Q-bit operation

A network entity not supporting Q-bit operation shall, upon receiving an FB-NPDU with the Q bit set to ONE, discard the FB-NPDU. The network entity shall transmit an FB-NPDU as the DLS-user-data parameter of a DL-DISCONNECT request. The reason parameter shall indicate “disconnection-abnormal condition”. The network entity shall consider the network connection to be released and so inform the NS-user by issuing an N-DISCONNECT indication. The originator parameter shall indicate “undefined” and the reason parameter shall indicate “disconnection-abnormal condition”.

6.10 Invalid NPDU

6.10.1 Purpose

The Invalid NPDU procedure specifies the action taken on receiving an NPDU that does not comply with the requirements of this protocol specification for structure and encoding. A Null NPDU (i.e. no NS-user data in the data link service primitive received) does not constitute an Invalid NPDU.

6.10.2 Procedure

A network entity receiving an invalid NPDU shall discard the NPDU.

6.11 NS-user initiated reset

6.11.1 Purpose

The NS-user initiated reset procedure is used by an NS-user to signal an N-RESET to the remote NS-user.

6.11.2 Data link service primitives

The procedure uses the DL-RESET data link service primitive.

6.11.3 Network service primitives

The procedure uses the N-RESET network service primitive.

6.11.4 NPDUs and parameters used

This procedure does not use an NPDU.

6.11.5 Procedure

A network entity receiving an N-RESET request from the NS-user shall issue a DL-RESET request with the reason parameter set to “user resynchronization”.

A network entity receiving a DL-RESET confirm, shall issue an N-RESET confirm to the NS-user.

7 FB-NPDU Structure and encoding

All the Network Protocol Data Units (NPDUs) shall contain an integral number of octets. The octets in an NPDU are numbered starting from 1 and increasing in the order they are put into a DLSDU. The bits in an octet are numbered from 1 to 8 and increase in the order they are put into a DLSDU. Bit 1 is the lowest order bit of each octet.

When consecutive octets are used to represent a binary number, the lower octet number has the most significant value.

NOTES

1 The numbering of bits within an octet is a convention local to this protocol specification.

2 The use of the terms “high order” and “low order” is common to this protocol specification and to adjacent layer Recommendations | International Standards.

3 The use of the above conventions does not affect the order of bit transmission on a serial communications link.

4 Both network entities respect these bit and octet ordering conventions, thus allowing communication to take place.

5 In this clause the encoding of NPDUs is represented in the following form:

a) octets are shown with the lowest numbered octet on the top; higher numbered octets being further below;

b) within an octet, bits are shown with bit 8 to the left and bit 1 to the right.

The FB-NPDU consists of 3 parts, each of which may or may not be present, as described below:

Part	Described in subclause	When used
Header Part	7.1	If Null PCI data transfer support has been negotiated, then the Header part shall not be present in FB-NPDUs associated with procedure 6.7; otherwise, the Header part shall always be present in an FB-NPDU.
Control Part	7.2	The control part shall be present in FB-NPDUs associated with procedures 6.2 and 6.3 if one or more Control part parameter sets are present; otherwise, the Control part shall not be present. The Control part shall not be present in FB-NPDUs associated with procedures 6.4, 6.5, 6.6, 6.7, 6.8, 6.9 and 6.11.
Data Part	7.3	The data part shall always be present in an FB-NPDU when NS-user data is being conveyed, but shall not be present in an FB-NPDU when NS-user data is not being conveyed.

The parts are ordered in an FB-NPDU such that the control part (if present) does not precede the header part, and the data part (if present) does not precede either the control part or the header part.

7.1 Header part

If Null PCI data transfer support has been negotiated, then the Header part shall not be present in FB-NPDUs associated with procedure 6.7. Otherwise, the Header part shall always be present in an FB-NPDU.

The Header part shall contain, in the following order:

1) The Fast Byte identifier octet; the value is set to binary 0000 0011 to identify this protocol.

2) The Parameter field

   a) Bit 8 is the extension bit (x):

      – when the x is set to ONE, the parameter field is not extended;

      – when the x is set to ZERO, the parameter field is extended.

In this version of the Network Fast Byte Protocol specification, when originating an FB-NPDU, x is set to ONE; if an FB-NPDU is received with a parameter field in which x is set to ZERO, then subsequent Parameter Extension octets (defined in a future version of this protocol specification) are ignored.

b) Bits 7, 4, 3, 1 are reserved (r) for future use, and set to ZERO when originating an FB-NPDU; the value is ignored by the received network entity.

c) Bit 6 is the Null-PCI parameter (n):

– when the n is set to ZERO, Null PCI data transfer support is not selected;

– when the n is set to ONE, Null PCI data transfer support is selected.

d) Bit 5 is the Q bit.

For connection establishment:

– the Q bit is used to negotiate the use of the Q-bit support during the network layer data transfer phase, as described in 6.2.5.

For data transfer:

– when the Q bit is set to ZERO, the receiving network entity transparently passes the NS-user data to the NS-user;

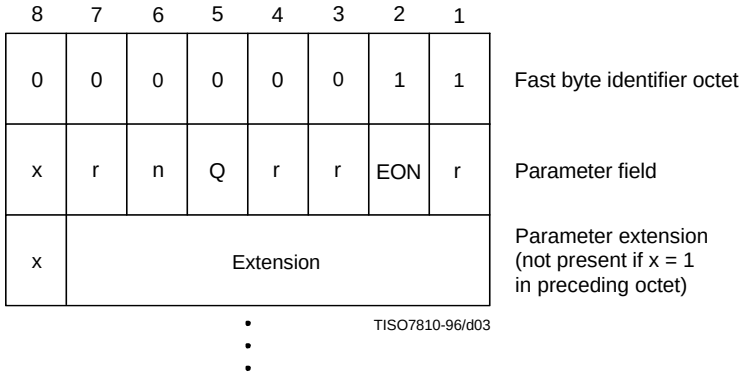
– when the Q bit is set to ONE, the NS-user data is processed within the Network Layer of the receiving open system (for example: may be used in conjunction with X.29), and is not transparently passed to the NS-user.

e) Bit 2 is the End of NSDU (EON):

– when the EON is set to ONE, the FB-NPDU is the last data unit of a complete FB-NPDU sequence;

– when the EON is set to ZERO, the FB-NPDU is not the last data unit of a complete FB-NPDU sequence.

The Header part is illustrated below.



7.2 Control part

The control part shall be present in FB-NPDUs associated with procedures 6.2 and 6.3 if one or more Control part parameter sets are present; otherwise, the Control part shall not be present. The Control part shall not be present in FB-NPDUs associated with procedures 6.4, 6.5, 6.6, 6.7, 6.8, 6.9 and 6.11.

The Control part shall contain, in the following order:

1) Data NPDU length parameter set – The Data NPDU length parameter set contains a 2-octet called-to-calling Data NPDU length for which the value is a binary integer and indicates the maximum Data NPDU length in octets, and a 2-octet calling-to-called Data NPDU length for which the value is a binary integer and indicates the maximum Data NPDU length in octets. If the parameter set is omitted, then a default Data NPDU length of 512 octets in both directions shall apply.

2) Address parameter set – The Address parameter set contains, in the following order:

   a) a 1-octet called or responding address length; the value is a binary integer and indicates the length of the called or responding address in octets;

   b) the called or responding address field;

   c) a 1-octet calling address length; the value is a binary integer and indicates the length of the calling address in octets;

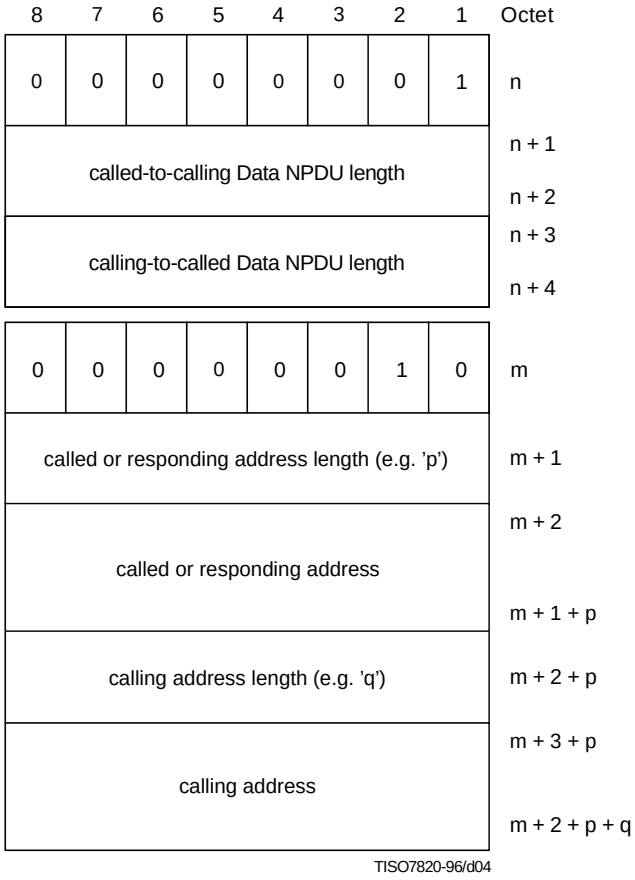
   d) the calling address field.

   The parameter set may be omitted, or an address field may be omitted by setting the corresponding address length to ZERO, provided local knowledge exists which is sufficient to enable the peer network entities to derive the omitted addresses.

   The called, responding, and calling addresses used by this protocol are NSAP addresses as defined in ITU-T Rec. X.213 | ISO/IEC 8348.

   These addresses are of variable length, and are encoded in their respective fields using the “preferred binary encoding” defined in ITU-T Rec. X.213 | ISO/IEC 8348.

The Control part is illustrated below



7.3 Data part

The Data part shall always be present in an FB-NPDU when NS-user data is being conveyed, but shall not be present in an FB-NPDU when NS-user data is not being conveyed.

The Data part identifier has a binary value of 4 (0000 0100). The Data part identifier, when present in the Data part, is the first octet of the Data part.

When NS-user data is being conveyed, and Null PCI data transfer support has not been negotiated, the Data part identifier is present in the Data part.

When NS-user data is being conveyed, and Null PCI data transfer support has been negotiated, the Data part identifier is not included in the Data part of a FB-NPDU which is associated with procedure 6.7, but is included in the Data part of FB-NPDUs which are associated with procedures other than 6.7.

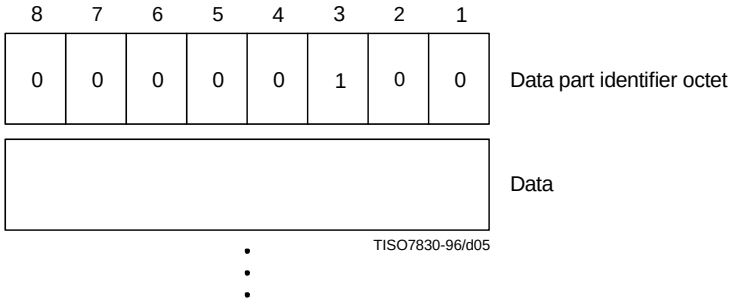
During the network layer connection establishment and release phases, the remainder of the Data part may contain any number of octets up to the maximum length of the user-data field of the underlying protocol minus the length of the Header part minus the length of the Control part minus 1.

During the network layer data transfer phase, the remainder of the Data part may contain any number of octets up to a maximum of:

a) the maximum length of the user-data field of the underlying protocol minus the length of the Header part minus 1 – if Null PCI data transfer support has not been negotiated; or

b) the maximum length of the user-data field of the underlying protocol – if Null PCI data transfer support has been negotiated.

The Data part is illustrated below:



8 Conformance

8.1 A system claiming to implement the procedures specified in this protocol specification shall comply with the requirements in 8.2, 8.3 and 8.4.

8.2 The system shall implement the procedures specified in clause 6.

8.3 The system shall implement the encodings specified in clause 7.

8.4 The supplier of a protocol implementation which is claimed to conform to this protocol specification shall complete a copy of the PICS proforma provided in Annex A and shall provide the information necessary to identify both the supplier and the implementation.

Annex A

Protocol Implementation Conformance Statement (PICS) proforma[2)]

(This annex forms an integral part of this Recommendation | International Standard)

A.1 General

A.1.1 Symbols used

Status symbols:

M	Mandatory
O	Optional to implement. If implemented the feature may or may not be used.
O.<n>	Optional but support of at least one of the group of options labelled by the same numeral <n> in this PICS proforma is required.
<index>:	This predicate symbol means that the status following it applies only when the PICS states that the feature identified by the index is supported. In the simplest case, <index> is the identifying tag of a single PICS item. <index> may also be a Boolean expression composed of several indices.
<index>::	When this group predicate is true the associated clause should be completed.

Support symbols:

Yes	Supported
No	Not supported
N/A	Not applicable

A.1.2 Instructions for completing the PICS proforma

The main part of the PICS proforma is a fixed-format questionnaire divided into a number of clauses. Answers to the questionnaire are to be provided in the rightmost column either by simply marking an answer to indicate a restricted choice (such as Yes or No) or by entering a value or a range of values or entering what action is taken.

A.2 Identification

A.2.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Names(s) and Version(s)	
Other information necessary for full identification – e.g. name(s) and version(s) of machines and/or operating systems; System Name(s)	

NOTES

1 Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification.

2 The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g. Type, Series, Model).

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2) **Copyright release for PICS proforma**

Users of this Recommendation | International Standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

A.2.2 Protocol Summary

Identification of protocol specification	ITU-T Rec. X.633 | ISO/IEC 14700
Identification of Amendments and Corrigenda to this PICS proforma which have been completed as part of this PICS	
Protocol Version(s) supported	Version 1
Have any Exception items been required? No [ ] Yes [ ] (The answer Yes means that the implementation does not conform to ITU-T Rec. X.633 | ISO/IEC 14700)	

Date of statement	

A.3 Indices used in this annex

A.4 Initiator/responder capability to establish connection

Index		References	Status	Support
IR1	Initiating a network connection	6.2.5	O.1	Yes No
IR2	Accepting a network connection	6.2.5	O.1	Yes No

A.5 Supported functions

The following functions are mandatory.

Index	Function	References	Status	Support
F1	NPDU transfer	6.1	M	Yes
F2	Connection establishment	6.2	M	Yes
F3	Connection refusal	6.3	M	Yes
F4	Normal release	6.4	M	Yes
F5	Error indication	6.5	M	Yes
F6	Abnormal release	6.6	M	Yes
F7	Data transfer	6.7	M	Yes
F8	Segmenting and reassembling	6.8	M	Yes
F9	Qualifier bit	6.9	M	Yes
F10	Invalid NPDU	6.10	M	Yes
F11	NS-user initiated reset	6.11	M	Yes

A.6 Supported NPDUs

Index	NPDUs	References	Status	Support
ST1	FB	7	M	Yes

A.7 Supported FB NPDU fields and parameters

Index	Supported FB NPDU fields and parameters	References	Status	Support
SP6	Fast Byte identifier octet	7.1 1)	M	Yes
SP7	Parameter field	7.1 2)	M	Yes
SP8	Data NPDU length parameter set	7.2 1)	O	Yes No
SP9	Address parameter set	7.2 2)	M	Yes
SP10	Data part identifier	7.3	M	Yes
SP11	Data	7.3	M	Yes

A.8 Negotiation and selection

A.8.1 Data NPDU size negotiation

Index		References	Status	Support
NS1	The initiator shall propose the maximum size for Data NPDUs in the called-to-calling, and calling-to-called directions. The values proposed by the initiator shall not exceed the maximum DLDU size.	6.2.5	IR1:M	Yes N/A
NS2	The responder shall select the maximum size for Data NPDUs in the called-to-calling, and calling-to-called directions. The values selected by the responder shall be equal to or less than the values proposed by the initiator.	6.2.5	IR2:M	Yes N/A

A.8.2 Null PCI data transfer negotiation

Index		References	Status	Support
NP1	Can the initiator select Null PCI data transfer support?	6.2.5	IR1:O.2	Yes No N/A
NP2	Can the initiator select non-use of Null PCI data transfer support?	6.2.5	IR1:O.2	Yes No N/A
NP3	Can the responder accept an initiator request for Null PCI data transfer support?	6.2.5	IR2:O	Yes No N/A

A.8.3 Expedited data negotiation

The following negotiation is mandatory.

Index		References	Allowed values	Supported values
ED1	The initiating NS-user may select the support of expedited data in an N-CONNECT request; however, the initiating network entity shall indicate the non-support of expedited data in the associated N-CONNECT confirm.	6.2.5	IR1:M	Yes N/A

A.8.4 Receipt confirmation negotiation

The following negotiation is mandatory.

Index		References	Allowed values	Supported values
RC1	The initiating NS-user may select the support of receipt confirmation in an N-CONNECT request; however, the initiating network entity shall indicate the non-support of receipt confirmation in the associated N-CONNECT confirm.	6.2.5	IR1:M	Yes N/A

A.8.5 Q-bit negotiation

Index		References	Status	Support
QB1	Can the initiator select Q-bit support?	6.2.5	IR1:O.2	Yes No N/A
QB2	Can the initiator select non-use of Q-bit support?	6.2.5	IR1:O.2	Yes No N/A
QB3	Can the responder accept an initiator request for Q-bit support?	6.2.5	IR2:O	Yes No N/A

A.9 Error handling

A.9.1 Actions on receipt of an invalid NPDU

Index	Event	References	Status	Support
RR1	A network entity receiving an invalid NPDU shall discard the NPDU.	6.10	M	Yes

Annex B

Subnetwork Dependent Convergence Function for subnetworks employing out-of-band signalling

(This annex forms an integral part of this Recommendation | International Standard)

B.1 Applicable subnetworks

This annex shall apply when the Network Layer Fast Byte protocol is operated over a subnetwork type listed below:

– Fame Relay SVC employing Digital Subscriber Signalling System No.1 (DSS 1 - Signalling Specification for Frame Relay Basic Call Control), as defined in Recommendation Q.933.

B.2 Fast Byte Protocol specification

The system implements one or both of the protocol specifications in B.2.1 and B.2.2.

B.2.1 Fast Byte Protocol specification – Exclusive use of the subnetwork User-plane

The Network Fast Byte Protocol operates exclusively in the User-plane of the subnetwork.

NOTE – The out-of-band set-up and release procedures which operate in the Control-plane, for the establishment of the User-plane, are not specified here. The relevant Recommendations | International Standards apply.

For operation over the User-plane, the network entities shall use the following procedures:

a) Network Protocol Data Unit (NPDU) transfer (see 6.1)

b) Connection establishment (see 6.2);

c) Connection refusal (see 6.3);

d) Normal release (see 6.4);

e) Error indication (see 6.5);

f) Abnormal release (see 6.6);

g) Data transfer (see 6.7);

h) Segmenting and reassembling (see 6.8);

i) Qualifier bit (see 6.9);

j) Invalid NPDU (see 6.10);

k) NS-user initiated reset (see 6.11).

The procedures define the transfer of NPDUs whose structure and coding is specified in clause 7. Network entities shall accept and respond to an NPDU received in a valid DLSDU and may issue NPDUs resulting from the elements of procedure specified in items a) through k).

B.2.2 Fast Byte Protocol specification – Use of the subnetwork User-plane and Control-plane

The Network Fast Byte Protocol operates using both the User-plane and the Control-plane of the subnetwork.

B.2.2.1 User-Plane procedures

The network entity shall use the following procedures for operation over the User-plane:

a) Error indication (see 6.5);

b) Data transfer (see 6.7);

c) Segmenting and reassembling (see 6.8);

d) Qualifier bit (see 6.9);

e) Invalid NPDU (see 6.10);

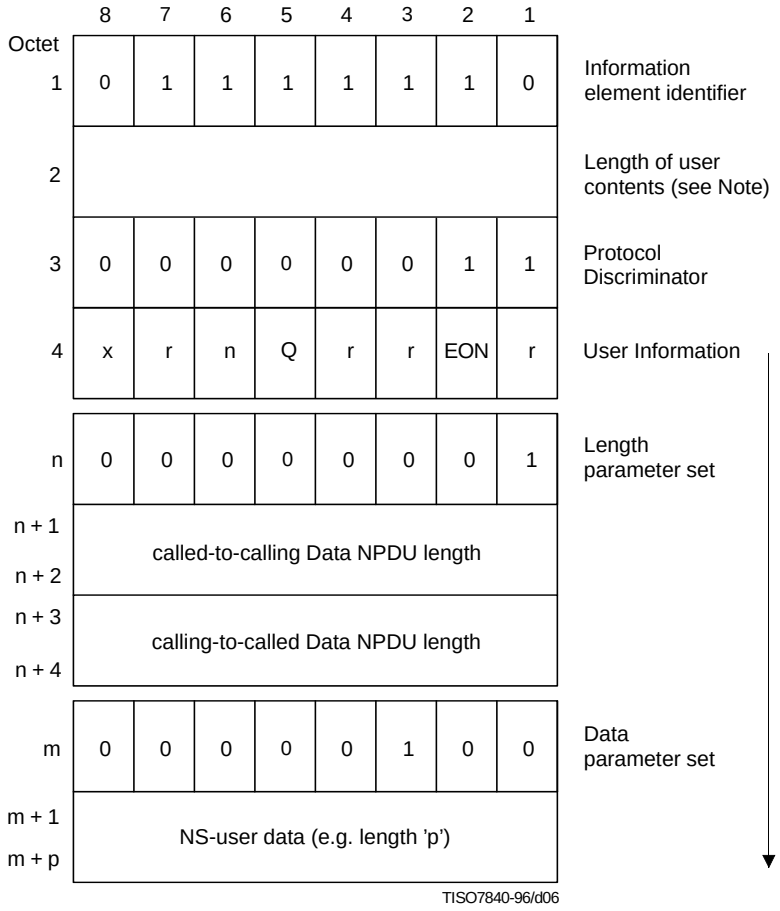
f) NS-user initiated reset (see 6.11).

B.2.2.2 Control-Plane procedures

B.2.2.2.1 Control-Plane procedures for Frame Relay SVC

The network entity shall perform the network service establishment and release phase as specified in Annex C/Q.933.

The following encoding of the User-user information element shall be used to perform the negotiation/exchange required to correctly operate the procedures specified in B.2.2.1.



NOTE – The Length of the user contents field is a binary value where bit 1 is the low order bit. The value of the field is determined as follows.

Length parameter set	Data parameter set	Length of user contents field
Present	Present	8 + p
Present	Not present	7
Not present	Present	3 + p
Not present	Not present	2

The following negotiations specified in 6.2.5 apply:

1) called-to-calling Data NPDU length, calling-to-called NPDU length;
2) Null PCI data transfer support;
3) Q-bit support.

The encoding for octet 4 shall conform to 7.1, item 2).

The encoding for octets 5-9 shall conform to 7.2, item 1).

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Telephone network and ISDN
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media
Series H	Transmission of non-telephone signals
Series I	Integrated services digital network
Series J	Transmission of sound-programme and television 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
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminal equipments and protocols for telematic services
Series U	Telegraph switching
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Series Z	Programming languages