The Frame Relay Forum

PVC User-to-Network Interface (UNI) Implementation Agreement

FRF 1.2

Frame Relay Forum Technical Committee

July 2000

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Full Notice

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Revision History

Version	Date	Changes
FRF 1		baseline document
FRF 1.1	January 1996	addition of high speed physical interfaces addition of optional loopback detection procedures
FRF 1.2	April 2000	• replacement of Physical Layer Interface Guidelines with reference to Physical Layer Interface Implementation Agreement • updated with consistent Address Field Variable section for consistent wording throughout the implementation agreements. Alignment of DLCI ranges for backward compatability between 2 and 4 octet address formats • enhanced LMI for large scale UNIs • enhanced LMI for passing PVC parameters from network to user

1 INTRODUCTION

1.1 PURPOSE

These agreements, reached in the Frame Relay Forum are based on the relevant frame relay protocol standards referenced in Section 2. They address the optional parts of these standards and document agreements reached among vendors/suppliers of frame relay products and services regarding the options to be implemented. These agreements will form the basis of conformance test suites produced by the Frame Relay Forum.

This document may be submitted to different bodies involved in ratification of implementation agreements and conformance testing to facilitate multi-vendor interoperability.

1.2 DEFINITIONS

- **Must**, **Shall**, or **Mandatory** — the item is an absolute requirement of the implementation agreement.
- **Should, Strongly Recommended** — the item is highly desirable.
- **May** or **Optional** — the item is not compulsory, and may be followed or ignored according to the needs of the implementor.

1.3 RELEVANT STANDARDS

The following is a list of standards on which these implementation agreements are based upon:

1. Recommendation I.122, Framework for providing Additional Packet Mode Bearer Services, ITU, Geneva, 1988.
2. Recommendation Q.922, ISDN Data Link Layer Specification for Frame Mode Bearer Services, ITU, Geneva, 1993.
3. ITU-T Recommendation Q.921, ISDN User-Network Interface-Data Link Layer Specification ITU, Geneva, 1997
4. ITU Recommendation Q.933, ISDN Signaling Specifications for Frame Mode Switched and Permanent Virtual Connections Control and Status Monitoring, ITU, Geneva, 1995.
5. ITU-T Recommendation Q.931, ISDN User-Network Interface Layer 3 Specification for Basic Call Control, ITU, Geneva, 1993.
6. FRF.4.1, D. Sinicrope (ed.), SVC User-to-Network Interface (UNI) Implementation Agreement, Frame Relay Forum, 2000.
7. FRF.14, K. Rehbehn (ed.), Physical Layer Interface Implementation Agreement, Frame Relay Forum, 1999.
8. ITU Recommendation I.370 - Congestion Management for the ISDN Frame Relaying Bearer Service, 1991.

2 IMPLEMENTATION AGREEMENTS

2.1 PHYSICAL LAYER INTERFACES GUIDELINES

Physical layer interface guidelines are provided in the Physical Interface Implementation Agreement (FRF.14).

2.2 DATA TRANSFER

Implementations for the Frame Relay UNI U-plane shall be based on ITU-T Q.922 Annex A. Implementation agreements on the optional parts of ITU Q.922 Annex A are as follows:

Note: This section is intended to be used for frame relay conformance testing.

2.2.1 Flag Sequence

Interframe time fill shall be accomplished by transmitting one or more contiguous HDLC flags with the bit pattern 01111110 when the data link layer has no frames to send. All equipment shall be able to receive, as a minimum, consecutive frames separated by 1 flag.

2.2.2 Section A.2.5 Frame Relay Information Field

A maximum frame relay information field size of 1600 octets shall be supported by the network and the user. In addition, maximum information field sizes less than or greater than 1600 octets may be agreed to between networks and users at subscription time.

2.2.3 Section A.3.3 - Address Field Variables

- Section A.3.3.6 Data Link Connection Identifier - The 2 octet address format shall be supported with DLCI values as defined in Table 1 of Q.922. The descriptions in Q.922 Table 1 and section 3.3.6 related to DLCI assignment on the D-Channel are not applicable.
- The 4 octet address format may optionally be supported with DLCI values as defined in Table 1 of Q.922, except that the range 1-15 is reserved rather than 1-131071, and virtual circuit identification begins at DLCI 16. The 17 bit DLCI format with DL-CORE control is not supported.
- The 3 octet address format is not supported.
- Other address structure variables (i.e., the command/response (C/R), discard eligibility indicator (DE), forward explicit congestion notification (FECN), and backward explicit congestion notification (BECN) bits) and their usage are as specified in Q.922 Annex A.

2.2.4 Section A.6 Congestion Control Procedures

Congestion control strategy for frame relay is defined in ITU I.370. The following implementation agreements apply to user equipment and network equipment respectively:

- I.370 Section 1.5.2 Network response to congestion & Explicit congestion signals (Q.922 §A.6.2.1)- Mandatory procedures of ITU I.370 shall be implemented. When implemented, rate enforcement using the DE indicator and/or setting of the FECN and BECN indicators should be implemented according to ITU I.370.
- I.370 Section 1.5.3 User response to congestion & Q.922 §§ A.6.1, A.6.2- User equipment

reaction is dependent on the protocols operating over the Data Link Core sublayer. The procedures of ITU Q.922 Appendix I should be implemented where appropriate.

2.2.5 Section A.7 Consolidated Link Layer Management (CLLM) Message

Use of the CLLM message is not required.

2.3 CONTROL (SIGNALING) PROCEDURES

2.3.1 Permanent Virtual Connection (PVC) Procedures

User devices (and the network) shall implement the mandatory procedures of the Q.933 Annex A (1995). By bilateral agreement, optional procedures of Annex A of the revised ITU Q.933 may be implemented. Refer to Q.933 section A.6 for a more thorough explanation of bidirectional procedures

Note: the number of PVCs that can be supported by Annex A is limited by the maximum frame size that can be supported by the user device and the network on the bearer channel (e.g. when the maximum frame relay information field size is 1600 octets, then a maximum of 317 PVC STATUS information elements may be encoded in the STATUS message).

2.3.2 Switched Virtual Connection (SVC) Procedures

Refer to FRF.4.1, Frame Relay SVC UNI Implementation Agreement.

2.3.3 Error Conditions

Error conditions are handled as described in section A.5 of Q.933.

ANNEX A ENHANCED PVC MANAGEMENT PROCEDURES TO INCREASE THE NUMBER OF PVCS IN FULL STATUS REPORTS

(NORMATIVE)

The PVC management procedures, as defined in section 2.3.1 of this implementation agreement, are based on the procedures of Q.933 Annex A. The section 2.3.1 procedures are limited to reporting status on a limited number of PVCs: "the number of PVCs that can be supported by Q.933 Annex A is limited by the maximum frame size that can be supported by the user device and the network on the bearer channel." These enhancement procedures are required to support "any number of" (e.g., greater than 1024) PVCs per bearer channel.

This annex defines optional enhanced PVC management procedures to increase the number of PVCs in Full Status reports.

When the number of PVCs cannot be supported by the maximum frame size, the enhanced procedures defined in this annex are to be supported by both the user device and the network. The enhanced procedures add a new Full Status Continued report type to the Report Type Information Element in order to segment the Full Status message. The user device transmits Full Status Enquiries to obtain status on additional PVCs. The sequence of messages is shown in Figure A-1.

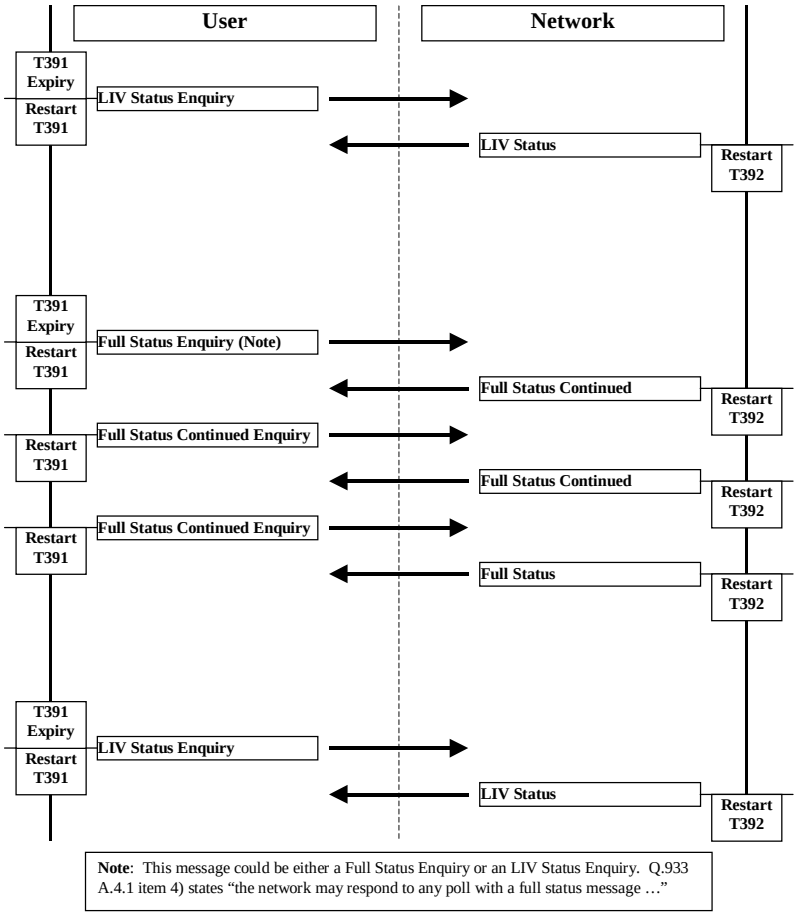


Figure A-1. Full Status *Continued* Enquiry Operation

In Figure A-1, the user initially queries for Full Status using the existing Full Status report type. If the network is unable to fit status for all PVCs within a single response, its response report type is set to Full Status *Continued*. The user then continues its enquiries using the Full Status *Continued* report type until it receives a "plain" Full Status

response indicating that status for all PVCs has been reported.

Note that these enhanced procedures are backward-compatible with devices that only support section 2.3.1 and that can fit status for all PVCs within a single Full Status message: the first Full Status Enquiry and its Full Status response would use the Full Status report type.

Modifications to the Q.933 Annex A messages, information elements, and procedures to support the enhanced procedures are defined in the following sections. The section numbers used in this annex are aligned with those of Q.933 Annex A. Changes to Q.933 Annex A tables are highlighted with **bold** words.

A.1 MESSAGES USED FOR PVC STATUS

No changes.

A.1.1 STATUS

No changes.

A.1.2 STATUS ENQUIRY

No changes.

A.2 INFORMATION ELEMENTS

A.2.1 Protocol discriminator

No changes.

A.2.2 Call reference

No changes.

A.2.3 Message type

No changes.

A.3 INFORMATION ELEMENTS

A.3.1 Report type

The report type of *full status continued* is added for the enhanced procedures.

8	7	6	5	4	3	2	1	Octet
0	report type 1	0	1	0	0	0	1 information element identifier	1
Length of report type contents								2
Type of report								3

Type of report (octet 3)

Bits

8765 4321

0000 0000 Full status (status of all PVCs on the bearer channel)

0000 0001 Link integrity verification only

0000 0010 Single PVC asynchronous status

0000 0011 Update PVC status

0000 0100 Full status continued (status of all PVCs do not fit within a single frame)

All other values are reserved.

Figure A-2. Report Type Information Element (FIGURE A.1/Q.933)

A.3.2 Link integrity verification

No changes.

A.3.3 PVC status

No changes.

A.4 PROCEDURES

No changes.

A.4.1 Periodic polling

Add the following to item 2):
The expiry of T391 will initiate sending of either the *link integrity verification status only* or the *full status* STATUS ENQUIRY. That is, every N391 expiries of T391 will initiate sending of the *full status* STATUS ENQUIRY – the remaining (N391-1) expiries will initiate sending of the *link integrity verification only* STATUS ENQUIRY. Sending of the *full status continued* STATUS ENQUIRY has no effect on the N391 count.

Add the following to item 3):
If the network cannot fit PVC status information elements for all PVCs in a single *full status* STATUS message, the network responds with a *full status continued* STATUS message, containing as many PVC status information elements as allowed by the message size.

The network responds to a *full status continued* STATUS ENQUIRY with a *full status* STATUS or *full status continued* STATUS message starting at the next DLCI that follows the last PVC Status IE reported by the network in the previous STATUS message. The *full status* STATUS response is sent when the network can fit all remaining PVC Status IEs in the STATUS message.

Replace item 4) with:
The user equipment shall parse the STATUS message depending on the type of report. The network may respond to any poll with a *full status* or a *full status continued* message in case of a PVC status change or to report a newly added PVC on the bearer channel. If it is a *full status*, or *full status continuted* STATUS message, the user equipment should update the status of each configured PVC.

Upon receipt of a *full status continued* STATUS message, the user equipment shall continue to request PVC status by sending a *full status continued* STATUS ENQUIRY message (without waiting for the next T391 interval). The

user equipment will restart timer T391 each time it transmits a *full status continued* STATUS ENQUIRY message.

When the network responds with a *full status* STATUS message, the user shall consider all PVC Status IEs reported.

Add the following to item 5):
For each *full status continued* STATUS message, the user equipment shall interpret omission of a previously reported PVC ***up to the last DLCI received in the last PVC Status IE of that full status continued* STATUS *message*** as an indication that the PVC is no longer provisioned. Once the final *full status* STATUS message is received, DLCIs with values greater than the last PVC Status IE can be considered no longer provisioned for the bearer channel.

A.4.2 Link integrity verification

No changes.

A.4.3 Reporting new PVCs

No changes.

A.4.4 Reporting the availability of a PVC

No changes.

A.5 ERROR CONDITIONS

No changes.

A.5.1 Network operation errors

Add to the second bullet of paragraph 2:
This includes the link integrity verification information element received in a *full status continued* STATUS ENQUIRY message.
Add the following information to this section:

In addition,
1) the network shall stop timer T392 when an *link integrity verification only*, *full status*, or *full status continued* STATUS ENQUIRY is received; and
2) the network shall start timer T392 upon sending an *link integrity verification only*, *full status*, or *full status continued* STATUS response message.

A.5.2 User equipment operation errors

Add a to bullet 1 as follows:
Receipt of an *link integrity verification only* STATUS message in response to a *full status continued* STATUS ENQUIRY is considered an errored event; in addition, no *full status continued* STATUS ENQUIRY message is to be issued. At the next T391 expiry, the *full status* STATUS ENQUIRY procedure is reinitiated (rather than *link integrity verification only* STATUS ENQUIRY).

Replace the second bullet with: :
Upon receipt of an unsolicited STATUS message with type of report set to *full status, full status continued* or *link integrity verification,* the message shall be ignored, and the error count shall be incremented.

Replace the third bullet, first sentence as follows:
Non-receipt of a STATUS message with report type equal to *link integrity verification only, full status,* or *full status continued* in a polling interval (within T391 seconds) after transmission of a STATUS ENQUIRY.

Add to fourth bullet as follows:
The PVC Status IEs received in a *full status continued* STATUS message containing an invalid receive sequence

number will not be processed; in addition, no *full status continued* STATUS ENQUIRY message is to be issued.. At the next T391 expiry, the *full status* STATUS ENQUIRY procedure is reinitiated (rather than *link integrity verification only* STATUS ENQUIRY).

Add a fifth bullet as follows:
If the *full status* or *full status continued* STATUS response to a *full status continued* STATUS ENQUIRY message indicates a lower-valued DLCI than the highest reported in the previous *full status continued* STATUS, this shall be considered an errored event and the PVC Status IEs contained will not be processed. In addition, no *full status continued* STATUS ENQUIRY message is to be issued.. At the next T391 expiry, the *full status* STATUS ENQUIRY procedure is reinitiated (rather than *link integrity verification only* STATUS ENQUIRY).

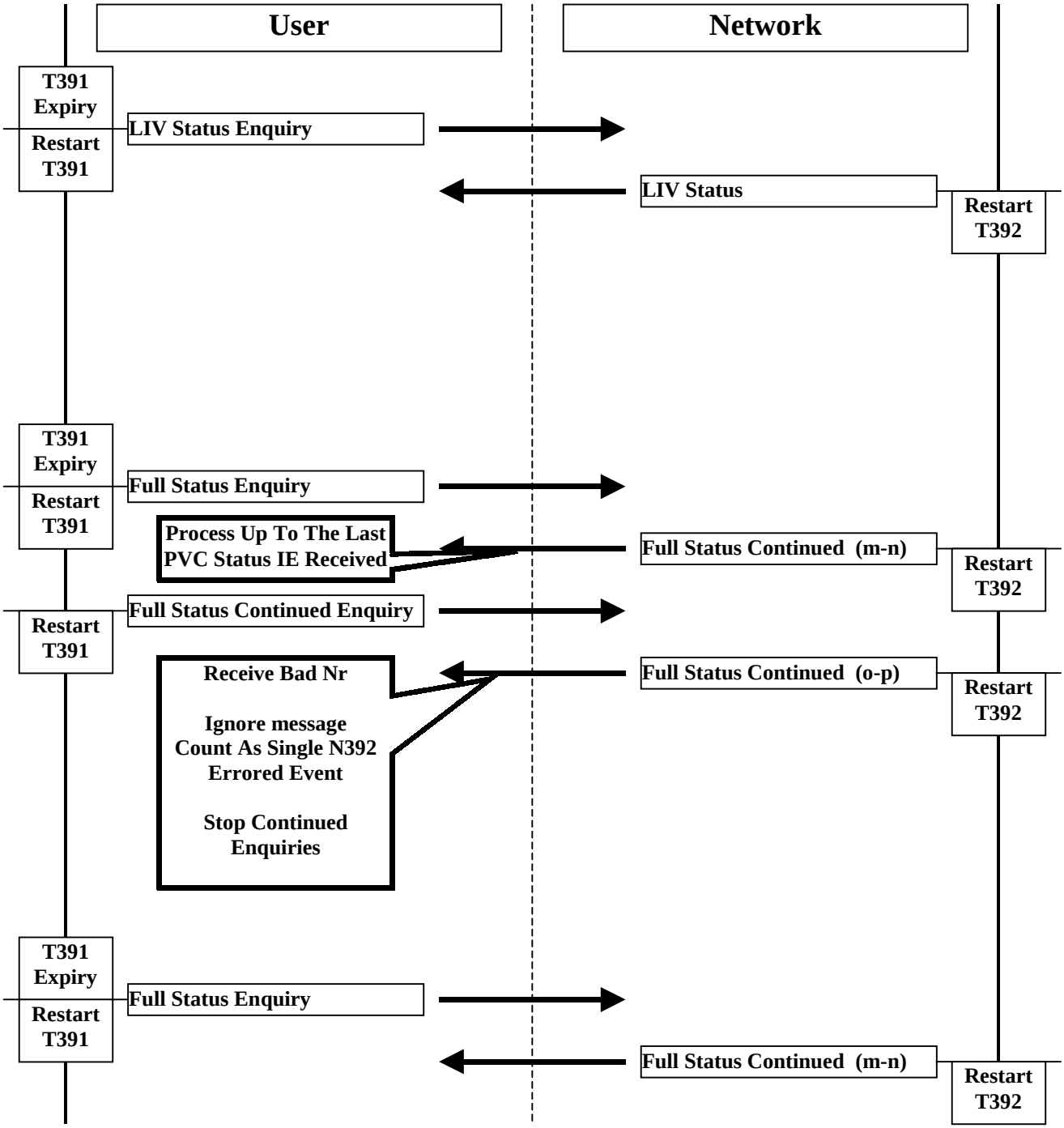
A.6 OPTIONAL BIDIRECTIONAL NETWORK PROCEDURES

The enhanced procedures supporting signaling of the full status continued STATUS and STATUS ENQUIRY messages may also apply to the optional bidirectional network procedures. As with the user-to-network interface, both sides of the interface must support the enhanced procedures to support a large number of PVCs.

A.7 SYSTEM PARAMETERS

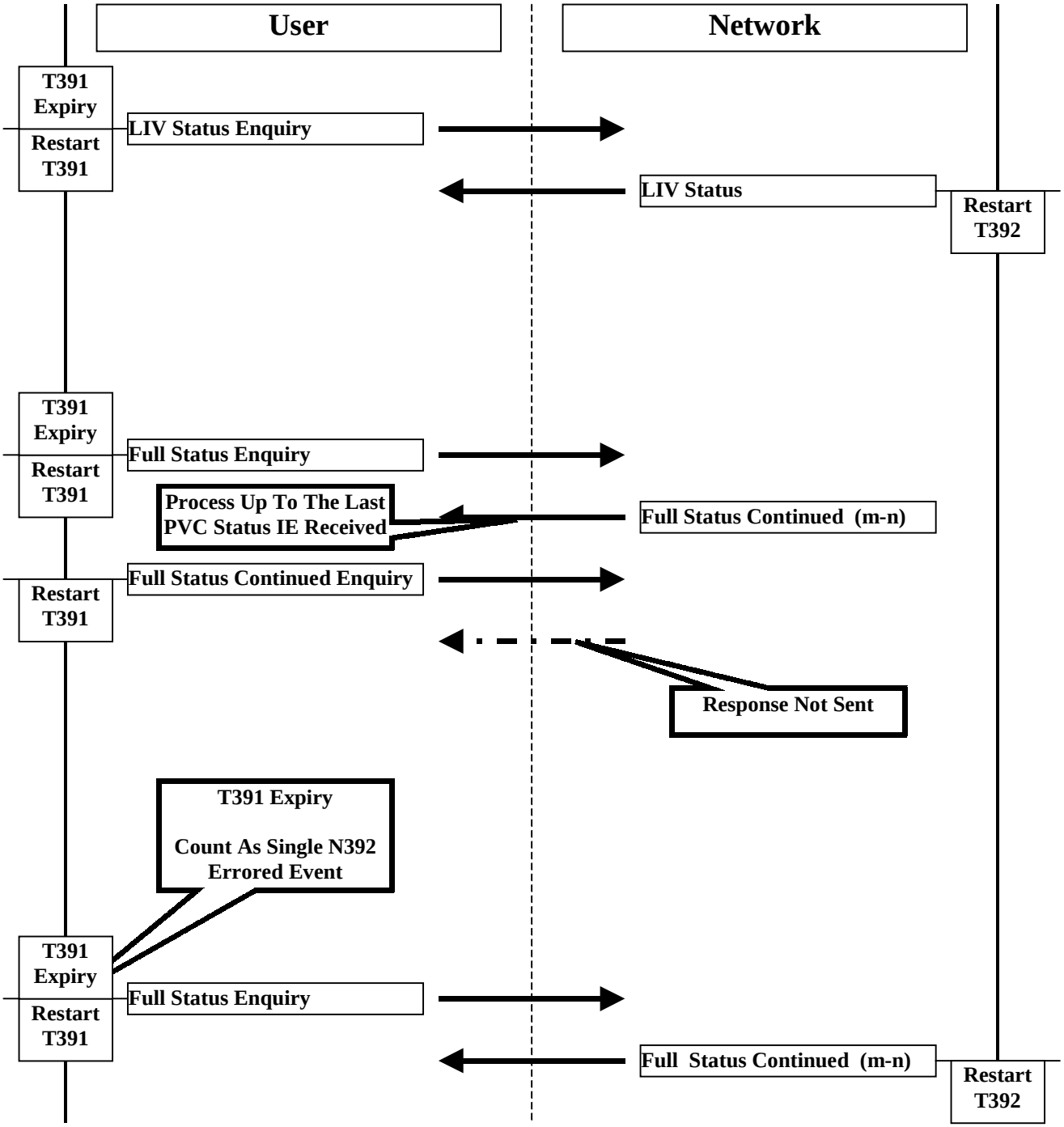
The maximum frame relay information field size defined in section 2.2.2 of this implementation agreement (default value of 1600 octets) shall also apply to the maximum size of the Full Status message.

The following figures are provided to illustrate operation under error conditions.



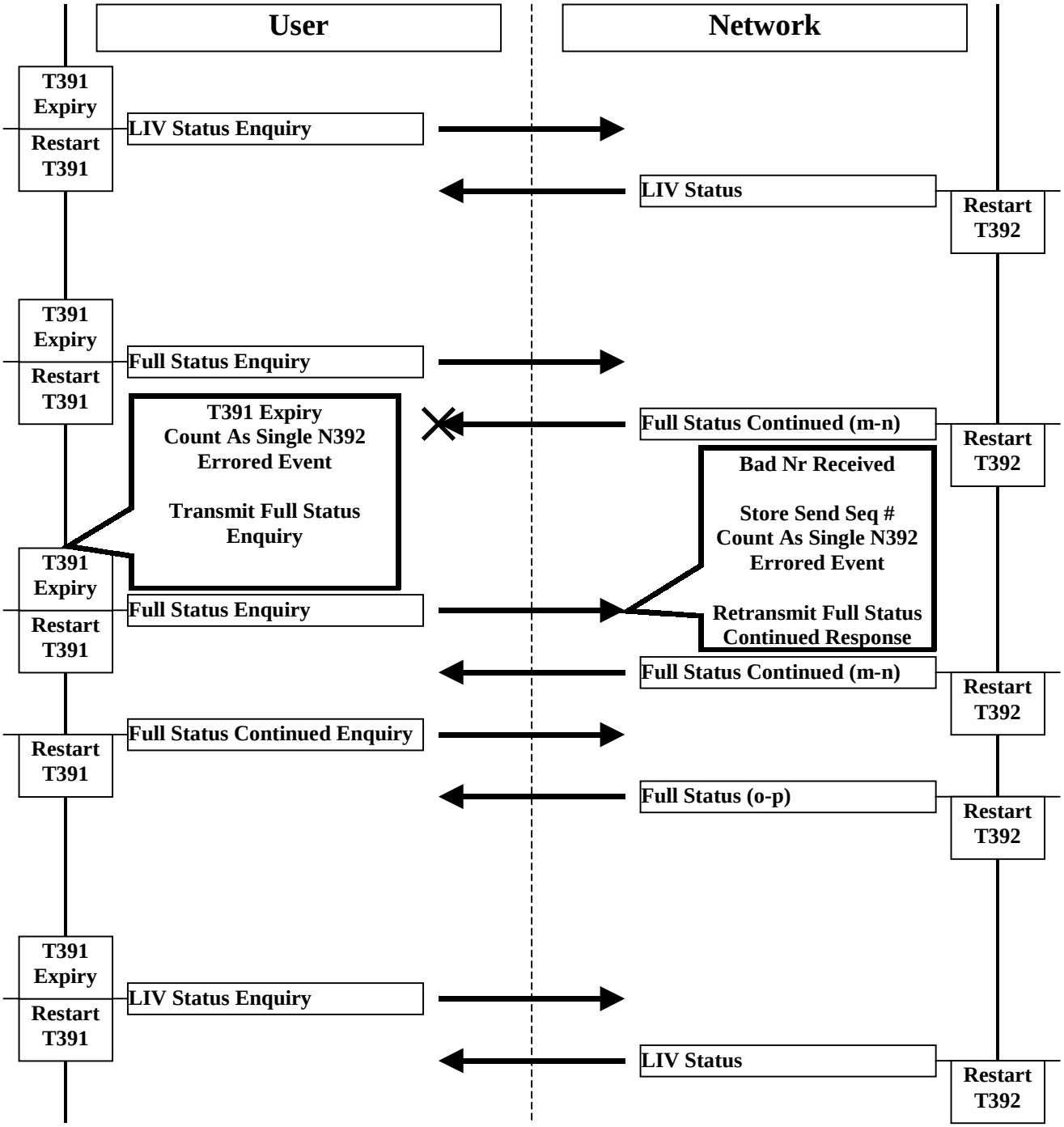
(m-n) : PVC Status IEs for DLCIs *m* thru *n*

Figure A-3. User Receives Errored Full Status *Continued* Response



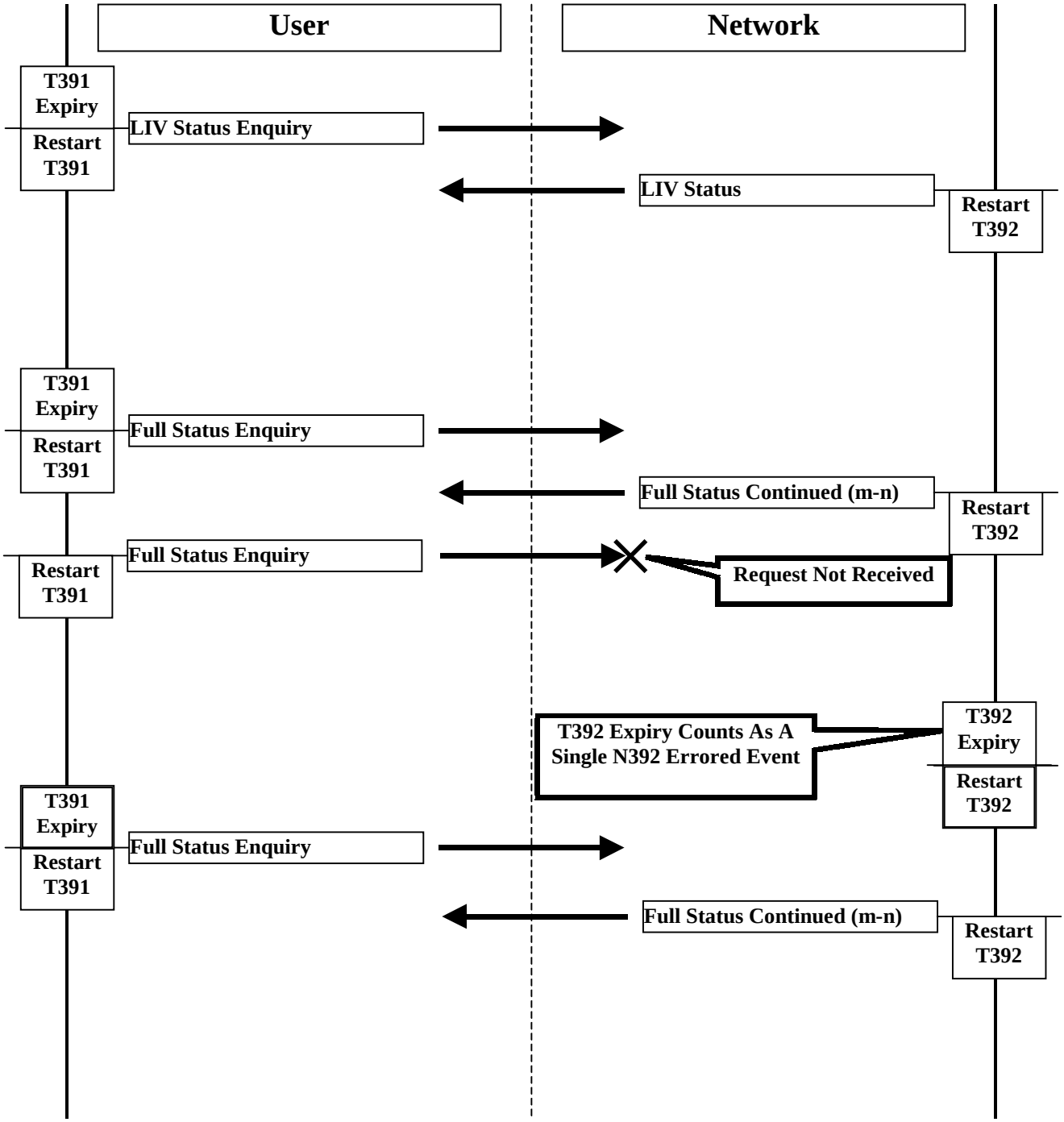
(m-n) : PVC Status IEs for DLCIs *m* thru *n*

Figure A-4. User T391 Expiry On Full Status *Continued* Response



(m-n) : PVC Status IEs for DLCIs *m* thru *n*

Figure A-5. Network Receives Errored Full Status *Continued* Enquiry



(m-n) : PVC Status IEs for DLCIs *m* thru *n*

Figure A-6. Network T392 Expiry

ANNEX B ENHANCEMENTS TO PVC STATUS MANAGEMENT TO TRANSFER CONFIGURATION PARAMETERS FROM THE NETWORK TO THE USER

(NORMATIVE)

The Q.933 frame relay PVC management procedures provide for transmission of a list of DLCIs provisioned on a User-to-Network Interface (UNI) in Full Status messages sent from the network to the user device. The information included in the Q.933 Full Status message is restricted to the status of the PVC (e.g. available). This optional annex extends the information reported in the Full Status message to include provisioned attributes of maximum frame size, throughput (i.e. CIR), burst size, excess burst size, transfer priority, discard priority, and service class. This additional information enables automatic configuration of user device operation based upon the network configuration. When reported through network management systems, the additional information can be used to detect improperly provisioned interfaces.

The procedures of this annex are backward compatible with the Q.933 PVC status procedures. As required in Q.931 section 5.8 error handling procedures, user devices that do not support this annex must discard the unrecognized information and continue to process the remainder of the message.

When this annex is used the maximum number of PVCs reported in a single STATUS message may be reduced for a given frame size. Because of the additional information element overhead, included in the STATUS message, not all PVCs reported in one STATUS message without parameters, may be reported in one STATUS message with parameters. The procedures of Annex A may be needed to report all PVCs on an interface when this annex is used. See section B.8 for examples of when Annex A may be used.

The capability defined in this annex is enabled on a network device through provisioning mechanisms of the network's element management system. The capability is enabled on a user device through provisioning mechanisms or as an automatic response to the presence of the new information elements in the Full Status message.

B.1 REFERENCE MODEL

This annex describes the flow of information from the network to the user from the perspective of the user device. Refer to Figure 1for an illustration of the message terminology.

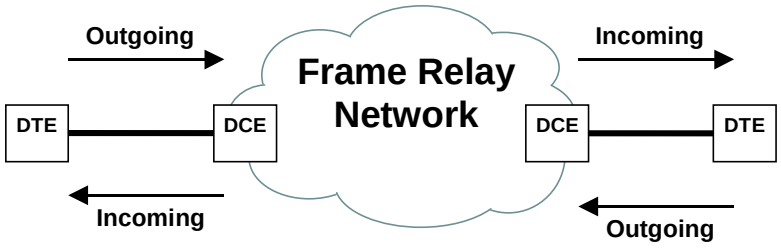


Figure 1 – Reference Model

B.2 PROCEDURE OVERVIEW

The normative procedure followed by implementations claiming support for this annex is described in Section B.3, Extensions to Q.933 Annex A. This overview provides an informative description of the procedures. If there is a discrepancy between this text and the text in section B.3, the text in section xxx shall apply.

The additional configuration information is transmitted by the DCE when:

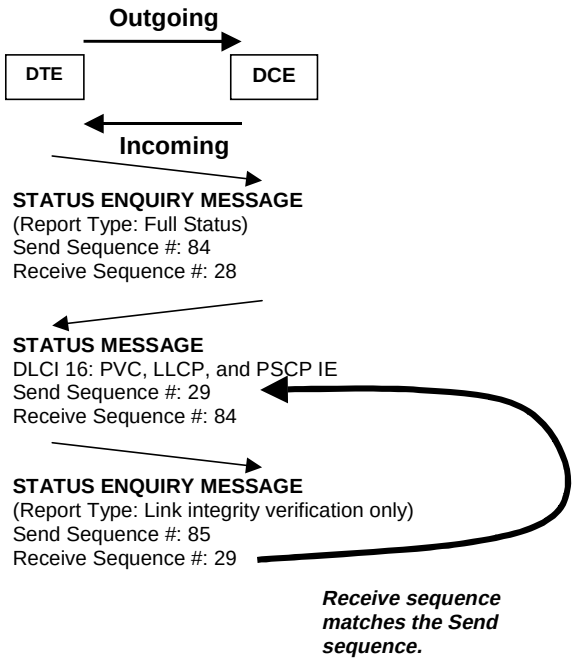
- a PVC is created,

- a PVC configuration is changed, and
- following recovery from a service affecting condition.

The additional information is transmitted to the DTE in a Full Status message sent by the DCE in response to a received Status Enquiry message. This information is encoded in two additional information elements: The Link Layer Core Parameters (LLCP) IE and the Priority and Service Class Parameters (PSCP) IE. The LLCP IE and the PSCP IE follow the PVC Status IE. A description of the LLCP IE and the PSCP IE is provided in [X.36].

To guarantee delivery of the additional configuration information, the additional information elements are transmitted in every Full Status message until the delivery of the additional information is confirmed through comparison of Send and Receive sequence numbers. The DCE will stop transmitting the additional information elements only when a DTE-originated Status Enquiry message is received that contains a Receive sequence number that equals a Send sequence number that tracks the previously transmitted Full Status message containing the additional information elements. See Figure 2 for an illustration of an acknowledge delivery.

Figure 2 - Confirmed Delivery of Additional Configuration Information



The presence of additional configuration information may result in a segmentation of the STATUS MESSAGE using the procedures described in Annex A, Enhanced PVC Management Procedures To Increase The Number Of PVCs In Full Status Reports. In the event of a segmented STATUS MESSAGE, the three information elements describing one PVC (i.e. the PVC Status, LLCP, and PSCP IEs) must be contained in the same STATUS MESSAGE segment.

DTEs that do not support Annex A may be limited in the number of PVCs that can be reported if the parameters from this annex are included. Table xxx shows the number of PVCs that may be reported given a particular frame size. To support more than the number of PVCs shown for a particular parameter combination, the procedures of Annex A must be used.

B.3 EXTENSIONS TO Q.933 ANNEX A

This Annex extends the messages and procedures of Q.933 Annex A. These extensions are shown in the following sections as additions to the base Q.933 Annex A text. The sub-section numbers used in this annex are aligned with those of Q.933 Annex A. Additions are shown in **bold characters** and deletions are shown as ~~struck text~~. Editorial instructions are *italicized.*

Q.933 Annex A introductory text is modified as follows: A new item, item e) is added to the list of items.

e) Communication of PVC attributes

B.3.1 Messages used for PVC status

No changes.

B.3.1.1 STATUS

The following IEs are added after the PVC status IE as shown in the following Table:

TABLE A.1/Q.933

Information element	Reference	Direction	Type	Length
Link layer core parameters	**B.3.3.1/FRF.1.2**	**n to u**	**O (Notes 4, 5,6)**	**18**
Priority and service class parameters	**B.3.3.2/FRF.1.2**	**n to u**	**O (Notes 4, 5, 7)**	**6**

NOTES

4. Included in the case of a full status and single PVC asynchronous statusmessages under conditions specified in the procedures. The Link layer core parameters and the Priority and service class parameters information elements refer to the PVC described in the previous PVC status information element. The following three information elements related to a specific PVC must appear in the following order when present: PVC status, Link layer core parameters and Priority and service class parameters information elements.

5. The information elements for a specific PVC must be contained within a single frame relay frame.

6. Included by the network to report PVC parameters to the user.

7. Included by the network to report priority or service classes information to the user.

B.3.1.2 STATUS ENQUIRY

No changes.

B.3.2 Information elements

B.3.2.1 Protocol discriminator

No changes.

B.3.2.2 Call reference

No changes.

B.3.2.3 Message type

No changes.

B.3.3 Information elements

Add the following two information elements:

B.3.3.1 Link layer core parameters

This is a new section not in Annex A of Q.933. It is part of the information elements used for SVC defined in Section 4.5.19 of Q.933.

The purpose of the Link layer core parameters information element is to indicate the provisioned parameters for a PVC in terms of:

1. **The maximum frame size**
2. **The committed information rate**
3. **The committed burst size**
4. **The excess burst size**

Only the "outgoing" provisioned parameters parameters are mandatory to report to the user the at the local UNI. The parameters represent the values to be used in the user to network direction. The "incoming" parameters are optional. An incoming parameter is included if it differs from the corresponding outgoing parameter and if it is available at the network side of the local UNI. The minimum acceptable throughput (octet group 5) is not used. The encoding of the LLCP IE is according to Q.933.

When the user receives this information element, it shall update the core parameter parameters for the specified PVC.

The maximum length of this information element is 26 octets.

B.3.3.2 Priority and service class parameters

This is a new section not in Annex A of Q.933. The Priority and service class parameters IE is used for SVC and is defined in Recommendation X.36.

The purpose of the Priority and Service Class information element is to indicate the provisioned parameters for a PVC in terms of:

1. **Transfer Priority**
2. **Service Classes**

The purpose of the Priority and service class parameters information element is to identify the transfer and discard priority indices or the service class to be used in the user to network direction. Only the "outgoing" parameters are mandatory to report to the user the provisioned priority parameters for the local UNI. The "incoming" parameters are optional. When the network does not provide configuration information for the "incoming" parameters, the parameters must be encoded with zeroes. **The network may include an incoming parameter if it differs from the corresponding outgoing value and if they are available at the network side of the local UNI.**

When the user receives this information element, it shall update the priority or service class parameters for the specified PVC.

The maximum length of this information element is 6 octets when the priority indices are included and 4 when a service class is used. Either the priority indices or a service class is/are included.

B.3.4 Procedures

No changes.

B.3.4.1 Periodic polling

Item 3 is modified as followed:

3) The network responds to each STATUS ENQUIRY message with a STATUS message and resets the T392 timer, which is used by the network to detect errors (see A.5). If the STATUS ENQUIRY requests full status, it must be responded to with a STATUS message with the type of report specifying full status. The STATUS message sent in response to a STATUS ENQUIRY contains the link integrity verification and report type information elements. If the content of the report type information element specifies *full status*, then the STATUS message must contain one PVC status information element for each PVC configured on the bearer channel. **For some PVCs the following information elements shall be included: The Link layer core parameters and/or the Priority and service class parameters. The conditions under which the additional information elements are included for a PVC are provided in the subsequent sections.**

B.3.4.2 Link integrity verification

No changes.

B.3.4.3 Reporting new PVCs

Items 1 and 2 are modified as followed:

1) When a new permanent virtual circuit has been added, the network sets the new bit to 1 in the PVC status information element. **The link layer core parameters information element and/or the Priority and service class parameters information element** for that PVC are sent in a full STATUS message.
2) The network shall not clear the new bit in the PVC status information element until it receives a STATUS ENQUIRY message containing a receive sequence number equal to the send sequence counter (i.e. the send sequence number transmitted in the last STATUS message). **Furthermore, the network shall retransmit the link layer core parameters and/or the Priority and service class parameters information elements until it receives a STATUS ENQUIRY message containing a receive sequence number equal to the send sequence number counter.**

B.3.4.4 Reporting the availability of a PVC

This section is modified with the following new paragraphs added after the first paragraph:

When a PVC goes from the inactive state to the active state the network shall include the following information elements after the corresponding PVC status information element: The link layer core parameters and/or the Priority and service class parameters.

In addition to the transition from inactive to active, the Link layer core parameters and/or the Priority and service class parameters information elements must be included for each PVC that satisfies one or more of the following conditions:

- **One or more of the Link layer core parameters or the Priority and service class parameters have changed. The entire set of parameters for the PVC are specified.**
- **Service restoration has occurred from a service affecting condition (e.g. detection of DTE restart (i.e., the receive sequence number in the STATUS ENQUIRY = 0), a link going down and up, or the re-initialization of the PVC management process at the DCE), and**
- **Delivery of a previously transmitted full STATUS message containing the LLCP and PSCP IEs has not been acknowledged through receipt of a STATUS ENQUIRY message containing a Receive sequence number equal to the Send sequence number for the previously transmitted STATUS message.**

If *single PVC asynchronous status* is used on the interface, the parameters are reported in the asynchronous STATUS messages. The parameters for a PVC are repeated in the subsequent full status messages until

acknowledged.

The network shall retransmit the link layer core parameters and the Priority and service class parameters information elements until it receives a STATUS ENQUIRY message containing a receive sequence number equal to the send sequence number counter.

B.3.5 Error conditions

The following item is added at the end of the list:

- **The link layer core parameters and the Priority and service class parameters information elements are ignored if the user receives them and does not recognize them.**

B.3.5.1 Network operation errors

No changes.

B.3.5.2 User equipment operation errors

The following items is added at the end of the list:

- **If an LLCP or an PSCP IE is present in a STATUS message without a preceeding PVC STATUS IE, the STATUS message contains a protocol error and is handled by the appropriate error handling procedures.**
- **Q.931 error handling procedures for unrecognized information elements are performed when a user side receives the LLCP or PSCP IE and does not recognize them.**

B.3.6 Optional bi-directional network procedures

Transmission of the LLCP and PSCP IEs in STATUS messages exchanged during bi-directional procedures is for further study.

B.3.7 System parameters

No changes.

B.4 EXAMPLE: CALCULATION OF MAXIMUM PVCS PER STATUS MESSAGE

Table 1 – Maximum Information Element Lengths

Element	Maximum Length	Description/Notes
STATUS message overhead	10 octets	Protocol Discriminator (1), Dummy Call Reference (1), Message Type (1), Report Type (3), Link Integrity Verification (4). These procedures will only be supported with Q.933 Annex A so there is no locking shift.
PVC Status IE	5 octets	per PVC (assuming 2 octet DLCI with range 16-991. Length= 7 octets for 4 octet DLCI format)
Link Layer Core Parameter IE	26 octets	max per PVC (all parameters signaled for each direction w/ magnitudes)
Service Class/Priority IE	6 octets	max per PVC (transfer priority or service class signaled with discard priority)

The table above shows the maximum sizes of the STATUS message information elements and overhead. Except for the STATUS message overhead, each of the information elements, if applicable, is repeated per PVC. The frame size will constrain the number of PVCs reported per STATUS message. The table below shows examples of the number of PVCs that may be reported in a single STATUS message.

Table 2 - Max number of PVCs before Annex A Procedures are needed

Max Frame Size for PVC Signaling	Max number of PVCs without connection parameters	Max number of PVCs with both connection parameters	Max number of PVCs with LLCP parameters only	Max number of PVCs with PSCP parameters only
Msg Overhead	10	10	10	10
Cost per PVC	5	37	31	11
100	18	2	2	8
500	98	13	15	44
1024	202	27	32	92
1600	318	42	51	144
2048	407	55	65	185
3072	612	82	98	278
4096	817	110	131	371
8192	976	221	263	743

Note: 976 is the maximum number of PVCs allowed using a 2 octet DLCI.

The general formula is:

MaxNumber of PVCs = MIN((maxDLCI-minDLCI+1),TRUNC((MaxFrameSize-MsgOverhead)/(CostPerPVC)))

APPENDIX A HANDLING OF PHYSICAL LAYER LOOPBACK CONDITIONS WHEN USING FRAME RELAY PVC BI-DIRECTIONAL PROCEDURES

(INFORMATIVE)

A. Recommended procedures for equipment that can detect loopback at the physical layer:

Frame relay equipment that can detect physical layer loopback conditions should internally remove the interface from service during a physical layer loopback condition. It is strongly recommended that the equipment declare a service affecting condition at the frame relay interface for the duration of the loopback condition.

B. Recommended procedures for equipment that cannot detect loopback at the physical layer:

Frame relay equipment that cannot detect loopback at the physical layer may do the following sequence number processing at the frame relay layer to handle a loopback condition. The term "message" in the following text refers to the STATUS and / or STATUS ENQUIRY messages of the revised ITU Q.933 Annex A procedures.

Note: The frame relay procedures cannot detect the loopback is occurring at the physical layer. They only detect there is a loopback condition somewhere on the interface.

The equipment suspects a loopback condition exists if the send sequence number on a message received by a procedure is equal to the send sequence count of the opposite procedure, (i.e. if the send sequence number of a received STATUS is equal to the send sequence count of the equipment's network procedures, or if the send sequence number of a received STATUS ENQUIRY is equal to the send sequence count of the equipment's user procedures). A message meeting this condition is discarded. The equipment then attempts to confirm the loopback condition.

Note: When both devices on an interface start with the same send sequence number, it produces an initial false loopback condition. It is strongly recommended that the send sequence counts for the user and network procedures of both devices be initialized to unique values. This significantly reduces the probability of an initial false loopback condition.

The procedure that suspects a loopback condition confirms it by incrementing its send sequence count by a value that may be fixed or randomly generated before it sends the next message, (i.e. If the user procedures suspect loopback, the send sequence number of the next STATUS ENQUIRY is incremented by this value. If the network procedures suspect loopback, the send sequence number of the STATUS response is incremented by this value.) A bilateral agreement should be reached to ensure that both devices on the interface do not use the same fixed value or same random number. If the next message received by the procedure opposite the one suspecting the loopback condition contains a send sequence number that matches the incremented send sequence count, the loopback condition is confirmed. The message with the matching send sequence number is discarded.

Once the loopback condition is confirmed, each message received that meets the loopback condition is discarded. This results in a service affecting condition until the loopback condition is cleared.

The equipment detects that the loopback has been cleared when it receives N392 consecutive messages where the send sequence number of the received message does not match the send sequence count of the opposite procedures.