The Frame Relay Forum
User-to-Network Implementation Agreement (UNI)

FRF 1.1

Frame Relay Forum Technical Committee

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Revision History

Version	Changes
FRF 1	baseline document
FRF 1.1	addition of high speed physical interfaces addition of optional loopback detection procedures

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** — 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. Recommendation Q.921, Digital Subscriber Signaling System No. 1 (DSS 1), Data Link Layer
4. Recommendation Q.933, ISDN Signaling Specification for Frame Mode Bearer Services, ITU, Geneva, 1991.
5. Revised ITU Recommendation Q.933, ISDN Signaling Specifications for Frame Mode Switched and Permanent Virtual Connections Control and Status Monitoring, ITU, Geneva, 1995.
6. FRF.4, Frame Relay UNI SVC Implementation Agreement, Frame Relay Forum
7. ANSI/EIA/TIA-530-A-1992, High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment, Including Alternative 26-Position Connector.
8. ITU Recommendation V.24, List of Definitions For Interchange Circuits Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE).
9. EIA-422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
10. ISO 2110:1989/Amd. 1:1991, 25-Pole DTE/DCE Interface Connector and Contact Number Assignments
11. ANSI T1.107a - Digital hierarchy - supplement to formats specifications (DS3 format applications), 1990.

12. ANSI T1.403 - Carrier to Customer Installation DS1 Metallic Interface, 1989.

13. ANSI/TIA/EIA-612-1993, Electrical Characteristics for an Interface at Data Signaling Rates up to 52 Mbit/s.

14. ANSI/TIA/EIA/-613-1993, High Speed Serial Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment.

15. ITU Recommendation G.703 - Physical/electrical characteristics of hierarchical digital interfaces, 1988.

16. ITU Recommendation G.704 - Synchronous Frame Structures used at Primary and Secondary Hierarchical Levels

17. ITU Recommendation I.370 - Congestion Management for the ISDN Frame Relaying Bearer Service, 1991.

18. ISO/IEC 2593 - 1993 Information technology - Telecommunications and information exchange between systems - 34 pole DTE/DCE interface connector mateability dimensions and contact number assignments.

19. ISO/IEC 4902 - 1989 Information technology - Data communication - 37 pole DTE/DCE interface connector and contact number assignments.

20. ISO/IEC 4903 - 1989 Information technology - Data communication - 15 pole DTE/DCE interface connector and contact number assignments.

21. ITU Recommendation V.11 - Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s.

22. ITU Recommendation V.24 - List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).

23. ITU Recommendation V.28 - Electrical characteristics for unbalanced double-current interchange circuits.

24. ITU Recommendation V.35 - Data transmission at 48 kilobits per second using 60-108 kHz Group Band Circuits.

25. ITU Recommendation V.36 - Modems for synchronous data transmission using 60-108 kHz group band circuits.

26. ITU Recommendation V.37 - Synchronous data transmission at a data signalling rate higher than 72 kbit/s using 60-108 kHz group band circuits.

27. ITU Recommendation X.21 - Interface between data terminal equipment and data circuit-terminating equipment for synchronous operation on public data networks.

28. ITU Recommendation X.27 - Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.

2 IMPLEMENTATION AGREEMENTS

2.1 PHYSICAL LAYER INTERFACES GUIDELINES

The recommended physical layer Interfaces supported by the Frame Relay network equipment are based on American National Standards and ITU (International Telecommunication Union) Recommendations. This section provides a description of the recommended physical layer interfaces that may be supported by a frame relay equipment. This section is not intended to be used for frame relay conformance testing. Interfaces other than those listed below may be used

when appropriate (e.g., ISDN, etc.). If the recommended interfaces are used they should be used as follows.

2.1.1 ANSI T1.403 - 1989 Carrier To Customer Installation DS1 Metallic Interface.

This specification will be followed, with the following exceptions:

1. Section 2.2 - Other Publications: The reference to ITU, Red Book Q.921 Recommendation is replaced by "ITU, Blue Book Vol. VI - Fascicle VI.10, Recommendation Q.921, Digital Subscriber Signaling System No. 1 (DSS 1), Data Link Layer".
2. Section 5.3.1 - Transmission Rate: The rate variation up to +/- 200 bit/s is not applicable.
3. Section 6.1 - Framing Format General: The Superframe (SF) format is not applicable.
4. Section 6.3 - Superframe Format: This section is not applicable.
5. Section 7 - Clear Channel Capability: The text in this section is replaced by the following: To provide DS1 Clear Channel Capability (CCC), a DS1 signal with unconstrained information bits is altered to meet the pulse density requirement of 5.6. The method used to provide DS1 CCC is B8ZS. This method shall be used in both directions of transmission.
6. Section 8 - Maintenance: The mention of SF format and the associated note 4 is not applicable.
7. Section 8.1 - Yellow Alarm - Item 1 of the list (Superframe format) and associated note 5 are not applicable. In the same section; item 3 of the list, is applicable to ESF only.
8. Section 8.3.1.1 - Line Loopback Using the SF Format: This section including note 6 is not applicable.
9. Section 8.4.3.3 - Format of Message-Oriented Performance Report: The sentence before last: "Throughput of the data link may be reduced to less than 4K bit/s in some cases" is not applicable.
10. Section 8.4.5 - Special Carrier Applications: Item 3 of the list and note 12 are not applicable.
11. Table 2 - Superframe Format: This table is not applicable.
12. Table 3 - Extended Superframe Format: The portion of the table "Signaling Bit Use Options" and notes related to Option T. Option 2, 4, and 16 are not applicable.

2.1.2 ITU Recommendation V.35

The interface specifications are as follows:

- Electrical characteristics according to ITU Recommendations V.35 and V.28;
- Connector and pin assignment according to ISO 2593 and;
- Interchange circuit definitions according to ITU Recommendation V.24.

2.1.3 ITU Recommendation G.703 (2048 kbit/s)

Applicable sections of this specification are as follows:

1. Introduction: Except those references which are to 1544 kbit/s.
2. Section 6: Interface at 2048 kbit/s.
3. Annex A: Definition of codes.
4. Annex B: Specification of the over voltage protection requirement.

In addition, when the 75 ohm interface is implemented, the transmit BNC connector should be labeled TFC OUT and the receive BNC connector shall be labeled TFC IN.

2.1.4 ITU Recommendation G.704 (2048 kbit/s)

Applicable sections of this specification are as follows:

1. General.
2. Section 2.3: Basic frame structure at 2040 kbit/s.
3. Section 5: Characteristics of frame structures carrying channels at various bit rates in 2048 kbit/s interfaces.
4. Annex A.3: CRC-4 procedure for interface at 2048 kbit/s.

Note that section 1. General specifies the electrical interface characteristics to be G.703.

2.1.5 ITU Recommendation X.21

This unstructured interface uses the leased line (i.e., point to point) subset of the X.21 Recommendation. The interface specifications are as follows:

- Electrical characteristics according to ITU Recommendation X.27 (V.11);
- Connector and pin assignment according to ISO 4903, and;
- Interchange circuit definitions according to ITU Recommendation X.24.

2.1.6 ANSI-530-A-1992

The ANSI/EIA/TIA-530-A-1992 standard, High Speed 25-Position Interface for Data TerminalEquipment and Data Circuit-Terminating Equipment, Including Alternative 26-Position Connector, specifies the electrical characteristics, connector and interchange circuits suitable for operation at all data rates below 2.1 Mbits/s and is intended for use in all applications requiring a balanced electrical interface. This standard is in alignment with ITU Recommendation V.24, List of Definitions For Interchange Circuits Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) and ISO 2110:1989/Amd. 1:1991, 25-Pole DTE/DCE Interface Connector and Contact Number Assignments. Applicable sections of ANSI/EIA/TIA-530-A-1992 are:

2.1.6.1 Electrical Characteristics

Section 2.1, Electrical Characteristics: The electrical characteristics of the specified balanced interchange circuits SHALL comply with EIA-422-A, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits.*

Section 2.1.1, Category I Circuits: This section identifies the category I interchange circuits and stipulates that use of EIA-422-A balanced electrical characteristics for category I circuits. The requirements of this section and Figure 2.1(a) SHALL apply. Category I interchange circuits CA, CB, CF and CJ are not applicable.

2.1.6.2 Required Balanced Interchange Circuits

The following Category I interchange circuits SHALL be supported:

Circuit BA -- Transmitted Data

Circuit BB -- Received Data

Circuit DA -- Transmit Signal Element Timing, DTE Source

Circuit DB -- Transmit Signal Element Timing, DCE Source

Circuit DD -- Receiver Signal Element Timing, DCE Source

Section 2.3 Shield: The requirements of Section 2.3 SHALL be met.

Section 2.4 Circuit Grounding (Signal Common): The requirements of Section 2.4 and Figure 2.2 SHALL be met.

2.1.6.3 Connector and Pin Assignments

Section 3.1 Definition of Mechanical Interface: The requirements of Section 3.1 and Figure 3.1(a), SHALL apply. The alternative 26-position connector (Alt A) is not applicable.

Section 3.2 25-Position Interface Connector. The requirements of Section 3.2, including Figures 3.2, 3.3, 3.4, 3.5 and 3.6, SHALL apply.

Section 3.4 Connector Contact Assignments. The requirements of Section 3.4 SHALL apply. Applicable connector contact assignments from Figure 3.9 SHALL be implemented as shown below:

Circuit Mnemonic	CCITT Number	Contact Number	Interchange Points	Circuit Name
		1		Shield
AB	102A	7	C-C'	Signal Common
AC	102B	23	C-C'	Signal Common
BA	103	2	A-A'	Transmitted Data
		14	B-B'	
BB	104	3	A-A'	Received Data
		16	B-B'	
DA	113	11	B-B'	Transmit Signal Element Timing DTE Source
		24	A-A'	
DB	114	12	B-B'	Transmit Signal Element Timing DCE Source
		15	A-A'	
DD	115	9	B-B'	Receiver Signal Element Timing DTE Source
		17	A-A'	

TABLE 1: CONNECTOR CONTACT ASSIGNMENTS FOR ANSI-530-A-1992

2.1.7 High Speed Serial Interface (HSSI)

The standard ANSI/TIA/EIA-613-1993 High Speed Serial Interface for DTE and DCE, together with ANSI/TIA/EIA-612-1993, Electrical Characteristics for an Interface at Data Signaling Rates up to 52 Mbit/s, provides for a general purpose DTE-DCE interface for data rates up to a maximum of 53 Mbit/s employing bit-serial data over balanced interchange circuits.

2.1.7.1 Electrical Characteristics

Section 3 of ANSI/TIA/EIA-613, Signal Characteristics (which references ANSI/TIA/EIA-612), shall apply.

2.1.7.2 Required Interchange Circuits

Section 5 of ANSI/TIA/EIA-613, Functional Description Of Interchange Circuits, shall apply with the exception of the following interchange circuits and subsections.

2.1.7.3 Connector and Pin Assignments

Section 4.1 of ANSI/TIA/EIA-613, 50-Position Interface Connector, in its entirety, shall apply.

Section 4.2 of ANSI/TIA/EIA-613, Connector Contact Assignments, shall apply with the following exceptions:

- 107 does not apply
- 108 / 2 does not apply
- 143 does not apply
- 144 does not apply
- 142 does not apply

2.1.8 DS3 Interface (44.736 Mbps) - ANSI T1.107a - 1990, Digital Hierarchy - Formats Specifications:

Applicable sections of this standard are:

1. Section 8.0, Interface rate: The sentence states the nominal bit rate.
2. Section 8.1, DS3 frame structure: All of 8.1 and its subsections.
3. Section 8.2, DS3 Application: M23 multiplex - 7 DS2 Channels: All of section 8.2.
4. Section 8.4, Asynchronous DS3 C-bit Parity: All of 8.4 and its subsections except that section 8.4.7, PMDL is optional.
5. DS3 C-bit Parity - Unchannelized Application: For further study.

2.1.9 E3 Interface (34.368 Mbps) - ITU Recommendation G.703 - 1988 (34.368 Mbps)

Applicable sections of this specification are:

1. Section 8: Interface at 34.368 Mbps
2. Annex A: Definition of codes
3. Annex B: Specification of the overvoltage protection requirement

In addition the transmit BNC connector shall be labeled TFC OUT and the receive BNC connector shall be labeled TFC IN.

2.1.10 ITU V.36 / V.37 (1988) Interface (2-to-10 Mbps)

ITU recommendations V.36 and V.37 specify the same connector (ISO 4902), pin assignments, electrical characteristics, and interchange circuit functions. Therefore, only the V.37 text is referenced below. Applicable sections of V.37 are:

2.1.10.1 Section 13.1, List of interchange circuits:

Support of the following balanced interchange circuits is required. Note 4 is ignored.

- 103 Transmitted data
- 104 Received data
- 113 Transmitter signal element timing (DTE source)
- 114 Transmitter signal element timing (DCE source)

- 115 Receiver signal element timing (DCE source)

2.1.10.2 Section 13.2, Electrical Characteristics:

The following text applies:

- Use of electrical characteristics conforming to Recommendation V.11 is required.

2.1.10.3 Connector:

Section 13.2 specifies the 37-pin-D ISO 4902 connector. ISO 2110 amendment 1, 1991, specifies the 25-pin-D connector and the mapping of V.36/V.37 ISO 4902 pins to ISO 2110 pins. The mapping of pins is shown in Table B.1 of ISO 2110 amendment 1 (page 2). The 37-pin-D connector shall not be used. The following summarizes the pin assignments of the V.36/V.37 interface using the required 25-pin-D connector:

- 103a - pin 2, 103b - pin 14
- 104a - pin 3, 104b - pin 16
- 113a - pin 24, 113b - pin 11
- 114a - pin 15, 114b - pin 12
- 115a - pin 17, 115b - pin 9

2.2 DATA TRANSFER

Implementations shall be based on ITU 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.

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.3.3.1 Length of address field - An address field of 2 octets shall be supported. All frames must have the EA bit set to 0 in the first octet of the address field and the EA bit set to 1 in the second octet of the address field.
- Section A.3.3.6 Data Link Connection Identifier - The 2 octet address format shall be supported with DLCI values as defined in Table 1a.
- Section A.3.3.7 DLCI or DL-CORE control indicator (D/C) - This section is not applicable.

Other address structure variables and their usage are as specified in ITU 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 - 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 - User equipment reaction is dependent on the protocols operating over the Data Link Core sublayer. It is recommended that the procedures if 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 revised Q.933 Annex A (1995). By bilateral agreement, optional procedures of Annex A of the revised ITU Q.933 may be implemented. Refer to revised 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, Frame Relay UNI SVC Implementation Agreement.

2.3.3 Error Conditions

Error conditions are handled as described in section A.5 of revised Q.933. Revised Q.933 is a supplement to ITU Q.933.

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.