ISO/IEC JTC 1 N 9437

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ISO/IEC JTC 1
Information Technology

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Document Title:	**SC 25 Proposal for a New Work Item ISO/IEC 14165-261: Information technology – Fibre Channel – Part 261: Link services (FC-LS)**
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Reference:	
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Action ID:	**ACT**
Due Date:	**2009-03-01**
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ISO/IEC JTC 1/SC 25 N 1611

Date: 2008-11-27

Replaces ISO/IEC JTC 1/SC 25 N/A

PROPOSAL FOR A NEW WORK ITEM **Pages 210**

Date of presentation of proposal: 2008-10-09	Proposer: ISO/IEC JTC 1/SC 25
Secretariat: Germany DIN	**ISO/IEC JTC 1 N 9437** ISO/IEC JTC 1/SC 25 N 1611

A proposal for a new work item shall be submitted to the secretariat of the Subcommittee of the ISO/IEC joint technical committee concerned with a copy to the Secretariat of ISO/IEC/JTC 1 and the ISO Central Secretariat.

Presentation of the proposal - to be completed by the proposer. Guidelines for proposing and justifying a new work item are given in ISO Guide 26.

Title ISO/IEC 14165-261: Information technology – Fibre Channel – Part 261: Link services (FC-LS)

Scope This standard describes Fibre Channel Extended Link Services and ancillary functions and services required to support the Fibre Channel Extended Link Services.

Purpose and justification The Fibre Channel Link Services standard along with the Fibre Channel Framing and Signaling - 2 standard (14165-252) are companion standards that supersede the Fibre Channel Framing and Signaling standard (ISO/IEC 14165-251).

Programme of work

If the proposed new work item is approved, which of the following document(s) is (are) expected to be developed?
__X_ a single International Standard with a prospective number 14165-261

___ more than one International Standard (expected number: .....)
_____ a multi-part International Standard consisting of ..... parts
_____ an amendment or amendments to the following International Standard(s) .....
_____ a technical report , type .....

And which standard development track is recommended for the approved new work item?

__ _a. Default Timeframe

__ X __b. Accelerated Timeframe

____c. Extended Timeframe

Relevant documents to be considered

Co-operation and liaison

Preparatory work offered with target date(s) INCITS 433:2007 (FC-LS)

Signature: Dr Walter von Pattay, Secretary of the ISO/IEC JTC 1/SC 25

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Home page: “http://www.iec.ch/sc25”

Will the service of a maintenance agency or registration authority be required? .....NO.....
- If yes, have you identified a potential candidate? .....
- If yes, indicate name .....

Are there any known requirements for coding? .....NO.....
-If yes, please specify on a separate page

Does the proposed standard concern known patented items? .....NO.....
- If yes, please provide full information in an annex

Comments and recommendations of the JTC 1/SC 25 Secretariat –

In accordance with Resolution SC 25:16/ 20, see SC 25 N 1099A, the acceptance of this NWIP authorizes passing to FCD stage the attached text that is an existing national or regional standard in the domain of WG 4.

Comments with respect to the proposal in general, and recommendations thereon:
It is proposed to assign this new item to JTC 1/SC 25. Project number: 1.25.13.13.35

Voting on the proposal - Each P-member of the ISO/IEC joint technical committee has an obligation to vote within the time limits laid down (normally three months after the date of circulation).

The vote shall be sent to the Secretary of ISO/IEC JTC 1 / SC 25 - Dr.-Ing. Walter P. von Pattay, Member of ZVEI FV 7 & FV 8, Germany,
Tel.: +49/89/923 967 57, Tfx.: +49/89/923 967 59 (on request only), **EM: Walter@Pattay.com**

Date of circulation:	**Closing date for voting:**	**Signature of Secretary:**
2008-11-27	2009-02-28	Dr. Walter P. von Pattay

NEW WORK ITEM PROPOSAL - PROJECT ACCEPTANCE CRITERIA		
Criterion	**Validity**	**Explanation**
A. Business Requirement		
A.1 Market Requirement	Essential _X_ Desirable ___ Supportive ___	
A.2 Regulatory Context	Essential _ _ Desirable ___ Supportive ___ Not Relevant X	
B. Related Work		
B.1 Completion/Maintenance of current standards	Yes _X_ No___	
B.2 Commitment to other organisation	Yes _ _ No_ X __	
B.3 Other Source of standards	Yes ___ No_X_	
C. Technical Status		
C.1 Mature Technology	Yes _X__ No___	

C.2 Prospective Technology	Yes _ _ No__ X _	
C.3 Models/Tools	Yes _ _ No__ X _	
D. Conformity Assessment and Interoperability		
D.1 Conformity Assessment	Yes ___ No_X_	
D.2 Interoperability	Yes ___ No_X_	
E. Adaptability to Culture, Language, Human Functioning and Context of Use		
E.1 Cultural and Linguistic Adaptability	Yes_____ No__X__	**Not applicable**
E.2 Adaptability to Human Functioning and Context of Use	Yes_____ No__X__	**Not applicable**
F. Other Justification		

Notes to Proforma

A. Business Relevance. That which identifies market place relevance in terms of what problem is being solved and or need being addressed.

A.1 Market Requirement. When submitting a NP, the proposer shall identify the nature of the Market Requirement, assessing the extent to which it is essential, desirable or merely supportive of some other project.

A.2 Technical Regulation. If a Regulatory requirement is deemed to exist - e.g. for an area of public concern e.g. Information Security, Data protection, potentially leading to regulatory/public interest action based on the use of this voluntary international standard - the proposer shall identify this here.

B. Related Work. Aspects of the relationship of this NP to other areas of standardisation work shall be identified in this section.

B.1 Competition/Maintenance. If this NP is concerned with completing or maintaining existing standards, those concerned shall be identified here.

B.2 External Commitment. Groups, bodies, or fora external to JTC 1 to which a commitment has been made by JTC for Co-operation and or collaboration on this NP shall be identified here.

B.3 External Std/Specification. If other activities creating standards or specifications in this topic area are known to exist or be planned, and which might be available to JTC 1 as PAS, they shall be identified here.

C. Technical Status. The proposer shall indicate here an assessment of the extent to which the proposed standard is supported by current technology.

C.1 Mature Technology. Indicate here the extent to which the technology is reasonably stable and ripe for standardisation.

C.2 Prospective Technology. If the NP is anticipatory in nature based on expected or forecasted need, this shall be indicated here.

C.3 Models/Tools. If the NP relates to the creation of supportive reference models or tools, this shall be indicated here.

D. Conformity Assessment and Interoperability

D.1 Indicate here if Conformity Assessment is relevant to your project. If so, indicate how it is addressed in your project plan.

D.2 Indicate here if Interoperability is relevant to your project. If so, indicate how it is addressed in your project plan

E. Adaptability to Culture, Language, Human Functioning and Context of Use

NOTE: The following criteria do not mandate any feature for adaptability to culture, language, human functioning or context of use. The following criteria require that if any features are provided for adapting to culture, language, human functioning or context of use by the new Work Item proposal, then the proposer is required to identify these features.

E.1 Cultural and Linguistic Adaptability. Indicate here if cultural and natural language adaptability is applicable to your project. If so, indicate how it is addressed in your project plan.

ISO/IEC TR 19764 (Guidelines, methodology, and reference criteria for cultural and linguistic adaptability in information technology products) now defines it in a simplified way:

“ability for a product, while keeping its portability and interoperability properties, to:

- be internationalized, that is, be adapted to the special characteristics of natural languages and the commonly accepted rules for their se, or of cultures in a given geographical region;

- take into account the usual needs of any category of users, with the exception of specific needs related to physical constraints”

Examples of characteristics of natural languages are: national characters and associated elements (such as hyphens, dashes, and punctuation marks), writing systems, correct transformation of characters, dates and measures, sorting and searching rules, coding of national entities (such as country and currency codes), presentation of telephone numbers and keyboard layouts. Related terms are localization, jurisdiction and multilingualism.

E.2 Adaptability to Human Functioning and Context of Use. Indicate here whether the proposed standard takes into account diverse human functioning and diverse contexts of use. If so, indicate how it is addressed in your project plan.

NOTE:

1. Human functioning is defined by the World Health Organization at http://www3.who.int/icf/beginners/bg.pdf as:
<<In ICF (*International Classification of Functioning, Disability and Health), the term functioning refers to all body functions, activities and participation.*>>

2. Content of use is defined in ISO 9241-11:1998 (*Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability) as:*
<<*Users, tasks, equipment (hardware, software and materials), and the physical and societal environments in which a product is used.*>>

3. Guidance for Standard Developers to address the needs of older persons and persons with disabilities).

F. Other Justification Any other aspects of background information justifying this NP shall be indicated here

ANSI®
INCITS 433-2007

American National Standard
for Information Technology –

Fibre Channel – Link Services (FC-LS)

Secretariat

Information Technology Industry Council

Approved July 5, 2007

American National Standards Institute, Inc.

Abstract
This standard describes the Link Services requirements. The Physical Interface requirements are described in Fibre Channel-Physical Interfaces - 2 (FC-PI-2). The Framing and Signaling requirements are described in Fibre Channel-Physical Framing and Signaling - 2 (FC-FS-2). This standard is recommended for new implementations but does not obsolete the existing Fibre Channel standards.

American National Standard

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

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Foreword (This foreword is not part of American National Standard ANSI INCITS 433-2007.)

The Fibre Channel Link Services (FC-LS) standard describes in detail the Fibre Channel Link Services introduced in FC-FS-2. In addition, this document describes any ancillary functions and services required to support the Fibre Channel Link Services.

This standard was developed by the INCITS Fibre Channel T11 Technical Committee (FC-TC) of Accredited Standards Committee INCITS during 2003-2006. The standard's approval process started in 2006. This document includes annexes that are informative and are not considered part of the standard.

Requests for interpretation, suggestions for improvements or addenda, or defect reports are welcome. They should be sent to the INCITS Secretariat, Information Technology Industry Council, 1250 Eye Street, NW, Suite 200, Washington, DC 20005-3922.

This standard was processed and approved for submittal to ANSI by the International Committee for Information Technology Standards (INCITS). Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, INCITS had the following members:

Karen Higginbottom, Chair
Jennifer Garner, Secretary

Organization Represented	*Name of Representative*
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Introduction

FC-LS is one of the Fibre Channel family of standards. This family includes ANSI INCITS 373-2003, FC-FS, which specifies the Framing and Signalling Interface. ANSI INCITS 418-2006, FC-SW-4, is related to Fabric requirements. ANSI INCITS 332:1999, FC-AL-2, specifies the arbitrated loop topology.

FC-LS defines requests and replies that comprise the set of Fibre Channel Extended Link Services (ELSs).

American National Standard
for Information Technology —

Fibre Channel —
Link Services (FC-LS)

1 Scope

FC-LS describes in detail the Fibre Channel Extended Link Services.

2 Normative References

2.1 Overview

The following standards contain provisions that, through reference in the text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

For electronic copies of some standards, visit ANSI's Electronic Standards Store (ESS) at www.ansi.org. For printed versions of all standards listed here, contact Global Engineering Documents, 15 Inverness Way East, Englewood, CO; 80112-5704, (800) 854-7179.

Additional availability contact information is provided below as needed.

2.2 Approved references

ANSI INCITS 332-1999, *Fibre Channel-Arbitrated Loop–2 (FC-AL-2)*

ANSI INCITS 332-1999/AM1-2003, *Fibre Channel-Arbitrated Loop–2 (FC-AL-2) Amendment 1*

ANSI INCITS 373-2003, *Fibre Channel - Framing and Signaling (FC-FS)*

ANSI INCITS 387-2004, *Fibre Channel - Generic Services - 4 (FC-GS-4)*

ANSI INCITS 384-2004, *Fibre Channel - Switch Fabric - 3 (FC-SW-3)*

ANSI INCITS 374-2003, *Fibre Channel - Single Byte Command Set - 3 (FC-SB-3)*

2.3 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the documents, or regarding availability, contact the relevant standards body or other organization as indicated.

ANSI INCITS Project 1619-D, *Fibre Channel - Framing and Signaling (FC-FS-2)*

ANSI INCITS Project 1677-D, *Fibre Channel Generic Services 5 (FC-GS-5)*

ANSI INCITS Project 1674-D, *Fibre Channel - Switch Fabric - 4 (FC-SW-4)*

ANSI INCITS Project 1560-D, *Fibre Channel - Protocol - 3 (FCP-3)*

2.4 Other references

IETF Request for Comments (RFCs) may be obtained directly from the IETF web site at http://www.ietf.org/rfc.html:

RFC 768, *User Datagram Protocol*, August1980.

RFC 791, *Internet Protocol*, September 1981.

RFC 793, *Transmission Control Protocol*, September 1981.

RFC 854, *Telnet Protocol Specification*, May 1983.

RFC 1157, *A Simple Network Management Protocol (SNMP)*, May 1990.

RFC 1901, *Introduction to Community-based SNMPv2*, January 1996

RFC 2373, *IP Version 6 Addressing Architecture*, July 1998.

RFC 2460, *Internet Protocol, Version 6 (IPv6) Specification*, December 1998.

RFC 2616, *Hypertext Transfer Protocol -- HTTP/1.1*, June 1999.

RFC 2818, *HTTP Over TLS*, May 2000.

RFC 4338, *Transmission of IPv6, IPv4, and Address Resolution Protocol (ARP) Packets over Fibre Channel*, January 2006.

3 Definitions and conventions

3.1 Overview

For FC-LS, the following definitions, conventions, abbreviations, acronyms, and symbols apply.

3.2 Definitions

3.2.1 acknowledged class: Any class of service that acknowledges a transfer.

3.2.2 address identifier: An address value used to identify source (S_ID) or destination (D_ID) of a frame (see FC-FS-2).

3.2.3 AE Principal Switch: An AE Switch has no Uplinks and assumes the primary role of distributing the Domain Topology Map in an Avionics Fabric (see FC-SW-4).

3.2.4 AE Secondary Principal Switch: An AE Switch that is capable of becoming the AE Principal Switch (see FC-SW-4).

3.2.5 AE Switch: An AE-Capable Switch that has activated at least one AE_Port. AE Switches are required to implement the requirements defined for Fast Fabric Intialization in FC-SW-4.

3.2.6 Alias_ID: An address identifier recognized by one or more Nx_Ports or the Alias Server, if the Nx_Port has registered with the Alias Server as a member of a group. An Alias_ID may be common to multiple Nx_Ports (see FC-FS-2).

3.2.7 Alias_Token: A 12-byte field to indicate the type of Alias_ID and certain properties associated with the Alias_ID (see FC-GS-5).

3.2.8 Arbitrated Loop topology: A Fibre Channel topology where L_Ports use arbitration to gain access to the loop (see FC-AL-2).

3.2.9 Association_Header: See FC-FS-2.

3.2.10 Avionics Fabric: A Fibre Channel Fabric that contains at least one AE Switch and supports all the requirements defined for Fast Fabric Intialization in FC-SW-4.

3.2.11 buffer-to-buffer credit (BB_Credit): The limiting value for BB_Credit_CNT in the buffer-to-buffer flow control model (see FC-FS-2).

3.2.12 buffer-to-buffer Credit_Count (BB_Credit_CNT): A counter used in the buffer-to-buffer flow control model (see FC-FS-2).

3.2.13 B_Port: A bridge port is a Fabric inter-element port used to connect bridge devices with E_Ports on a switch. The B_Port provides a subset of the E_Port functionality (see FC-SW-3.).

3.2.14 buffer: A logical construct that holds a single frame.

3.2.15 circuit: A bi-directional path within the Fabric.

3.2.16 class of service: Type of frame delivery service used by the communicating Nx_Ports that may also be supported through a Fabric (see FC-FS-2).

3.2.17 Class 1 service: A service that establishes a dedicated connection between two communicating Nx_Ports (see FC-FS-2).

3.2.18 Class 2 service: A service that multiplexes frames at frame boundaries to or from one or more Nx_Ports with acknowledgement provided (see FC-FS-2).

3.2.19 Class 3 service: A service that multiplexes frames at frame boundaries to or from one or more Nx_Ports without acknowledgement (see FC-FS-2).

3.2.20 Class 6 service: A service that allows an Nx_Port to establish simultaneous dedicated connections with multiple Nx_Ports (see FC-FS-2).

3.2.21 Class F service: A service that multiplexes frames at frame boundaries with acknowledgement provided. The service is used for control and coordination of the internal behavior of the Fabric (see FC-SW-3).

3.2.22 Class N service: A class of service other than Class F (see FC-SW-3).

3.2.23 Common Controlling Entity: The entity that controls and manages the resources for a Hunt Group (see FC-FS-2).

3.2.24 concatenation: A logical operation that "joins together" strings of data and is represented with the symbol "||". Two or more fields are concatenated to provide a reference of uniqueness (e.g., S_ID||X_ID).

3.2.25 Connection Initiator: The Nx_Port that initiates a Class 1 or 6 Connection with a destination Nx_Port through a connect-request and also receives a valid response from the destination Nx_Port to complete the Connection establishment (see FC-FS-2).

3.2.26 Connection Recipient: The destination Nx_Port that receives a Class 1 or 6 connect-request from the Connection Initiator and accepts establishment of the Connection by transmitting a valid response (see FC-FS-2).

3.2.27 connectionless buffers: Receive buffers participating in connectionless service and capable of receiving connectionless frames (see FC-FS-2).

3.2.28 connectionless frames: Frames participating in connectionless service (i.e., Class 1 or Class 6 frames with SOF_{c1}, Class 2, and Class 3 frames referred to individually or collectively) (see FC-FS-2).

3.2.29 connectionless service: Communication between two Nx_Ports performed without a dedicated connection.

3.2.30 continuously increasing relative offset: The condition of operation that requires frames ordered by SEQ_CNT within a Sequence to have a larger relative offset value in each frame (see FC-FS-2).

3.2.31 Core N_Port_Name: An N_Port_Name associated with the Physical N_Port of a VFT Tagging N_Port, and not with any other FC_Port within the scope of its Name_Identifier format (see FC-FS-2).

3.2.32 Core Switch_Name: In a Virtual Fabric capable Switch, the Switch_Name identifying the physical Switch (see FC-SW-4).

3.2.33 Credit: The maximum number of buffers available at a recipient to receive frames from a transmitting FC_Port (see FC-FS-2).

3.2.34 data block: An ordered string of application data contained in a single Information Category.

3.2.35 data frame: An FC-4 Device_Data frame, an FC-4 Video_Data frame, or a Link_Data frame (see FC-FS-2).

3.2.36 dedicated connection: A communicating circuit guaranteed and retained by the Fabric for two given Nx_Ports for a Class 1 or Class 6 connection.

3.2.37 Destination_Identifier (D_ID): The address identifier used to indicate the targeted destination Nx_Port of the transmitted frame (see FC-FS-2).

3.2.38 destination Nx_Port: The Nx_Port designated by the Destination_Identifier of a frame..

3.2.39 discard policy: An error handling policy where a Sequence Recipient is able to discard Data frames received following detection of a missing frame in a Sequence (see FC-FS-2).

3.2.40 Domain Controller: The entity that controls activity within a given domain. Each Domain Controller is allocated an address (see FC-SW-3.).

3.2.41 Domain_ID: The highest or most significant hierarchical level in the three-level addressing hierarchy (i.e., the most significant byte of the address identifier) (see FC-FS-2 and FC-SW-3).

3.2.42 Domain Topology Map: An entity within the Avionics Fabric that unambiguously describes the Domain_IDs and all of the Inter-Switch Links of the Avionics Fabric. The Domain_IDs and all of the Inter-Switch Links shall remain unchanged for the duration of a mission (see FC-SW-4).

3.2.43 end-to-end Credit (EE_Credit): The limiting value for EE_Credit_CNT in the end-to-end flow control model (see FC-FS-2).

3.2.44 end-to-end Credit_Count (EE_Credit_CNT): A counter used in the end-to-end flow control model (see FC-FS-2).

3.2.45 E_Port: A Fabric expansion port that connects to another E_Port or B_Port to create an Inter-Switch Link (see FC-SW-3).

3.2.46 Exchange: The unit of protocol activity that transfers information between a specific Originator Nx_Port and specific Responder Nx_Port using one or more related non-concurrent Sequences that may flow in the same or opposite directions. The Exchange is identified by an OX_ID and a RX_ID (see FC-FS-2).

3.2.47 Exchange_Identifier (X_ID): A collective reference to OX_ID and RX_ID (see FC-FS-2).

3.2.48 Exchange Status Block: A logical construct that contains the status of an Exchange. An Originator Nx_Port has an Originator Exchange Status Block and the Responder Nx_Port has a Responder Exchange Status Block for each active Exchange (see FC-FS-2).

3.2.49 exclusive connection: A Class 1 or Class 6 dedicated connection without Intermix (see FC-FS-2).

3.2.50 F_Port: The LCF within the Fabric that attaches to an N_Port through a link. An F_Port is addressable by the N_Port attached to it, with a common well-known address identifier (FFFFFEh) (see FC-FS-2).

3.2.51 Fabric: The entity that interconnects Nx_Ports attached to it and is capable of routing frames by using the D_ID information in a FC-2 frame header (see FC-FS-2).

3.2.52 Fabric Controller: The logical entity responsible for operation of the Fabric identified by the well-known address FFFFFDh (see FC-SW-4).

3.2.53 F_Port Controller: The entity at the well-known address FFFFFEh (see FC-SW-4).

3.2.54 Fabric_Name: A Name_Identifier associated with a Fabric (see FC-FS-2).

3.2.55 Fast Fabric Initialization (FFI): A technique that provides accelerated initialization of an Avionics Fabric through the distribution of the Domain Topology Map. The Domain Topology Map is distributed to all AE Switches via the AE Principal Switch using the FFI request Sequence (see FC-SW-4).

3.2.56 FC-4 TYPE: An FC-4 protocol associated with the value in the Type field in the header of a data frame (see FC-FS-2).

3.2.57 FC_Port: A port that is capable of transmitting or receiving Fibre Channel frames according to the requirements defined in this standard. FC_Ports include N_Ports, NL_Ports, Nx_Ports, L_Ports, F_Ports, FL_Ports, Fx_Ports, E_Ports, and B_Ports.

3.2.58 FFI Link State Record: For an individual AE Switch, a description of the Domain and all the AE_Port Inter-Switch Link connections of that Switch (see FC-SW-4).

3.2.59 FFI SW_ILS: An AE specific SW_ILS command that distributes the Domain Topology Map throughout the Avionics Fabric or for reporting changes in link status and error conditions (see FC-SW-4).

3.2.60 Fibre Channel interaction space: The set of Fibre Channel ports, devices, and Fabrics that are connected by Fibre Channel links or are accessible by a common instance of an administrative tool or tools.

3.2.61 FL_Port: An F_Port that contains Arbitrated Loop functions associated with Arbitrated Loop topology (see FC-AL-2).

3.2.62 frame: An indivisible unit of information used by FC-2 (see FC-FS-2).

3.2.63 F_Port_Name: A Name_Identifier associated with an F_Port (see FC-FS-2).

3.2.64 Fx_Port: A switch port capable of operating as an F_Port or FL_Port (see FC-AL-2).

3.2.65 Hunt Group: A set of Nx_Ports with a common Alias_ID managed by a Common Controlling Entity. The management and initialization of Hunt Groups is outside the scope of this standard (see FC-FS-2).

3.2.66 Hypertext Transfer Protocol: A protocol for communicating various formats of text with embedded links and display controls (see RFC 2616).

3.2.67 Infinite buffer: A terminology to indicate that at FC-2 level, the amount of buffer available at the Sequence Recipient is unlimited.

3.2.68 Information Category: The category to which the frame Payload belongs (e.g., Solicited Data, Unsolicited Data, Solicited Control and Unsolicited Control). Information category is indicated by the INFORMATION field in the frame header if the value of the ROUTING field in the frame header is 0000b (Device_Data), 0010b (Extended Link Services), 0011b (FC-4 Link_Data), 0100b (Video_Data), or 1111b (Extended Routing) (see FC-FS-2).

3.2.69 Information Unit: An organized collection of data specified by an upper level to be transferred as a single Sequence by FC-2.

3.2.70 initial relative offset: A relative offset value specified at the sending end by an upper level for a given data block and used by the sending FC-2 in the first frame of that data block (see data block, and relative offset). Initial relative offset value may be zero or non-zero (see FC-FS-2).

3.2.71 Intermix: A service that interleaves Class 2 and Class 3 frames on an established Class 1 or Class 6 Connection (see FC-FS-2).

3.2.72 Internet Protocol: A protocol for communicating data packets between identified endpoints on a multipoint network. It is in wide use in versions 4 and 6. (see RFC 791, RFC 2373, and RFC 2460).

3.2.73 IP Address: An identifier of an endpoint in Internet Protocol.

3.2.74 link: Two unidirectional fibres transmitting in opposite directions and their associated transmitters and receivers.

3.2.75 Link Control Facility (LCF): A hardware facility that attaches to an end of a link and manages transmission and reception of data. It is contained within each FC_Port (see FC-FS-2).

3.2.76 local Fx_Port: The Fx_Port to which an Nx_Port is directly attached by a link or an Arbitrated Loop (see remote Fx_Port).

3.2.77 Logical F_Port: In a VFT Tagging F_Port, the part of the Link Control Facility that processes frames for one Virtual Fabric.

3.2.78 Logical N_Port: In a VFT Tagging N_Port, the part of the Link Control Facility that processes frames for one Virtual Fabric, and has one or more N_Port_IDs in that Virtual Fabric (see FC-FS-2).

3.2.79 Loop Fabric Address (LFA): An address identifier used to address an FL_Port for the purpose of loop management (see FC-SW-4).

3.2.80 Loss-of-signal: See FC-FS-2.

3.2.81 L_Port: A port that contains Arbitrated Loop functions associated with Arbitrated Loop topology (see FC-AL-2).

3.2.82 Multi-function device: A device that provides more than one function.

3.2.83 Name_Identifier: A 64-bit identifier, with a 60-bit value preceded by a 4-bit Network_Address_Authority Identifier, used to identify entities in Fibre Channel (e.g., Nx_Port, node, F_Port, or Fabric) (see FC-FS-2).

3.2.84 NAS server: A device that connects to a network and provides file access services.

3.2.85 Network_Address_Authority (NAA): An organization such as IEEE that administers network addresses (see FC-FS-2).

3.2.86 Network_Address_Authority (NAA) identifier: A four-bit identifier defined to indicate a Network_Address_Authority (NAA) (see FC-FS-2).

3.2.87 NL_Port: An N_Port that contains the Loop Port State Machine defined in [], FC-AL-2. It may be attached via a link to one or more NL_Ports and zero or more FL_Ports in an Arbitrated Loop topology. Without the qualifier "Public" or "Private," an NL_Port is assumed to be a Public NL_Port.

3.2.88 node: A collection of one or more Nx_Ports controlled by a level above FC-2 (see FC-FS-2).

3.2.89 Node_Name: A Name_Identifier associated with a node (see FC-FS-2).

3.2.90 N_Port: A hardware entity that includes a LCF but not Arbitrated Loop functions associated with Arbitrated Loop topology, and has the ability to act as an Originator, a Responder, or both. Well-known addresses are considered to be N_Ports (see FC-AL-2 and FC-FS-2).

3.2.91 N_Port_ID: A topology (see FC-FS-2) unique address identifier of an Nx_Port. The identifier may be assigned by the Fabric during the initialization procedure or by other procedures not defined in this standard. The identifier is used in the S_ID and D_ID fields of a frame (see FC-FS-2).

3.2.92 N_Port_Name: A Name_Identifier associated with an Nx_Port (see FC-FS-2).

3.2.93 Nx_Port: A port capable of operating as an N_Port or Public NL_Port, but not as a Private NL_Port. By use of the term Nx_Port, this standard neither specifies nor constrains the behavior of Private NL_Ports (see FC-AL-2).

3.2.94 open: The period of time starting when a Sequence or an Exchange is initiated until that Sequence or Exchange is normally or abnormally terminated (see FC-FS-2).

3.2.95 Originator: The logical function associated with an Nx_Port responsible for originating an Exchange.

3.2.96 Originator Exchange_ID (OX_ID): An identifier assigned by an Originator to identify an Exchange (see FC-FS-2).

3.2.97 Payload: Contents of the Data Field of a frame, excluding Optional Headers and fill bytes, if present (see FC-FS-2).

3.2.98 Permanent Port Name: The Permanent Port Name is the Name_Identifier associated with a physical Nx_Port (see FC-GS-5).

3.2.99 Policy: The rule used to determine how frames not received are handled during error recovery (see FC-FS-2).

3.2.100 Port VF_ID: A configurable VF_ID that is associated with any untagged frame received by a VF capable N_Port or F_Port (see FC-FS-2).

3.2.101 Private NL_Port: An NL_Port that does not attempt a Fabric Login and does not transmit OPN(00,x) (see FC-AL-2).

3.2.102 Process_Associator: A value used in the Association_Header to identify a process or a group of processes within a node. Process_Associator is the mechanism a process uses to address another communicating process. Process_Associator is a generic reference to Originator Process_Associator and Responder Process_Associator (see FC-FS-2).

3.2.103 Public NL_Port: An NL_Port that attempts a Fabric Login (see FC-AL-2).

3.2.104 random relative offset: The relationship specified between relative offset values contained in frame (n) and frame (n+1) of an Information Category within a single Sequence. For a given Information Category I within a single Sequence, initial relative offset (ROI) value for a frame (n+1) is unrelated to that of the previous frame (n) (see FC-FS-2).

3.2.105 relative offset: The displacement, expressed in bytes, of the first byte of a Payload related to an upper level defined origin for a given Information Category (see continuously increasing relative offset, random relative offset and)(see FC-FS-2).

3.2.106 relative offset space: A virtual address space defined by the sending upper level for a set of information carried in one or more information units.

3.2.107 remote Fx_Port: Relative to an Nx_Port that is communicating through a Fabric to a remote Nx_Port, the Fx_Port to which the remote Nx_Port is directly attached (see local Fx_Port).

3.2.108 Responder: The logical function in an Nx_Port responsible for supporting the Exchange initiated by the Originator in another Nx_Port.

3.2.109 Responder Exchange_ID (RX_ID): An identifier assigned by a Responder to identify an Exchange and meaningful only to the Responder.

3.2.110 Secured Hypertext Transfer Protocol: A protocol for communicating various formats of text with embedded links and display controls used in combination with a subordinate protocol that provides security features (see RFC 2818).

3.2.111 Sequence: A set of one or more Data frames with a common Sequence_ID (SEQ_ID), transmitted unidirectionally from one Nx_Port to another Nx_Port with a corresponding response, if applicable, transmitted in response to each Data frame (see FC-FS-2).

3.2.112 Sequence_ID (SEQ_ID): An identifier used to identify a Sequence (see FC-FS-2).

3.2.113 Sequence Initiator: The Nx_Port that initiates a Sequence and transmits Data frames to the destination Nx_Port (see FC-FS-2).

3.2.114 Sequence Recipient: The Nx_Port that receives Data frames from the Sequence Initiator and, if applicable, transmits responses (i.e., Link_Control frames) to the Sequence Initiator (see FC-FS-2).

3.2.115 Sequence Status Block: A logical construct that tracks the status of a Sequence. Both the Sequence Initiator and the Sequence Recipient have a Sequence Status Block for each concurrently active Sequence (see FC-FS-2).

3.2.116 Simple Network Management Protocol: A protocol for communicating simply structured management information. It is in wide use in versions 1 and 2. (see RFC 1157, RFC 1901).

3.2.117 Source_Identifier (S_ID): The address identifier used to indicate the source Nx_Port of the transmitted frame (see FC-FS-2).

3.2.118 source Nx_Port: The Nx_Port where a frame is originated.

3.2.119 Storage access device: A device that provides storage management and access for heterogeneous hosts and heterogeneous devices (e.g., a medium changer device).

3.2.120 Storage subsystem: An integrated collection of storage controllers, storage devices, and necessary software, that provides storage services to one or more hosts.

3.2.121 streamed Sequence: A new sequence initiated by a Sequence Initiator in any class of service for an Exchange while it already has Sequences Open for that Exchange (see FC-FS-2).

3.2.122 T10 Vendor ID: A character string that uniquely identifies a vendor. See 3.7.

3.2.123 TCP Port Number: An identifier of a destination in Transmission Control Protocol.

3.2.124 Telnet: A protocol for communicating control of a character-oriented terminal over Transmission Control Protocol (see RFC 854).

3.2.125 Transmission Control Protocol: A protocol communicating reliable flow-controlled byte streams over Internet Protocol allowing independent concurrent streams to multiple destinations at any IP Address (see RFC 793).

3.2.126 UDP Port Number: An identifier of a destination in User Datagram Protocol.

3.2.127 Upper Level: A level above FC-2.

3.2.128 Upper Level Protocol (ULP): The protocol user of FC-4 (see FC-FS-2).

3.2.129 User Datagram Protocol: A protocol communicating a packet stream with no incremental reliability over Internet Protocol allowing multiple independent concurrent destinations at any IP Address (see RFC 768).

3.2.130 VFT Tagging F_Port: An F_Port that has enabled processing of Virtual Fabric Tagging Headers.

3.2.131 VFT Tagging N_Port: An N_Port that has enabled processing of Virtual Fabric Tagging Headers (see FC-FS-2).

3.2.132 Virtual Fabric Tagging Header (VFT_Header): See FC-FS-2.

3.2.133 Virtualization device: A device that integrates one or more entities (either logical or physical), along with any additional functionality, for the purpose of providing a useful abstraction (e.g., a SCSI logical unit virtualization device).

3.2.134 Wavelength division multiplexer: A device that modulates/demodulates each of several data streams (e.g., Fibre Channel protocol data streams) to/from a different part of the light spectrum in an optical fiber.

3.2.135 Well-known addresses: Those address identifiers explicitly defined in this standard or other standards to access services (e.g. name server).

3.2.136 word: A string of four contiguous bytes occurring on boundaries that are zero modulo 4 from a specified reference.

3.2.137 Worldwide_Name: A Name_Identifier that is worldwide unique (see FC-FS-2).

3.3 Editorial Conventions

In this standard, a number of conditions, mechanisms, sequences, parameters, events, states or other terms are printed with the first letter of each word in uppercase and the rest lowercase. This indicates that they have a special meaning in the context of this standard. The meaning is either described in the relevant text, in the glossary of this standard, or in a referenced standard (e.g., Exchange and Class). Any use of these terms in lowercase indicates that the words have the normal technical English meanings.

Lists sequenced by letters (e.g., a-red, b-blue, c-green) show no priority relationship between the listed items. Numbered lists (e.g., 1-red, 2-blue, 3-green) show a priority ordering between the listed items.

The ISO convention of numbering is used (i.e., the thousands and higher multiples are separated by a space and a comma is used as the decimal point.) A comparison of the American and ISO conventions are shown in table 1.

Table 1 – ISO and American Conventions

ISO	American
0,6	0.6
1 000	1,000
1 323 462,9	1,323,462.9

In case of any conflict between figure, table, and text, the text, then tables, and finally figures take precedence. Exceptions to this convention are indicated in the appropriate sections.

In all of the figures, tables, and text of this document, the most significant bit of a binary quantity is shown on the left side. Exceptions to this convention are indicated in the appropriate sections.

If a field or a control bit in a frame is specified as reserved, the entity that sends the frame shall set the field or control bit to zero, and the entity that receives the frame shall not check that field or control bit.

When the value of the bit or field is not relevant, x or xx appears in place of a specific value.

Unless stated otherwise: numbers that are not immediately followed by lower-case b or h are decimal values; numbers immediately followed by lower-case b (xxb) are binary values; and numbers or upper case letters immediately followed by lower-case h (xxh) are hexadecimal values.

3.4 State Machine notation

State machines in this standard should use the style shown in figure 1.

These state machines make three assumptions:

a) Time elapses only within discrete states.

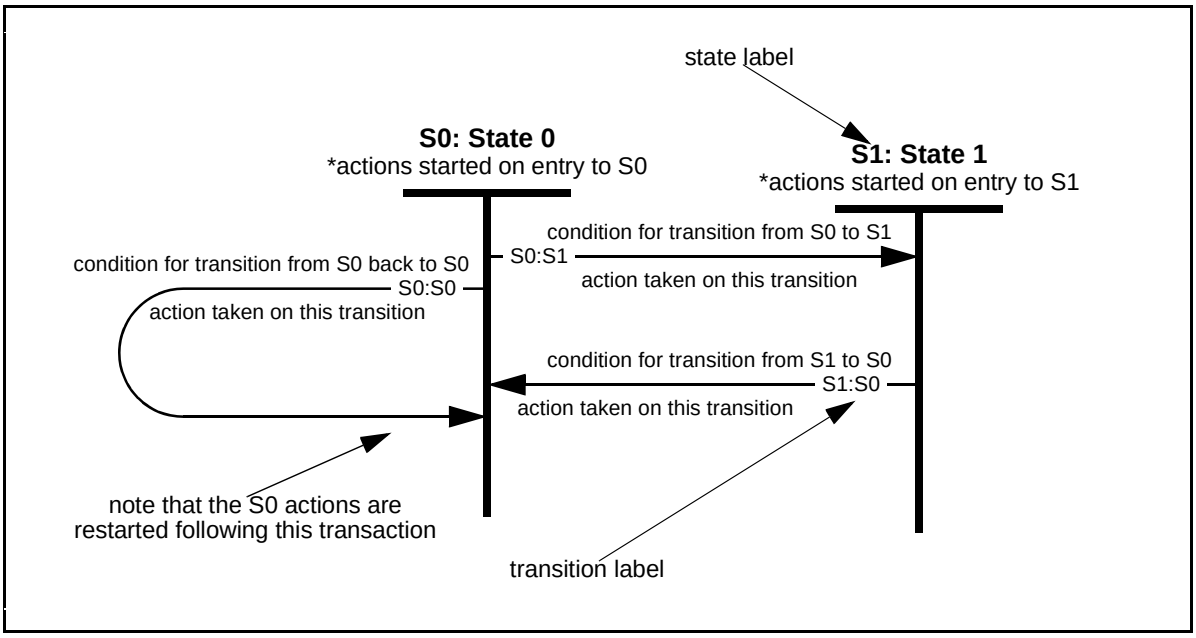

Figure 1 – State Machine Example

b) State transitions are logically instantaneous, so the only actions taken during a transition are setting flags and variables and sending signals. These actions complete before the next state is entered.

c) Every time a state is entered, the actions of that state are started. Note that this means that a transition that points back to the same state repeats the actions from the beginning. All the actions started upon entry complete before any tests are made to exit the state.

d) When Virtual Fabrics are used there is a different state for each Virtual Fabric negotiated to be used on a link. The state Px for Virtual Fabric K is denoted Px(k).

3.5 Abbreviations and acronyms

Abbreviations and acronyms applicable to this standard are listed. Definitions of several of these items are included in 3.2.

ABTS	Abort Sequence
ACK	Acknowledgement
ADVC	Advise Credit
AE	Avionics Environment
AL_PA	Arbitrated Loop Physical Address
BA_ACC	Basic Accept
BB_Credit	buffer-to-buffer Credit
BB_Credit_CNT	buffer-to-buffer Credit_Count
BB_SCs	buffer-to-buffer State Change (SOF)
BB_SCr	buffer-to-buffer State Change (R_RDY)
BB_SC_N	buffer-to-buffer State Change Number
BSY	busy
Credit_CNT	Credit_Count
CR_TOV	Connection Request_Timeout value
DF_CTL	Data_Field Control
D_ID	Destination_Identifier

DSCP	Differentiated Services Code Point
E_D_TOV	Error_Detect_Timeout value
EE_Credit	end-to-end Credit
EE_Credit_CNT	end-to-end Credit_Count
ELS	Extended Link Service
ELS_Command	Extended Link Service Command
EOFdt	End-of-Frame Disconnect Terminate (see FC-FS-2)
EOFt	End-of-Frame Terminate (see FC-FS-2)
ESB	Exchange Status Block
ESTC	Estimate Credit
ESTS	Establish Streaming
FACT	Fabric Activate Alias
F_BSY	Fabric_Port_Busy
F_BSY(DF)	F_BSY response to a Data frame
F_BSY(LC)	F_BSY response to any Link_Control except P_BSY
FC	Fibre Channel
FC-2	FC-2 level (see FC-FS-2)
FC-4	FC-4 level (see FC-FS-2)
FCS	Frame Check Sequence
F_CTL	Frame Control (see FC-FS-2)
FDACT	Fabric Deactivate Alias
FFI	Fast Fabric Initialization
FLOGI	Fabric Login
F_RJT	Fabric Reject
GAID	Get Alias_ID
HBA	Host Bus Adapter
hex	hexadecimal notation
HG_ID	Hunt Group Identifier
HTTP	Hypertext Transfer Protocol
HTTPS	Secured Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
LCF	Link Control Facility
LCR	Link Credit Reset
LESB	Link Error Status Block (see FC-FS-2)
LFA	Loop Fabric Address (see FC-AL-2)
LILP	Loop Initialization Loop Position (see FC-AL-2)
LIP	Loop Initialization Primitive (see FC-AL-2)
LISA	Loop Initialization Soft Assigned (see FC-AL-2)
LOGO	Logout
LR	Link Reset Primitive Sequence (see FC-FS-2)
LRR	Link Reset Response Primitive Sequence (see FC-FS-2)
LS_ACC	Link Service Accept
m	Metre
MB	MegaByte
ms	millisecond
µs	microsecond
N/A	not applicable
NAA	Network_Address_Authority
NACT	N_Port Activate Alias
NAS	Network Attached Storage
NDACT	N_Port Deactivate Alias
NOP	No Operation
NOS	Not_Operational Primitive Sequence (see FC-FS-2)

ns	nanosecond
OLS	Offline Primitive Sequence (see FC-FS-2)
OX_ID	Originator Exchange_ID
P_BSY	N_Port_Busy
PDISC	Discover N_Port Service Parameters
PLOGI	N_Port Login
P_RJT	N_Port_Reject
PRLI	Process Login
PRLO	Process Logout
R_A_TOV	Resource_Allocation_Timeout value (see FC-FS-2)
RCS	Read Connection Status
R_CTL	Routing Control
RJT	reject
RMC	Remove Connection
RNC	Report node Capability
RO	relative offset
R_RDY	Receiver_Ready
R_T_TOV	Receiver_Transmitter_Timeout value
RTV	Read Timeout Value
RX_ID	Responder Exchange_ID
s	second
SBCCS	Single Byte Command Code Sets
SCR	State Change Registration
SEQ_CNT	Sequence Count
SEQ_ID	Sequence_ID
S_ID	Source_Identifier
SNMP	Simple Network Management Protocol
SOF	Start-of-Frame (see FC-FS-2)
SSB	Sequence Status Block
TCP	Transmission Control Protocol
TPLS	Test Process Login Status
TYPE	Data structure type
UDP	User Datagram Protocol
ULP	Upper Level Protocol
WWN	Worldwide_Name
X_ID	Exchange_Identifier

3.6 Symbols

Unless indicated otherwise, the following symbols have the listed meaning.

||	concatenation
m	micro (e.g., μm = micrometer)
L >>	Received from Link

3.7 Keywords

3.7.1 expected: A keyword used to describe the behavior of the hardware or software in the design models assumed by this standard. Other hardware and software design models may also be implemented.

3.7.2 ignored: A keyword used to describe an unused bit, byte, word, field or code value. The contents or value of an ignored bit, byte, word, field or code value shall not be examined by the receiving device and may be set to any value by the transmitting device.

3.7.3 invalid: A keyword used to describe an illegal or unsupported bit, byte, word, field or code value. Receipt of an invalid bit, byte, word, field or code value shall be reported as an error.

3.7.4 mandatory: A keyword indicating an item that is required to be implemented as defined in this standard.

3.7.5 may: A keyword that indicates flexibility of choice with no implied preference (equivalent to "may or may not").

3.7.6 may not: A keyword that indicates flexibility of choice with no implied preference (equivalent to "may or may not").

3.7.7 meaningful: A control field or bit that shall be applicable and that shall be interpreted by the recipient.

3.7.8 not meaningful: A control field or bit that shall be ignored by the recipient.

3.7.9 obsolete: A keyword indicating that an item was defined in prior Fibre Channel standards but has been removed from this standard.

3.7.10 optional: A keyword that describes features that are not required to be implemented by this standard. However, if any optional feature defined by this standards is implemented, then it shall be implemented as defined in this standard.

3.7.11 reserved: A keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard. Recipients are not required to check reserved bits, bytes, words or fields for zero values. Receipt of reserved code values in defined fields shall be reported as error.

3.7.12 restricted: A keyword referring to bits, bytes, words, and fields that are set aside for use in other Fibre Channel standards. A restricted bit, byte, word, or field shall be treated as a reserved bit, byte, word or field for the purposes of the requirements defined in this standard.

3.7.13 shall: A keyword indicating a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this standard.

3.7.14 should: A keyword indicating flexibility of choice with a strongly preferred alternative; equivalent to the phrase "it is strongly recommended".

3.7.15 x or **xx:** The value of the bit or field is not relevant.

3.8 T10 Vendor ID fields

A T10 Vendor ID shall be a string of one to eight characters that is recorded in an informal list of Vendor IDs maintained by INCITS Technical Committee T10 (see http://www.t10.org).

A field described as containing a T10 Vendor ID shall contain the first character of the T10 Vendor ID in the most significant byte of the field, and successive characters of the T10 Vendor ID in succes-

sively less significant bytes of the field. Any bytes of the field not filled by characters of the T10 Vendor ID shall be filled with ASCII space characters (20h).

4 Extended Link Services

4.1 Introduction

An Extended Link Service (ELS) request solicits a destination Nx_Port to perform a function. An ELS reply shall be transmitted in response to an ELS request, unless otherwise specified. Each request or reply is composed of a single Sequence with the ELS_Command code being specified in the first word of the Payload of the first frame of the Sequence. If Zoning is active in the Fabric (see FC-GS-5), an ELS response from a well-known address (e.g., the Domain Controller) shall only include data relating to Nx_Ports that are in the same zone(s) as the requesting Nx_Port.

Each Sequence may be composed of one or more frames. Normal rules for Exchange and Sequence management apply to ELS frames, Sequences, and Exchanges. An Accept (LS_ACC) to an ELS shall terminate the Exchange by setting the Last Sequence bit to one on the last frame of the reply. An ELS request and the corresponding reply shall be performed within a single Exchange. Normal rules for Exchange and Sequence management as defined in FC-FS-2 shall apply.

The TYPE field for ELS frames shall be set to 01h.

The R_CTL shall be set as specified in table 2.

Table 2 – Extended Link Services Routing Bits and Information Categories

R_CTL		
ROUTING	**INFORMATION**	**Description**
0010b	0001b	Solicited Data[a]
	0010b	Request
	0011b	Reply
	Others	Reserved

[a] This value is only used by the Clock Synchronization Update (CSU) ELS.

The first byte of the Payload (ELS_Command code) of the request or reply Sequence shall be as shown in table 3. The remainder of the Payload is ELS unique. Subsequent frames, if any, for a request or reply Sequence shall only contain additional Payload in the Payload field (i.e., the ELS_Command code is not repeated in each frame).

4.2 Extended Link Service requests

4.2.1 Introduction

A Sequence Initiator shall transmit an ELS Sequence in order to solicit the destination Nx_Port to perform a link-level function or service. Unless otherwise noted, Extended Link Service requests shall not be issued prior to completion of N_Port Login. Table 3 applies to ELSs sent to or received by all valid addresses, including well known addresses. FLOGI is required before all ELSs if a Fabric is present.

The LFA is used as the destination ID (D_ID) in the LINIT and LSTS ELS Request Sequences, and is used as the source ID (S_ID) in the Reply Sequences. No other Sequences shall be directed to a LFA.

Table 3 – ELS_Command codes

Value (Bits 31-24)	Description	Abbr.	Reference	N_Port Login Required
01h	Link Service Reject	LS_RJT	4.3.4	N/A
02h	Link Service Accept	LS_ACC	4.3.2	N/A
03h	N_Port Login	PLOGI	4.2.7	No
04h	F_Port Login	FLOGI	4.2.7	No
05h	Logout	LOGO	4.2.8	No
06h	Abort Exchange - obsolete	ABTX	N/A	N/A
07h	Read Connection Status	RCS	4.2.9	Yes
08h	Read Exchange Status Block - obsolete	RES	N/A	N/A
09h	Read Sequence Status Block - obsolete	RSS	N/A	N/A
0Ah	Request Sequence Initiative	RSI	4.2.13	Yes
0Bh	Establish Streaming	ESTS	4.2.6	Yes
0Ch	Estimate Credit	ESTC	4.2.5	Yes
0Dh	Advise Credit	ADVC	4.2.3	Yes
0Eh	Read Timeout Value	RTV	4.2.11	Yes
0Fh	Read Link Error Status Block	RLS	4.2.10	Yes
10h	Echo	ECHO	4.2.4	No
11h	Test	TEST	4.2.14	Yes
12h	Reinstate Recovery Qualifier	RRQ	4.2.12	Yes
13h	Read Exchange Concise	REC	4.2.42	Yes
14h	Reserved for legacy implementations[a]			
20h	Process Login	PRLI	4.2.20	Yes

[a] Some early implementations of FCP-2 may have used the value 14h for SRR (Sequence Retransmission Request). This code is permanently reserved in this standard to avoid conflicts with such implementations. See FCP-3 for the standard implementation of SRR as an FC-4 Link Service.

Table 3 – ELS_Command codes (Continued)

Value (Bits 31-24)	Description	Abbr.	Reference	N_Port Login Required
21h	Process Logout	PRLO	4.2.21	Yes
22h	State Change Notification - obsolete	SCN	N/A	N/A
23h	Test Process Login State	TPLS	4.2.22	Yes
24h	Third Party Process Logout	TPRLO	4.2.34	Yes
25h	Login Control List Management - obsolete	LCLM	N/A	N/A
30h	Get Alias_ID	GAID	4.2.26	No
31h	Fabric Activate Alias_ID	FACT	4.2.27	No
32h	Fabric Deactivate Alias_ID	FDACT	4.2.28	No
33h	N_Port Activate Alias_ID	NACT	4.2.29	No
34h	N_Port Deactivate Alias_ID	NDACT	4.2.30	No
40h	Quality of Service Request - obsolete	QoSR	N/A	N/A
41h	Read Virtual Circuit Status - obsolete	RVCS	N/A	N/A
50h	Discover N_Port Service Parameters	PDISC	4.2.31	Yes
51h	Discover F_Port Service Parameters	FDISC	4.2.32	Yes
52h	Discover Address	ADISC	4.2.33	Yes
53h	Report node Capability - obsolete	RNC	N/A	N/A
54h	Fibre Channel Address Resolution Protocol Request - obsolete	FARP_REQ	N/A	N/A
55h	Fibre Channel Address Resolution Protocol Reply - obsolete	FARP_REPLY	N/A	N/A
56h	Read Port Status Block - obsolete	RPS	N/A	N/A
57h	Read Port List - obsolete	RPL	N/A	N/A
58h	Report Port Buffer Condition	RPBC	4.2.37	Yes

[a] Some early implementations of FCP-2 may have used the value 14h for SRR (Sequence Retransmission Request). This code is permanently reserved in this standard to avoid conflicts with such implementations. See FCP-3 for the standard implementation of SRR as an FC-4 Link Service.

Table 3 – ELS_Command codes (Continued)

Value (Bits 31-24)	Description	Abbr.	Reference	N_Port Login Required
60h	Fabric Address Notification	FAN	4.2.15	No
61h	Registered State Change Notification	RSCN	4.2.18	No
62h	State Change Registration	SCR	4.2.19	No
63h	Report node FC-4 Types	RNFT	4.2.38	Yes
68h	Clock Synchronization Request	CSR	4.2.35	No
69h	Clock Synchronization Update	CSU	4.2.36	No
70h	Loop Initialize	LINIT	4.2.16	No
71h	Loop Port Control - obsolete	LPC	N/A	No
72h	Loop Status	LSTS	4.2.17	No
77h	Vendor Specific			N/A
78h	Request node Identification Data	RNID	4.2.23	No
79h	Registered Link Incident Report	RLIR	4.2.24	Yes
7Ah	Link Incident Record Registration	LIRR	4.2.25	Yes
7Bh	Scan Remote Loop	SRL	4.2.39	Yes
7Ch	Set Bit-error Reporting Parameters	SBRP	4.2.40	Yes
7Dh	Report Port Speed Capabilities	RPSC	4.2.41	Yes
7Eh	Query Security Attributes	QSA	see FC-SP	see FC-SP
7Fh	Exchange Virtual Fabrics Parameters	EVFP	4.2.43	N/A
80h	Link Keep Alive	LKA	4.2.44	No

[a] Some early implementations of FCP-2 may have used the value 14h for SRR (Sequence Retransmission Request). This code is permanently reserved in this standard to avoid conflicts with such implementations. See FCP-3 for the standard implementation of SRR as an FC-4 Link Service.

Table 3 – ELS_Command codes (Continued)

Value (Bits 31-24)	Description	Abbr.	Reference	N_Port Login Required
90h	Authentication ELS	AUTH_ELS	see FC-SP	see FC-SP
97h	Request Fabric Change Notification	RFCN	see FC-SP	see FC-SP
A0h	Define FFI Domain Topology Map	FFI_DTM	4.2.45	Yes
A1h	Request FFI Domain Topology Map	FFI_RTM	4.2.46	Yes
A2h	FFI AE Principal Switch Selector	FFI_PSS	4.2.47	Yes
A3h	FFI Map Update Registration	FFI_MUR	4.2.48	Yes
A4h	FFI Registered Map Update Notification	FFI_RMUN	4.2.49	Yes
A5h	FFI Suspend Map Updates	FFI_SMU	4.2.50	Yes
A6h	FFI Resume Map Updates	FFI_RMU	4.2.51	Yes
Others	Reserved			

[a] Some early implementations of FCP-2 may have used the value 14h for SRR (Sequence Retransmission Request). This code is permanently reserved in this standard to avoid conflicts with such implementations. See FCP-3 for the standard implementation of SRR as an FC-4 Link Service.

An ELS Protocol is composed of an ELS request Sequence and, for some requests, an ELS Reply Sequence. The last Data frame of an ELS request Sequence with a Reply Sequence shall transfer the Sequence Initiative to the Recipient in order to allow the reply to be transmitted (see FC-FS-2). If an ELS request Sequence that has a Reply Sequence is transmitted without the transfer of Sequence Initiative, the Recipient shall abort the Exchange and not perform the request.

The following ELS requests and their replies shall be supported by an Nx_Port (all others are optional for purposes of this standard, other standards or Technical Reports may require further ELS support):

a) FLOGI

b) PLOGI

c) LOGO

An Nx_Port receiving an ELS request shall respond to it in accord with table 4, depending on its N_Port Login state with the Nx_Port sending the ELS request and the PLOGI requirement for the ELS specified in table 3.

Table 4 – Responses to Received ELSs

N_Port Login Required? (see table 3)	Logged in with Source N_Port?	
	Yes	**No**
Yes	Respond as appropriate for the ELS and the current state of the Nx_Port	If a reply sequence is defined for the ELS, originate a LOGO ELS Exchange to the sender of the received ELS or reply with an LS_RJT ELS Sequence with a reason code of "Unable to perform command request" and a reason code explanation of "N_Port Login required". If a reply sequence is not defined for the ELS, it shall be discarded
No	Respond as appropriate for the ELS and the current state of the Nx_Port.	Respond as appropriate for the ELS and the current state of the Nx_Port.

An Nx_Port is not required to generate and send the PLOGI ELS request. However, if an Nx_Port receives a PLOGI ELS request, the Nx_Port shall respond with a LS_ACC Link Service Reply, or with LS_RJT. LS_RJT shall not be issued with a reason code of "Command not supported" in response to a PLOGI.

NOTE 1 – If an Nx_Port that does not generate PLOGI, is in a point-to-point topology, and has an N_Port_Name greater than the other Nx_Port's, the other Nx_Port may timeout, waiting to receive PLOGI.

There is one ELS request Sequence in which a collision is possible with the other Nx_Port involved in the same target Exchange. This request is Request Sequence Initiative (RSI) (e.g., Nx_Port (A) may transmit an RSI request to Nx_Port (B) at the same time that Nx_Port (B) transmits an RSI request to Nx_Port (A) for the same target Exchange).

If such an instance occurs, the Originator Nx_Port of the target Exchange shall reject the RSI request sequence with an LS_RJT with a reason code of "command already in progress". The Responder Nx_Port of the target Exchange shall honor and process the RSI request Sequence normally.

4.2.2 Sequence and Exchange management

Extended Link Service communication shall observe all relevant rules of FC-FS-2.

All ELS requests, excluding ESTS, ESTC, and ADVC, and the corresponding replies shall be performed within a single Exchange, intended exclusively for the purpose of ELS processing (see FC-FS-2 for the procedure using ESTS, ESTC, and ADVC). The Advise Credit request may also be performed in a separate Exchange. Most ELS protocols are performed as a two Sequence Exchange. Each of these two Sequence Exchanges consist of a request Sequence by the Originator, transfer of Sequence Initiative, and a reply Sequence from the Responder that terminates the Exchange by setting the Last_Sequence bit (bit 20) in F_CTL.

More than one frame may be used to form a request or reply Sequence.

The following rules regarding Sequence and Exchange management apply to ELSs in addition to the rules specified in FC-FS-2:

a) Request and Reply Sequences may be sent in any class of service;

NOTE 2 – Not all of the classes make sense for all ELSs, but there is no restriction.

b) Reply frames and Sequences shall be transmitted in the same class as the request;

c) If Login has not been completed successfully, the default Login values shall be used;

d) If Login has completed successfully, the Originator of the Exchange shall use the Discard multiple Sequences Error Policy for all ELS Exchanges (see FC-FS-2);

e) The Originator of an ELS Exchange shall detect an Exchange error following Sequence Initiative transfer if the Reply Sequence is not received within a timeout interval of 2 X R_A_TOV;

f) If the Exchange Originator of an ELS Exchange detects an Exchange error, it shall abort the Exchange using ABTS-LS and retry the protocol of the aborted Exchange with a different Exchange;

g) If the Sequence Initiator aborts a Sequence using ABTS due to receiving an ACK with the Abort Sequence bits set to 01b, the Sequence Initiator shall retry the Sequence after the BA_ACC is received for the aborted Sequence one time only. If the retry fails, the ELS Exchange shall be aborted using ABTS-LS;

h) If the Sequence Initiator attempts to abort a Sequence using ABTS and it detects an E_D_TOV waiting for the ACK frame in response to the ABTS, it shall abort the Exchange using ABTS-LS, if conditions permit, and retry the original ELS with a different Exchange; and

i) If the Sequence Initiator attempts to abort a Sequence using ABTS-LS and it detects an E_D_TOV waiting for the ACK frame in response to the ABTS-LS, it may retry the original ELS with a different Exchange.

4.2.3 Advise Credit (ADVC)

4.2.3.1 Description

The ADVC ELS is used to advise the destination Nx_Port of the estimated end-to-end Credit that the source Nx_Port requests to be allocated. The ADVC ELS request shall be a separate Sequence. It may also be requested in a separate Exchange. See FC-FS-2 for the usage of this ELS. The ADVC request may also be used independently from the Estimate Credit procedure (see FC-FS-2).

4.2.3.2 Protocol

a) Advise Credit Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.3.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Credit revision. The D_ID field designates the destination Nx_Port.

Payload: The format of the Payload is shown in table 5. The Payload shall contain the requested end-to-end Credit in the end-to-end Credit field of the appropriate Class Service Parameters (see 6.6.5) as indicated by the Class Validity bit. For each class in which a revised end-to-end Credit is requested, the Class Validity bit shall be set to one. The recipient shall ignore the other Service Parameter fields.

Table 5 – ADVC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ADVC (0Dh)	00h	00h	00h
1	MSB	Common Service Parameters (16 bytes)		
..				
4				LSB
5	MSB	N_Port_Name (8 bytes)		
6				LSB
7	MSB	Node_Name (8 bytes)		
8				LSB
9	MSB	Class 1 Service Parameters (16 bytes)		
..				
12				LSB
13	MSB	Class 2 Service Parameters (16 bytes)		
..				
16				LSB
17	MSB	Class 3 Service Parameters (16 bytes)		
..				
20				LSB
21	MSB	Reserved (16 bytes)		
..				
24				LSB
25	MSB	Vendor Version Level (16 bytes)		
..				
28				LSB

4.2.3.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the ADVC command.

LS_ACC: LS_ACC signifies successful completion of the ADVC function and permanently replaces the end-to-end Credit in effect for the current N_Port Login.

The format of the LS_ACC Payload is shown in table 6. The Payload shall contain the revised end-to-end Credit allocated in the Credit field for the appropriate Class Service Parameters as indicated by the Class Validity bit. The revised end-to-end Credit shall replace the end-to-end Credit for the current Login for the Nx_Port transmitting the LS_ACC Sequence (see clause 6). For each class in which a revised end-to-end Credit is updated, the Class Validity bit shall be set to one. The recipient shall ignore the other Service Parameter fields. This revised end to-end Credit value is determined by the destination Nx_Port based on its buffering scheme, buffer management, buffer availability, and Nx_Port processing time (see FC-FS-2).

Table 6 – ADVC LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	MSB	Common Service Parameters (16 bytes)		
..				
4				LSB
5	MSB	N_Port_Name (8 bytes)		
6				LSB
7	MSB	Node_Name (8 bytes)		
8				LSB
9	MSB	Class 1 Service Parameters (16 bytes)		
..				
12				LSB
13	MSB	Class 2 Service Parameters (16 bytes)		
..				
16				LSB
17	MSB	Class 3 Service Parameters (16 bytes)		
..				
20				LSB
21	MSB	Reserved (16 bytes)		
..				
24				LSB
25	MSB	Vendor Version Level (16 bytes)		
..				
28				LSB

4.2.4 Echo (ECHO)

4.2.4.1 Description

The Echo ELS requests the Recipient to transmit the Payload contents that follows the ELS_Command back to the Initiator of the Echo command in the same order as received using the LS_ACC Reply Sequence. The Echo ELS Request provides a means to transmit a Data frame and have the Payload content returned for a simple loopback diagnostic function. The Echo command shall be transmitted as a one frame Sequence and the LS_ACC Reply Sequence is also a one frame Sequence.

4.2.4.2 Protocol

a) Echo Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.4.3 Request Sequence

Addressing: The D_ID field designates the destination of the request while the S_ID field designates the source of the request.

Payload: The format of the Payload is shown in table 7. If a Login with the destination Nx_Port does not exist, the maximum size of the ECHO data field shall be the default Buffer-to-buffer Receive Data_Field Size - 4 (i.e., 124 bytes). If a Login with the destination Nx_Port exists, the ECHO data field size is limited by the smallest Receive Data_Field Size supported by the destination Nx_Port, the Fabric, and the source Nx_Port for the class of service being used - 4 (i.e., the ECHO data field in the LS_ACC frame shall be equal in size to the ECHO data field size in the ECHO Request Sequence).

Table 7 – ECHO Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ECHO (10h)	00h	00h	00h
1	MSB	ECHO data (up to max frame length - 4, any byte boundary)		
..				
n				LSB

4.2.4.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the ECHO command.

LS_ACC: LS_ACC signifies successful completion of the ECHO function. The format of the LS_ACC Payload is shown in table 8. The Payload shall contain the ECHO data contained in the Payload of the ECHO Request frame.

Table 8 – ECHO LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	MSB	ECHO data (up to max frame length - 4, any byte boundary) Excludes word 0 of ECHO Payload.		
..				
n				LSB

4.2.5 Estimate Credit (ESTC)

4.2.5.1 Description

The ESTC ELS is used to estimate the minimum Credit required to achieve the maximum bandwidth for a given distance between an Nx_Port pair.

The class of the SOF of the ESTC Request identifies the class for which Credit is being estimated. The destination Nx_Port shall acknowledge Data frames as specified by its Login parameters. See FC-FS-2 for the usage of this frame.

4.2.5.2 Protocol

a) Estimate Credit Request Sequence

b) No Reply Sequence

4.2.5.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting the Credit estimate. The D_ID field designates the destination Nx_Port specified in the Establish Streaming frame.

Payload: The format of the Payload is shown in table 9. The first word of the Payload of the first frame of the Sequence shall contain the ELS_Command code. The content of the Payload after the ELS_Command and for subsequent frames shall be valid data bytes.

Table 9 – ESTC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ESTC (0Ch)	00h	00h	00h
1	MSB	Any data (see FC-FS-2)		
..				
n				LSB

4.2.5.4 Reply Sequence

None.

4.2.6 Establish Streaming (ESTS)

4.2.6.1 Description

The ESTS ELS requests a temporary allocation of Credit known as Streaming Credit large enough to perform continuous streaming of Data frames. The SOF of the ESTS Request identifies the class for which Credit is being estimated. See FC-FS-2 for the usage of this frame.

4.2.6.2 Protocol

a) Establish Streaming Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.6.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Streaming. The D_ID field designates the destination Nx_Port addressed.

Payload: The format of the Payload is shown in table 10.

Table 10 – ESTS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ESTS (0Bh)	00h	00h	00h

4.2.6.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the ESTS command

LS_ACC: LS_ACC signifies successful completion of the ESTS function. The format of the LS_ACC Payload is shown in table 11. The Payload shall contain Streaming Credit allocated in the Nx_Port end-to-end Credit field of the appropriate Class Service Parameters (see 6.6.5). The Class Validity bit, when set to one, identifies the class that contains the Streaming Credit. The recipient shall ignore the other Service Parameter fields.

Table 11 – ESTS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	MSB	Common Service Parameters (16 bytes)		
4				LSB
5	MSB	N_Port_Name (8 bytes)		
6				LSB
7	MSB	node Name (8 bytes)		
8				LSB
9	MSB	Class 1 Service Parameters (16 bytes)		
..				
12				LSB
13	MSB	Class 2 Service Parameters (16 bytes)		
..				
16				LSB
17	MSB	Class 3 Service Parameters (16 bytes)		
..				
20				LSB
21	MSB	Reserved (16 bytes)		
..				
24				LSB
25	MSB	Vendor Version Level (16 bytes)		
..				
28				LSB

4.2.7 Login (FLOGI/PLOGI)

4.2.7.1 Description

The FLOGI/PLOGI ELS shall transfer Service Parameters from the initiating Nx_Port to the FC_Port associated with the D_ID. The FLOGI frame provides the means by which an Nx_Port may request Login with the Fabric (see 6.2). The PLOGI frame provides the means by which an Nx_Port may request Login with another Nx_Port prior to other Data frame transfers (see 6.3).

In order to Login with the Fabric and determine the Fabric operating characteristics, an Nx_Port shall specify the D_ID as the well-known F_Port_ID (i.e., FFFFFEh).

In order to direct the Login ELS frame to a Fibre Channel Service, an Nx_Port shall specify the N_Port_ID for the Nx_Port providing the service or the appropriate well-known Address Identifier (see FC-FS-2).

When an Nx_Port receives a Login from an Nx_Port, all open Sequences with the Nx_Port performing Login shall be abnormally terminated.

4.2.7.2 Protocol

a) FLOGI or PLOGI Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.7.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Login. If unidentified, as in Fabric Login, binary zeros are used. The D_ID field designates the destination Nx_Port or Fx_Port of the Login.

Payload: The format of the Payload is shown in table 149. The Service Parameters are defined in 6.6.

4.2.7.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the FLOGI or PLOGI Request Sequence

LS_ACC: LS_ACC signifies successful completion of the FLOGI or PLOGI Request Sequence. The format of the LS_ACC Payload is shown in table 149. The Service Parameters are defined in 6.6.

4.2.8 Logout (LOGO)

4.2.8.1 Description

The LOGO ELS provides a method for explicitly removing service between two Nx_Port_IDs or between an N_Port_ID and a Fabric. Logout releases resources, identifiers, and relationships associated with maintaining Service between an Nx_Port_ID and a destination Nx_Port_ID or Fabric.

If the S_ID and D_ID of a LOGO ELS are both Address_Identifiers of Nx_Ports, the LOGO requests removal of service between the N_Port_ID specified in the LOGO Payload and the N_Port_ID specified in the D_ID. The N_Port_ID in the LOGO Payload may differ from the S_ID. This allows an Nx_Port to Logout its old Identifier using a new Identifier after its N_Port_ID has changed. Both the source Nx_Port and the destination Nx_Port of the Logout Request Sequence shall abnormally terminate all open Exchanges (see clause 6) that used the N_Port_ID indicated in the Payload of the Logout Request Sequence.

If either the S_ID or D_ID of a LOGO ELS is the F_Port well-known address (FFFFFEh), the LOGO ELS requests Fabric logout and release of the previously assigned N_Port_ID specified in the LOGO Payload. An Nx_Port that requests or accepts explicit logout from the Fabric shall implicitly log out the N_Port_ID indicated in the Payload of the Logout Request Sequence from all other Nx_Port_IDs and abnormally terminate all open Exchanges (see clause 6) that used the N_Port_ID indicated in the Payload of the Logout Request Sequence.

4.2.8.2 Protocol

a) Logout Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.8.3 Request Sequence

Addressing: For an explicit Nx_Port Logout, the S_ID field designates the source Nx_Port_ID requesting Logout and the D_ID field designates the destination Nx_Port of the Logout Request. For an explicit Fabric Logout originated by an Nx_Port, the S_ID field shall be the Nx_Port_ID to be logged out (i.e., the same as the N_Port_ID in the Payload) and the D_ID shall be the F_Port Well-known address (i.e., FFFFFEh). For an explicit Fabric Logout originated by the Fabric, the S_ID field shall be the F_Port Well-known address (i.e., FFFFFEh) and the D_ID shall be the Nx_Port_ID to be logged out (i.e., the same as the N_Port_ID in the Payload).

Payload: The format of the Payload is shown in table 12.

Table 12 – LOGO Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	LOGO (05h)	00h	00h	00h
1	Reserved	N_Port_ID		
2	MSB	N_Port_Name (8 bytes)		
3				LSB

4.2.8.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the LOGO command.

LS_ACC: LS_ACC signifies that service has been removed for the N_Port_ID indicated in the payload of the LOGO ELS. When the LOGO ELS requested Fabric Logout, LS_ACC signifies that the N_Port_ID specified in the Payload of the LOGO ELS has been logged out from the Fabric and released. The format of the LS_ACC Payload is shown in table 13.

Table 13 – LOGO LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.9 Read Connection Status (RCS)

4.2.9.1 Description

The RCS ELS requests the Fabric Controller to return the current dedicated connection status for the Nx_Port specified in the Payload of the RCS frame. The RCS Request provides the means by which an Nx_Port may interrogate the Fabric for the Connection status of other Nx_Ports within the Fabric.

In order to direct the RCS ELS Request frame to the Fabric, an Nx_Port specifies the D_ID as the Fabric Controller (i.e., FFFFFDh).

4.2.9.2 Protocol

a) Read Connection Status Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.9.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Connection status. The D_ID field is the Fabric Controller, (FFFFFDh).

Payload: The format of the Payload is shown in table 14. The first word of the Payload shall contain the ELS_Command code. The second word shall contain the N_Port_ID for which Connection status is being requested.

Table 14 – RCS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RCS (07h)	00h	00h	00h
1	Reserved	N_Port_ID		

4.2.9.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RCS command.

LS_ACC: LS_ACC signifies that the Fabric has completed the request. The format of the LS_ACC Payload is shown in table 15.

Table 15 – RCS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Connection Status	N_Port_ID		

The Connection Status Codes are defined in table 16.

Bits 23 through 0 specify the address identifier of the Nx_Port involved in a dedicated connection with the other Nx_Port specified by the RCS ELS Request Sequence frame (i.e., the Connection established bit is set to one).

Table 16 – Connection Status Codes

Name	Bit Number	Value	Definition
Connect-Request delivered	31	0	The specified Nx_Port is either not Connected, or is involved in an Established Connection based on the setting of the Connection established bit.
		1	A connect-Request has been delivered to the specified Nx_Port, but the Nx_Port has not yet responded with a proper response frame and a dedicated connection does not yet exist.
Connect-Request stacked	30	0	No connect-Request is stacked for the specified Nx_Port on behalf of the requesting Nx_Port.
		1	One or more connect-Requests are stacked, but have not been delivered to the specified Nx_Port on behalf of the requesting Nx_Port
Connection established	29	0	The specified Nx_Port in the RCS Request is not in a dedicated connection
		1	The specified Nx_Port is involved in a dedicated connection. The address identifier in bits 23-0 identifies the other Nx_Port involved in the dedicated connection.
Intermix mode	28	0	The N_Port specified in the RCS frame is not functioning in Intermix mode.
		1	The N_Port specified in the request is functioning in Intermix mode. An N_Port is functioning in Intermix mode if both the N_Port and the F_Port have both previously indicated that each supports Intermix during Login.

4.2.10 Read Link Error Status Block (RLS)

4.2.10.1 Description

The RLS ELS requests an FC_Port to return the identified Link Error Status Block (LESB) associated with the Port_ID specified in the Payload. This provides the Nx_Port transmitting the request with information regarding Link Errors detected within the designatedFC_Port.

4.2.10.2 Protocol

a) Read Link Error Status Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.10.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting the LESB. The D_ID field shall be set as follows:

a) to any Domain Controller well known address (FFFCxxh);

b) to the F_Port well known address (FFFFEh); or

c) to any Nx_Port logged in with the S_ID address.

Payload: The format of the Payload is shown in table 17.

Table 17 – RLS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RLS (0Fh)	00h	00h	00h
1	Reserved	N_Port_ID		

The requested LESB is identified as follows:

a) If the D_ID is a Domain Controller well known address (FFFCxxh), the N_Port_ID field shall be set to an N_Port_ID withihn the associated domain. The LESB requested is for the F_Port that the N_Port_ID is logged in with;

b) if the D_ID is the F_Port well known address (FFFFFEh), the N_Port_ID field is not meaningful and the LESB request is for the local Fx_Port that the S_ID is logged in with; or

c) for all other D_IDs, the N_Port_ID field is not meaningful and the LESB requested is for the Nx_Port assigned to the D_ID.

4.2.10.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RLS command. The LS_RJT reason code and reason code explanation are set as follows:

a) If an FC_Port does not support the LESB, it shall reply with an LS_RJT specifying a reason code of "Unable to perform command request" (09h) and should respond with a reason code explanation of "Request not supported" (2Ch); or

b) if the N_Port_ID is not logged in with an F_Port within the domain, the Domain Controller should reply with an LS_RJT specifying a reason code of "Logical error" (03h) and reason code explanation "Invalid N_Port_ID" (1Fh).

LS_ACC: LS_ACC signifies that the FC_Port has transmitted the requested data. The format of the LS_ACC Payload is shown in table 18. The format of the Link Error Status Block is specified in FC-FS-2**.**

Table 18 – RLS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	MSB	Link Error Status Block (see FC-FS-2) (24 bytes)		
..				
6				LSB

4.2.11 Read Timeout Value (RTV)

4.2.11.1 Description

The RTV ELS requests an FC_Port to return the R_A_TOV and the E_D_TOV in the LS_ACC. The LS_ACC returns the value that the FC_Port uses for R_T_TOV. This provides the FC_Port transmitting the RTV ELS with information regarding these values from another FC_Port. Usage of R_A_TOV, E_D_TOV and R_T_TOV requirements are given in FC-FS-2.

4.2.11.2 Protocol

a) Read Timeout Value (RTV) Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.11.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting the timeout interval values. The D_ID field designates the destination FC_Port to which the request is being made.

Payload: The format of the Payload is shown in table 19.

Table 19 – RTV Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RTV (0Eh)	00h	00h	00h

4.2.11.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RTV command.

LS_ACC: LS_ACC returns the requested R_A_TOV and E_D_TOV values. The format of the LS_ACC Payload is shown in table 20. E_D_TOV Timeout values are specified as a count of either 1 ms or 1 ns increments, depending on the setting of the E_D_TOV Resolution (see FC-FS-2).

Table 20 – RTV LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Resource_Allocation_Timeout Value (R_A_TOV) (see FC-FS-2)			
2	Error_Detect_Timeout Value (E_D_TOV) (see FC-FS-2)			
3	Timeout Qualifier			

The Timeout Qualifier word is defined as follows:

a) Bits 31-27: Reserved

b) Bit 26: E_D_TOV Resolution

If the E_D_TOV Resolution bit is zero, the value specified in the E_D_TOV field shall indicate a count of 1 ms increments. If the E_D_TOV Resolution bit is one, the value specified in the E_D_TOV field shall indicate a count of 1 ns increments.

c) Bits 25-20: Reserved

d) Bit 19: R_T_TOV Value

If this bit is set to zero, the value of R_T_TOV shall be the default value of 100 milliseconds. If it is set to one, the value of R_T_TOV shall be 100 microseconds.

e) Bits 18-0: Reserved

4.2.12 Reinstate Recovery Qualifier (RRQ)

4.2.12.1 Description

The RRQ ELS shall be used to notify the destination Nx_Port that the Recovery_Qualifier shall be available for reuse. The Recovery_Qualifier (S_ID, D_ID, OX_ID, RX_ID, and low SEQ_CNT minus high SEQ_CNT) shall be associated with an Exchange in which the Abort Sequence or Abort Exchange was previously performed.

In the case of Abort Exchange (i.e., ABTS-LS), the ESB and Recovery_Qualifier are immediately available for reuse. In the case of Abort Sequence Protocol, the Recovery_Qualifier is purged.

A request to Reinstate the Recovery_Qualifier shall only be accepted if the Originator Nx_Port N_Port_ID or the Responder Nx_Port N_Port_ID of the target Exchange is the same as the N_Port_ID of the Nx_Port that makes the request. If the RRQ Request is not accepted, an LS_RJT with reason code "Unable to perform command request" and reason code explanation "Invalid Originator S_ID" shall be returned.

A separate Exchange shall be used to reinstate the Recovery_Qualifier. The Payload shall contain the OX_ID and RX_ID for the Exchange Recovery_Qualifier, in addition to the S_ID of the Nx_Port

that originated the Exchange being aborted. Resources associated with the OX_ID in the Originator, and with the RX_ID in the Responder, shall be released following transmission and reception of the LS_ACC reply Sequence if the Exchange had been aborted with ABTS-LS.

Both the Originator and Responder shall ensure that the OX_ID and RX_ID pair being terminated is currently associated with the OX_ID and RX_ID pair specified in the RRQ Request.

The Recovery_Qualifier range shall be timed out for an R_A_TOV timeout period (i.e., RRQ shall not be transmitted until an R_A_TOV timeout period after BA_ACC for ABTS has been received) by the Nx_Port that transmitted and successfully completed the ABTS frame.

4.2.12.2 Protocol

a) Reinstate Recovery Qualifier Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.12.3 Request Sequence

Addressing: The D_ID field designates the destination Nx_Port of the RRQ Request Sequence while the S_ID field designates the source Nx_Port that is requesting that the Recovery_Qualifier be reinstated.

Exchange: A separate Exchange is required.

SEQ_ID and SEQ_CNT: The SEQ_ID and the SEQ_CNT shall be appropriate for an open Sequence.

Payload: The format of the Payload is shown in table 21.

Table 21 – RRQ Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RRQ (12h)	00h	00h	00h
1	Reserved	Exchange Originator S_ID		
2	OX_ID		RX_ID	
3	MSB	Association_Header (optional) (32 bytes)		
..				
10				LSB

4.2.12.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RRQ command.

LS_ACC: LS_ACC signifies that the destination Nx_Port reinstated the Recovery_Qualifier. The format of the LS_ACC Payload is shown in table 22.

Table 22 – RRQ LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.13 Request Sequence Initiative (RSI)

4.2.13.1 Description

The RSI ELS is used to request that Sequence Initiative be passed to the Sequence Recipient of an Exchange in progress. A request to pass Sequence Initiative shall only be accepted if the Originator Nx_Port or the Responder Nx_Port of the target Exchange makes the request. A separate Exchange shall be used to perform the Request Sequence Initiative. The Payload shall contain the OX_ID and RX_ID for the target Exchange, in addition to the S_ID of the Nx_Port that originated the Exchange. The LS_ACC Reply is sent subsequent to the transfer of Sequence Initiative on the target Exchange.

Transmission of RSI is allowed while the identified Exchange is open. Both the Originator and Responder shall ensure that the OX_ID and RX_ID pair for which Sequence Initiative is being passed are currently associated with the OX_ID and RX_ID pair specified in the RSI Request.

If there is a Sequence active for the target Exchange, the Sequence Initiator of the active Sequence of the target Exchange shall terminate them and transfer Sequence Initiative as follows:

a) If there is an active Sequence for which the last Data frame has not been transmitted, the Sequence Initiator of the target Exchange shall terminate the Sequence by transmitting a Data frame with the End_Sequence and Sequence Initiative bits set to one in F_CTL.

b) If there are no Data frames to be sent for the active Sequence, the Sequence Initiator of the target Exchange shall transmit a NOP Basic Link Service frame (see FC-FS-2) with the End_Sequence and Sequence Initiative bits set to one in F_CTL.

If there is no Sequence active, the Sequence Initiator of the target Exchange shall transfer Sequence Initiative by initiating a new Sequence consisting of a single NOP Basic Link Service frame (a one frame Sequence) with the End_Sequence and Sequence Initiative bits set to 1 in F_CTL.

The LS_ACC to the Exchange requesting Sequence Initiative shall be transmitted after Sequence Initiative has been passed (see FC-FS-2) on the target Exchange.

4.2.13.2 Protocol

a) Request Sequence Initiative Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.13.3 Request Sequence

Addressing: The D_ID field designates the destination Nx_Port of the Exchange for which Sequence Initiative is being requested and the S_ID field designates the source Nx_Port that is requesting Sequence Initiative.

Exchange: A separate Exchange is required other than the Exchange for which Sequence Initiative is being requested in order to properly track status.

SEQ_ID and SEQ_CNT: The SEQ_ID and the SEQ_CNT shall be appropriate for an open Sequence.

Payload: The format of the Payload is shown in table 23.

Table 23 – RSI Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RSI (0Ah)	00h	00h	00h
1	Reserved	Originator S_ID		
2	OX_ID		RX_ID	
3	MSB	Association_Header (optional) (32 bytes)		
..				
10				LSB

4.2.13.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RSI command.

LS_ACC: LS_ACC signifies that the destination Nx_Port has transferred the Sequence Initiative for the target Exchange. The format of the LS_ACC Payload is shown in table 24.

Table 24 – RSI LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.14 Test (TEST)

4.2.14.1 Description

The TEST ELS shall consist of a single Sequence being transmitted from the Sequence Initiator to the Sequence Recipient. The Test Request may be used in diagnostic or testing procedures to provide system loading. There is no Reply Sequence. The Payload may consist of any frame size up to the maximum allowable for the class and other normal Sequence and frame limitations.

4.2.14.2 Protocol

a) Test Request Sequence

b) No Reply Sequence

4.2.14.3 Request Sequence

Addressing: The D_ID field designates the destination of the request while the S_ID field designates the source of the request.

Payload: The format of the Payload is shown in table 25.

Table 25 – TEST Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	TEST (11h)	00h	00h	00h
1	MSB	TEST data (up to max Data Field size, any byte boundary)		
..				
n				LSB

The Payload size is limited by the smallest Data Field size supported by the destination Nx_Port and the Fabric for the class being used.

4.2.14.4 Reply Sequence

none

4.2.15 Fabric Address Notification (FAN)

4.2.15.1 Description

The FAN ELS shall be sent by a Fabric F_Port (FFFFFEh) to all known previously logged in (via FLOGI) attached NL_Ports following an initialization event. This initialization event is typically Loop Initialization on an Arbitrated Loop, though other events that may cause a port to change its ID may also be considered. The F_Port Controller shall report the F_Port_Name and Fabric_Name as they were reported in the prior FLOGI, and shall report the current Loop Fabric Address. The F_Port Controller shall send this ELS using the default login parameters (i.e., the parameters that are in effect prior to a FLOGI Request).

The attached ports may use this information to authenticate active Exchanges and operating parameters (e.g., login BB_Credit).

The F_Port Controller shall report identical information to all attached NL_Ports. If the information changes in any way before the F_Port Controller is able to send the service to all attached ports, the F_Port Controller shall begin a new initialization event.

The attached NL_Ports shall not initiate a Reply Sequence to this ELS.

4.2.15.2 Protocol

a) Fabric Address Notification Request Sequence

b) No Reply Sequence

4.2.15.3 Request Sequence

Addressing: The S_ID is the Fabric Controller (FFFFFEh) sending the FAN. The D_ID is the NL_Port receiving the FAN.

Payload: The format of the FAN Request Payload is shown in table 26.

Table 26 – FAN Payload

Bits / Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FAN (60h)	00h	00h	00h
1	Reserved	Loop Fabric Address		
2	MSB	F_Port_Name (8 bytes)		
3				LSB
4	MSB	Fabric_Name (8 bytes)		
5				LSB

4.2.15.4 Reply Sequence

none

4.2.16 Loop Initialize (LINIT)

4.2.16.1 Description

The LINIT ELS requests the start of Loop Initialization on a designated loop. The FL_Port connected to the loop addressed by the Loop Fabric Address shall originate a LIP of the type specified in the Payload and begin the Initialization Process as described in FC-AL-2. The LS_ACC Reply Sequence shall not be initiated before the FL_Port has transitioned from the OPEN-INIT to MONITORING State, and the Fabric Controller has completed sending any FAN ELS (see FC-AL-2). If the LINIT ELS is received by a non-FL_Port, the port shall originate an LS_RJT with a reason code of "Command not supported".

4.2.16.2 Protocol

a) Loop Initialize Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.16.3 Request Sequence

Addressing: The S_ID designates the Nx_Port requesting Loop Initialization of the loop. The D_ID field shall be the Loop Fabric Address (LFA) of the loop to be initialized.

Payload: The format of the LINIT Request Payload is shown in table 27.

Table 27 – LINIT Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	LINIT (70h)	00h	00h	00h
1	Reserved	Initialization Function	LIP byte 3	LIP byte 4

The Initialization Function field defines modifications of the initialization to be performed. The format of the Initialization Function is shown in table 28.

Table 28 – Initialization Function

Function	Value
Normal Initialization - The Fabric determines the best method by which to complete the initialization.	0
Force Login - The L_bit shall be set in the Loop Initialization Soft Assigned (LISA) Sequence to force all affected L_Ports to perform FLOGI.	1
Reserved	2 - 255

The LIP Byte 3 field is the 3rd byte of the LIP to be originated. The LIP Byte 4 field is the 4th byte of the LIP Primitive Sequence to be originated. LIP Byte 3 and LIP Byte 4 should only be set to values permitted by FC-AL-2.

4.2.16.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the LINIT command

LS_ACC: LS_ACC signifies acceptance of the LINIT Request and completion of Loop Initialization. The format of the LS_ACC Payload is shown in table 29.

Table 29 – LINIT LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Reserved			Status

The format of the Status field is shown in table 30.

Table 30 – LINIT Status

State	Value
Reserved	0
Success - The requested function was completed.	1
Failure - The requested function could not be completed.	2
Reserved	3-255

4.2.17 Loop Status (LSTS)

4.2.17.1 Description

The LSTS ELS is used to request the Fabric Controller to report on the state of the specified loop.

4.2.17.2 Protocol

a) Loop Status Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.17.3 Request Sequence

Addressing: The S_ID is the Nx_Port requesting status for the specified loop. The D_ID field shall be the Loop Fabric Address (LFA) of the loop for which status is being requested.

Payload: The format of the LSTS Payload is shown in table 31.

Table 31 – LSTS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	LSTS (72h)	00h	00h	00h

4.2.17.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the LSTS command.

LS_ACC: LS_ACC supplies the requested status for the identified Loop. The format of the LS_ACC Payload is shown in table 32.

Table 32 – LSTS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Reserved	Failed Receiver	FC-FLA Compliance Level - obsolete	Loop State
2	MSB	Current Public Loop Devices bit map (16 bytes)		
..				
5				LSB
6	MSB	Current Private Loop Devices bit map (16 bytes)		
..				
9				LSB
10	MSB	AL_PA Position Map (128 bytes)		
..				
41				LSB

The Payload fields are defined as follows:

a) **Failed Receiver field:** The Failed Receiver field shall contain the AL_PA of the L_Port that detected the Loop Failure. This field is valid only if the Loop State indicates a Loop Failure. This field shall be set to 00h if the FL_Port detected the failure. This field shall be set to F7h if the Fabric Controller is unable to determine the port that detected the failure.

b) **Compliance Level field:** obsolete.

c) **Loop State field:** The format of the Loop State field is shown in table 33.

Table 33 – Loop State

State	Value
Reserved	0
Online – The loop is not performing Loop Initialization, and no Failure has been detected.	1
Loop Failure - A Loop Failure has been detected. The AL_PA that detected the failure is reported in the Failed Receiver field.	2
Initialization Failure - The FL_Port has not been able to complete Loop Initialization.	3
Initializing - The loop is currently performing Loop Initialization.	4
Reserved	5 - 255

d) **Current Public Loop Devices:** The format of the Current Public Loop Devices field follows the AL_PA bit mapped format defined in FC-AL-2. If a bit is set to one in this field, then a Loop Device that has performed FLOGI is present at the identified location. This field is valid only when the value in the Loop State field is Online.

e) **Current Private Loop Devices:** The format of the Current Private Loop Devices field follows the AL_PA bit mapped format defined in FC-AL-2. If a bit is set to one in this field, then a Loop Device is present at the identified location. This field is valid only when the value in the Loop State field is Online.

f) **AL_PA Position Map:** The format of the AL_PA Position Map field follows the AL_PA position map format defined in FC-AL-2 for the Loop Initialization Loop Position (LILP) Sequence. If Byte 0 of the first word of the AL_PA position map is set to zero, then no AL_PA position map is available. This field is valid only when the value in the Loop State field is Online.

4.2.18 Registered State Change Notification (RSCN)

4.2.18.1 Introduction

A RSCN ELS shall be sent to registered Nx_Ports when an event occurs that may have affected the state of one or more Nx_Ports, or the ULP state within the Nx_Port. The term, state, is used here to refer to any condition of an Nx_Port that is considered important enough to notify other Nx_Ports of a change in that state. The definition of important is specific to an Nx_Port implementation, but should include the Login state or Link state. The RSCN additionally provides an indication of the change of state that is being reported.

RSCN is intended to provide a timely indication of changes in nodes to avoid the considerable traffic that polling may generate. RSCN may be used to indicate a failed node, allowing the release of resources tied up by the failed node. RSCN may also be used to notify interested nodes of new devices coming online, and of changes within an online node that affect the operation of the system (e.g.,

more storage has become available). The sender of the RSCN Request may coalesce several events into a single report.

A RSCN Request may be sent by the Fabric to notify registered Nx_Ports of changes detected by the Fabric. The Fabric Controller (FFFFFDh) issues the RSCN Request to the registered Nx_Ports. An Nx_Port may also issue a RSCN Request to the Fabric Controller or another Nx_Port to indicate changes of state within the Nx_Port that are not otherwise detectable by the Fabric.

The Payload of a RSCN Request includes a list containing the addresses of the affected Nx_Ports. The RSCN includes a summary indication of the type of state change being reported to assist in analyzing the change. The sending of RSCN between Nx_Ports, neither of which are the Fabric Controller, is permitted.

4.2.18.2 RSCNs issued by the Fabric Controller

The Fabric Controller shall issue an RSCN Request to all registered Nx_Ports for an affected Nx_Port when the Fabric detects an event. The Fabric Controller shall ensure that any Fabric-provided resources (e.g., the Name Service) have received updates to reflect changes caused by the event, prior to issuing the RSCN for the event. An event may include any of the following:

a) an implicit Fabric Logout of the affected Nx_Port, including Loss-of-Signal, NOS, and OLS, or when the Fabric receives a FLOGI that contains new or different information from a port that had already completed FLOGI;

b) a loop initialization of the affected L_Port, and the L_bit was set in the LISA Sequence;

c) a Fabric Login from an affected Nx_Port not previously logged in;

d) the Fabric path between the affected Nx_Port and any other Nx_Port has changed (e.g., a change to the Fabric routing tables that affects the ability of the Fabric to deliver frames in order, or an E_Port initialization or failure);

e) any other Fabric-detected state change of the affected Nx_Port;

f) the affected Nx_Port issues an RSCN Request to the Fabric Controller.

A registered Nx_Port that receives an RSCN Request may perform any operation to determine the nature of the state change. These operations include the PDISC ELS, the ADISC ELS, a query to the Name Service, or a ULP query. The Fabric may accumulate affected Nx_Port addresses for subsequent delivery to reduce the volume of RSCN traffic.

4.2.18.3 RSCN issued by the affected Nx_Port

An Nx_Port shall issue an RSCN Request to the Fabric Controller or the Nx_Port that has registered for receipt of RSCN Requests or both when an event is detected by an Nx_Port. Fabric Controllers are implicitly registered to receive RSCNs after a successful implicit or explicit FLOGI. Nx_Ports, neither of which are the Fabric Controller, that request RSCNs are hereafter called registered Nx_Ports. Unless it is providing a service associated with a well known address an Nx_Port shall only issue RSCNs with an event qualifier of 2h or 0h. An event may include any of the following:

a) a failure within the affected Nx_Port;

b) any other important state change of the affected Nx_Port (e.g., an event defined by a FC-4).

4.2.18.4 RSCN initiative

An affected Nx_Port shall issue one RSCN Request for all state changes that occur prior to the initiation of the RSCN Request; multiple RSCN Requests shall not be queued for initiation. An RSCN Request shall be considered initiated when the SOF of the first frame of the RSCN Request Sequence has been transmitted.

4.2.18.5 RSCN registration

A node (Fabric Controller, service, Nx_Port) shall only issue RSCN requests to Nx_Ports that have registered with the node to be notified of state changes. These registrations shall be performed using the State Change Registration (SCR) ELS.

4.2.18.6 Protocol

a) RSCN Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.18.7 Request Sequence

Addressing: If the Fabric is using RSCN to notify a registered Nx_Port of a state change (see 4.2.18.2), the S_ID is the Fabric Controller, (FFFFFDh) and the D_ID is the address of the registered Nx_Port destination. If an affected Nx_Port is using RSCN to notify the Fabric or a registered Nx_Port of a state change (see 4.2.18.3), the S_ID designates either the Nx_Port indicating a state change to the Fabric Controller or the registered Nx_Port and the D_ID is either the Fabric Controller, (FFFFFDh) or the address of the registered Nx_Port destination.

Payload: The format of the RSCN Request Payload is shown in table 34.

Table 34 – RSCN Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RSCN (61h)	Page Length (04h)	Payload Length	
1	affected Port_ID pages (1 to 255 pages, 4 bytes each)			
..				
N				

The RSCN Payload fields are defined as follows:

a) **Page Length:** This field is the length in bytes of an affected Port_ID page. This value is fixed at 04h.

b) **Payload Length:** This field is the length in bytes of the entire Payload, inclusive of the word 0. This value shall be a multiple of 4 bytes. The minimum value of this field is 8 bytes. The maximum value of this field is 1024 bytes.

c) **Affected Port_ID Pages:** Each affected Port_ID page contains the ID of the Nx_Port, Fabric Controller, E_Port, domain, or area for which the event was detected. The RSCN Payload

shall contain one or more of these pages. The generic format of the affected Port_ID page is shown in table 35.

Table 35 – Generic affected Port_ID page

Bit in Byte Byte	7	6	5	4	3	2	1	0
0 (Bits 31 - 24)	reserved		RSCN Event Qualifier				Address Format	
1 (Bits 23 - 16)	affected Port_ID byte 1 (Domain)							
2 (Bits 15 - 08)	affected Port_ID byte 2 (Area)							
3 (Bits 07 - 00)	affected Port_ID byte 3 (Port)							

A) **RSCN Event Qualifier:** The RSCN Event Qualifier values are shown in table 36.

Table 36 – RSCN Event Qualifier values

RSCN event Qualifier	Value			
	Bit 5	**Bit 4**	**Bit 3**	**Bit 2**
Event is not specified	0	0	0	0
CHANGED NAME SERVER OBJECT - An object maintained by the Name Server has changed state for the port, area or domain indicated by the affected Port_ID.	0	0	0	1
CHANGED PORT ATTRIBUTE - An internal state of the port specified by the affected Port_ID has changed. The change of state is identified in a protocol specific manner.	0	0	1	0
CHANGED SERVICE OBJECT - An object maintained by the service identified by the well-known address contained in affected Port_ID has changed state. This Event Qualifier value shall not be used by services accessed through N_Port_ID that are not well-known addresses.	0	0	1	1
CHANGED SWITCH CONFIGURATION - Switch configuration has changed for the area or domain specified by the affected Port_ID.	0	1	0	0
REMOVED OBJECT - The port, area or domain indicated by the affected Port_ID is no longer accessible on the Fabric.	0	1	0	1
Reserved	All Other Values			

B) **Address Format:** The format of the Address Format field is shown in table 37.

Table 37 – Address Format

Format	Value
Port Address - Bytes 1, 2, and 3 of the affected Port_ID are valid, and indicate a single Nx_Port or service with a well-known address.	0
Area Address Group - Bytes 1 and 2 of the affected Port_ID are valid, and indicates a group of addresses that encompass an Area of E_Port or Nx_Port addresses. Byte 3 shall be zero. Any links and ports within the area may be affected.	1
Domain Address Group - Byte 1 of the affected Port_ID is valid, and indicates a group of addresses that encompass a Domain. Bytes 2 and 3 shall be zero. Any links and ports within the domain may be affected.	2
Fabric Address Group - This format indicates a group of addresses that encompass the entire Fabric of Nx_Port addresses. Bytes 1, 2 and 3 shall be zero. Any links and ports within the area may be affected.	3

4.2.18.8 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the RSCN command

LS_ACC: LS_ACC signifies acceptance of the RSCN Request. The format of the LS_ACC Payload is shown in table 38.

Table 38 – RSCN LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.19 State Change Registration (SCR)

4.2.19.1 Description

The SCR ELS requests the Fabric Controller or Nx_Port to add the Nx_Port that is sending the SCR Request to the list of Nx_Ports registered to receive the RSCN ELS.

4.2.19.2 Protocol

a) State Change Registration Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.19.3 Request Sequence

Addressing: The S_ID designates the Nx_Port requesting registration for State Change Notification. The D_ID designates either the Fabric Controller, FFFFFDh, or the address of the Nx_Port from which RSCNs are desired.

Payload: The format of the SCR Request Payload is shown in table 39.

Table 39 – SCR Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	SCR (62h)	00h	00h	00h
	Reserved			Registration Function

Registration Function: The format of the Registration Function field is shown in table 40.

Table 40 – Registration Function

Function	Value
Reserved	0
Fabric Detected registration - Register to receive all RSCN Requests issued by the Fabric Controller for events detected by the Fabric.	1
Nx_Port Detected registration - Register to receive all RSCN Requests issued for events detected by the affected Nx_Port.	2
Full registration - Register to receive all RSCN Requests issued. The RSCN Request shall return all affected N_Port_ID pages.	3
Reserved	4 - 254
Clear registration - Remove any current RSCN registrations.	255

4.2.19.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the SCR command.

LS_ACC: LS_ACC signifies acceptance of the SCR Request and registration for RSCN. The format of the LS_ACC Payload is shown in table 41.

Table 41 – SCR LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.20 Process login (PRLI)

4.2.20.1 Introduction

The PRLI ELS is used to establish the operating environment between a group of related processes at the originating Nx_Port and a group of related processes at the responding Nx_Port (see 7.1).

4.2.20.2 Protocol

a) Process Login Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.20.3 Request Sequence

Addressing: The S_ID field designates the Nx_Port requesting Process Login. The D_ID field designates the destination Nx_Port of the Process Login.

Payload: The format of the Payload is shown in table 42.

Table 42 – PRLI Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	PRLI (20h)	Page Length	Payload Length	
1		Service Parameter page		
..				
N				

The Payload Field are defined as follows:

a) **Page length:** Byte 1 of word 0 contains an 8-bit value that specifies the length of the Service Parameter page. The right-most two bits shall be zeros. The minimum Page Length value is 12 (see table 43).

b) **Payload length:** Bytes 2-3 of word 0 contain a 16-bit value that specifies the length of the PRLI Payload. The right-most two bits shall be zeros. The value specified shall be greater than or equal to 16, and less than or equal to 65 532 (see table 43).

c) **Service parameter page:** Words 1:N of the PRLI Payload contain the Service Parameter page. The Service Parameter page contains Service Parameters for a single image pair and is

associated with either a single FC-4 TYPE or is common to all FC-4 TYPE codes for the specified image pair. The format of PRLI Service Parameter pages is specified in table 43.

Table 43 – PRLI service parameter page format

Item	Word	Bit
TYPE Code or Common Service Parameters*	0	31-24
TYPE Code Extension	0	23-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Establish Image Pair	0	13
Reserved	0	12-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Service Parameters (optional per FC-4)	3 - 63 as sepcified by each FC-4	31-0

The PRLI service parameter page format fields are defined as follows:

a) **TYPE code or common service parameters:** Identifies the protocol associated with this Service Parameter page. If byte 0 of the first word of a Service Parameter page contains the value 00h, the Service Parameter page contains Service Parameters common to all FC-4 Types at that image pair or Nx_Port pair. If byte 0 of the first word of a Service Parameter page contains the value other than 00h, the Service Parameter page contains Service Parameters for the FC-4 TYPE indicated.

b) **TYPE code extension:** Reserved for future use.

c) Originator Process_Associator validity:

0 = not meaningful
1 = meaningful

d) Responder Process_Associator validity:

0 = not meaningful
1 = meaningful

e) Establish Image Pair:

0 = Exchange Service Parameters only
1 = Establish image pair and exchange Service Parameters

f) Originator Process_Associator: Identifies the process or group of processes within the Originator (see FC-FS-2).

g) Responder Process_Associator: Identifies the process or group of processes within the Responder (see FC-FS-2).

h) **Service Parameters:** No Common Service Parameters are currently specified. The length of the optional Service Paramters may be from 0 to 60 words as specified in the respecitive FC-4 standard (see 7.1.1). The first three words of each PRLI service parameter page shall be as specified in table 43, words 0 to 2.

4.2.20.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the PRLI Request

LS_ACC: LS_ACC signifies successful completion of the PRLI Request. The format of the LS_ACC Payload is shown in table 44.

Table 44 – PRLI LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Page Length	Payload Length	
1		Service Parameter Response page		
..				
N				

The LS_ACC Payload fields are defined as follows:

a) **Page length:** Byte 1 of word 0 contains an 8-bit value that specifies the length of the Service Parameter Response page. The right-most two bits shall be zeros. The value shall be the same value as in the Page Length field of the PRLI Request.

b) **Payload length:** Bytes 2-3 of word 0 contain a 16-bit value that specifies the length of the PRLI LS_ACC Payload. The right-most two bits shall be zeros. The value specified shall be greater than or equal to 16, and less than or equal to 65 532.

c) **Service parameter response page:** Words 1:N of the PRLI LS_ACC Payload contain the Service Parameter Response page. The Service Parameter Response page contains Service Parameter responses for a single image pair or Nx_Port pair and is associated with a single FC-4 TYPE or common to all FC-4 Types at that image pair or Nx_Port pair.

The format of PRLI LS_ACC Service Parameter Response pages is described in table 45.

Table 45 – PRLI LS_ACC service parameter response page format

Item	Word	Bit
TYPE Code or Common Service Parameters*	0	31-24
TYPE Code Extension	0	23-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Image Pair Established	0	13
Reserved	0	12
Response Code (see table 46)	0	11-8
Reserved	0	7-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Service Parameter Response (optional per FC-4)	3 - 63 as specified by each FC-4	31-0

The PRLI LS_ACC service parameter response page format fields are defined as follows:

a) **TYPE code or common service parameters:** Identifies the protocol associated with this Service Parameter Response page. If byte 0 of the first word of a Service Parameter Response page contains the value 00h, the Service Parameter page contains Service Parameters common to all FC-4 Types at that image pair or Nx_Port pair. If byte 0 of the first word of a Service Parameter Response page contains a value other than 00h, the Service Parameter page contains Service Parameters for the FC-4 TYPE indicated.

b) **TYPE code extension:** Reserved for future use.

c) Originator Process_Associator validity:

0 = not meaningful
1 = meaningful

d) Responder Process_Associator validity:

0 = not meaningful
1 = meaningful

e) **Image Pair Established:** Image Pair Established is valid only if bit 13 was set to one on the corresponding Service Parameter page of the PRLI Request.

0 = Image pair not established, see response code for additional information
1 = Image pair established

f) **Response code:** The response code field contains an encoded binary value indicating the result of the PRLI Request. The meanings of the encoded response code values are shown in table 46.

g) **Service parameter response:** Provides feedback to the Originator as to the resultant state of the Service Parameters as returned by the Responder. The length of the PRLI LS_ACC service parameter repsonse may be 0 to 60 words long as specified in the respective FC-4 standard (see 7.1.1). The first three words of each PRLI LS_ACC service parameter response page shall be as specified in table 45, words 0 to 2.

Table 46 – PRLI accept response code

Encoded Value Word 0, Bits 11-8	Description
0000b	Reserved
0001b	Request executed
0010b	The Exchange recipient has no resources available for establishing image pairs between the specified source and destination Nx_Ports. The PRLI Request may be retried.
0011b	Initialization is not complete for the Exchange recipient. The PRLI Request may be retried.
0100b	The Exchange recipient corresponding to the Responder Process_Associator specified in the PRLI Request and PRLI LS_ACC response does not exist. The PRLI Request shall not be retried.
0101b	The Exchange recipient has a predefined configuration that precludes establishing this image pair. The PRLI Request shall not be retried.
0110b	Request executed conditionally. Some Service Parameters were not able to be set to their requested state (see table 43)
0111b	Obsolete
1000b	Service Parameters are invalid
1001b to 1111b	Reserved

4.2.21 Process logout (PRLO)

4.2.21.1 Description

The PRLO ELS is used to request invalidation of the operating environment between an image at the initiating Nx_Port and an image at the recipient Nx_Port. PRLO frees resources committed by a previous PRLI function (see 7.2).

4.2.21.2 Protocol

a) Process Logout Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.21.3 Request Sequence

Addressing: The S_ID field designates the Nx_Port requesting Process Logout. The D_ID field designates the destination Nx_Port of the Process Logout.

Payload: The format of the Payload is shown in table 47.

Table 47 – PRLO Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	PRLO (21h)	Obsolete (10h)[a]	Payload Length	
1	Logout Parameter page (4 words)			
..				
N				

[a] This field is obsolete, but shall be set to 10h for compatibility.

The PRLO Payload fields shall be defined as follows:

a) **Payload length:** The Payload length shall be 20.

b) **Logout parameter page:** Words 1:N of the PRLO Payload contain the Logout Parameter page. The Logout Parameter page contains logout parameters for a single image pair and is associated with either a single FC-4 TYPE or is common to all FC-4 TYPE codes for the specified image pair.

The format of PRLO Logout Parameter pages is described in table 48.

Table 48 – PRLO logout parameter page format

Item	Word	Bit
TYPE Code or Common Logout Parameters[a]	0	31-24
TYPE Code Extension	0	23-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Reserved	0	13-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Reserved	3	31-0

[a] If byte 0 of the first word of a Logout Parameter page is set to the value 00h, the Logout Parameter page is common to all FC-4 Types at that image pair.

The PRLO logout parameter page format fields shall be defined as follows:

a) **TYPE code or common logout parameters:** Identifies the protocol associated with this Logout Parameter page. If byte 0 of the first word of a Logout Parameter page contains the value 00h, the Logout Parameter page contains Logout Parameters common to all FC-4 Types at that image pair or Nx_Port pair. If byte 0 of the first word of a Logout Parameter page contains the value other than 00h, the Logout Parameter page contains Logout Parameters for the FC-4 TYPE indicated.

b) **TYPE code extension:** Reserved for future use.

c) **Originator Process_Associator validity:** Identifies the process or group of processes within the Originator (see FC-FS-2).

   0 = not meaningful
   1 = meaningful

d) **Responder Process_Associator validity:** Identifies the process or group of processes within the Responder (see FC-FS-2).

   0 = not meaningful
   1 = meaningful

4.2.21.4 Reply sequence

LS_RJT: LS_RJT signifies rejection of the PRLO Request

LS_ACC: LS_ACC signifies successful completion of the PRLO Request

LS_ACC Payload: The format of the LS_ACC Payload is shown in table 49.

Table 49 – PRLO LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Obsolete (10h)[a]	Payload Length	
1	Logout Parameter Response page (4 words)			
..				
N				

[a] This field is obsolete, but shall be set to 10h for compatibility.

The PRLO LS_ACC Payload fields shall be defined as follows:

a) **Payload length:** The Payload length shall be 20 (see table 50).

b) **Logout parameter response page:** Words 1:N of the PRLO LS_ACC Payload contain the Logout Parameter Response page. The Logout Parameter Response page contains a logout parameter response for a single image pair and is associated with a single FC-4 TYPE or common to all FC-4 Types at that image pair or Nx_Port pair.

The format of PRLO LS_ACC Logout Parameter Response pages is described in table 50.

Table 50 – PRLO LS_ACC logout parameter response page format

Item	Word	Bit
TYPE Code or Common Logout Parameters[a]	0	31-24
TYPE Code Extension	0	23-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Reserved	0	13-12
Response Code (see table 51)	0	11-8
Reserved	0	7-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Reserved	3	31-0

[a] If byte 0 of the first word of a Logout Parameter page is set to the value 00h, the Logout Parameter page is common to all FC-4 Types at that image pair.

The PRLO LS_ACC logout parameter response page format fields shall be defined as follows:

a) **TYPE code or common logout parameters:** Identifies the protocol associated with this Logout Parameter Response page. If byte 0 of the first word of a Logout Parameter Response page contains the value 00h, the Logout Parameter page contains Logout Parameters common to all FC-4 Types at that image pair or Nx_Port pair. If byte 0 of the first word of a Logout Parameter Response page contains a value other than 00h, the Logout Parameter page contains Logout Parameters for the FC-4 TYPE indicated.

b) **TYPE code extension:** Reserved for future use.

c) **Originator Process_Associator validity:** Identifies the process or group of processes within the Originator (see FC-FS-2).

   0 = not meaningful
   1 = meaningful

d) **Responder Process_Associator validity:** Identifies the process or group of processes within the Responder (see FC-FS-2).

   0 = not meaningful
   1 = meaningful

e) **Response code:** The Response code field contains an encoded binary value indicating the result of the PRLO Request and the status of the image pair. The meanings of the encoded Response code values are shown in table 51.

Table 51 – PRLO accept response code

Encoded Value Word 0, Bits 11-8	Description
0000b	Reserved
0001b	Request executed
0010b - 0011b	Reserved
0100b	The Exchange recipient corresponding to the Responder Process_Associator specified in the PRLO Request and PRLO LS_ACC response does not exist. The PRLO Request shall not be retried.
0101b - 0110b	Reserved
0111b	Obsolete
1000b	Obsolete
1001b - 1111b	Reserved

4.2.22 Test Process Login State (TPLS)

4.2.22.1 Description

The TPLS ELS is used to determine whether image pairs are established for the image pairs specified by the combination of the S_ID || Originator Process_Associator || D_ID || Responder Process_Associator. Upon receiving a TPLS Request, the receiving Nx_Port checks whether it has an image pair established for each specified image.

TPLS verifies the Login state for the source Nx_Port at the destination Nx_Port.

The LS_ACC Reply Sequence confirms the successful completion of the TPLS function and indicates whether or not an image pair is established for the source specified by the S_ID and image pair(s) contained in the Payload. The Payload of the LS_ACC Reply indicates the state of the image pair.

4.2.22.2 Protocol

a) Test Process Login State Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.22.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port associated with the image pair. The D_ID field designates the destination Nx_Port associated with the image pair.

Payload: The format of the Payload is shown in table 52.

Table 52 – TPLS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	TPLS (23h)	Obsolete (10h)[a]	Payload Length	
1		Image Pair ID page (4 words)		
..				
N				

[a] This field is obsolete, but shall be set to 10h for compatibility.

a) **Payload length:** The Payload length sall be 20.

b) **Image pair ID page:** Words 1:N of the TPLS Payload contain the Image Pair ID pages. The Image Pair ID page contains parameters required to identify a single image pair. The format of Image Pair ID pages is described in table 53.

Table 53 – TPLS image pair ID page format

Item	Word	Bit
Reserved	0	31-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Reserved	0	13-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Reserved	3	31-0

a) **Originator Process_Associator validity:** Identifies the process or group of processes within the Originator (see FC-FS-2).

0 = not meaningful
1 = meaningful

b) **Responder Process_Associator validity:** Identifies the process or group of processes within the Responder (see FC-FS-2).

0 = not meaningful
1 = meaningful

4.2.22.4 Reply sequence

LS_RJT: LS_RJT signifies rejection of the TPLS Request.

LS_ACC: LS_ACC signifies successful completion of the TPLS Request. The format of the LS_ACC Payload is shown in table 54.

Table 54 – TPLS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	(02h)	Obsolete (10h)[a]	Payload Length	
1	TPLS Response page (4 words)			
..				
N				

[a] This field is obsolete, but shall be set to 10h for compatibility.

a) **Payload length:** Bytes 2-3 of word 0 contain a 16-bit value that specifies the length of the TPLS LS_ACC Payload. The value shall be 20.

b) **TPLS response page:** Words 1:N of the TPLS Payload contain the Image Pair ID page. The TPLS Response page contains TPLS response information associated with a single image pair.

The format of TPLS Response pages is described in table 55.

Table 55 – TPLS response page format

Item	Word	Bits
Reserved	0	31-16
Originator Process_Associator Validity	0	15
Responder Process_Associator Validity	0	14
Reserved	0	13-12
Response Code (see table 56)	0	11-8
Reserved	0	7-0
Originator Process_Associator	1	31-0
Responder Process_Associator	2	31-0
Reserved	3	31-1
Image Pair State	3	0

a) **Originator Process_Associator validity:** Identifies the process or group of processes within the Originator (see FC-FS-2).

0 = not meaningful
1 = meaningful

b) **Responder Process_Associator validity:** Identifies the process or group of processes within the Responder (see FC-FS-2).

0 = not meaningful
1 = meaningful

c) **Response code:** The Response code field contains an encoded binary value indicating the result of the PRLI Request and the status of the image pair. The meanings of the encoded Response code values are shown in table 56.

Table 56 – TPLS accept response code

Encoded Value Word 0, Bits 11-8	Description
0000b	Reserved
0001b	Request executed
0010b - 0110b	Reserved
0111b	Obsolete
1000b - 1111b	Reserved

d) **Image pair state:**

1 = image pair established
0 = image pair not established

4.2.23 Request Node Identification Data (RNID)

4.2.23.1 Introduction

The RNID ELS is an ELS for acquiring Node Identification Data. The normal response shall be an Accept (ACC) ELS Sequence with Node Identification Data in its payload. If the recipient Nx_Port or Fx_Port does not support the RNID ELS, it shall reply with an LS_RJT ELS Sequence with a reason code of "Command not supported". If the recipient Nx_Port or Fx_Port does not support the requested Node Identification Data format, it shall either reply with an LS_RJT ELS Sequence with a reason code of "Unable to perform command request" and reason code explanation of "Unable to supply requested data" or reply with an Accept ELS Payload containing only the Common Identification Data.

If an Nx_Port sends an RNID ELS and receives an LS_RJT Sequence with a reason code of "Unable to perform command request" and reason code explanation of "Unable to supply requested data", the ULP may cause the Nx_Port to retry the RNID ELS with a different Node Identification Data Format request if an Nx_Port sends an RNID ELS and receives a reply with an Accept ELS containing only Common Identification Data (see Table 61) in its payload, the ULP usage of the Common Identification Data and any further discovery processing is beyond the scope of this standard.

The RNID ELS may be sent to any Nx_Port or Fx_Port in the Fabric. If the destination is known to be an Fx_Port, then the RNID ELS shall be sent to the Fabric Controller (FFFFFDh). If an RNID ELS is sent to the Fabric Controller (FFFFFDh), the reply shall represent the Fabric Controller node that contains the Fx_Port to which the requesting FC port is attached. If the receiving FC port has been determined to be an Nx_Port, then the RNID ELS shall be sent to that Nx_Port.

4.2.23.2 Protocol

a) Request Node-Identification (RNID) request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.23.3 Request Sequence

Addressing: The S_ID field designates the requesting source port or the Fabric Controller (FFFFFDh). The D_ID field designates the Nx_Port or Fx_Port receiving the RNID request or the Fabric Controller (FFFFFDh).

Payload: The format of the RNID Payload is shown in table 57.

Table 57 – RNID Payload

Bits Word	31 ... 24 Byte 0	23 ... 16 Byte 1	15 ... 08 Byte 2	07 ... 00 Byte 3
0	RNID (78h)	00h	00h	00h
1	Node Identification Data Format	Reserved		

Node Identification Data Format: The format of the Node Identification Data field is shown in table 58.

Table 58 – Node Identification Data Format

Value	Description
00h	Shall be set when the requesting Nx_Port is requesting Common Identification Data only (see table 61).
01h – DEh	For Specific Indentification Data corresponding to a specific ULP (e.g., FC-SB-3), shall be set to the FC-4 TYPE (see FC-FS-2) of that ULP.
DFh	Shall be used if the General Topology Discovery format (see 4.2.23.5) is to be returned in the RNID Accept Payload.
E0h – FFh	Shall be used to indicate that Specific Node Identification Data in a vendor specific format is to be returned.

4.2.23.4 Reply Sequence

LS_RJT: Signifies the rejection of the RNID request

LS_ACC: Signifies acceptance of the RNID request and presents Node Identification Data Format. The format of the Accept Payload is shown in table 59.

Table 59 – RNID Accept Payload

Bits Word	31 ... 24 Byte 0	23 ... 16 Byte 1	15 ... 08 Byte 2	07 ... 00 Byte 3
0	02h	00h	00h	00h
1	Node Identification Data Format	Common Identification Data Length (0 or 16)	Reserved	Specific Identification Data Length
2		Common Identification Data (0 bytes or 16 bytes)		
...				
5				
6		Specific Identification Data (m) (0 - max bytes)		
...				
m				

a) **Node Identification Data Format:** The value of the Node Identification Data Format field is shown in table 60.

Table 60 – Node Identification Data Format

Value	Description
00h	The RNID Accept Payload only contains the Common Identification Data (see table 61).
01h – DEh	The RNID Accept Payload may contain the Common Identification Data and shall contain the Specific Identification Data for the ULP that is assigned an FC-4 frame type (see FC-FS-2) equal to the value of the Node Identification Data Format from the RNID Payload (see table 58).
DFh	The RNID Accept Payload shall contain the Common Identification Data and General Topology Discovery format Specific Identification Data.
E0h – FFh	The RNID Accept Payload may contain the Common Identification Data and shall contain vendor specific Specific Identification Data.

b) **Common Identification Data Length:** When Common Node Identification Data is included in the RNID Accept payload, the Common Identification Data length shall specify 16 bytes as the size of the Common Identification Data field. When the ULP indicates in the Node Identification Data Format that no (see table 60) Common Node Identification Data is to be included in the RNID Accept payload, the Common Identification Data length shall be set to zero.

c) **Specific Identification Data Length:** The Specific Identification Data Length field indicates the number of bytes in the Specific Identification Data field. The length is determined by the Node Identification Data Format requested for the respective ULP. This value shall be a multiple of 4. The minimum value of this field is zero bytes. The maximum value of this field is 252 bytes.

d) **Common Identification-Data:** The format of the Common Identification Data field is shown in table 61.

Table 61 – Common Identification Data

Bits Word	31 ... 24 Byte 0	23 ... 16 Byte 1	15 ... 08 Byte 2	07 ... 00 Byte 3
0	MSB	N_Port_Name (8 bytes)		
1				LSB
2	MSB	Node_Name (8 bytes)		
3				LSB

A) **N_Port_Name:** The N_Port_Name field provides the Name_Identifier (see FC-FS-2) of the Nx_Port or Fx_Port to which the RNID ELS was directed.

B) **Node_Name:** The Node_Name field provides the Name_Identifier (see FC-FS-2) of the node associated with the Nx_Port or Fx_Port indicated in the N_Port_Name field.

e) **Specific Identification Data:** The format of the Specific Identification Data field shall be dependent on the Node Identification Data Format field (see Table 58). If the value of the Node Identification Data Format field is set to DFh (see 4.2.23.5). For all other values of the Node Identification Data Format field the standard for the related ULP defines the format, fields used, and size of the parameters.

NOTE 3 – The information in the Specific Identification Data should only be used to determine the product identity of a node. The information in the Specific Identification Data should not be used to determine the functional characteristics or the service capabilities of a node.

4.2.23.5 General Topology Discovery format:

When the Node Identification Data Format field in the RNID LS_ACC Payload (see table 60) indicates the General Topology Discovery format (DFh) the RNID LS_ACC payload shall contain the following:

a) Node Identification Data Format field set to DFh;

b) Common Identification-Data length set to 16;

c) Specific Identification-Data length set to 52;

d) Common Node Identification Data (see table 61);

e) Specific Identification Data (see table 62).

Table 62 – General Topology Specific Identification Data

Bits Word	31 ... 24 Byte 0	23 ... 16 Byte 1	15 ... 08 Byte 2	07 ... 00 Byte 3
0	MSB	Vendor Unique (16 bytes)		
...				
3				LSB
4	Associated Type			
5	Physical Port Number			
6	Number of Attached Nodes			
7	Node Management	IP Version	UDP/TCP Port Number	
8	MSB	IP Address (16 bytes)		
...				
11				LSB
12	Reserved		Vendor Specific	

a) **Associated Type:** The Associated Type (see table 63) is the type of Fibre Channel functionality associated with the node of the Nx_Port or Fx_Port receiving the RNID request (e.g., switch, hub, storage device).

b) **Physical Port Number:** A vendor unique value that identifies the physical port that has a Fibre Channel link attached.

c) **Number of Attached Nodes:** The number of nodes attached to the Nx_Port, or Fx_Port, receiving the RNID request. The minimum value is one. The maximum value is 126. For any Nx_Port receiving the RNID, the Number of Attached Nodes shall be set to one. For any FL_Port receiving the RNID, the Number of Attached Nodes shall be set to the number of nodes known to that FL_Port (i.e., the number of loop devices know to that FL_Port).

d) **Node Management:** The Node Management field contains the protocol by which a Node Management Entity for the responding node may be accessed (see table 65).

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Table 63 – Associated Type

Value (hex)	Type
00 00 00 00	Reserved
00 00 00 01	Unknown
00 00 00 02	Other (none of the following)
00 00 00 03	Hub
00 00 00 04	Switch
00 00 00 05	Gateway
00 00 00 06	obsolete
00 00 00 07	obsolete
00 00 00 09	Storage device (i.e., disk drive, CD-ROM drive, tape drive).
00 00 00 0A	Host
00 00 00 0B	Storage subsystem (e.g., raid, library)
00 00 00 0E	Storage Access Device (e.g., Media changer)
00 00 00 11	NAS server
00 00 00 12	Bridge
00 00 00 13	Virtualization device
xx xx xx FF	Multi-function device (see table 64 for values to fill in for xx xx xx)
All Others	Reserved

Table 64 – Multi-function device bit definitions

Bit position	Function
31	Hub
30	Switch
29	Gateway
28	Storage device
27	Host
26	Storage subsystem
25	Storage access device
24	Wavelength division multiplexer
23	NAS server
22	Bridge
21	Virtualization device
20-8	Reserved

Table 65 – Node Management

Value	Protocol	Reference
00h	IP/UDP/SNMP	See RFC 791, RFC 2460, RFC 768, RFC 1157, and RFC 1901
01h	IP/TCP/Telnet	See RFC 791, RFC 2460, RFC 793 and RFC 854
02h	IP/TCP/HTTP	See RFC 791, RFC 2460, RFC 793, and RFC 2616
03h	IP/TCP/HTTPS	See RFC 791, RFC 2460, RFC 793, and RFC 2818
04h	IP/TCP/HTTP/XML	See RFC 791, RFC 2460, RFC 793, RFC 2616, CIM[a], XML[b], CIM-XML[c], and CIM-HTTP[d]
05h - FFh	Reserved	

[a] Distributed Management Task Force, *Common Information Model (CIM) in XML*, Version 2.2, June 14, 1999

[b] World Wide Web consortium, *Extensible Markup Language (XML) 1.0*, Second Edition, October, 6, 2000

[c] Distributed Management Task Force, *Specification for the Representation of CIM in XML (CIM-XML),* Version 2.0, July 20, 1999

[d] Distributed Management Task Force, *Specification for CIM Operations over HTTP (CIM-HTTP),* Version 1.0, August 11, 1999

e) **IP Version:** The IP versions are shown in table 66.

Table 66 – IP Version

Value	Version	Description
00h	None	Indicates that this port is not providing IP support, and the Node Management, UDP Port, and IP Address fields shall be ignored.
01h	IPv4 (IP version 4)	See RFC 791
02h	IPv6 (IP version 6)	See RFC 2460
03h - FFh	Reserved	

f) **UDP/TCP Port Number:** The numerical value used in UDP (see RFC 768) or TCP (see RFC 793) to distinguish among multiple destinations at the same IP address.

g) **IP Address:** The IP address by which a Node Management Entity for the responding node may be reached. If the IP version field is set to one, the IPv4 address shall be stored in the least significant word of the IP field and the remainder shall be set to zero.

4.2.24 Registered Link Incident Report (RLIR)

4.2.24.1 Description

The following terms are used to reference the ports, nodes, and records related to link incident reporting:

a) incident port: The port on which the link incident occurred and that detected the link incident.

b) connected port or connected node: The port or node connected directly to the incident port by a Fibre Channel link.

c) reporting port: The port that sends the Link Incident Record.

d) registered port: A port that is registered with the reporting port to receive link incident reports.

e) reporting node: The node that creates the Link Incident Record describing the incident on the incident port.

The RLIR ELS shall provide a method for a reporting Nx_Port to send a Link Incident Record to a registered Nx_Port. The normal response to an RLIR ELS Sequence shall be a LS_ACC ELS Sequence with no Payload. If the recipient Nx_Port does not support the RLIR ELS, it shall reply with an LS_RJT ELS Sequence with a reason code of "Command not supported". If the recipient Nx_Port is unable to accept the specified Link Incident Record type, it shall reply with an LS_RJT ELS Sequence with a reason code of "Unable to perform command request".

A port shall recognize a link incident when a condition is detected for which an incident code (see table 72) is defined. When a link incident is recognized and a recipient of Link Incident Records is registered for the incident port, a Link Incident Record that contains information related to the link incident shall be created. When a Link Incident Record is generated, the reporting port shall use the link incident reporting procedure to pass the Link Incident Record to a registered port. The link incident reporting mechanism, if any, for a port that does not use this link incident reporting procedure is beyond the scope of this standard.

After a Link Failure is detected, the reporting node may delay recognizing and considering this link failure as a reportable link incident condition, for a specific period of time. Some FC-4 protocols may be capable of transparently recovering from a Link Failure condition, and may not generate a Link Incident Record. If the Link Failure condition persists for longer than the FC-4 specified time out period, then a Link Incident Record is generated and reported.

4.2.24.2 Link Incident reporting procedure

The incident port's reporting node shall generate one Link Incident Record for each link incident. The number of Link Incident Records a reporting node may hold is vendor specific. If the incident port’s reporting node attempts to generate a Link Incident Record but does not have resources to hold the record, the oldest Link Incident Record shall be discarded, and the new Link Incident Record shall be retained.

The port selected as the reporting port by the reporting node shall present the Link Incident Records by sending RLIR ELSs to ports registered as valid recipients of Link Incident Records. After sending all required RLIR ELSs containing the Link Incident Record, the port may discard the Link Incident Record.

The reporting port shall select ports from the registrant list for each Link Incident Record Format. The RLIR shall first be sent to all registered ports that have registered to always receive RLIRs. If no registered ports are registered to always receive RLIR or if RLIR was not successfully transmitted to at least one of those ports registered to always receive RLIRs, then the reporting port shall send the RLIR to a registered port selected from among those that have registered to conditionally receive RLIR. If RLIR is not successfully transmitted to the selected registered port registered to conditionally receive RLIR, the sending port shall select another port, if any, from the established registration list. The RLIR ELS is considered successfully transmitted if a LS_ACC is received for the RLIR within 2xR_A_TOV.

If a reporting port is not able to successfully deliver a RLIR ELS to a registered port, the registered port's registration for the incident port may be discarded. If a reporting node is not able to successfully deliver an RLIR ELS through a particular reporting port, it may select a different reporting port and try again. If no registration is established, it is vendor specific as to whether the incident port's reporting node generates and retains or discards the Link Incident Record.

4.2.24.3 Protocol

a) RLIR Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.24.4 Request Sequence

Addressing: The S_ID designates the reporting port that is providing the Link Incident Record. The D_ID field designates the registered port.

Payload: The format of the RLIR Payload is shown in table 67.

Table 67 – RLIR Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RLIR (79h)	00h	00h	00h
1	Link Incident Record Format	Common Link Incident Record Length	Common Link Incident-Descriptor Length	Specific Link Incident Record Length
2	MSB	Common Link Incident Record (m) (m=4 or 16)		
..				
m+1				LSB
m+2	Common Link Incident Descriptor IQ	IC	EPAI (domain/area of ISL)	
m+3		Specific Link Incident Record (0-max bytes)		
..				
n				

a) **Link Incident Record Format:** The format of the Link Incident Record-Format field is shown in table 68.

Table 68 – Link Incident Record Format

Description	Value
Common Link Incident Record	00h
Specific-coded value	01h - FFh

If the length of the Specific Link Incident Record is zero, the Link Incident Record Format field shall be set to zero. If the length of the Specific Link Incident Record is not zero, the Link Incident Record Format field shall be set to the FC-4 TYPE (see FC-FS-2) associated with the format of the Specific Link Incident Record. A value of zero in the Specific-coded value field indicates that only the Common Link Incident Record and the Common Link Incident Descriptor are being reported and that the Specific Link Incident Record Length shall be zero.

b) **Common Link Incident Record Length:** When only the incident port's Name_Identifiers (i.e., the N_Port_Name and the Node_Name) are included in the RLIR ELS Payload, the Common Link Incident Record length shall specify 16 bytes, indicating the size of the Common Link Incident Record field. When the additional Common Link Incident Record fields are included in the Payload, the Common Link Incident Record Length shall specify 64 bytes. The link identified by the N_Port_Name and the Node_Name shall be one end of the link for which the report is being made. The report may be passed through that link or by any other path to the node that has registered to receive RLIR ELSs.

c) **Common Link Incident Descriptor Length:** The Common Link Incident Descriptor length shall be set to 4h, specifying the number of bytes in the Link Incident Descriptor field.

d) **Specific Link Incident Record Length:** The Specific Link Incident Record Length shall be specified according to the Link Incident Record Format indicated for the respective ULP. The length shall specify the number of bytes in the Specific Link Incident Record field. This value shall be a multiple of 4. The minimum value of this field is 0. The maximum value of this field is 252.

e) **Common Link Incident Record:** If the Common Link Incident Length field value is 16 (i.e., m=4), then the Common Link Incident Record shall contain only the first four words (i.e., the Incident port N_Port_Name and Incident port Node Name fields) in table 69. If the Common Link Incident Length field value is 64 (i.e., m=16), then the Common Link Incident Record shall contain all the words specified in table 69. Optional fields (i.e., words 4 through 15) that have unknown values shall be set to zero. The Common Link Incident Record format is specified in table 69.

Table 69 – Common Link Incident Record Data

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	MSB	Incident port N_Port_Name		
1				LSB
2	MSB	Incident port Node_Name		
3				LSB
4	Incident Port Type	Obsolete		
5	MSB	Connected port N_Port_Name		
6				LSB
7	MSB	Connected port Node_Name		
8				LSB
9	MSB	Fabric_Name		
10				LSB
11	Incident Port Number			
12	Transaction ID			
13	reserved			Time Stamp Format
14	MSB	Time Stamp		
15				LSB

A) **Incident port N_Port Name:** The Name_Identifier that is the incident port's N_Port_Name.

B) **Incident port Node_Name:** The Name_Identifier that is the incident port's Node_Name.

C) **Incident Port Type:** The value in the Incident Port Type field specifies the type of the incident port. Port Type values are defined in FC-GS-3. A value of zero in the field indicates the Incident Port Type is unknown or unspecified.

D) **Connected Port N_Port_Name:** The Name_Identifier that is the connected port's N_Port_Name.

aa) If the incident port is an L_Port in a private loop, the connected port shall be the port associated with the link incident, if known.

bb) If the incident port is an L_Port in a public loop, the connected port shall be the FL_Port.

cc) If the incident port is an Nx_Port connected to a Fabric, the connected port shall be the F_Port.

dd) If the incident port is an FL_Port, the connected port shall be the port associated with the link incident, if known.

ee) If the connected port's N_Port_Name is unknown or unspecified, the Connected Port N_Port_Name may be zero

E) **Connected Port Node_Name:** The Name_Identifier that is the Node_Name of the port described by the Connected Port N_Port_Name. If the connected port is an Fx_Port, the Node_Name may be the Fabric_Name, the Node_Name of the local Fabric element, or unspecified. If the Node_Name is unknown or unspecified, the corresponding field shall be zero.

F) **Fabric_Name:** The Fabric_Name of the incident port's Fabric. For Nx_Port devices this is the value obtained in the FLOGI LS_ACC Payload. Private loop devices do not have a Fabric_Name and shall report zeros.

G) **Incident Port Number:** The vendor specific identification of the incident port within the unit having Fibre Channel ports. When this field is presented in the Common Link Incident Record, the Incident Port Number shall be valid.

H) **Transaction ID:** A 32-bit value that starts at one and is incremented by one for each link incident record generated by the reporting node. Applications receiving link incident records may use this value to eliminate duplicates or detect missing records. The value of zero shall be used only to indicate that the Transaction ID is unknown or unspecified.

I) **Time Stamp Format:** This field specifies the format of the Time Stamp field as shown in table 70.

J) **Time Stamp:** The time stamp value in the format specified by the Time Stamp Format field. If the Time Stamp Format value is 0, the Time Stamp field is unknown or unspecified and may have any value.

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Table 70 – Time Stamp Format values

Value	Meaning
00h	The Time Stamp field is unknown or unspecified.
01h	Time Server: The 64-bit time stamp is reported in units of seconds and fractions of a second. The time stamp uses the value obtained from the Time Server (see FC-GS-4).
02h	Clock synchronization format: The 64-bit time stamp is reported as defined for the Clock Synchronization Update (CSU) ELS.
03h to FFh	reserved

f) **Common Link Incident Descriptor:**

A) **Incident Qualifier (IQ):** This field (byte 0 of the Common Link Incident Descriptor) qualifies the manner in which the contents of the Link Incident Record shall be interpreted. The meaning is defined in table 71.

Table 71 – Incident Qualifier

Bits	Meaning
31	Reserved.

Table 71 – Incident Qualifier(Continued)

Bits	Meaning	
30	Reserved.	
29	Switch: When set to one, indicates that the incident port is a port on a switch node. When set to zero, indicates that the incident port is not a port on a switch node.	
28	Expansion Port: When set to one, indicates that the switch port is an Inter-Switch-Link Expansion port (E_Port). When zero, bit 28 indicates that the switch port is not an Inter-Switch-Link Expansion port.	
27-26	Severity Indication: Bits 27-26 constitute a two-bit code that identifies the severity indication for the link incident. The codes and their meanings are as follows:	
	Code	Meaning
	0	Informational report: Indicates link incident notification of an informational purpose.
	1	Link degraded but operational: Indicates if the link associated with the incident port is not in a Link-Failure or Offline State as a result of the event that generated the Link Incident Record.
	2	Link not operational: Indicates if the link associated with the incident port is in a Link-Failure or Offline State as a result of the event that generated the Link Incident Record.
	3	Reserved.
25	Subassembly type: When set to one, specifies that the type of subassembly used for the port that is the subject of this Link Incident Record is a laser. When set to zero, specifies that the type of subassembly used for the port that is the subject of this Link Incident Record is not a laser.	
24	FRU identification: When set to one, specifies that the Specific-Link Incident Record Data is in a format that provides field-replaceable-unit (FRU) identification. When set to zero, specifies that the Specific-Link Incident Record Data is not in a format that provides field-replaceable-unit (FRU) identification.	

B) Incident Code (IC): This field (byte 1 of the Common Link Incident Descriptor) contains the incident code that describes the incident that was observed by the incident node.

aa) Bit 23 is reserved.

bb) Bits 22-16 is the value that specifies the type of incident that was observed. The values specified and their meanings are shown in table 72.

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Table 72 – Incident Code values

Value	Meaning
00h	Reserved.
01h	Implicit incident: A condition, caused by an event known to have occurred within the incident port, has been recognized by the incident port. The condition affects the attached link in such a way that it may cause a link incident to be recognized by the connected port.
02h	Bit-error-rate threshold exceeded: The incident port has detected that the Error Interval Count equals the Error Threshold (see FC-FS-2).
03h	Link Failure - Loss-of-Signal or synchronization: The incident port has recognized a Loss-of-Synchronization condition, and it persisted for more than the R_T_TOV timeout period (see FC-FS-2).
04h	Link Failure - NOS recognized: The NOS has been recognized by the incident port (see FC-FS-2)
05h	Link Failure - Primitive Sequence timeout: The incident port has recognized either a Link-Reset-Protocol timeout (see FC-FS-2), or a timeout when timing for the appropriate response while in the LF1 State and after NOS is no longer recognized (see FC-FS-2).
06h	Link Failure - Invalid Primitive Sequence for port state: The incident port recognized either a LR or LRR Primitive Sequence while in the OL3 State (see FC-FS-2).
07h	Link Failure - Loop Initialization time out: The incident port failed to complete loop initialization within the normal loop time out period (see FC-AL-2).
08h	Link Failure – receiving LIP(F8): The incident port is receiving LIP(F8) indicating some other port on the loop is experiencing a Loss-of-Signal condition.
09h - FFh	Reserved.

C) **Expansion Port address identifier (EPAI):** When bits 29 and 28 of the IQ field of the Common Link Incident Descriptor word of the RLIR payload (see table 67) of the Payload are both ones, indicating that the incident port is an Inter-Switch-Link Expansion port (word 0 bits 15-0 of the Common Link Incident Descriptor) contain the Domain and Area address identifiers (DDAAh) of the connected Expansion port on this Inter-Switch-Link.

D) **Specific Link Incident Record:** The format of the Specific Link Incident Record Field is dependent on the Link Incident Record Format. Specific Link Incident Record formats are defined in the specification for the specific FC-4 (e.g., FC-SB-3) indicated by the Link Incident Record Format.

4.2.24.5 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the RLIR Request

LS_ACC: LS_ACC signifies acceptance of the RLIR Request and its Link Incident Record. The format of the LS_ACC Payload is shown in table 73.

Table 73 – RLIR LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.25 Link Incident Record Registration (LIRR)

4.2.25.1 Description

See 4.2.24.1 for terms related to link incident reporting.

The LIRR ELS requests the recipient to add or remove this source Nx_Port to or from the list of Nx_Port's registered to receive the Registered Link Incident Report (RLIR) ELS. The normal response to a LIRR ELS Sequence shall be a LS_ACC ELS Sequence with no Payload. If the recipient Nx_Port does not support the LIRR ELS, it shall reply with a LS_RJT ELS Sequence with a reason code of "Command not supported". If the recipient Nx_Port is unable to perform the requested LIRR registration function or the specified format is not supported, it shall reply with a LS_RJT ELS Sequence with a reason code of "Unable to perform command request".

When an Nx_Port is registering or de-registering with the Fabric for receipt of Link Incident Records from the Fabric, the LIRR ELS shall be sent to the Management Server (FFFFFAh).

4.2.25.2 Registration for Link Incident Records

To obtain and process Link Incident Records, a ULP shall register it's port with other ports of interest. The term 'ports of interest' refers to all ports that the registered port may address and for which the port requires their Link Incident Records.

An Nx_Port shall attempt to register as a valid recipient of subsequent Link Incident Records by sending a LIRR ELS as soon as the requesting Nx_Port has determined its address identifier and has determined the address identifiers for the ports of interest. The ULP shall indicate the format of Link Incident Records of interest that are being registered. The recipient Nx_Port shall respond with a LS_ACC ELS with no Payload.

When a registered ULP is no longer interested in receiving Link Incident Records from any port or ports of interest, it shall send a LIRR ELS to de-register their port as a valid recipient of Link Incident Records. The ULP shall indicate the format of Link Incident Records that are being de-registered.

If a LIRR ELS requesting a de-registration function for a port that is not registered is received, the recipient port accepts the request by sending a LS_ACC ELS and performs no further action. If a LIRR ELS requesting a registration for a port that is already registered for the specified format, the recipient port shall accept by sending a LS_ACC ELS request and perform no further action.

The recipient of a LIRR ELS shall maintain a separate established registration list of valid Link Incident Record recipients for each registration format specified. The size of the established registration

list maintained by each port for each specified format is vendor specific. If the established registration list is full when an add registration function occurs, the port does not accept this registration, and rejects this request indicating "unable to perform command request".

A Logout occurring between a node and a valid-registered-recipient node shall cause de-registration of the valid-recipient port in the established registration list maintained by the port.

4.2.25.3 Responsibilities of Valid-Registered Recipients

A valid-registered recipient shall be capable of receiving and processing Link Incident Records that are generated according to the Link Incident reporting procedure (see 4.2.24.2). The usage and coordination of Link Incident Records by ULPs is beyond the scope of this standard.

If a valid registered recipient receives a Link Incident Record for a format that does not match its registration format, the recipient port shall reject the RLIR ELS with a reason code of "Unable to perform command request".

4.2.25.4 Protocol

a) LIRR Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.25.5 Request Sequence

Addressing: The S_ID designates the source port requesting registration for Link Incident Records. The D_ID field designates the port receiving the registration request.

Payload: The format of the LIRR Payload is shown in table 74.

Table 74 – LIRR Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	LIRR (7Ah)	00h	00h	00h
1	Registration Function	Link Incident Record-Registration Format	Reserved	

The LIRR Payload field shall be defined as follows:

a) **Registration Function:** The Registration function shall specify the mode of registration (i.e., whether the recipient node adds or removes the sending Nx_Port to or from its list of registered

nodes, hereafter referred to as the established registration list). The format of the Registration Function field is shown in table 75.

Table 75 – Registration Function

value	Function
00h	Reserved
01h	Set registration – conditionally receive: The source port is registered as a valid recipient of subsequent RLIR ELSs for the format specified. The port is added to the appropriate format specific established registration list. This source port is chosen as the recipient of a link incident record only if no other recipients from this established registration list have been chosen.
02h	Set registration – always receive: The source port is registered as a valid recipient of subsequent RLIR ELSs for the format specified. The port is added to the appropriate format specific established registration list. This source port is always chosen as a recipient of a link incident record.
03h - FEh	Reserved
FFh	Clear registration: The source port is de-registered as a valid recipient of subsequent RLIR ELSs for the format specified (i.e., remove from the established registration list).

b) **Link Incident Record-Registration Type:** The type of the requested Link Incident Record Registration is shown in table 76.

Table 76 – Link Incident Record-Registration Format

Value	Description
00h	Common Format
01h - FFh	Specific-coded value

A Link Incident Record Registration Format of 00h specifies that only the Common Link Incident Record and the Link Incident Descriptor is reported. If the Link Incident Record Registration format is non-zero, it shall be set to the Specific-coded value (FC-4 Device Type) of the registration format being requested for a specific client ULP (e.g., see FC-SB-3). The Specific-coded value uses the TYPE codes defined in FC-4 data structures of this standard. These codes allow clients to define and register for Link Incident Record formats for their own particular usage according to the unique FC-4 protocol.

4.2.25.6 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the LIRR Request

LS_ACC: LS_ACC Signifies acceptance of the LIRR Request and the registration for RLIR ELSs. The format of the LS_ACC Payload is shown in table 77.

Table 77 – LIRR LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.26 Get Alias_ID (GAID)

4.2.26.1 Description

The GAID ELS shall be sent to the Fabric Controller by the Alias Server (see FC-FS-2) to request a unique Alias_ID to be associated with the Alias Group indicated in the passed Alias_Token.

4.2.26.2 Protocol

a) GAID Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.26.3 Request Sequence

Addressing: The S_ID designates the Alias Server (FFFFF8h). The D_ID field designates the Fabric Controller (FFFFFDh).

Payload: The format of the Payload is shown in table 78.

Table 78 – GAID Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	GAID (30h)	00h	00h	00h
1	MSB	Alias_Token (12 bytes)		
2				
3				LSB
4		Alias_SP (80 bytes)		
..				
23				
24	NP_List_Length (Number of NP_List entries = n)			
25	NP_List (1)			
..	..			
24 + n	NP_List (n)			

a) **Alias Group Token (Alias_Token):** This is the token identifying the Alias Group. See FC-GS-5 for a description of the Alias_Token.

b) **Alias Group Service Parameters (Alias_SP):** The Alias_SP defines the Service Parameters to be used for all operations with this Alias Group. The Service Parameters are passed as defined by the Common Service Parameters and the appropriate Class Service Parameters (see 6.6).

NOTE 4 – This field is used by the Fabric Controller to ensure that the Service Parameters to be used by the Alias Group are not in conflict with the Fabric Service Parameters.

c) **Nx_Port List Length (NP_List_Length):** The NP_List_Length specifies the number of entries in the following NP_List.

d) **Nx_Port List (NP_List):** The NP_List contains one entry for each N_Port_ID to be included in the Alias Group. The N_Port_ID shall not be an Alias_ID. The format of each NP_List entry is as shown in table 79.

Table 79 – NP_List Entry Format

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Reserved	N_Port_ID		

NOTE 5 – The Fabric Controller uses the NP_List to determine whether it supports an Alias Group composed of these Nx_Ports (e.g., if the Fabric does not support an Alias Group that spans Domains, and the NP_List contains Nx_Ports in multiple Domains, the request may be rejected). Alternatively, the Fabric may form an Alias Group from the Nx_Ports within a single Domain.

4.2.26.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the GAID Request. An LS_RJT shall be returned if an Alias_ID is not generated. A reason code of "Unable to perform command request" shall be generated, along with a reason code explanation given in table 147.

LS_ACC: The format of the Payload for the LS_ACC indicating that this request has been successfully completed is shown in table 80.

Table 80 – Get Alias_ID LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Alias Group Identifier			

The Alias Group Identifier field contains the Alias_ID that the Nx_Port shall recognize, in addition to its native address identifier.

4.2.27 Fabric Activate Alias_ID (FACT)

4.2.27.1 Description

The FACT ELS shall be sent to the Fabric Controller by the Alias Server (see FC-FS-2) to cause it to assign the passed Alias_ID as an Alias_ID for the passed Nx_Ports.

4.2.27.2 Protocol

a) FACT Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.27.3 Request Sequence

Addressing: The S_ID designates the Alias Server (FFFFF8h). The D_ID field designates the Fabric Controller (FFFFFDh).

Payload: The Payload of the request contains a list of the Nx_Ports for which the Alias_ID is to be recognized and the Alias_ID to be recognized as an Alias_ID. The format of the Payload is shown in table 81.

Table 81 – Fabric Activate Alias_ID Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FACT (31h)	00h	00h	00h
1	Alias_ID			
2	NP_List_Length (Number of NP_List entries = n)			
3	NP_List (1)			
..	..			
2 + n	NP_List (n)			

a) **Alias Group Identifier (Alias_ID):** This is the Alias_ID that the Fabric shall recognize for the Nx_Ports in the list, in addition to their native address identifiers.

b) **Nx_Port List Length (NP_List_Length):** The NP_List_Length specifies the number of entries in the following NP_List.

c) **Nx_Port List (NP_List):** The NP_List contains one entry for each Nx_Port for which the Alias_ID is to be assigned as an Alias_ID. The N_Port_ID shall be right aligned within the NP_List entry (i.e., the high-order byte of the entry shall be ignored and the low-order 3 bytes shall contain the N_Port_ID).

4.2.27.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FACT Request. n LS_RJT with a reason code of "Unable to perform command request" shall be returned if an Alias_ID is not activated as an Alias_ID.

LS_ACC: The format of the Payload for the LS_ACC indicating that this request has been successfully completed is shown in table 82.

Table 82 – Fabric Activate Alias_ID LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.28 Fabric Deactivate Alias_ID (FDACT)

4.2.28.1 Description

The FDACT ELS shall be sent to the Fabric Controller by the Alias Server (see FC-FS-2) to request that it deassign the indicated Alias_ID as an Alias Group identifier for the passed Nx_Ports. When there are no longer any Nx_Ports for which the Alias_ID is active, the Fabric Controller shall free up the Alias_ID for subsequent reassignment.

4.2.28.2 Protocol

a) FDACT Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.28.3 Request Sequence

Addressing: The S_ID designates the Alias Server (FFFFF8h). The D_ID field designates the Fabric Controller (FFFFFDh).

Payload: The Payload of the request contains the Alias_ID to be deactivated, and the list of Nx_Ports for which this Alias_ID is to be deactivated. The format of the Payload is shown in table 83.

Table 83 – Fabric Deactivate Alias_ID Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FDACT (32h)	00h	00h	00h
1	Alias_ID			
2	NP_List_Length (Number of NP_List entries = n)			
3	NP_List (1)			
..	..			
2 + n	NP_List (n)			

a) **Alias Group ID (Alias_ID):** This is the Alias_ID to be deactivated.

b) **Nx_Port List Length (NP_List_Length):** The NP_List_Length specifies the number of entries in the following NP_List.

c) **Nx_Port List (NP_List):** The NP_List contains one entry for each Nx_Port for which the Alias_ID is to be deactivated as an Alias_ID. The N_Port_ID shall be right aligned within the NP_List entry (i.e., the high-order byte of the entry shall be ignored and the low-order 3 bytes shall contain the N_Port_ID).

4.2.28.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FDACT Request. An LS_RJT with a reason code of "Unable to perform command request" shall be returned if the Alias_ID is not deactivated as an Alias_ID.

LS_ACC: The format of the Payload for the LS_ACC indicating that this request has been successfully completed is shown in table 84.

Table 84 – Fabric Deactivate Alias_ID LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.29 N_Port Activate Alias_ID (NACT)

4.2.29.1 Description

The NACT ELS shall be sent to an Nx_Port by Alias Server (see FC-FS-2) to cause it to assign the passed Alias_ID as an Alias_ID.

4.2.29.2 Protocol

a) NACT Request Sequence

b) LS_ACC or LS_RJT

4.2.29.3 Reply Sequence

Addressing: The S_ID designates the Alias Server (FFFFF8h). The D_ID field designates the Nx_Port receiving the NACT.

Payload: The Payload of the request contains the Alias_Token of the Alias Group that the Nx_Port is joining, the Service Parameters associated with that Alias Group, and the Alias_ID to be assigned to the Nx_Port. The format of the Payload is shown in table 85.

Table 85 – N_Port Activate Alias_ID Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FACT (33h)	00h	00h	00h
1	MSB	Alias_Token (12 bytes)		
2				
3				LSB
4	Alias_ID			
5		Alias_SP (80 bytes)		
..				
24				

a) **Alias Group Token (Alias_Token):** This is the token identifying the Alias Group. It contains the Alias_Class and Alias_Qualifier of the Alias Group the Nx_Port is being requested to join. The Nx_Port validates that it supports that particular Alias Class. See FC-GS-5 for a description of the Alias_Token.

b) **Alias Group Identifier (Alias_ID):** The Alias Group Identifier field contains the Alias_ID that the Nx_Port shall recognize, in addition to its native address identifier.

c) **Alias Group Service Parameters (Alias_SP):** The Alias_SP defines the Service Parameters to be used for all operations with this Alias Group (see FC-FS-2).

NOTE 6 – These Service Parameters may differ from those passed during Login.

For Multicast Groups, only the Common Service Parameters and Class 3 Service Parameters are used. For Hunt Groups, all Service Parameters may be used.

The Nx_Port shall transmit a LS_ACC to notify the Alias Server if the Nx_Port:

a) Supports the Alias_Class in the Alias_Token.

b) Supports the Alias Group Service Parameters specified in Alias_SP.

c) Has assigned the passed Alias_ID as an Alias_ID for this Nx_Port.

4.2.29.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the NACT Request. An LS_RJT shall be returned if the Alias_ID is unable to be activated as an Alias_ID. A reason code of "Unable to perform command request" shall be generated, along with a reason code explanation given in table 147.

LS_ACC: The format of the Payload for the LS_ACC indicating that this request has been successfully completed is shown in table 86. If the Nx_Port is unable to perform all of the above functions, it shall send an LS_RJT as a reply.

Table 86 – N_Port Activate Alias_ID LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.30 N_Port Deactivate Alias_ID (NDACT)

4.2.30.1 Description

The NDACT ELS shall be sent to an Nx_Port by Alias Server (see FC-FS-2) to cause it to deactivate the passed Alias_ID as an Alias_ID.

4.2.30.2 Protocol

a) NDACT Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.30.3 Request Sequence

Addressing: The S_ID designates the Alias Server (FFFFF8h). The D_ID field designates the Nx_Port receiving the NDACT.

Payload: The Payload of the request contains, among other parameters, the Alias_ID to be deactivated by the Nx_Port. The format of the Payload is shown in table 87.The Nx_Port shall transmit a LS_ACC to notify the Alias Server of a deactivation of an Alias_ID.

Table 87 – N_Port Deactivate Alias_ID Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	NDACT (34h)	00h	00h	00h
1	Alias_ID			

Alias Group Identifier (Alias_ID): The Alias Group Identifier field shall contain the Alias_ID that the Nx_Port no longer recognizes.

4.2.30.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the NDACT Request. An LS_RJT shall be returned if the Alias_ID is unable to be deactivated as an Alias_ID. A reason code of "Unable to perform command request" shall be generated, along with one of the reason code explanations in table 147.

LS_ACC: The format of the Payload for the LS_ACC indicating that this request has been successfully completed is shown in table 88. If the Nx_Port is unable to perform all of the above functions, it shall send an LS_RJT as a reply.

Table 88 – N_Port Deactivate Alias_ID LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.31 Discover N_Port/Service Parameters (PDISC)

4.2.31.1 Description

The PDISC ELS shall transfer Service Parameters from the initiating Nx_Port to the Nx_Port associated with the D_ID without affecting the operating environment between the two ports. This provides the means for exchange of Service Parameters without terminating open Sequences or open Exchanges.

4.2.31.2 Protocol

a) PDISC Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.31.3 Request Sequence

The Payload in PDISC and the LS_ACC are, except for the ELS_Command, identical to the Payloads in PLOGI (see 4.2.7) and the corresponding LS_ACC (see 4.3.2). The interchange of PDISC information shall not modify the operating environment or Service Parameters between the two ports. Service Parameters contained in PDISC shall be ignored and no error condition shall be reported.

4.2.31.4 Reply Sequence

A response shall not be sent to a PDISC if a LR or loop initialization occurs before the LS_ACC is sent. An LS_ACC for a PDISC shall be ignored if a LR or loop initialization occurred between the PDISC and the LS_ACC.

4.2.32 Discover F_Port Service Parameters (FDISC)

4.2.32.1 Description

The FDISC ELS shall transfer Service Parameters from the initiating Nx_Port to the Fx_Port at well-known F_Port_ID (i.e., FFFFFEh). This provides the means for the exchange of Service Parameters and the assignment of an additional N_Port_IDs without changing service parameters.

4.2.32.2 Protocol

a) FDISC Sequence

b) LS_ACC, LS_RJT Reply Sequence

4.2.32.3 Request Sequence

The Payload in FDISC and the corresponding LS_ACC are, except for the ELS_Command, identical to the Payloads in FLOGI (see 4.2.7) and the LS_ACC (see 4.3.2). When the S_ID of the FDISC ELS is equal to zero, the FDISC ELS shall transfer an N_Port Name and node name, and request the assignment and login of an additional N_Port_ID. The FDISC ELS with an S_ID equal to zero shall only be sent by an N_Port with at least one N_Port_ID that is currently logged in with the Fabric, and the assignment of an additional N_Port_ID shall not modify the Service Parameters between the two ports.

When the S_ID of the FDISC ELS is set to a previously-assigned N_Port_ID, the FDISC ELS shall contain the N_Port_Name and node name corresponding to that N_Port_ID. The interchange of FDISC information shall not modify the operating environment or Service Parameters between the two ports. Service Parameters contained in FDISC shall be ignored and no error condition shall be reported.

4.2.32.4 Reply Sequence

When the S_ID of the FDISC ELS is zero, the D_ID field of the LS_ACC shall be set to the additional N_Port_ID being assigned. When the Fabric sends the LS_ACC, it shall consider Fabric Login to have occurred for the additional N_Port_ID.

When the S_ID of the FDISC ELS is not zero and is currently logged in, the D_ID of the LS_ACC shall be set to the S_ID of the FDISC ELS.

If an FDISC ELS with an S_ID set to zero is received by a F_Port Controller and no N_Port ID is logged in, or if the S_ID is set to a non-zero N_Port_ID that is not currently logged, then an F_RJT with the reason code set to ‘Login required’ shall be returned to the S_ID of the FDISC ELS if it was issued in Class 1, or Class 2, and the FDISC ELS shall be discarded if it was issued in Class 3.

4.2.33 Discover Address (ADISC)

4.2.33.1 Description

The ADISC ELS shall exchange addresses and identifiers of communicating Nx_Ports.

4.2.33.2 Protocol

a) ADISC Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.33.3 Request Sequence

The ADISC Request payload format is shown in table 89.

Table 89 – ADISC Request payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ADISC (52h)	00h	00h	00h
1	Reserved	Hard Address of Originator		
2	MSB	N_Port_Name of Originator (8 bytes)		
3				LSB
4	MSB	Node_Name of Originator (8 bytes)		
5				LSB
6	Reserved	N_Port_ID of Originator		

a) **Hard Address of Originator:** A 24-bit L_Port_ID that consists of:

   A) the 8-bit Domain address in the most significant byte;

   B) the 8-bit Area address in the next most significant byte; and

   C) the 8-bit AL_PA that an L_Port attempts to acquire in the LIHA sequence during loop initialization in the least significant byte (see FC-AL-2).

If an L_Port does not have a hard address, or if a port does not have FC-AL-2 capability, it shall report zeroes in this field.

b) **N_Port_Name of Originator:** The 8-byte N_Port_Name of the Originator.

c) **Node_Name of Originator:** The 8-byte Node_Name of the Originator.

d) **N_Port_ID of Originator:** The 24-bit S_ID used in the header of the ADISC Request frame.

4.2.33.4 Reply Sequence

The LS_ACC Payload format is shown in table 90.

Table 90 – ADISC LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Reserved	Hard Address of Responder		
2	MSB	N_Port_Name of Responder (8 bytes)		
3				LSB
4	MSB	Node_Name of Responder (8 bytes)		
5				LSB
6	Reserved	N_Port_ID of Responder		

a) **Hard Address:** A 24-bit L_Port_ID that consists of:

   A) the 8-bit Domain address in the most significant byte;

   B) the 8-bit Area address in the next most significant byte; and

   C) the 8-bit AL_PA that an L_Port attempts to acquire in the LIHA sequence during loop initialization in the least significant byte (see FC-AL-2).

If an L_Port does not have a hard address, or if a port does not have FC-AL-2 capability, it shall report zeroes in this field.

b) **N_Port_Name of Responder:** The 8-byte N_Port_Name of the Responder.

c) **Node_Name of Responder:** The 8-byte Node_Name of the Responder.

d) **N_Port_ID of Responder:** The 24-bit S_ID used in the header of the ADISC LS_ACC frame.

A response shall not be sent to an ADISC if an LR or loop initialization occurs before the LS_ACC is sent. An LS_ACC for a ADISC shall be ignored if an LR or loop initialization occurred between the ADISC and the LS_ACC.

Table 91 summarizes the responses to FDISC, PDISC and ADISC.

Table 91 – Response summary to FDISC/PDISC

ELS command	Responding Port Status	Responding Nx_Port	Responding F_Port Controller	
		Class 1, 2, or 3	Class 1, or 2	Class 3
FDISC	Logged in	LS_RJT[c]	LS_ACC	LS_ACC
	Not Logged in	LS_RJT[c]	F_RJT[b]	Discard
PDISC	Logged in	LS_ACC	LS_RJT[c]	Discard
	Not Logged in	LS_RJT[a]	F_RJT[b]	Discard
ADISC	Logged in	LS_ACC	LS_RJT[c]	Discard
	Not Logged in	LS_RJT[a]	F_RJT[b]	Discard

[a] A LOGO ELS sequence or an LS_RJT ELS Sequence with the reason code set to "Unable to perform command request" and the reason code explanation set to "N_Port Login required" shall be returned.

[b] An F_RJT with the Reject reason code set to "Login required" shall be returned.

[c] A LOGO ELS Sequence or an LS_RJT ELS Sequence with the reason code set to"Command not supported" and the reason code explanation set to "Request notsupported" shall be returned.

4.2.34 Third Party Process Logout (TPRLO)

4.2.34.1 Description

The TPRLO ELS is used to invalidate the operating environments (i.e., remove image pairs and associated resources) at the recipient Nx_Port for the specified TYPE.

TPRLO has the same effect on the recipient Nx_Port as if all Nx_Ports that have performed Process Login with the recipient Nx_Port for the specified TYPE, performed PRLO with the recipient Nx_Port.

4.2.34.2 Protocol

a) TPRLO Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.34.3 Request Sequence

Addressing: The S_ID field designates the Nx_Port initiating TPRLO. The D_ID field designates the destination Nx_Port of the TPRLO.

Payload: The TPRLO format is shown in table 92.

Table 92 – TPRLO Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	TPRLO (24h)	Obsolete (10h)[a]	Payload Length	
1	Logout Parameter page (4 words)			
..				
n				

[a] This field is obsolete, but shall be set to 10h for compatibility.

a) **Payload length:** The payload length shall be 20.

b) **Logout parameter page:** Words 1:N of the TPRLO Payload contain the Logout Parameter page. The Logout Parameter page contains logout parameters for a single image pair and is associated with either a single FC-4 TYPE or is common to all FC-4 TYPE codes for the specified image pair.

The TPRLO Logout parameter page is shown in table 93.

Table 93 – TPRLO logout parameter page

Item	Word	Bit
TYPE Code or Common Service Parameters	0	31-24
TYPE Code Extension	0	23-16
Third Party Originator Process _Associator Validity - obsolete	0	15
Responder Process_Associator Validity - obsolete	0	14
Third Party Originator N_Port_ID Validity - obsolete	0	13
Global Process Logout	0	12
Reserved	0	11-0
Third Party Originator Process_Associator - obsolete	1	31-0
Responder Process_Associator - obsolete	2	31-0
Reserved	3	31-24
Third Party Originator N_Port_ID - obsolete	3	23-0

a) **TYPE Code or Common Logout Parameters:** Identifies the protocol associated with this TPRLO Logout Parameter page. If byte 0 of the first word of a TPRLO Logout Parameter page contains the value 00h, the TPRLO Logout Parameter page contains logout parameters com-

mon to all FC-4 Types at that image pair or Nx_Port pair. If byte 0 of the first word of a TPRLO Logout Parameter page contains the value other than 00h, the TPRLO Logout Parameter page contains logout parameters for the FC-4 TYPE indicated.

b) **TYPE code extension:** Reserved for future use.

c) **Global Process Logout:** The Global Process Logout bit shall be set to one, and specifies:

A) only the TYPE code and TYPE code extension fields shall have meaning, along with the Global Process Logout bit itself;

B) all image pairs for all Nx_Ports with which Process Login has been performed shall be removed from the recipient Nx_Port for the specified TYPE; and

C) all resources associated with the establishment of all image pairs of the specified TYPE at the recipient Nx_Port shall be released.

The TPRLO LS_ACC Payload format is shown table 94.

Table 94 – TPRLO LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Obsolete (10h)[a]	Payload Length	
1	Logout Parameter page (4 words)			
..				
n				

[a] This field is obsolete, but shall be set to 10h for compatibility.

a) **Payload Length:** The Payload Length field specifies the length of the TPRLO LS_ACC payload. The Payload Length value shall be 20.

b) **Logout Parameter page:** The TPRLO LS_ACC Logout Parameter page format is the same as the TPRLO Request Logout Parameter page format (see table 93) and the field values shall be set to the values received in the TPRLO Request Logout Parameter page.

4.2.35 Clock Synchronization Request (CSR)

4.2.35.1 Description

The CSR ELS is used to request the Clock Synchronization Server to either send or to quit sending periodic Clock Synchronization Update (CSU) ELS frames or Clock Synchronization primitives, depending on the method implemented (see FC-FS-2).

4.2.35.2 Protocol

a) Clock Synchronization Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.35.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Clock Synchronization updates. The D_ID field designates either the Clock Synchronization Server (FFFFF6h) or the Fabric Controller (FFFFFDh).

Payload: The format of the Payload is shown in table 95.

Table 95 – CSR Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	CSR (68h)	00h	00h	00h
1	Clock Sync Mode	CS_Accuracy	CS_Implemented_MSB	CS_Implemented_LSB
3	CS_Update_Period			

a) **Clock Sync Mode:** The meaning of the Clock Sync Mode byte in the CSR Payload is defined in table 96;

Table 96 – CSR Clock Sync Mode Meaning

Value	When sent to the Clock Sync Server	When sent to the Fabric Controller
00h	Enable Clock Synchronization service to this client. The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields are not meaningful in the CSR Request.	Return Quality of Service parameters. The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields are not meaningful in the CSR Request.
01h	Enable Clock Synchronization service to this client. The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields contain the requested Quality of Service parameters.	Return Quality of Service parameters. The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields contain the requested Quality of Service parameters.
02h – FEh	Reserved	Reserved
FFh	Disable Clock Synchronization service to this client	Reserved

b) **CS_Accuracy (Mantissa and Exponent):** This field contains the CS_Accuracy_Mantissa (Bits 23-21) and CS_Accuracy_Exponent (Bits 20-16).These bits indicate the requested accuracy of the Clock Synchronization value as it leaves the server port. Specifically, the request is that the Clock Count value is always within the range of:

$$T\_reference \pm (0.5 + CS\_Accuracy\_Mantissa * 2^{-4}) * 2^{(CS\_Accuracy\_Exponent-30)},$$

where

A) T_reference is the clock reference value internal to the server;

B) CS_Accuracy_Mantissa is a value from 000b to 111b; and

C) CS_Accuracy_Exponent is a value from 00000b to 11111b;

Example #1, if CS_Accuracy Mantissa and Exponent = 001b and 01011b, respectively, the Clock Synchronization value as it exits the server is requested to be within the range of:

T_reference ± 1,073 µsec

Example #2, if CS_Accuracy Mantissa and Exponent = 111b and 11000b, respectively, the Clock Synchronization value as it exits the server is requested to be within the range of:

T_reference ± 14,65 msec

c) **CS_Implemented_MSB:** This field is a value that is constrained to the range of 0 to 63. These bits indicate the requested most significant bit position within the 64-bit Clock Count field (e.g., a value of '110111b' indicates that the client requests that the highest bit that contains meaningful information be the MSB of byte 1 of the Clock Count field);

d) **CS_Implemented_LSB:** This field is a value that is constrained to the range of 0 to 63. These bits indicate the requested least significant bit position within the 64-bit Clock Count field (e.g., a value of 001000b indicates that the client requests that the lowest bit that contains meaningful information be the LSB of byte 6 of the Clock Count field); and

e) **CS_Update_Period:** This field is a value. It represents the requested time, in microseconds, between consecutive updates from the Clock Synchronization server.

4.2.35.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the CSR command.

LS_ACC: LS_ACC signifies that the Clock Synchronization Server agrees to perform the action requested in the CSR Payload. The format of the LS_ACC Payload is shown in table 97. The Clock Sync Mode item in the CSR LS_ACC Payload shall contain the value that was received in the Clock Sync Mode item of the CSR Payload.

Table 97 – CSR LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Clock Sync Mode	CS_Accuracy	CS_Implemented_MSB	CS_Implemented_LSB
2	CS_Update_Period			

a) **Clock Sync Mode:** The meaning of the Clock Sync Mode byte in the CSR Payload is defined in table 98;

Table 98 – CSU Clock Sync Mode Meaning

Hex Value	Meaning
00h	Clock synchronization service enabled to this client
01h - FEh	Reserved
FFh	Clock synchronization service disabled to this client

b) **CS_Accuracy (Mantissa and Exponent):** This field consists of two values, CS_Accuracy_Mantissa (Bits 23-21) and CS_Accuracy_Exponent (Bits 20-16). These bits indicate the accuracy of the Clock Synchronization value as it leaves the server port. Specifically, the server shall supply a CS_Accuracy value such that the Clock Count value is always within the range of:

$$T\_reference \pm (0.5 + CS\_Accuracy\_Mantissa * 2^{-4}) * 2^{(CS\_Accuracy\_Exponent-30)},$$

where

A) T_reference is the clock reference value internal to the server;

B) CS_Accuracy_Mantissa is a value from 000b to 111b; and

C) CS_Accuracy_Exponent is a value from 00000b to 11111b;

Example #1, if CS_Accuracy Mantissa and Exponent = 001b and 01011b, respectively, the Clock Synchronization value as it exits the server shall always be within the range of:

T_reference ± 1,073 µsec

Example #2, if CS_Accuracy Mantissa and Exponent = 111b and 11000b, respectively, the Clock Synchronization value as it exits the server shall always be within the range of:

T_reference ± 14,65 msec

c) **CS_Implemented_MSB:** This field is a value that is constrained to the range of 0 to 63. It represents the most significant bit position within the Clock Count field that shall contain meaningful information (e.g., a value of 110111b indicates that the MSB of byte 1 of the Clock Count field is the highest bit that contains meaningful information);

d) **CS_Implemented_LSB:** This field is a value that is constrained to the range of 0 to 63. It represents the least significant bit position within the Clock Count field that shall contain meaningful information (e.g., a value of 001000b indicates that the LSB of byte 6 of the Clock Count field is the lowest bit that contains meaningful information); and

e) **CS_Update_Period:** This field is a value. It represents the time, in microseconds, between consecutive updates from the Clock Synchronization server.

4.2.36 Clock Synchronization Update (CSU)

4.2.36.1 Description

The CSU ELS is used by the Clock Synchronization Server to send its current clock value to its clients (see FC-FS-2).

4.2.36.2 Protocol

a) Clock Synchronization Update Request Sequence
b) No Reply Sequence

4.2.36.3 Request Sequence

Information Category: The Information Category value (Header word 0, bits 24-27) shall indicate Solicited Data (0001b).

Addressing: The S_ID field designates the Clock Synchronization Server well-known address (FFFFF6h). The D_ID field designates the Nx_Port(s) that is/are to receive the clock information.

Payload: The format of the Payload is shown in table 99.

Table 99 – CSU Payload

Bits / Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	CSU (69h)	Reserved		
1	Clock Count (8 bytes)			
2				

The meaning of the Clock Count field is given in table 100.

Table 100 – Clock Count Field Meaning

Byte Number	Meaning
0	Counter value, byte 0 (MSB)
1	Counter value, byte 1
2	Counter value, byte 2
3	Counter value, byte 3
4	Counter value, byte 4
5	Counter value, byte 5
6	Counter value, byte 6
7	Counter value, byte 7 (LSB)

The bit values are derived from clock frequencies that are used in 1Gbits/s Fibre Channel and shall be defined as follows. The value of the Bit 7 in Word 2 shall be equal to 1/106,25MHz, roughly 9,4

ns. Every other bit value is a binary multiple of this value. The next most significant bit is 2x that value, or 18,8ns. The next least significant value is ½ that value, or 4.7ns. The overall least significant bit is 73,5ps. The overall range that may be represented is 1,36 x 10^9 sec, approximately equal to 43 years.

The Clock Count value shall represent the time at which the most significant bit was placed on the link by the CSU ELS originator.

Any bits outside the range of CS_Implemented_MSB to CS_Implemented_LSB shall be set to zero. This applies to both the Clock Sync Server and to the Fabric.

4.2.36.4 Reply Sequence

none.

4.2.37 Report Port Buffer Conditions (RPBC)

4.2.37.1 Description

The RPBC ELS shall provide a method for a Port to report its buffer conditions. The normal response to an RPBC ELS Sequence shall be a LS_ACC ELS Sequence. If the recipient Port does not support the RPBC ELS, it shall reply with an LS_RJT ELS Sequence with a reason code of "Command not supported".

4.2.37.2 Protocol

a) Report Port Buffer Conditions (RPBC) Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.37.3 Request Sequence

Addressing: The S_ID designates the source port that is requesting port buffer conditions. The D_ID field designates the recipient that is to process the RPBC request and report buffer conditions.

Payload: The format of the RPBC Payload is shown in table 101.

Table 101 – RPBC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RPBC (58h)	Reserved		
1	ELS Buffer Parameters			
2	Reserved	Originator S_ID - obsolete		

The ELS Buffer Parameter field contained in word 1 of the RPBC Payload relates to the ELS buffer conditions of the sender of the RPBC ELS and the contents are shown in table 102.

Table 102 – ELS Buffer Parameters Field

Bits	Field Name
31	Multi-frame ELS sequence supported
30-12	Reserved.
11-00	ELS Receive Data Field Size

The Multi-frame ELS sequence supported bit indicates that the port either supports multi-frame ELS's (bit 31=1) or does not support multi-frame ELS's (bit 31=0).

The ELS Receive Data Field Size field (word 1, bits 11-0) specifies the largest ELS frame that may be received by the FC_Port responding with the RPBC LS_ACC. Values shall be a multiple of four bytes, and less than 128 or greater than 2 112 are invalid. For each class of service, the maximum usable ELS Receive Data Field Size is the lessor of the reported ELS Receive Data Field Size or the Buffer-to-buffer Receive Data Field Size reported during Login.

4.2.37.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RPBC command

LS_ACC: LS_ACC signifies acceptance of the RPBC Request and its Accept Payload. The format of the RPBC LS_ACC Payload is shown in table 103.

Table 103 – RPBC LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Reserved		
1	ELS Buffer Parameters			

The ELS Buffer Parameter field contained in word 1 of the RPBC LA_ACC Payload relates to the ELS buffer conditions of the sender of the RPBC_ACC ELS and the contents are shown in table 102.

4.2.38 Report node FC-4 Types (RNFT)

4.2.38.1 Description

The RNFT ELS provides for the exchange of supported FC-4 protocol lists. It may be used any time after N_Port Login to verify that the remote Nx_Port supports a given FC-4 protocol.

The RNFT requests a list of the FC-4 protocols supported by the responder, and the RNFT LS_ACC provides the requested list to the source of the of the RNFT.

A specific FC-4 may require that its Nx_Ports support RNFT, and therefore may conclude that a remote Nx_Port that returns LS_RJT with reason code of "Command not supported" does not support that FC-4.

4.2.38.2 Protocol

a) Report node FC-4 Types (RNFT) Request sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.38.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting the FC-4 Types information. The D_ID field designates the destination Nx_Port to which the request is being made.

Payload: The format of the request Payload is shown in table 104.

Table 104 – RNFT Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RNFT (63h)	Reserved	Maximum Size	
1	Reserved			Index

a) **Maximum Size:** Bytes 2-3 of Word 0 contain a 16-bit value that specifies the maximum length of the RNFT LS_ACC that the originator is able to accept. The value zero implies the RNFT LS_ACC may be any size.

b) **Index:** Byte 3 of Word 1 contains an 8-bit value that specifies the index of the first FC-4 Entry to be returned in the RNFT Reply.

Each FC-4 protocol supported by the responder has an index in the range from zero to (List Length – 1) that should be used to specify a subset of the entries when the entire list does not fit into one reply. NOTE - The index of the entry for a particular FC-4 TYPE may not be consistent between subsequent RNFT Requests (e.g., due to additions or deletions of supported FC-4 TYPEs).

4.2.38.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the RNFT command.

LS_ACC: LS_ACC Signifies that the destination Nx_Port has transmitted the requested data. The format of the LS_ACC Payload is shown in table 105.

Table 105 – RNFT LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Reserved	Payload Length (M)	
1	Reserved	List Length	Reserved	Index
2	FC-4 Entry 1			
..	...			
N+1	FC-4 Entry N			

a) **Payload Length:** Bytes 2-3 of Word 0 contain a 16-bit value that specifies the length M of the RNFT LS_ACC Payload in bytes.

M = 8 + N*4

where

N is the number of FC-4 Entries contained in the Payload.

b) **List Length:** Byte 1 of Word 1 contains an 8-bit value that specifies the total number of FC-4 protocols supported by the responder.

If List Length exceeds Index+N then the originator may request additional records with another RNFT in which Index is increased by N.

c) **Index:** Byte 3 of Word 1 contains an 8-bit value that specifies the index of the first FC-4 Entry returned in the RNFT reply.

d) **FC-4 Entry:** The FC-4 Entry record contains a FC-4 Entry and is shown in table 106.

Table 106 – RNFT FC-4 Entry

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
1	FC-4 Type	FC-4 Qualifier		

A) **FC-4 Type:** The FC-4 TYPE code of a FC-4 protocol that is supported by the sending Nx_Port. The values are defined in FC-FS-2**.**

B) **FC-4 Qualifier:** The FC-4 Qualifier may be used to distinguish between two protocols that use the same FC-4 TYPE code.

For FC-4 type codes that are reserved or assigned for specific use in this standard (00h - 68h), the value of the FC-4 Qualifier shall be zero.

For Vendor specific FC-4 TYPE codes (E0h through FFh), the FC-4 Qualifier shall be selected from one of the 24-bit Company_ID values assigned by the IEEE Registration Authority to the organization that defines the Vendor specific FC-4 protocol, and that Company_ID shall be used to qualify that FC-4 TYPE in all implementations. It is up to the organization that defines the Vendor specific FC-4 protocol to assure that the protocol has a unique qualified FC-4 Type.

4.2.39 Scan Remote Loop (SRL)

4.2.39.1 Description

The SRL ELS shall require a switch to scan attached loops to determine if any L_Ports have been disabled or removed. If the switch determines any L_Ports that are currently logged in with the Fabric have been removed or disabled it shall update the name server and send an RSCN to all registered Nx_Ports.

The SRL Payload indicates whether the switch shall scan all attached loops or a single loop. If a single loop is to be scanned the Payload shall contain the FL_Port_ID of the loop to be scanned.

4.2.39.2 Protocol

a) Scan Remote Loop Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.39.3 Request Sequence

Addressing: The S_ID field designates the source Nx_Port requesting Scan Remote Loop. The D_ID field designates the destination of the address identifier for the Domain Controller of the switch for which loops are being scanned. The format of the Domain Controller address is FFFCh || Domain_ID. Domain_ID is the Domain_ID of the switch being queried.

Payload: The format of the Payload is shown in table 107.

Table 107 – SRL Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	SRL (7Bh)	Reserved		
1	Flag	Flag Parameter		

a) **Flag:** Byte 0 of word 1 indicates if the FL_Port shall be scanned, if all FL_Ports within the domain shall be scanned, or the scan period that all FL_Ports within the domain shall be scanned. The meaning of bits 0-7 is given in table 108.

Table 108 – Flag field definitions

Value (hex)	Meaning	Flag Parameter
00	All the FL_Ports within the domain shall be scanned.	Ignored
01	Only the loop attached to the FL_Port addressed in the address identifier of the FL_Port field shall be scanned.	Address identifier of the FL_Port
02	Enable periodic scanning for all FL_ports.	Scan period[a]
03	Disable periodic scanning for all FL_ports.	Ignored
All Others	Reserved	

[a] Scan period in seconds. If the scan period is set to zero the scan period is vendor specific. If the switch does not support this option it shall reject the SRL ELS with a reason code of "Unable to perform command request" and a reason code explanation of "Periodic Scanning not supported". If the switch does not support the selected value it shall reject the SRL ELS with a reason code of "Unable to perform command request" and a reason code explanation of "Periodic Scan Value not allowed".

b) **Flag Parameter:** See table 108.

4.2.39.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the SRL Request

LS_ACC: LS_ACC signifies acceptance of the SRL Request. If the period scanning is enabled then the switch shall return the value of the periodic scanning period in the LS_ACC payloads Scan Period field. If the periodic scanning period is disabled then the switch shall set the LS_ACC payload Scan Period field to zero.

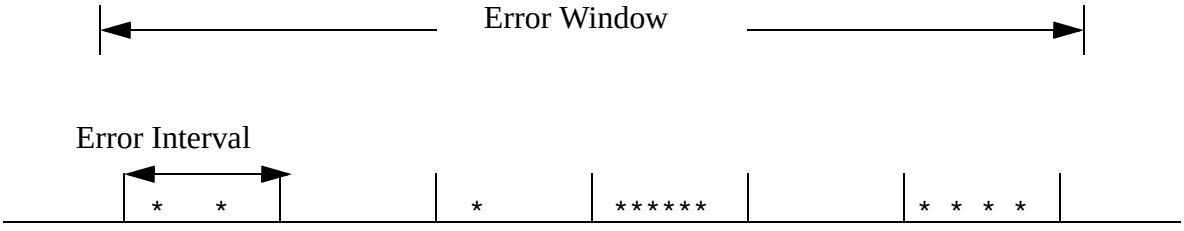
Table 109 – SRL LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Scan Period		

4.2.40 Set Bit-error Reporting Parameters (SBRP)

4.2.40.1 Description

Set SBRP ELS is used to communicate a set of bit error reporting parameters to a Port or to all Ports in a particular Domain in a Fabric. There are 3 parameters, Error Interval, Error Window, and Error Threshold. Error Interval is the time period over which bit error bursts are integrated to produce a single reported error. An Error Window is composed of one or more Error Intervals. The Error Interval Count is the number of Error Intervals occurring in an Error Window. If the Error Interval Count is greater than or equal to the Error Threshold, a Registered Link Incident Report (RLIR) is generated with an Incident Code specifying Bit-error-rate threshold exceeded (see FC-FS-2). At the end of the Error Window, the count is set to zero and the process is repeated. See figure 2 for illustration of the parameters.



Any Error Interval with one or more errors is counted as a single error.

* = Bit Error

Figure 2 – Illustration of parameters

SBRP may be used to determine an acceptable set or the current set of bit error reporting parameters in the destination Port or Domain, without changing the settings.

The setting of parameters in a particular Port or Domain is done by a controlling entity that is outside the scope of this standard.

4.2.40.2 Protocol

a) Set Bit-error Reporting Parameters (SBRP) Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.40.3 Request Sequence

Addressing: The S_ID designates the source Nx_Port requesting the bit error rate reporting parameters. The D_ID designates the destination Nx_Port or the Domain Controller (FFFCh || <Domain_ID>). Domain_ID is the Domain_ID of the recipient switch) to process the SBRP ELS.

Payload: The format of the SBRP Payload is shown in table 110.

Table 110 – SBRP Payload

Bits Word	31 .. 28	27 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 03	02 .. 00
0	SBRP (7Ch)		00h	00h		00h	
1	Error Flags						
2	Error Window exponent	Error Window value		Error Interval exponent	Error Interval value		
3	Error Threshold						

a) **Error Flags:** The following bits are mutually exclusive and only one bit shall be set for each instance of the SBRP ELS.

Bit 0 – Set Error Reporting Parameters: The bit is set to request that the destination set the Error Window, the Error Interval and the Bit-error Threshold parameters. If the destination is the Domain Controller then the request is for the switch to set all ports to the requested values.

Bit 1 – Report Error Reporting Parameters: The bit is set to request that the destination return the active parameters, currently being enforced.

Bits 2-31: Reserved

b) **Error Window exponent and Error Window value:** The Error Window is a time duration described by a 16-bit value. Twelve bits, Bits 28-16, are used for the base value. Four bits, Bits 31-28 are encoded to form the exponent. The product of the base value and the exponent yields the time duration in seconds. The encoded exponent is defined as follows:

0h represents 10^{0}

1h represents 10^{-1}

2h represents 10^{-2}

.
.
.

Fh represents 10^{-15}

(e.g., a base value of 300h multiplied by an exponent of 0h would yield a value of 1 times 10^{-0} or 300h seconds). The tolerance for the Error Window -0 to + 1 Error Interval.

c) **Error Interval exponent and Error Interval value:** The Error Interval is a time duration in seconds and has the same, exact definitions for exponent and base value as Error Window (e.g., a base value of 15 multiplied by an exponent of 1h would yield a value of 15 times 10^{-1} ot 1.5 seconds). The Error Interval has a tolerance of – 50% to + 50%.

d) **Error Threshold:** The Error Threshold fields specifies the basis for a comparison value with the Error Interval Count.

4.2.40.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the SBRP Request.

LS_ACC: LS_ACC signifies acceptance of the SBRP Request and presents SBRP data. The format of the LS_ACC Payload is shown in table 111.

The LS_ACC Payload conveys either:

a) the current Bit Error Rate Reporting Parameters (i.e., the requestor is querying for currently set parameters) or,

b) the accepted Bit Error Rate Reporting Parameters (a request to set the parameters was accepted) or,

c) acceptable Bit Error Rate Report Parameters (a request to set the parameters was rejected because the parameters requested are not within the range supported by the port or switch).

Table 111 – SBRP LS_ACC Payload

Bits Word	31	30 .. 28	27 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 00
0	02h			00h	00h		00h
1	SBRP Request Accepted	Reserved					
2	Error Window exponent		Error Window value		Error Interval exponent	Error Interval value	
3	Error Threshold						

a) **SBRP Request Accepted:** When a request to set the reporting parameters is indicated (request Payload word 1 bit 0 is set to one) and the recipient accepts the requested parameters, it shall set the SBRP Request Accepted bit to zero (Accepted) and echo the requested Error Window, Interval and Threshold parameters in words 2 and 3.

When a request to set the reporting parameters is indicated (i.e., request Payload word 1 bit 0 is set to one) and the recipient does not accept the parameters as requested the recipient shall set the SBRP Request Accepted bit to one and echo in words 2 and 3 those parameters that are accepted. Values not accepted by the recipient shall be set to zero.

When a request to report the parameters is indicated (request Payload word 1 bit 1 is set to one) the recipient shall set the SBRP Request Accepted bit to zero (Accepted) report the cur-

rent Bit Error Rate reporting parameters being enforced. If no Bit Error Rate reporting is being enforced, words 2 and 3 shall be set to zero.

4.2.41 Report Port Speed Capabilities (RPSC)

4.2.41.1 Description

The RPSC ELS shall provide a method for a Port to report its current and potential link operating speeds. The normal response to an RPSC ELS Sequence shall be a LS_ACC ELS Sequence. If the recipient Port does not support the RPSC ELS, it shall reply with an LS_RJT ELS Sequence with a reason code of "Command not supported".

4.2.41.2 Protocol

a) RPSC Request Sequence

b) LS_ACC or LS_RJT Reply Sequence

4.2.41.3 Request Sequence

Addressing: The S_ID designates the source port that is requesting port speeds. The D_ID field designates the recipient that is to process the RPSC request. If the recipient is a Domain Controller, the request is for all the ports within that domain.

Payload: The format of the RPSC Payload is shown in table 112.

Table 112 – RPSC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	RPSC (7Dh)	00h	00h	00h

4.2.41.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the RPSC Request

LS_ACC: LS_ACC signifies acceptance of the RPSC Request and its Accept Payload. The format of the LS_ACC Payload is shown in table 113.

Table 113 – RPSC LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	Reserved	Number of entries	
1	Port Speed Capabilities (Port 1)		Port Operating Speed (Port 1)	
2	Port Speed Capabilities (Port 2)		Port Operating Speed (Port 2)	
..	...			
n	Port Speed Capabilities (Port n)		Port Operating Speed (Port n)	

a) **Number of Entries:** Specifies the number of Port entries in the Payload.

b) **Port Speed Capabilities:** Identifies the operating speed capabilities of the port

Bit 31 – 1 Gb capable
Bit 30 – 2 Gb capable
Bit 29 – 4 Gb capable
Bit 28 – 10 Gb capable
Bit 27 – 8 Gb capable
Bit 26 – 16 Gb capable
Bits 25 through 17 – reserved
Bit 16 - Unknown

c) **Port Operating Speed:** Identifies the current operating speed if set.

Bit 15 – 1 Gb Operation
Bit 14 – 2 Gb Operation
Bit 13 – 4 Gb Operation
Bit 12 – 10 Gb Operation
Bit 11 – 8 Gb Operation
Bit 10 – 16 Gb Operation
Bits 9 through 2 – reserved
Bit 1 - Unknown
Bit 0 – Speed not established.

4.2.42 Read Exchange Concise (REC)

4.2.42.1 Description

This ELS shall be used only for purposes specific to an FC-4. The REC (Read Exchange Concise) Extended Link Service requests an Nx_Port to return Exchange information for the RX_ID and OX_ID originated by the S_ID specified in the Payload of the request Sequence.

A Read Exchange Concise Request shall only be accepted if the Originator Nx_Port N_Port_ID or the Responder Nx_Port N_Port_ID of the target Exchange is the same as the N_Port_ID of the Nx_Port that makes the request. If the REC Request is not accepted, an LS_RJT with reason code "Unable to perform command request" and reason code explanation "Invalid Originator S_ID" shall be returned.

The specification of OX_ID and RX_ID shall be provided for the destination Nx_Port to locate the status information requested. A Responder destination Nx_Port shall use the RX_ID and verify that the OX_ID is consistent, unless the RX_ID is unassigned (i.e., RX_ID = FFFFh). If the RX_ID is unassigned in the request, the Responder shall identify the Exchange by means of the S_ID specified in the Payload of the request Sequence and OX_ID. An Originator Nx_Port shall use the OX_ID and verify that the RX_ID is consistent.

If the destination Nx_Port of the REC request determines that the Originator S_ID, OX_ID, or RX_ID are inconsistent, then it shall reply with an LS_RJT Sequence with a reason code of "Unable to perform command request" and a reason code explanation of "Invalid OX_ID-RX_ID combination".

The value of the Parameter field in the frame header of an REC ELS and an LS_ACC in response to an REC ELS shall be specified by the FC-4 that sends the frame. The Relative offset present bit in the frame header of an REC ELS or an LS_ACC in response to an REC ELS shall be set to zero.

4.2.42.2 Protocol

a) Read Exchange Concise (REC) Request Sequence
b) LS_ACC or LS_RJT Reply Sequence

4.2.42.3 Request Sequence

Addressing: The S_ID designates the source port that is requesting exchange information. The D_ID field designates the recipient that is requested to provide exchange information.

Payload: The format of the REC Payload is shown in table 114.

Table 114 – REC Payload

Bits Word	31 .. 24 Byte 0	23 .. 16 Byte 1	15 .. 08 Byte 2	07 .. 00 Byte 3
0	REC (13h)	00h	00h	00h
1	Reserved	Exchange Originator S_ID		
2	OX_ID		RX_ID	

Exchange Originator S_ID: shall be set to the address identifier of the target Exchange Originator.

OX_ID: shall be set to the Originator Exchange_ID value of the target Exchange.

RX_ID: shall be set to the Responder Exchange_ID value of the target Exchange.

4.2.42.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the REC Request

LS_ACC: LS_ACC signifies acceptance of the REC Request and returns the requested exchange information. The format of the LS_ACC Payload is shown in table 115.

Table 115 – REC LS_ACC Payload

Bits Word	31 .. 24 Byte 0	23 .. 16 Byte 1	15 .. 08 Byte 2	07 .. 00 Byte 3
0	LS_ACC (02h)	00h	00h	00h
1	OX_ID		RX_ID	
2	Reserved	Originator Address Identifier		
3	Reserved	Responder Address Identifier		
4	FC4VALUE			
5	E_STAT			

The Originator Address Identifier field shall be set to the address identifier of the Originator of the exchange about which information was requested.

The Responder Address Identifier field shall be set the address identifier of the Responder of the exchange about which information was requested.

The value of the FC4VALUE field shall be specified by the FC-4 that sends the LS_ACC to a REC ELS.

E_STAT shall be as defined in FC-FS-2 for the E_STAT field in the Exchange Status Block for the exchange about which information was requested. The bits specifying whether the Exchange is complete (Bit 29) and whether the responder holds Sequence Initiative (Bit 30) shall be valid; the setting of other bits may not be valid.

4.2.43 Exchange Virtual Fabrics Parameters (EVFP)

4.2.43.1 EVFP Messages Structure

4.2.43.1.1 EVFP Request Sequence

Protocol: Exchange Virtual Fabrics Parameters (EVFP) Request Sequence

Format: FT–1

Addressing: For an N_Port, the S_ID field shall be set to FFFFF0h, indicating the N_Port Controller of the originating N_Port. The D_ID field shall be set to FFFFFEh, indicating the F_Port Controller of the destination F_Port. For an F_Port, the S_ID field shall be set to FFFFFEh, indicating the F_Port Controller of the originating F_Port. The D_ID field shall be set to FFFFF0h, indicating the N_Port Controller of the destination N_Port

Payload: Two types of EVFP messages are defined. All EVFP Request messages share the same message structure, shown in table 116.

Table 116 – EVFP Request Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	7Fh	00h	00h	00h
1	Protocol Version	Message Code	Transaction Identifier	
2	MSB	Core N_Port_Name / Core Switch_Name		
3				LSB
4	Reserved		Message Payload Length	
5 .. N	Message Payload			

Protocol Version: Shall be set to one.

EVFP Message Code: Specifies the EVFP message that is to be transmitted from the source to the destination. The defined EVFP message codes are shown in table 117.

Table 117 – EVFP Message Codes

Value	Description	Reference
01h	EVFP_SYNC	4.2.43.2
02h	EVFP_COMMIT	4.2.43.3
all others	Reserved	

Transaction Identifier: Uniquely identifies an EVFP transaction between two entities. The Transaction Identifier shall be set by the EVFP Initiator, and each subsequent EVFP message shall contain the same value, until the EVFP transaction is completed.

NOTE 7 – The usage of the Transaction Identifier is very similar to the usage of an OX_ID when an Exchange Originator is enforcing uniqueness via the OX_ID mechanism (see FC-FS-2), but it is not related in any way to the OX_ID present in the Fibre Channel frames carrying the EVFP messages.

Core N_Port_Name / Core Switch_Name: If the originating FC_Port is an N_Port, this field shall be set to its Core N_Port_Name. If the originating FC_Port is an F_Port, this field shall be set to the Core Switch_Name of the Switch it belongs to.

Payload Length: Shall be set to the total length in bytes of the EVFP Payload (i.e., 20 + the Message Payload length).

4.2.43.1.2 EVFP Reply Sequence

Accept (LS_ACC)
Signifies acceptance of the EVFP request.

Accept Payload: All EVFP Accept messages share the same message structure, shown in table 118.

Table 118 – EVFP Accept Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h
1	Protocol Version	Message Code	Transaction Identifier	
2	MSB	Core N_Port_Name / Core Switch_Name		
3				LSB
4	Reserved		Message Payload Length	
5 .. N	Message Payload			

The fields in table 118 are the same as defined in table 116.

Service Reject (LS_RJT)
Signifies the rejection of the EVFP request

Table 119 shows the use of reason codes and reason code explanations under some error conditions.

Table 119 – LS_RJT Reason Codes for EVFP

Error Condition	Reason Code	Reason Code Explanation
EVFP ELS not supported	Command not supported	No additional explanation
EVFP collision	Command already in progress	No additional explanation
Protocol Version not supported	Protocol error	No additional explanation
EVFP_COMMIT before EVFP_SYNC	Logical error	No additional explanation
Insufficient Resources	Unable to perform command request	No additional explanation
Invalid Payload Message	Protocol error	No additional explanation

4.2.43.2 EVFP_SYNC Message Payload

4.2.43.2.1 Overview

The EVFP_SYNC Message Payload carries a list of descriptors. Each descriptor is self-identifying (see table 121). The format of the EVFP_SYNC Message Payload is shown in table 120. This Message Payload is used in both EVFP_SYNC Request and EVFP_SYNC Accept.

Table 120 – EVFP_SYNC Message Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Descriptor #1 = Tagging Administrative Status (see 4.2.43.2.2)[a]			
1				
2	Descriptor #2 = Port VF_ID (see 4.2.43.2.3)[b]			
3				
4	Descriptor #3 = Locally-Enabled VF_ID List (see 4.2.43.2.4)[c]			
..				
132				
...	...			
H				
...	Descriptor #m			
K				

[a] Decriptor #1 is required to be present in EVFP_SYNC request.
[b] Decriptor #2 is required to be present in EVFP_SYNC request.
[c] Decriptor #3 is required to be present in EVFP_SYNC request.

All descriptors share the same format, shown in table 121.

Table 121 – Descriptor Format

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Descriptor Control	Descriptor Type	Descriptor Length	
1	Descriptor Value			
..				
M				

Descriptor Control: Specifies the behavior of the receiving entity if the descriptor is unsupported. The defined codes are shown in table 122.

Table 122 – Descriptor Control Codes

Value	Description
01h	Critical. Abort the EVFP transaction if the descriptor is unsupported.[a]
02h	Non critical. Skip the descriptor if unsupported and continue the EVFP transaction.[a]
all others	Reserved

[a] The Descriptor Control provides extensibility to the protocol. An implementation supporting a subset of the descriptors is able to process the unknown ones as specified by the Descriptor Control value.

Descriptor Type: Specifies the type of the descriptor. The defined descriptors are summarized in table 123.

Table 123 – Descriptor Types

Value	Description	Reference
01h	Tagging Administrative Status Descriptor	4.2.43.2.2
02h	Port VF_ID Descriptor	4.2.43.2.3
03h	Locally-Enabled VF_ID List Descriptor	4.2.43.2.4
F0h .. FEh	Vendor Specific Descriptor	4.2.43.2.5
all others	Reserved	

Descriptor Length: Specifies the length in bytes of the Descriptor Value.

4.2.43.2.2 Tagging Administrative Status Descriptor

The format of the Tagging Administrative Status descriptor is shown in table 124.

Table 124 – Tagging Administrative Status Descriptor

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Descriptor Control = 01h	Descriptor Type = 01h	Descriptor Length = 0004h	
1	Administrative Tagging Mode			

The defined Administrative Tagging Modes are shown in table 125.

Table 125 – Administrative Tagging Modes

Value	Notation	Description
0000 0001h	OFF	The FC_Port shall not perform VFT Tagging
0000 0002h	ON	The FC_Port may perform VFT Tagging if the peer does not prohibit it
0000 0003h	AUTO	The FC_Port may perform VFT Tagging if the peer request it

In absence of any explicit configuration, the default Administrative Tagging Mode of a VF capable N_Port or F_Port should be AUTO.

Table 126 shows how VFT tagging is negotiated between peer FC_Ports.

Table 126 – Tagging Mode Negotiation

		Peer Tagging Mode		
		OFF	**ON**	**AUTO**
Local Tagging Mode	**OFF**	Non Tagging	Non Tagging	Non Tagging
	ON	Non Tagging	Tagging	Tagging
	AUTO	Non Tagging	Tagging	Non Tagging

4.2.43.2.3 Port VF_ID Descriptor

The format of the Port VF_ID descriptor is shown in table 127.

Table 127 – Port VF_ID Descriptor

Bits Word	**31 .. 24**	**23 .. 16**	**15 .. 08**	**07 .. 00**
0	Descriptor Control = 01h	Descriptor Type = 02h	Descriptor Length = 0004h	
1	Port Flags		Port VF_ID	

Port Flags: Reserved. Shall be set to zero.

Port VF_ID: The 12 least significant bit of this field shall be set to the Port VF_ID. The four most significant bit shall be set to zero. In absence of any explicit configuration, the value 001h should be used as Port VF_ID.

4.2.43.2.4 Locally-Enabled VF_ID List Descriptor

The format of the Locally-Enabled VF_ID List descriptor is shown in table 128.

Table 128 – Locally-Enabled VF_ID List Descriptor

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Descriptor Control = 01h	Descriptor Type = 03h	Descriptor Length = 0200h	
1	VF_ID Bitmap			
..				
128				

VF_ID Bitmap: Each Virtual Fabric is identified by a bit in the VF_ID Bitmap. The high-order bit represents VF_ID zero, each successive bit represents the successive VF_ID, and the low-order bit represents VF_ID 4095. Virtual Fabric K is allowed on the Interconnect_Port if the Kth bit of the VF_ID Bitmap is set to one; is disallowed if the Kth bit of the VF_ID Bitmap is set to zero. The bit representing the Control VF_ID (see FC-FS-2) shall be set to zero.

The list of Virtual Fabrics operational over a link is computed by performing a bit-wise 'AND' between the received VF_ID Bitmap and the locally configured VF_ID Bitmap.

4.2.43.2.5 Vendor Specific Descriptor

The format of the Vendor Specific descriptor is shown in table 129.

Table 129 – Vendor Specific Descriptor

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Descriptor Control	Descriptor Type	Descriptor Length	
1	T10 Vendor ID			
2				
3	Vendor Specific			
..				
N				

T10 Vendor ID: Shall be set to the Vendor's T10 Vendor ID.

4.2.43.3 EVFP_COMMIT Message Payload

Both EVFP_COMMIT Request and EVFP_COMMIT Accept have no Message Payload.

4.2.44 Link Keep Alive (LKA)

4.2.44.1 Overview

The LKA ELS is used for traffic generation. It provides a means to generate traffic in order to confirm that the link is still intact and/or to ensure the link is not terminated due to lack of traffic. The LKA ELS was specifically designed to keep Fibre Channel backbone links alive (e.g., some TCP implementations will disconnect connections that are not used for some time period).

The LKA ELS is sent by a VE_Port or B_Access portal to a remote peer in order to determine the health of a link between them, or simply to generate traffic to keep a link from being terminated. Should a link be comprised of more than one physical or virtual connection, the LKA may be transmitted on each of the connections. If a connection is configured to handle only specific class(es) of traffic, the LKA shall be sent on a class of service the connection is configured for.

The LKA ELS request Sequence shall consist of a single frame requesting the recipient to reply using the ACC reply Sequence consisting of a single frame. The LKA ELS request frame shall indicate End_Sequence and Sequence Initiative transfer as well as other appropriate F_CTL bits as defined in FC-FS-2. The LKA ELS shall be transmitted as a single frame Sequence and the ACC reply Sequence is also a single frame Sequence. The LKA ELS shall be transmitted as an Exchange that is separate from any other Exchange. The LKA ELS is applicable to Class F, 2, 3, and 4.

The LKA ELS may be sent at any time. The LKA ELS should be sent at least every K_A_TOV if no traffic has been sent and/or received on the connection. The default value for K_A_TOV shall be 1/2 E_D_TOV.

If an accept is not received within E_D_TOV, a new LKA ELS may be transmitted in a new Exchange. The Exchange used for the previous LKA request shall be aborted.

Upon discovering an error (e.g. due to service reject or failure to receive a timely accept in response to one or more LKA ELS requests), the initiator shall initiate appropriate exception handling. The definition of appropriate exception handling is topology-specific.

4.2.44.2 Protocol

a) Link Keep Alive request Sequence; and

b) LS_ACC or LS_RJT reply Sequence.

4.2.44.3 Request Sequence

Addressing: The S_ID field shall be set to FFFFFDh, indicating the Fabric Controller of the VE_Port or B_Access portal originating the request. The D_ID field shall be set to FFFFFDh, indicating the Fabric Controller of the remote peer.

Payload: The format of the LKA Request Payload is shown in table 130.

Table 130 – LKA Payload

Bits Word	31... 24	23... 16	15... 08	07... 00
0	80h	00h	00h	00h

4.2.44.4 Reply Sequence

LS_RJT: LS_RJT signifies rejection of the LKA request.

LS_ACC: LS_ACC signifies that the connection is intact. The format of the LS_ACC payload is found in table 131.

Table 131 – LKA LS_ACC Payload

Bits / Word	31... 24	23... 16	15... 08	07... 00
0	02h	00h	00h	00h

4.2.45 Define FFI Domain Topology Map (FFI_DTM)

4.2.45.1 Description

The FFI_DTM ELS Request shall transfer a complete initial or replacement Domain Topology Map to the Domain Controller of the AE Principal Switch.

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal Switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_DTM request currently is not the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported”.

4.2.45.2 Protocol

a) FFI Domain Topology Map Request Sequence; and

b) LS_ACC or LS_RJT Reply Sequence.

4.2.45.3 Request Sequence

Addressing: The S_ID designates the Nx_Port sending an FFI Domain Topology Map. The D_ID designates the Domain Controller of the AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_DTM Request Payload is shown in table 132.

Table 132 – FFI_DTM Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_DTM (A0h)	00h	Payload Length	
1	FFI Incarnation Number			
2	Reserved	Reserved	Number of FFI Link State Records	
3	FFI Link State Records			
..				
n				

Payload Length: This field is the length in bytes of the entire Payload, inclusive of the length of word 0. This value shall be a multiple of 4. The minimum value of this field is 28. The maximum value of this field is 65532.

FFI Incarnation Number: This field contains the new incarnation of the FFI Domain Topology Map.

Number of FFI Link State Records: This field shall specify the number of FFI Link State Records that follow this field. The minimum value is 2.

FFI Link State Records: This field contains all of the individual FFI Link State Records that describe the Domain Topology Map of the Avionics Fabric. The format of the FFI Link State Record is described in FC-SW-4.

4.2.45.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_DTM Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of the FFI_DTM Request. The format of the LS_ACC Payload for FFI_DTM is shown in table 133.

Table 133 – FFI_DTM LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.46 Request FFI Domain Topology Map (FFI_RTM)

4.2.46.1 Description

The FFI_RTM ELS Request shall request the Domain Controller of the AE Principal Switch to return the current Domain Topology Map in the LS_ACC Reply Sequence.

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal Switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_RTM request currently is not the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported.”

4.2.46.2 Protocol

a) FFI Domain Topology Map Request Sequence; and

b) LS_ACC or LS_RJT Reply Sequence.

4.2.46.3 Request Sequence

Addressing: The S_ID field value identifies the Nx_Port requesting the Domain Topology Map from the Domain Controller of the AE Principal Switch. The D_ID designates the Domain Controller of the AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_RTM Request Payload is shown in table 134.

Table 134 – FFI_RTM Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_RTM (A1h)	00h	00h	00h

4.2.46.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_RTM Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of a valid FFI_RTM Request and that the AE Principal Switch has transmitted the requested data. The format of the LS_ACC Payload for FFI_RTM is shown in table 135.

Table 135 – FFI_RTM LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	Payload Length	
1	FFI Incarnation Number			
2	Reserved	Reserved	Number of FFI Link State Records	
3	FFI Link State Records			
..				
n				

Payload Length: This field is the length in bytes of the entire Payload, inclusive of the length of word 0. This value shall be a multiple of 4 bytes. The minimum value of this field is 28 bytes. The maximum value of this field is 65532.

FFI Incarnation Number: This field contains the current incarnation of the FFI Domain Topology Map.

Number of FFI Link State Records: This field shall specify the number of FFI Link State Records that follow this field. The minimum value is 2.

FFI Link State Records: This field contains all of the individual FFI Link State Records that describe the Domain Topology Map of the Avionics Fabric. The format of the FFI Link State Record is described in FC-SW-4.

4.2.47 FFI AE Principal Switch Selector (FFI_PSS)

4.2.47.1 Description

The FFI_PSS ELS Request shall be sent to an AE Switch that is not currently the AE Principal Switch in order to command the recipient to become the AE Principal Switch.

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal Switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_PSS request currently is the AE Principal Switch or is not capable of becoming the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported”.

4.2.47.2 Protocol

a) FFI AE Principal Switch Selector Request Sequence; and

b) LS_ACC or LS_RJT Reply Sequence.

4.2.47.3 Request Sequence

Addressing: The S_ID field value identifies the Nx_Port requesting a change of AE Principal Switch. The D_ID field value identifies the Domain Controller of an AE Switch that is not the current AE Principal Switch but is capable of becoming an AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_PSS Request Payload is shown in table 136.

Table 136 – FFI_PSS Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_PSS (A2h)	00h	00h	00h

4.2.47.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_PSS Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of the FFI_ PSS Request. The format of the LS_ACC Payload for FFI_ PSS is shown in table 137.

Table 137 – FFI_PSS LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.48 FFI Map Update Registration (FFI_MUR)

4.2.48.1 Description

The FFI_MUR ELS Request shall request the Domain Controller of the AE Principal Switch to add or remove the Nx_Port that is sending the FFI_MUR Request (S_ID value) to/from the list of Nx_Ports registered to receive the FFI_RMUN ELS Requests (see 4.2.49).

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_MUR request currently is not the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported”.

4.2.48.2 Protocol

a) FFI Map Update Registration Request Sequence; and

b) LS_ACC or LS_RJT Reply Sequence.

4.2.48.3 Request Sequence

Addressing: The S_ID designates the Nx_Port requesting registration for FFI Map Update Notification. The D_ID designates the Domain Controller of the AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_MUR Request Payload is shown in table 138.

Table 138 – FFI_MUR Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_MUR (A3h)	00h	00h	00h
1	00h	00h	00h	Registration Function

Registration Function: The format of the Registration Function field is shown in table 139.

Table 139 – Registration Function

Function	Value
Reserved	0
Full registration - Register to receive FFI_RMUN Requests. If the requesting Nx_Port is already registered, this request is treated as a NOP function.	3
Reserved	4 - 254
Clear registration – Remove the current FFI_RMUN registration, if any. If the requesting Nx_Port is not registered, this request is treated as a NOP function.	255

4.2.48.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_MUR Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of the FFI_MUR Request and registration to receive FFI_RMUN Requests. The format of the LS_ACC Payload for FFI_MUR is shown in table 140.

Table 140 – FFI_MUR LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.49 FFI Registered Map Update Notification (FFI_RMUN)

4.2.49.1 Description

A unidirectional FFI_RMUN Request shall be sent to registered Nx_Ports (see 4.2.48) when the AE Principal Switch sends an Fast Fabric Initialization (FFI) Request Sequence initiated by the AE Principal Switch.

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal Switch. Support for this ELS is optional for Nx_Ports. However, if the Nx_Port invokes the FFI_MUR ELS, it shall support receipt of the FFI_RMUN Request.

FFI_RMUN Request is intended to provide a timely indication of Map Updates to avoid the considerable time to discover any such failure.

Sending FFI_RMUN Requests between Nx_Ports is prohibited. Sending FFI_RMUN Requests by a Domain Controller that is not an AE Principal Switch is prohibited.

4.2.49.2 Registration to Receive FFI_RMUN Requests

See 4.2.48.

4.2.49.3 Protocol

a) FFI_RMUN Request Sequence.

4.2.49.4 Request Sequence

Addressing: The S_ID is the Domain Controller of the AE Principal Switch (FFFCxxh) and the D_ID is the address of the Registered Nx_Port destination.

Payload: The format of the FFI_RMUN Request Payload is shown in table 141.

Table 141 – FFI_RMUN Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_RMUN (A4h)	00h	Payload Length	
1	FFI Incarnation Number			
2	Reserved	Reserved	Number of FFI Link State Records	
3	FFI Link State Records			
..				
n				

Payload Length: This field is the length in bytes of the entire Payload, inclusive of the length of word 0. This value shall be a multiple of 4 bytes. The minimum value of this field is 28 bytes. The maximum value of this field is 65532.

FFI Incarnation Number: This field contains the current incarnation of the FFI Domain Topology Map.

Number of FFI Link State Records: This field shall specify the number of FFI Link State Records that follow this field. The minimum value is 2.

FFI Link State Records: This field contains all of the individual FFI Link State Records that describe the Domain Topology Map of the Avionics Fabric. The format of the FFI Link State Record is described in FC-SW-4.

4.2.49.5 Reply Sequence

LS_RJT: none

LS_ACC: none

4.2.50 FFI Suspend Map Updates (FFI_SMU)

4.2.50.1 Description

The FFI_SMU ELS Request shall request the Domain Controller of the AE Principal Switch, to suspend Domain Topology Map updates as specified in FC-SW-4. If Domain Topology Map updates are currently suspended, this request is treated as a NOP function. Successful execution of this ELS shall also suspend Registered Map Updates Notifications, if any (see 4.2.49).

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_SMU request currently is not the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported”.

4.2.50.2 Protocol

a) FFI Suspend Map Updates Request Sequence; and

b) LS_ACC or LS_RJT Reply Sequence.

4.2.50.3 Request Sequence

Addressing: The S_ID field value identifies the Nx_Port requesting suspension of Domain Topology Map updates by the Domain Controller of the AE Principal Switch. The D_ID field value identifies the Domain Controller of the AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_SMU Request Payload is shown in table 142.

Table 142 – FFI_SMU Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_SMU (A5h)	00h	00h	00h

4.2.50.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_SMU Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of a valid FFI_SMU Request and indicates that the Domain Controller of the AE Principal Switch has suspended Domain Topology Map updates. The format of the LS_ACC Payload for FFI_SMU is shown in table 143.

Table 143 – FFI_SMU LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.2.51 FFI Resume Map Updates (FFI_RMU)

4.2.51.1 Description

The FFI_RMU ELS Request shall request the Domain Controller of the AE Principal Switch, to resume Domain Topology Map updates as specified in FC-SW-4. If Domain Topology Map updates are currently not suspended, this request is treated as a NOP function. Successful execution of this ELS shall also resume Registered Map Updates Notifications, if any (see 4.2.49).

Support for this ELS is mandatory for a Domain Controller in an AE Principal Switch or an AE Switch that is capable of becoming an AE Principal Switch. Support for this ELS is optional for Nx_Ports.

If the Domain Controller that receives an FFI_RMU request currently is not the AE Principal Switch, it shall respond with an LS_RJT reply with a reason code of “Logical error”.

If a destination receives this ELS Request that is not a Domain Controller, it shall respond with an LS_RJT reply with a reason code of “Command not supported”.

4.2.51.2 Protocol

a) FFI Resume Map Updates Request Sequence; and

b) b) LS_ACC or LS_RJT Reply Sequence.

4.2.51.3 Request Sequence

Addressing: The S_ID field value identifies the Nx_Port requesting resumption of Domain Topology Map updates by the Domain Controller of the AE Principal Switch. The D_ID field value identifies the Domain Controller of the AE Principal Switch in the form FFFCxxh, where xx is the one-byte value assigned to the Domain Controller.

Payload: The format of the FFI_RMU Request Payload is shown in table 144.

Table 144 – FFI_RMU Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	FFI_RMU (A6h)	00h	00h	00h

4.2.51.4 Reply Sequence

LS_RJT: LS_RJT signifies the rejection of the FFI_RMU Request. The LS_RJT reply contains an appropriate reject reason code.

LS_ACC: LS_ACC signifies acceptance of a valid FFI_RMU Request and indicates that the Domain Controller of the AE Principal Switch has resumed Domain Topology Map updates. The format of the LS_ACC Payload for FFI_RMU is shown in table 145.

Table 145 – FFI_RMU LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	02h	00h	00h	00h

4.3 Extended Link Service Reply Sequences

4.3.1 Overview

An ELS Reply Sequence shall signify that the ELS request Sequence is completed. The reply Sequence may contain data in the Payload following the ELS_Command code word. The format and meaning of the Payload is specified in the request ELS definition.

4.3.2 LS_ACC

The Link Service Accept (LS_ACC) ELS reply Sequence shall notify the originator of an ELS request that the ELS request Sequence has been completed. The Responder shall terminate the Exchange by setting the Last Sequence bit (Bit 20) in F_CTL on the last Data frame of the reply Sequence. The first byte of the Payload shall contain 02h. The remainder of the Payload is unique to the ELS request.

Protocol: LS_ACC is the reply Sequence for several ELSs as indicated in the applicable clause.

Addressing: The D_ID field designates the source of the ELS Sequence being accepted while the S_ID field designates the destination of the request Sequence being accepted.

Payload: The Payload content following the ELS_Command code (02XXXXXXh) is defined within individual ELS requests.

4.3.3 Reply Sequence

none

4.3.4 Link Service Reject (LS_RJT)

4.3.4.1 Description

The Link Service Reject (LS_RJT) shall notify the transmitter of a Link Service request that the Link Service request Sequence has been rejected. A four-byte reason code shall be contained in the Data Field. Link Service Reject may be transmitted for a variety of conditions that may be unique to a specific Link Service request (e.g., if the Service Parameters specified in a Login frame were logically inconsistent or in error, a P_RJT frame would not be transmitted in response, but rather a Link Service Reject).

4.3.4.2 Payload

Addressing: The D_ID field designates the source of the ELS request being rejected while the S_ID field designates the destination of the request Data frame Sequence being rejected.

Payload: The first word of the Payload shall contain the ELS_Command code (01000000h). The next four bytes of this field shall indicate the reason for rejecting the request (see figure 3 and tables 146 and 147). The first error condition encountered shall be the error reported.

NOTE 8 – The applicable ELSs column in table 147 is not necessarily complete (i.e., a given reply may contain a reason code explanation other than what is indicated for it in the table).

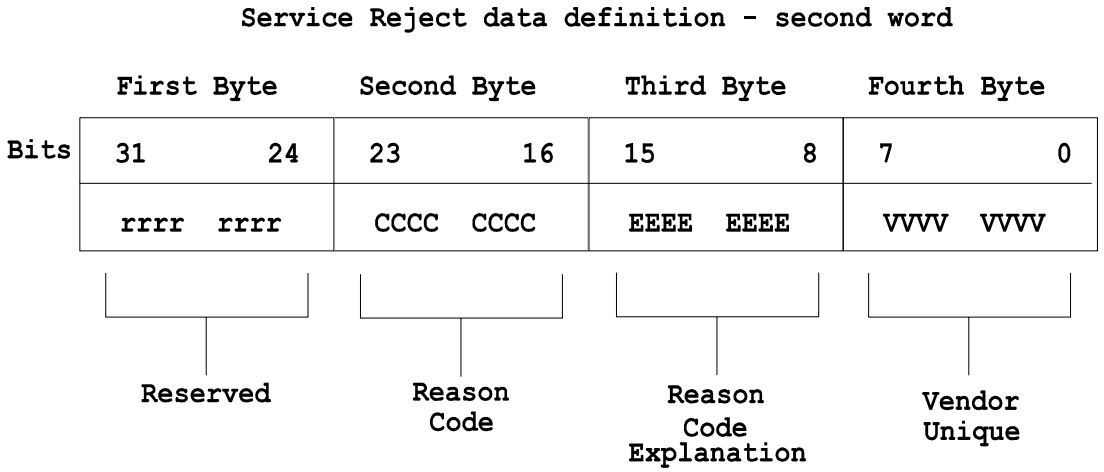


Figure 3 – LS_RJT format

Table 146 – LS_RJT Reason Codes

Encoded Value (Bits 23-16)	Description	Explanation
01h	Invalid ELS_Command code	The ELS_Command code in the Sequence being rejected is invalid.
03h	Logical error	The request identified by the ELS_Command code and Payload content is invalid or logically inconsistent for the conditions present.
05h	Logical busy	The Link Service is logically busy and unable to process the request at this time.
07h	Protocol error	This indicates that an error has been detected that violates the rules of the ELS Protocol that are not specified by other error codes.
09h	Unable to perform command request	The Recipient of a Link Service command is unable to perform the request at this time.
0Bh	Command not supported	The Recipient of a Link Service command does not support the command requested.
0Eh	Command already in progress	
FFh	Vendor specific error (See bits 7-0)	The Vendor specific error bits may be used by Vendors to specify additional reason codes.
Others	Reserved	

4.3.4.3 Reply Sequence

none

Table 147 – LS_RJT Reason Code Explanations

Encoded Value (Bits 15-8)	Description	Applicable ELSs
00h	No additional explanation	ADVC, ESTS, FLOGI, PLOGI, LOGO, RCS, REC, RLS, RTV, RSI, PRLI, PRLO, TPLS, TPRLO, GAID, FACT, FDACT, NACT, NDACT, PDISC, FDISC, ADISC, RNC, CSR, RNFT
01h	Service Parm error - Options	FLOGI, PLOGI
03h	Service Parm error - Initiator Ctl	FLOGI, PLOGI
05h	Service Parm error - Recipient Ctl	FLOGI, PLOGI
07h	Service Parm error - Rec Data Field Size	FLOGI, PLOGI
09h	Service Parm error - Concurrent Seq	FLOGI, PLOGI
0Bh	Service Parm error - Credit	ADVC, FLOGI, PLOGI
0Dh	Invalid N_Port/F_Port_Name	FLOGI, PLOGI
0Eh	Invalid node/Fabric Name	FLOGI, PLOGI
0Fh	Invalid Common Service Parameters	FLOGI, PLOGI
11h	Invalid Association_Header	RRQ, RSI
13h	Association_Header required	RRQ, RSI
15h	Invalid Originator S_ID	REC, RRQ, RSI
17h	Invalid OX_ID-RX_ID combination	REC, RRQ, RSI
19h	Command (request) already in progress	PLOGI, RSI
1Eh	N_Port Login required	see table 3
1Fh	Invalid N_Port_ID	RCS, RLS
21h	Obsolete	
23h	Obsolete	

Table 147 – LS_RJT Reason Code Explanations(Continued)

Encoded Value (Bits 15-8)	Description	Applicable ELSs
25h	Obsolete	
27h	Obsolete	
29h	Insufficient resources to support Login	FLOGI, PLOGI, FDISC
2Ah	Unable to supply requested data	ADVC, ESTS, RCS, RLS, RTV
2Ch	Request not supported	ADVC, ESTS, PRLI, PRLO, TPLS, TPRLO, GAID, FACT, FDACT, NACT, NDACT, PDISC, FDISC, ADISC, RNC, RNFT
2Dh	Invalid Payload length	FLOGI, PLOGI
30h	No Alias_IDs available for this Alias_ID Type	Get Alias_ID
31h	Alias_ID not activated (no resources available)	Fabric Activate Alias ID, N_Port Activate Alias ID
32h	Alias_ID not activated (invalid Alias_ID)	Fabric Activate Alias ID, N_Port Activate Alias ID
33h	Alias_ID not deactivated (doesn't exist)	Fabric Deactivate Alias ID, N_Port Deactivate Alias ID
34h	Alias_ID not deactivated (resource problem)	Fabric Deactivate Alias ID, N_Port Deactivate Alias ID
35h	Service Parameter conflict	N_Port Activate Alias ID
36h	Invalid Alias_Token	Get Alias_ID
37h	Unsupported Alias_Token	N_Port Activate Alias ID

Table 147 – LS_RJT Reason Code Explanations(Continued)

Encoded Value (Bits 15-8)	Description	Applicable ELSs
38h	Alias Group cannot be formed	Get Alias ID
40h	Obsolete	
41h	Obsolete	
42h	Obsolete	
44h	Invalid Port/Node_Name	LCLM
46h	Login Extension not supported	PLOGI, FLOGI
48h	Authentication required (see FC-SP)	PLOGI, FLOGI
50h	Periodic Scan Value not allowed	SRL
51h	Periodic Scanning not supported	SRL
Others	Reserved	

5 FC-4 Link Service

An FC-4 Link Service request solicits a destination Port (Fx_Port or Nx_Port) to perform a function or service in order to support an individual FC-4 Device_Data protocol. The Information Category for a request shall be specified as Unsolicited Control. A FC-4 Link Service reply may be transmitted in answer to a FC-4 Link Service request. The Information Category for a reply shall be specified as Solicited Control. Each request or reply shall be composed of a single Sequence. The format of the request or reply shall be specified by the individual FC-4 being supported and is beyond the scope of this standard. Each Sequence may be composed of one or more frames.

The protocols supported by the FC-4 Link Services shall be performed within a single Exchange, intended exclusively for the purpose. FC-4 Link Service protocols are performed using a two Sequence Exchange. The protocols consist of a request Sequence by the Originator (Nx_Port), transfer of Sequence Initiative (see FC-FS-2), and a reply Sequence from the Responder (Nx_Port or Fx_Port). The execution of a FC-4 Link Service may perform sequence abort functions and modify sequence initiative of other exchanges in a protocol specific manner. The Sequence Initiator and Sequence Recipient shall follow the rules for Sequence management and Recovery_Qualifier reuse as specified in FC-FS-2. The following rules regarding Sequence and Exchange management apply to FC-4 Link Services in addition to the rules specified in FC-FS-2:

a) FC-4 Link Services shall only be Exchanges originated following N_Port Login.

b) the Originator of the Exchange shall use the Discard multiple Sequences Exchange Error Policy (see FC-FS-2) for all FC-4 Link Service Exchanges.

c) the Originator of an FC-4 Link Service Exchange shall detect an Exchange error following Sequence Initiative transfer if the reply Sequence is not received within a timeout interval equal to twice the value of R_A_TOV.

d) if the Exchange Originator of an FC-4 Link Service Exchange detects an Exchange error, it shall abort the Exchange using ABTS and retry the protocol of the aborted Exchange with a different Exchange.

e) if the Sequence Initiator aborts a Sequence using ABTS (Abort Sequence Protocol) due to receiving an ACK with the Abort Sequence bits (5-4) set to 01b, the Sequence Initiator shall re-try the Sequence after the Basic Accept (see FC-FS-2) is received for the aborted Sequence one time only.

R_CTL bits 31-28 (Word 0) are set = to 0011b to indicate a FC-4 Link_Data frame. The TYPE field for each FC-4 Link Service frame shall match the FC-4 Device_Data TYPE field as specified in FC-FS-2.

6 Login and Service Parameters

6.1 Introduction

The Login procedure is a method by which an Nx_Port establishes its operating environment with a Fabric, if present, and other destination Nx_Ports with which it communicates. Fabric Login and N_Port Login are both accomplished with a similar procedure using different D_IDs and possibly different S_IDs.

Login between an Nx_Port and the Fabric or between two Nx_Ports is long-lived. The number of concurrent Nx_Ports with which an Nx_Port may be logged in with is a function of the Nx_Port facilities available. There is no one to one relationship between Login and Class 1 dedicated connections.

Login between an Nx_Port and the Fabric or between two Nx_Ports may use an explicit or implicit method. When Login is referred to throughout other sections of this standard, either the explicit or implicit procedure may be used. Implicit Login is assumed to provide the same functionality as Explicit Login.

Explicit Login is accomplished using a Login (FLOGI or PLOGI) ELS (see 4.2.7) within a new Exchange to transfer the Service Parameters (contained in the Payload) of the Nx_Port initiating the Login Exchange. The LS_ACC contains the Service Parameters of the Responder (contained in the Payload).

Implicit Login is a method of defining and specifying the Service Parameters of destination Nx_Ports by means other than the explicit use of the Login ELS. Specific methods of implicit Login are not defined in this standard.

Implicit Fabric Login, unlike Explicit Fabric Login, does not require the support, within an Nx_Port, of the FLOGI Link Service request and reply. Implicit Fabric Login may be supported in a variety of ways, requiring varying levels of support within an Nx_Port.

An Nx_Port determines its own native N_Port_ID through explicit or implicit Login by

a) the Fabric, if present,

b) implicit definition, or

c) assignment in the PLOGI Sequence transmitted to a destination Nx_Port attached in a point-to-point topology.

Nx_Ports may collect Address Identifiers from other potential destination Nx_Ports from:

a) a name server function, if present,

b) implicit definition, or

c) an alternate initialization procedure.

6.2 Fabric Login

6.2.1 Introduction

Login with the Fabric is required for all Nx_Ports, regardless of the class supported. Communication with other Nx_Ports shall not be attempted until the Fabric Login procedure is complete.

Fabric Login accomplishes the following functions:

a) It determines the presence or absence of a Fabric.

b) If a Fabric is present, it provides the Nx_Port with the specific set of operating characteristics associated with the entire Fabric, F_Port_Name and Fabric_Name.

c) If a Fabric is present, it provides the Fabric with the specific set of operating characteristics, N_Port_Name and Node_Name of the Nx_Port

d) If a Fabric is present, the Fabric shall optionally assign or shall confirm the N_Port_ID of the Nx_Port that initiated the Login.

e) If a Fabric is present, it initializes the buffer-to-buffer Credit.

f) If the Nx_Port and the Fabric support Authentication, it enables the subsequent Nx_Port to Fabric Authentication (see FC-SP).

g) If the N_Port and the Fabric support Virtual Fabrics, it enables the subsequent negotiation of Virtual Fabrics parameters (see 8.2).

6.2.2 Explicit Fabric Login

6.2.2.1 Introduction

The explicit Fabric Login procedure shall require an Nx_Port to transmit a Fabric Login (FLOGI) Link Service ELS (see 4.2.7).

Explicit Fabric Login replaces previous Service Parameters. The Login procedure shall follow the Exchange and Sequence management rules, the buffer-to-buffer flow control rules, and the end-to-end flow control rules as specified in FC-FS-2.

6.2.2.2 Explicit Fabric Login Request

The Nx_Port shall transmit the FLOGI in a new Exchange. The Payload of FLOGI contains the Service Parameters of the Nx_Port, a 64-bit N_Port_Name of the Nx_Port, and a 64-bit Node_Name. The Service Parameters are as specified for F_Port Login in 6.6. The applicability of the Service Parameters to Fabric Login are given in tables 150 and 155. The Nx_Port shall assign an OX_ID and set the D_ID to the well-known F_Port address (i.e., FFFFFEh).

If the Nx_Port is unidentified, an Nx_Port shall set the S_ID in the FLOGI to 000000h or 0000h || YY. If the Nx_Port sets the S_ID to 000000h, the Nx_Port is requesting the Fabric assign all 24 bits of the N_Port_ID. If the Nx_Port sets the S_ID to 0000h || YY, the Nx_Port is requesting the Fabric assign the upper 16 bits, bits 23 to 8, and validate the lower 8 bits, bits 7 to 0, of the N_Port_ID. An example of the use of S_ID of 0000h || YY is FC-AL-2. The lower 8 bits of the N_Port_ID are the AL_PA.

6.2.2.3 Responses to Explicit Fabric Login

The following are possible responses the Nx_Port may receive when transmitting a FLOGI:

a) LS_ACC reply Sequence with OX_ID equal to the OX_ID of the FLOGI, and the Common Service N_Port/F_Port bit set to one (Fx_Port) - This is the normal response to a Fabric Login request. The D_ID of the LS_ACC shall be the N_Port_ID assigned by the Fabric. If the S_ID in the FLOGI was 000000h, the D_ID shall be XXXXXX. If the S_ID in the FLOGI was 0000h || YY, the D_ID shall be XXXXYY. If the S_ID in the FLOGI was XXXXXX, the D_ID shall be same value of XXXXXX. The Payload shall include the Service Parameters for the entire Fabric, a 64-bit F_Port_Name and 64-bit Fabric_Name. The Service Parameters are as specified for F_Port Login in 6.6. The applicability of the Service Parameters to Fabric Login are given in tables 150 and 155. The Nx_Port may continue operation with other Nx_Ports if the N_Port_ID, F_Port_Name, and Fabric_Name are the same as in a previous Fabric Login or proceed to N_Port Login.

b) LS_ACC reply Sequence with OX_ID equal to the OX_ID of the FLOGI, and the Common Service Nx_Port/F_Port bit set to zero (Nx_Port) This indicates a point-to-point connection with another Nx_Port. The D_ID of the LS_ACC shall be the S_ID of the FLOGI. The Payload shall include the Service Parameters from the FLOGI with all classes marked invalid, a 64-bit N_Port_Name and 64-bit Node_Name of the connected Nx_Port. If the received N_Port_Name is less than its N_Port_Name, the Nx_Port proceeds to N_Port Login. If the received N_Port_Name is greater than its N_Port_Name, the Nx_Port waits for PLOGI from the attached N_Port.

c) F_BSY with OX_ID equal to the OX_ID of the FLOGI. The D_ID shall be the S_ID of the FLOGI. The Fabric is busy. The Nx_Port may retry the FLOGI again later.

d) P_BSY Sequence with OX_ID equal to the OX_ID of the FLOGI. The D_ID shall be the S_ID of the FLOGI. This indicates a point-to-point connection with another Nx_Port that is currently busy. The Nx_Port may proceed to N_Port Login after a delay to allow the destination Nx_Port to become not busy.

e) F_RJT Sequence with OX_ID equal to the OX_ID of the FLOGI. The D_ID shall be the S_ID of the FLOGI. The Fabric has rejected the FLOGI request. The reason code contained in the Payload determines the Nx_Port's action. If the reason code is "Class not supported", the Nx_Port may originate a FLOGI in a different class. If the reason code is "Invalid S_ID", the Nx_Port may originate a FLOGI with a different S_ID:

   A) If the S_ID of the rejected FLOGI was 000000h or 0000h || YY, the Nx_Port may select a 24 bit value, XXXXXX, for its N_Port_ID by a method outside this standard and originate a FLOGI with this value in the S_ID.

   B) If the S_ID of the rejected FLOGI was XXXXXX, the Nx_Port may select a value of '00 00 00' or '00 00 yy', or a new value 'XX XX XX' for its N_Port_ID by a method outside this standard and originate a FLOGI with this value in the S_ID.

f) P_RJT Sequence, with OX_ID equal to the OX_ID of the FLOGI. The D_ID shall be the S_ID of the FLOGI. This indicates a point-to-point connection with another Nx_Port. The reason code contained in the Payload determines the Nx_Port's action. If the reason code is "Class not supported", the Nx_Port may proceed to N_Port Login in a different class than used for the FLOGI. For other reason codes, the Nx_Port should respond accordingly.

g) LS_RJT Sequence with OX_ID equal to the OX_ID of the FLOGI. The D_ID of the LS_RJT shall be the N_Port_ID assigned by the Fabric. If the S_ID in the FLOGI was 000000h, the D_ID shall be XXXXXX. If the S_ID in the FLOGI was 0000h || YY, the D_ID shall be XXXXYY. If the S_ID in the FLOGI was XXXXXX, the D_ID shall be XXXXXX. The reason code contained in the Payload determines the Nx_Port's action. The Nx_Port may alter the Service Parameters based on the reason code and originate a new FLOGI.

h) No Response may indicate a delivery error, e.g., error on the physical transport. The Nx_Port shall perform error recovery per FC-FS-2. The Nx_Port may originate a new FLOGI after recovery.

i) If the received N_Port_Name is equal to its N_Port_Name, then the Nx_Port is connected to itself and this case is outside the scope of this standard. The FLOGI is discarded.

6.2.2.4 Nx_Port response to FLOGI

If an Nx_Port receives a FLOGI, the Nx_Port shall respond to the received FLOGI with an LS_ACC reply Sequence with the OX_ID equal to the OX_ID of the received FLOGI and the Common Service Parameter Nx_Port/F_Port bit set to zero (i.e., an Nx_Port). This indicates a point-to-point connection with another Nx_Port. The D_ID of the LS_ACC shall be the S_ID of the received FLOGI. The Payload shall include the Service Parameters from the received FLOGI with all classes marked invalid, and the 64-bit N_Port_Name and 64-bit Node_Name of the connected Nx_Port. If the received N_Port_Name is less than its N_Port_Name, the Nx_Port proceeds to N_Port Login. If the received N_Port_Name is greater than its N_Port_Name, the Nx_Port waits for PLOGI from the attached N_Port.

6.2.2.5 Relogin with the Fabric

During a Login with the Fabric, if the Nx_Port was previously logged in with the Fabric and the N_Port_ID, F_Port_Name, and the Fabric_Name are the same as the previous login, the Nx_Port may continue current communications with other Nx_Ports that it has established logins with; if the Nx_Port detects that the N_Port_ID, F_Port_Name, and/or the Fabric_Name has changed since the last Fabric Login, the Nx_Port shall implicitly logout with all Nx_Ports and wait an R_A_TOV timeout period before initiating or accepting communication with other Nx_Ports. The timeout period shall start when the Nx_Port detects the change. After waiting the timeout period, new N_Port Logins are required before the Nx_Port may communicate with other Nx_Ports.

6.2.3 SOFs

Fabric Login shall only be performed in Class 1, 2, or 3. Since the Fabric may not support all three classes, the FLOGI Sequence may require retry in a different Class with the appropriate SOF.

Fabric Login is valid for all supported classes as indicated by the validity bits in the FLOGI LS_ACC Reply Sequence.

SOF_{c1} may be used to attempt Fabric Login or Fabric Relogin. SOF_{i1} is not allowed.

Class 6 shall not be used for Fabric Login since the D_ID field requires an Alias_ID multicast address.

Selection of the SOF for the FLOGI Sequence is based on the Classes supported by the originating Nx_Port. The FLOGI Sequence is transmitted and the appropriate action is specified in 6.2.2.3. If an F_RJT with reason code "Class of service not supported by entity at FFFFFEh" is received, another supported SOF shall be attempted until the Login procedure is complete or until all supported SOF

types have been attempted. If all supported SOF types have been attempted and the Fabric has rejected all or timed out, the Fabric and Nx_Port are incompatible and outside intervention is required.

The Fabric shall remove all Class 1, and 6 connections to an N_Port when the N_Port performs a Fabric Login.

6.2.4 Frequency

Login between an Nx_Port and the Fabric should be long-lived. If Implicit Logout with the Fabric has occurred, it is necessary to perform a new Login with the Fabric (see 6.4.4).

6.2.5 Fabric Login completion - Originator

The Originator of the FLOGI request considers Fabric Login to have ended when

a) in Class 1, the Originator has transmitted the ACK (EOF_t or EOF_{dt}) to the LS_ACC, or

b) in Class 2, the Originator has transmitted the ACK (EOF_t) to the LS_ACC, or

c) in Class 3, the Originator has received the LS_ACC.

When Login is ended, the values of buffer-to-buffer Credit are initialized.

6.2.6 Fabric Login completion - Responder

The Responder of the FLOGI request considers Fabric Login to have ended when

a) in Class 1, the Responder has received the ACK (EOF_t or EOF_{dt}) to the LS_ACC, or

b) in Class 2, the Responder has received the ACK (EOF_t) to the LS_ACC, or

c) in Class 3, the Responder has transmitted the LS_ACC.

When Fabric Login has ended successfully, the values of buffer-to-buffer Credit are initialized.

6.3 N_Port Login

6.3.1 Introduction

N_Port Login follows the Fabric Login procedure. If a Fabric is present, as determined by performing the Fabric Login procedure, an Nx_Port proceeds with N_Port Login according to 6.3.2.2. If a Fabric is not present, as determined by performing the Fabric Login procedure, an Nx_Port proceeds with N_Port Login according to 6.3.2.4.

N_Port Login accomplishes the following functions:

a) It provides each Nx_Port with the other Nx_Port's operating characteristics, N_Port_Name and Node_Name.

b) If a Fabric is not present, it assigns the native N_Port_ID for both Nx_Ports.

c) If initializes the Nx_Port end-to-end Credit.

d) In point-to-point topology or between NL_Ports on the same loop, buffer-to-buffer Credit is initialized

N_Port Login between two Nx_Ports is complete when each Nx_Port has received the Service Parameters of the other Nx_Port. This may be accomplished by either implicit or explicit N_Port Login.

An Nx_Port is required to Login with each Nx_Port with which it intends to communicate. This includes reserved and well-known address identifiers since they are considered to be N_Ports (see FC-FS-2).

NOTE 9 – It is not required that an Nx_Port provide the same Login information with each destination Nx_Port or with the Fabric. However, an Nx_Port should avoid using contradictory or conflicting parameters with different Login destinations.

The N_Port Common Service Parameters during N_Port Login are specified in 6.6.2 (See table 150 for applicability). The N_Port Class Service Parameters during N_Port Login are specified in 6.6.5 (See table 155 for applicability). Both the Common Service Parameters and Class Service Parameters apply to each Nx_Port during N_Port Login.

NOTE 10 – When an Nx_Port (A) receives a PLOGI from another Nx_Port (B), Nx_Port (A) should verify that it is not already logged in with an Nx_Port (C) with the same N_Port_Name but different Nx_Port native address identifier and Node_Name. If so, it should consider the prior Login to be ended and all open Sequences that it originated with or received from the destination Nx_Port are terminated before accepting the new Login. Such a situation may arise if configuration changes have occurred.

N_Port Login provides each Nx_Port with the other Nx_Port's Service Parameters. Knowledge of a destination Nx_Port's receive and transmit characteristics is required for data exchanges. Service Parameters of destination Nx_Ports are saved and used when communication with those Nx_Ports is initiated. The Service Parameters interchanged between two Nx_Ports may be asymmetrical. Saving the Service Parameters of destination Nx_Ports with which an Nx_Port communicates requires Nx_Port resources. These resources should be released using the destination N_Port Logout procedure (see 6.4).

Due to the resetting behavior of a PLOGI (e.g., termination of all open exchanges with the destination port), a port shall only send a PLOGI to a destination port if it is not logged in with the destination port. Examples of why a port is not logged in include:

a) it has determined that a configuration change has occurred;

b) it has lost knowledge of the login parameters with the destination port;

c) the destination port has responded with a frame that indicates an error condition (e.g., LOGO, P_RJT);

d) the local port has logged out the destination port, either implicitly or explicitly, due to resource constraints; and

e) the destination port failed to respond after 2 times R_A_TOV has expired.

A configuration change shall be determined by comparing the Port_Name, Node_Name, and Address_Identifier received in the ACC from an ADISC or PDISC with the values previously established during the previous login process. A configuration change has occurred if either N_Port_Name or N_Port_ID do match and any of the three parameters do not match.

6.3.2 Explicit N_Port Login

6.3.2.1 Introduction

The explicit N_Port Login procedure shall require an Nx_Port to transmit a PLOGI Link request Sequence.

Explicit N_Port Login replaces previous Service Parameters. The Login procedure shall follow the Exchange and Sequence management rules, the buffer-to-buffer flow control rules, and the end-to-end flow control rules as specified in FC-FS-2.

A well-behaved Nx_Port shall Logout with another Nx_Port prior to initiating a new N_Port Login. However, if an Nx_Port receives or transmits a PLOGI request with another Nx_Port, it shall abnormally terminate open Sequences and respond to any new Sequences with that Nx_Port as though a Logout had been previously performed. During the N_Port Login procedure, other communication with the destination Nx_Port shall not be initiated or accepted. Once the N_Port Login procedure has been successfully completed, communication between the Nx_Ports may be initiated or accepted, (e.g., if Nx_Port(A) performs a PLOGI request with Nx_Port(B) and Nx_Port(B) transmits the LS_ACC reply, then either Nx_Port(A) or Nx_Port(B) may initiate communication for other protocols. Nx_Port(B) shall not be required to transmit a PLOGI request Sequence to Nx_Port(A) unless it wishes to invalidate or alter the existing Login parameters).

6.3.2.2 N_Port Login - Fabric present

The destination Nx_Port explicit Login procedure requires transmission of a N_Port Login (PLOGI) Link Service Sequence. The PLOGI is sent within an Exchange with an assigned OX_ID, the D_ID of the destination Nx_Port and a S_ID of originating Nx_Port. The Payload of this Sequence contains the Service Parameters, N_Port_Name, and Node_Name of the Nx_Port originating the PLOGI Sequence. The N_Port Service Parameters are as specified in 6.6. The applicability of the Service Parameters to N_Port Login are given in tables 150 and 155.

The normal reply Sequence to a PLOGI Link Service Sequence by an Nx_Port is a LS_ACC Link Service Reply Sequence within the Exchange identified by the OX_ID of the Login Sequence and the RX_ID assigned by the Responder with a D_ID of the originating Nx_Port (PLOGI Sequence) and a S_ID of the responding Nx_Port. The Payload of the LS_ACC contains the Service Parameters of the responding Nx_Port.

6.3.2.3 Responses to N_Port Login - Fabric present

The following are possible responses the Nx_Port may receive in response to transmitting a PLOGI with a Fabric present:

a) LS_ACC reply Sequence with OX_ID equal to the OX_ID of the PLOGI, and the Common Service N_Port/F_Port bit = 0 (Nx_Port) - This is the normal response to a N_Port Login request. The D_ID of the LS_ACC shall be the S_ID from the PLOGI. The S_ID of the LS_ACC shall be D_ID from the PLOGI. The Payload shall include the Service Parameters for the destination Nx_Port, a 64-bit N_Port_Name and a 64-bit Node_Name. The N_Port Service Parameters are as specified for in 6.6. The applicability of the Service Parameters to N_Port Login are given in tables 150 and 155. The Nx_Port may begin normal communication with the remote N_Port.

b) F_BSY with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The Fabric is busy. The Nx_Port may retry the PLOGI again later.

c) F_RJT Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The Fabric has rejected the PLOGI request. The reason code contained in the Payload determines the Nx_Port's action. If the reason code is "Invalid D_ID", N_Port Login is not possible with the addressed Nx_Port. The Nx_Port may attempt Login with other destination Nx_Ports. For other reason codes, the Nx_Port should respond according to the code.

d) P_BSY Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The destination Nx_Port is busy. The Nx_Port may retry the PLOGI again later.

e) P_RJT Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The reason code contained in the Payload determines the Nx_Port's action. If the reason code is "Class not supported", the Nx_Port may attempt PLOGI in a different class. For other reason codes, the Nx_Port should responded according to the code.

f) PLOGI Sequence. The D_ID is the N_Port_ID of receiving Nx_Port. The S_ID is the N_Port_ID of the originating Nx_Port. The OX_ID is as assigned by the originating Nx_Port. The Payload shall include a 64-bit N_Port_Name and 64-bit Node_Name of the Nx_Port originating the PLOGI. This indicates a collision with N_Port Login from the destination Nx_Port. If the received N_Port_Name is less than the receiving Nx_Port's N_Port_Name, the Nx_Port sends LS_RJT to the originating Nx_Port with reason code "Command already in progress". If the received N_Port_Name is greater than its N_Port_Name, the Nx_Port processes the received PLOGI.

g) LS_RJT Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID of the LS_ACC shall be the N_Port_ID of the destination Nx_Port. The reason code contained in the Payload determines the Nx_Port's action. The Nx_Port may alter the Service Parameters based on the reason code and originate a new PLOGI.

h) No Response may indicate a delivery error, e.g., error on the physical transport. The Nx_Port shall perform error recovery per FC-FS-2. The Nx_Port may originate a new PLOGI after recovery.

i) If the received N_Port_Name is equal to its N_Port_Name, then the Nx_Port is connected to itself and this case is outside the scope of this standard.

6.3.2.4 N_Port Login - No Fabric present

This procedure is based on the Nx_Port discovering the Fabric is not present during an attempted Fabric Login (see 6.2.2.3). The destination N_Port explicit Login procedure requires transmission of a PLOGI Link Service Sequence in a new Exchange.

Only one Nx_Port in the point-to-point connection is required to transmit a PLOGI. If the N_Port_Names are exchanged during Fabric Login, the Nx_Port with the highest N_Port_Name shall transmit the PLOGI.

If either Nx_Port does not have access the N_Port_Name of the connected Nx_Port, it may send a PLOGI. The processing requirements for responses received after transmitting a PLOGI resolves the condition of both Nx_Ports transmitting PLOGI.

An Nx_Port in a point-to-point configuration transmits PLOGI within a new Exchange. The S_ID shall be different than the D_ID. The Payload of this Sequence contains the Service Parameters, N_Port_Name, and Node_Name of the Nx_Port originating the PLOGI Sequence. The N_Port Service Parameters are as specified for in 6.6. The applicability of the Service Parameters to N_Port Login are given in tables 150 and 155.

6.3.2.5 Responses to N_Port Login - No Fabric present

The following are possible responses the Nx_Port may receive in response to transmitting a PLOGI in a point-to-point configuration:

a) LS_ACC reply Sequence with OX_ID equal to the OX_ID of the PLOGI, and the Common Service N_Port/F_Port bit = 0 (Nx_Port). The D_ID of the LS_ACC shall be the S_ID from the PLOGI. The S_ID shall be the destination Nx_Port's N_Port_ID assigned by the D_ID in the PLOGI. The Payload shall include the Service Parameters for the destination Nx_Port, a 64-bit N_Port_Name and a 64-bit Node_Name. The N_Port Service Parameters are as specified in 6.6. The applicability of the Service Parameters to N_Port Login are given in tables 150 and 155. This is the normal response to a N_Port Login request. The Nx_Port may begin normal communication with the remote N_Port.

b) P_BSY Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The destination Nx_Port is busy. The Nx_Port may retry the PLOGI again later.

c) P_RJT Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID shall be the S_ID of the PLOGI. The reason code contained in the Payload determines the Nx_Port's action. If the reason code is "Class not supported", the Nx_Port may attempt N_Port Login in a different Class. For other reason codes, the Nx_Port should respond according to the code.

d) LS_RJT Sequence with OX_ID equal to the OX_ID of the PLOGI. The D_ID of the LS_ACC shall be the N_Port_ID of the destination Nx_Port. The reason code contained in the Payload determines the Nx_Port's action. The Nx_Port may alter the Service Parameters based on the reason code and originate a new PLOGI.

e) PLOGI Sequence. The D_ID is the address identifier of receiving Nx_Port. The S_ID is the N_Port_ID of the originating Nx_Port. The OX_ID is as assigned by the originating Nx_Port. The Payload shall include a 64-bit N_Port_Name and 64-bit Node_Name of the Nx_Port originating the PLOGI. This indicates a collision with N_Port Login from the destination Nx_Port. If the received N_Port_Name is less than the receiving Nx_Port's N_Port_Name, the Nx_Port sends LS_RJT to the originating Nx_Port with reason code "Command already in progress". If the received N_Port_Name is greater than its N_Port_Name, the Nx_Port processes the received PLOGI.

f) No Response may indicate a delivery error, e.g., error on the physical transport. The Nx_Port shall perform error recovery per FC-FS-2. The Nx_Port may originate a new PLOGI after recovery.

g) If the received N_Port_Name is equal to its N_Port_Name, then the Nx_Port is connected to itself and this case is outside the scope of this standard.

6.3.3 SOFs

N_Port Login is only supported in Class 1, 2, and 3. Since the destination Nx_Port may not support all these classes for Login, the PLOGI Sequence may require retransmission in a different Class with the appropriate SOF in the same manner described for Fabric Login (see 6.2.3). Login is valid for all supported classes as indicated by the validity bits in the PLOGI LS_ACC Reply Sequence.

6.3.4 Frequency

The frequency of N_Port Login is installation dependent based on the frequency of configuration changes that may alter the N_Port_ID within an installation. Service Parameters of other Nx_Ports are retained until the next N_Port Login or until N_Port Logout (implicit or explicit) is performed.

6.3.5 N_Port Login completion - Originator

The Originator of the PLOGI request considers Login to have ended when

a) in Class 1, the Originator has transmitted the ACK (EOFt or EOFdt) to the LS_ACC, or

b) in Class 2, the Originator has transmitted the ACK (EOFt) to the LS_ACC, or

c) in Class 3, the Originator has received the LS_ACC.

When N_Port Login is ended with a Fabric present, the value of end-to-end Credit is initialized. When N_Port Login is ended in a point-to-point topology, the values of buffer-to-buffer and end-to-end Credit are initialized.

6.3.6 N_Port Login completion - Responder

The Responder of the PLOGI request considers Login to have ended when

a) in Class 1, the Responder has received the ACK (EOFt or EOFdt) to the LS_ACC, or

b) in Class 2, the Responder has received the ACK (EOFt) to the LS_ACC, or

c) in Class 3, the Responder has transmitted the LS_ACC.

When N_Port Login is ended with a Fabric present, the value of end-to-end Credit is initialized. When N_Port Login is ended in a point-to-point topology, the values of buffer-to-buffer and end-to-end Credit are initialized.

6.4 Logout

6.4.1 Introduction

The destination Logout procedure provides a method for removing service between two N_Port_IDs or between an N_Port_ID and a Fabric. Logout releases resources, identifiers, and relationships associated with maintaining service between an N_Port_ID and a destination N_Port_ID or Fabric. Explicit Nx_Port Logout may be requested by an Nx_Port to another Nx_Port (see 6.4.2). Explicit Fabric Logout may be requested by an Nx_Port to a Fabric (e.g., to remove a virtual N_Port_ID previously assigned by the Fabric) or by a Fabric to an Nx_Port (see 6.4.3). Implicit Logout may occur between an Nx_Port and the Fabric (see 6.4.4).

6.4.2 Explicit N_Port Logout

Logout is accomplished by transmitting a Logout (LOGO) Link Service request Sequence (see FC-FS-2) to a destination Nx_Port. The Logout procedure is complete when the responding Nx_Port transmits a LS_ACC Link Service reply Sequence.

To explicitly Logout, the initiating Nx_Port shall terminate other open Sequences that it initiated with the destination Nx_Port prior to performing Logout, otherwise, the state of other open Sequences is

unpredictable. If an Nx_Port receives a Logout request while another Sequence is open that was initiated from the requesting Nx_Port, it may reject the Logout request using an LS_RJT (Link Service Reject).

After an explicit Logout is performed with an Nx_Port, the default Login Service Parameters specified in table 150 and table 155 shall be functional if Login was explicit. After an explicit Logout is performed with an Nx_Port, the implicit Login Service Parameters shall be functional if Login was implicit.

6.4.3 Explicit Fabric Logout

Explicit Fabric Logout of an N_Port_ID shall be accomplished by transmitting a Logout (LOGO) Link Service request Sequence (see 4.2.8) from an Nx_Port to an Fx_Port (i.e., Well-known address FFFFFEh) or from an Fx_Port to an Nx_Port. The explicit Fabric Logout procedure shall be complete for the responding FC_Port when it transmits a LS_ACC Link Service reply Sequence. The explicit Fabric Logout procedure shall be complete for the requesting FC_Port when it receives a LS_ACC Link Service reply Sequence.

If an FC_Port that does not support explicit Fabric Logout receives a LOGO that requests explicit Fabric Logout, it shall reject the explicit Fabric Logout request using an LS_RJT with reason code "Command not supported" and reason code explanation "No additional explanation". If an FC_Port that sends a LOGO that requests explicit Fabric Logout receives in reply an LS_RJT with reason code "Command not supported" and reason code explanation "No additional explanation" the FC_Port that sent the LOGO shall implicitly log out the other FC_Port.

An Fx_Port that supports N_Port_ID virtualization shall support explicit Fabric Logout originated by an Nx_Port.

An Nx_Port that has requested or accepted explicit Fabric Logout of an N_Port_ID shall implicitly log out the N_Port_ID with all other N_Port_IDs with which the N_Port_ID was logged in, and shall not originate frames from the N_Port_ID until after it has subsequently been reassigned the N_Port_ID by the Fabric. An Fx_Port that has explicitly logged out an N_Port_ID shall neither originate nor route frames to the N_Port_ID until after it has completed a subsequent reassignment of the N_Port_ID.

6.4.4 Implicit Logout

If an Nx_Port receives or transmits an NOS or OLS, it shall be implicitly logged out from the Fabric, if present, or attached Nx_Port in a point-to-point topology. Communication with other Nx_Ports shall not be accepted until the Fabric Login procedure is complete (implicit or explicit).

During Login with the Fabric, if the Nx_Port detects that the N_Port_ID, F_Port_Name and/or the Fabric_Name has changed since the last Fabric Login, and the Clean Address bit is zero, the Nx_Port shall implicitly logout with all Nx_Ports and wait an R_A_TOV timeout period before initiating or accepting communication with other Nx_Ports. The timeout period shall start when the Nx_Port detects the change. After waiting the timeout period, new N_Port Logins are required before the Nx_Port may communicate with other Nx_Ports.

During Login with the Fabric, if the Nx_Port detects that the N_Port_ID, F_Port_Name and/or the Fabric_Name has changed since the last Fabric Login, and the Clean Address bit is set to one, the

Nx_Port shall implicitly logout with all Nx_Ports before initiating or accepting communication with other Nx_Ports.

NOTE 11 – If an Nx_Port receives OLS from the Fabric, the Fabric may be indicating configuration changes internal to the Fabric using the Online to Offline Protocol.

NOTE 12 – If an Nx_Port is concerned that a partial Fabric Login may be in process using its link immediately preceding its attempted Fabric Login, it may wait an R_A_TOV in order to ensure that the response it receives from the Fx_Port during Fabric Login is associated with its Login request.

6.4.5 The effects of FLOGI, FDISC, and LOGO

The effects of FLOGI, FDISC, and LOGO on pre-existing Fabric Logins is summarized in table 148.

Table 148 – Effects of FLOGI, FDISC, & LOGO on Permanent Port Name (PPN)

ELS Received (with D_ID FFFFFEh)	Condition of F_Port		
	Condition 1: FLOGI not completed, or all IDs logged out	**Condition 2: FLOGI Completed, & at least one ID logged in**	**Condition 3: FDISC(s) completed, & at least one ID logged in**
FLOGI S_ID=0[d]	- LS_ACC, assign first N_Port ID. - Set PPN of new N_Port ID to Port_Name in FLOGI request.	- Set BB_Credit to zero - Implicit logout of all logged-in N_Port IDs - Disassociate the logged-out N_Port IDs with PPN - Re-assign one N_Port ID - Set PPN of new N_Port ID to Port_Name in FLOGI request.	- See Condition 2 (previous column).
FLOGI S_ID not = 0[d]	- Confirm or reject S_ID (see 6.2.2.3), "Response to Explicit Fabric Login." - If confirmed, set PPN of FLOGI S_ID (i.e. new N_Port ID) to Port_Name in FLOGI request	- Set BB_Credit to zero - Implicit logout of all logged-in N_Port IDs - Disassociate logged-out N_Port IDs with PPN - Confirm or reject S_ID (see 6.2.2.3), "Response to Explicit Fabric Login." - If N_Port_ID logged-in, set PPN of N_Port ID to Port_Name in FLOGI request	- See Condition 2 (previous column).

[a] If another N_Port ID is currently logged in with the same Port Name as contained in the FDISC request payload, or if the Port Name is the same as the Permanent Port Name associated with another N_Port, then the response should be LS_RJT (Logical error, invalid port name).

[b] When an FDISC with S_ID=0 is received when no more N_Port_IDs are available, the F_Port shall respond with an LS_RJT with an LS_RJT Reason Code of Unable to perform command request and an LS_RJT Reason Code Explanation of insufficient resources.

[c] Any assigned N_Port ID may be individually logged out and disassociated with the Permanent Port Name, including the FLOGI-assigned N_Port ID; Name Server attributes for the N_Port ID are cleared. Other logged-in N_Port IDs continue to be associated with their current Permanent Port Names. See FC-GS-5 for a definition of Permanent Port name.

[d] Whenever a new N_Port ID is assigned by either FLOGI or FDISC, or logged out, the nameserver database is updated and the applicable RSCNs are sent.

Table 148 – Effects of FLOGI, FDISC, & LOGO on Permanent Port Name (PPN)

ELS Received (with D_ID FFFFFEh)	Condition of F_Port		
	Condition 1: FLOGI not completed, or all IDs logged out	**Condition 2: FLOGI Completed, & at least one ID logged in**	**Condition 3: FDISC(s) completed, & at least one ID logged in**
FDISC S_ID=0[d]	- F_RJT (RC=login required) for Class 1, or Class 2. - Discard for Class 3.	- If N_Port ID virtualization supported, LS_ACC (D_ID = assigned N_Port ID), and set PPN of new N_Port ID to Port_Name in FLOGI request.[a, b] - If N_Port ID virtualization not supported, LS_RJT (RC=command not supported, RCE=Request not supported.)	- LS_ACC (D_ID = assigned N_Port ID), and set PPN of new N_Port ID to Port_Name in FLOGI request.[a, b]
FDISC S_ID not = 0	- F_RJT (RC=login required) for Class 1, or Class 2. - Discard for Class 3.	- If S_ID logged-in, LS_ACC - if S_ID not logged-in: F_RJT (RC=login required) for Classes 1,2, or 4. - Discard for Class 3.	- See Condition 2 (previous column).
OLS/NOS	- Perform Primitive Sequence Protocols (see FC-FS-2).	- Implicit logout of all logged-in N_Port IDs; Perform Primitive Sequence Protocols (see FC-FS-2). - Dissasociate the logged-out N_Port IDs with PPN.	- See Condition 2 (previous column).
LOGO[d]	- LS_ACC, no action	- If S_ID logged-in, log out the individual S_ID only, and disassociate only the logged-out N_Port ID with the PPN.[c] - if S_ID not logged-in, LS_ACC no action.	- See Condition 2 (previous column).

[a] If another N_Port ID is currently logged in with the same Port Name as contained in the FDISC request payload, or if the Port Name is the same as the Permanent Port Name associated with another N_Port, then the response should be LS_RJT (Logical error, invalid port name).

[b] When an FDISC with S_ID=0 is received when no more N_Port_IDs are available, the F_Port shall respond with an LS_RJT with an LS_RJT Reason Code of Unable to perform command request and an LS_RJT Reason Code Explanation of insufficient resources.

[c] Any assigned N_Port ID may be individually logged out and disassociated with the Permanent Port Name, including the FLOGI-assigned N_Port ID; Name Server attributes for the N_Port ID are cleared. Other logged-in N_Port IDs continue to be associated with their current Permanent Port Names. See FC-GS-5 for a definition of Permanent Port name.

[d] Whenever a new N_Port ID is assigned by either FLOGI or FDISC, or logged out, the nameserver database is updated and the applicable RSCNs are sent.

6.5 Extended Login Processing

Support for an Extended Login request is specified by the Payload Bit (see 6.6.2.4.19) set to one in a PLOGI or FLOGI request and the associated LS_ACC. An Extended Login request provides the following information:

a) Services Availability (see 6.6.7);

b) Login Extension Data (see 6.6.8); and

c) Clock Synchronization QoS (see 6.6.9).

If a Login of 256 bytes or more is required when the buffer conditions of the destination port are unknown, a timeout may be avoided with the following procedure:

1) issue a Login request with the Payload Bit (see 6.6.2.4.19) set to zero;

2) if the Query Buffer Conditions bit (see 6.6.2.4.14) is set to one in the LS_ACC, issue an RPBC ELS (see 4.2.37); and

3) if both the ELS Receive Data Field Size field in the RPBC LS_ACC Payload and the Buffer-to-buffer Receive Data_Field Size field in the Login LS_ACC Payload are at least 256 bytes, issue a Login request with the Payload Bit set to one.

6.6 Service Parameters

6.6.1 ELS and LS_ACC Payload

Table 149 defines the Payload format for the FLOGI and PLOGI ELSs and the LS_ACCs. The definitions of the parameters are applicable to PLOGI, FLOGI, PLOGI LS_ACC and FLOGI LS_ACC unless stated otherwise.

There are no separate Class 6 login Service Parameters as Class 1 service parameters are used instead.

NOTE 13 – The Link Service may further limit values supplied during Login as specified by individual Upper Level Protocols.

Table 149 – FLOGI, PLOGI or LS_ACC Payload

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	ELS_Command code			
1	MSB	Common Service Parameters (16 bytes)		
..				
4				LSB
5	MSB	Port_Name		
6				LSB
7	MSB	Node_ or Fabric_Name		
8				LSB
9	MSB	Class 1 and Class 6 Service Parameters (16 bytes)		
..				
12				LSB
13	MSB	Class 2 Service Parameters (16 bytes)		
..				
16				LSB
17	MSB	Class 3 Service Parameters (16 bytes)		
..				
20				LSB
21	Obsolete			
..				
24				
25	MSB	Vendor Version Level (16 bytes)		
..				
28				LSB
29	MSB	Services Availability[a] (8 bytes)		
30				LSB
31	Login Extension Data Length[a]			
32	Reserved			
..				
61				
62	Clock Synchronization QoS[a] (8 bytes)			
63				
64 to n	Login Extension Data (if any)			

[a] These fields are only present when the Payload Bit (see 6.6.2.4.19) is set to one. When the Payload bit is set to zero, these fields are not present in the Payload (i.e., the Payload is 116 bytes long).

6.6.2 Common Service Parameters

6.6.2.1 Applicability

Table 150 defines the applicability, by class as well as by PLOGI, FLOGI, PLOGI LS_ACC and FLOGI LS_ACC, of the Common Service Parameters to N_Port and Fabric Login. The Default Login Value column (see table 150) refers to the Login values to be used prior to a sucessful Login. These are words 1-4 in the Payload (see table 150).

Table 150 – Common Service Parameter applicability

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
FC-PH Version - obsolete	0	31-16	2020h	n	n	n	n	n	n	n	n	n
Buffer-to-buffer Credit	0	15-0	0 or 1[d]	y	y	y	y	y	y	y	y	y
Common Features	1	31-16										
Continuously increasing relative offset	1	31	0	y	y	y	n	n	n	n	n	n
Clean Address	1	31	0	n	n	n	n	n	n	y	y	y
Multiple N_Port_ID Support	1	31	0	n	n	n	y	y	y	n	n	n
Random relative offset	1	30	0	y	y	y	n	n	n	n	n	n
Virtual Fabrics bit	1	30	0	n	n	n	y	y	y	y	y	y
Valid Vendor Version Level	1	29	0	y	y	y	y	y	y	n	n	n
Multiple N_Port_ID Assignment	1	29	0	n	n	n	n	n	n	y	y	y

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

[b] E_D_TOV resolution and the corresponding value are only meaningful in a point-to-point topology or when doing PLOGI with an NL_Port on the same loop.

[c] The Common Service Parameter applicability is specified in FC-SP.

[d] Default buffer-to-buffer credit = 1 for all ports but an L_Port, and Buffer-to-buffer credit=0 for an L_Port.

[e] N_Port/F_Port=0 for an N_Port, and N_Port/F_Port=1 for an F_Port.

[f] BB_Credit Management=0 for an N_Port or F_Port, BB_Credit_Management=1 for an L_Port

Table 150 – Common Service Parameter applicability(Continued)

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
N_Port/F_Port	1	28	0 or 1[e]	y	y	y	y	y	y	y	y	y
BB_Credit Management	1	27	0 or 1[f]	y	y	y	y	y	y	n	n	n
E_D_TOV Resolution	1	26	0	y[b]	y[b]	y[b]	n	n	n	y	y	y
Multicast supported by Fabric	1	25	0	n	n	n	n	n	n	y	y	y
Broadcast supported by Fabric	1	24	0	n	n	n	n	n	n	y	y	y
Hunt Group routing supported by Fabric	1	23	0	n	n	n	n	n	n	y	y	y
Query Data Buffer conditions	1	22	0	y	y	y	y	y	y	y	y	y
Security bit (see FC-SP)	1	21	0	-[c]	-[c]	-[c]	-[c]	-[c]	-[c]	-[c]	-[c]	-[c]
Clock Synchronization Primitive Capable	1	20	0	y	y	y	y	y	y	y	y	y
R_T_TOV Value	1	19	0	y	y	y	y	y	y	y	y	y
Dynamic Half Duplex Supported	1	18	0	y	y	y	y	y	y	y	y	y
SEQ_CNT	1	17	0	y	y	y	n	n	n	n	n	n
Payload Bit	1	16	0	y	y	y	y	y	y	y	y	y

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

[b] E_D_TOV resolution and the corresponding value are only meaningful in a point-to-point topology or when doing PLOGI with an NL_Port on the same loop.

[c] The Common Service Parameter applicability is specified in FC-SP.

[d] Default buffer-to-buffer credit = 1 for all ports but an L_Port, and Buffer-to-buffer credit=0 for an L_Port.

[e] N_Port/F_Port=0 for an N_Port, and N_Port/F_Port=1 for an F_Port.

[f] BB_Credit Management=0 for an N_Port or F_Port, BB_Credit_Management=1 for an L_Port

Table 150 – Common Service Parameter applicability(Continued)

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
BB_SC_N	1	15-12	0	y	y	y	y	y	y	y	y	y
Buffer-to-Buffer Receive Data Field Size	1	11-0	128	y	y	y	y	y	y	y	y	y
Nx_Port Total Concurrent Sequences	2	31-16	1	y	y	y	n	n	n	n	n	n
Relative offset by Info Category	2	15-0	0	y	y	y	n	n	n	n	n	n
R_A_TOV	2	31-0	10 000	n	n	n	n	n	n	y	y	y
E_D_TOV Value	3	31-0	2 000	y[b]	y[b]	y[b]	n	n	n	y	y	y

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

[b] E_D_TOV resolution and the corresponding value are only meaningful in a point-to-point topology or when doing PLOGI with an NL_Port on the same loop.

[c] The Common Service Parameter applicability is specified in FC-SP.

[d] Default buffer-to-buffer credit = 1 for all ports but an L_Port, and Buffer-to-buffer credit=0 for an L_Port.

[e] N_Port/F_Port=0 for an N_Port, and N_Port/F_Port=1 for an F_Port.

[f] BB_Credit Management=0 for an N_Port or F_Port, BB_Credit_Management=1 for an L_Port

6.6.2.2 Payload

The Common Service Parameters Payload for FLOGI is shown in table 151.

Table 151 – Common Service Parameters - FLOGI

Bits Word	31 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 00
0	FC-PH Version - obsolete		Buffer-to-buffer Credit		
1	Common Features (see table 150)		BB_SC_N	Buffer-to-buffer Receive Data Field size	
2	Reserved		Reserved		
3	Reserved		Reserved		

The Common Service Parameters Payload for PLOGI and PLOGI LS_ACC is shown in table 152.

Table 152 – Common Service Parameters - PLOGI and PLOGI LS_ACC

Bits Word	31 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 00
0	FC-PH Version - obsolete		Buffer-to-buffer Credit		
1	Common Features (see table 150)		BB_SC_N	Buffer-to-buffer Receive Data Field size	
2	Reserved	Total Concurrent Sequences	Relative offset by Information Category		
3	E_D_TOV				

The Common Service Parameters Payload for FLOGI LS_ACC is shown in table 153.

Table 153 – Common Service Parameters - FLOGI LS_ACC

Bits Word	31 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 00
0	FC-PH Version - obsolete		Buffer-to-buffer Credit (Fx_Port)		
1	Common Features (see table 150)		BB_SC_N	Buffer-to-buffer Receive Data Field size	
2	R_A_TOV				
3	E_D_TOV				

6.6.2.3 Buffer-to-buffer Credit

The buffer-to-buffer Credit field (word 0, bits 15-0) defines the number of buffers available for holding Class 1 and Class 6 connect-request, Class 2, or Class 3 frames received. An FC_Port tracks Buffer-to-buffer Credit as a single entity for all frames subject to buffer-to-buffer flow control (see FC-FS-2). Values in the Buffer-to-buffer Credit field are 1 to 32767. The value 0 is reserved.

For N_Port Login, this field shall only be meaningful for an Nx_Port in a point-to-point topology and between two NL_Ports on the same loop.

6.6.2.4 Common Features

6.6.2.4.1 Continuously increasing relative offset

0 = not supported
1 = supported

If the continuously increasing relative offset bit (word 1, bit 31) is set to one, the Nx_Port supplying this parameter shall be capable of supporting continuously increasing relative offset, if present (F_CTL bit 3), within a Sequence on a frame by frame SEQ_CNT basis. This bit shall only be applicable to those Information Categories in which an Nx_Port supports relative offset (i.e., word 2, bits 15-0). See FC-FS-2 for the use of continuously increasing relative offset.

This bit shall be applicable to a Sequence Initiator in addition to a Sequence Recipient for all Classes of Service supported by the Nx_Port.

6.6.2.4.2 Clean Address

0 = No information
1 = Clean Address

The Clean Address bit (word 1, bit 31) provides an indication to an Nx_Port as to whether the address it was assigned by the Fabric had been previously used by another device within R_A_TOV. If this bit is set to zero, the assigned address may or may not have been used by a previous device within R_A_TOV. If this bit is set to one, the assigned address has not been used by any other device within R_A_TOV, or has been assigned to the current device for a previous FLOGI and not been changed within R_A_TOV. This bit is only meaningful in the FLOGI LS_ACC, it is not meaningful in the FLOGI request.

6.6.2.4.3 Multiple N_Port_ID Support

0 = not supported
1 = supported

The Multiple N_Port_ID Support bit (word 1, bit 31) shall be set to one to indicate that the N_Port supplying this parameter is capable of requesting multiple N_Port_IDs using the FDISC ELS. The N_Port_ID Support bit shall be set to zero to indicate that the N_Port supplying this parameter is not capable of requesting additional N_Port_IDs. This bit is only meaningful in the FLOGI request, it is not meaningful in the FLOGI LS_ACC.

6.6.2.4.4 Random relative offset

0 = not supported
1 = supported

The random relative offset bit (word 1, bit 30) indicates that the Nx_Port supplying this parameter shall be capable of supporting random relative offset values, if present (F_CTL bit 3). Random values may increase, decrease, or otherwise fluctuate within a Sequence. This bit shall only be applicable to those Information Categories in which an Nx_Port supports relative offset (i.e., word 3, bits 15-0). See FC-FS-2 for the use of random relative offset.

This bit shall be applicable to a Sequence Initiator in addition to a Sequence Recipient for all Classes of Service supported by the Nx_Port.

6.6.2.4.5 Virtual Fabrics bit

0 = not supported
1 = supported

The Virtual Fabrics bit (word 1, bit 30) indicates support for Virtual fabrics (see clause 8).

6.6.2.4.6 Valid Vendor Version Level

0 = not valid
1 = Valid

In PLOGI, PLOGI LS_ACC, and FLOGI, if the Valid Vendor Version Level bit (word 1, bit 29) is set to one, the Vendor Version Level (words 25 through 28 in table 149) contains valid information. If it is set to zero, the Vendor Version Level field is not meaningful.

6.6.2.4.7 Multiple N_Port_ID Assignment

0 = not supported
1 = supported

When the Multiple N_Port_ID Support bit (word 1, bit 31) in the FLOGI request is one, the Multiple N_Port_ID Assignment bit (word 1, bit 29) shall be set to one if the F_Port supplying this parameter is capable of assigning multiple N_Port IDs to the attached N_Port using the FDISC ELS. The Multiple N_Port_ID Assignment bit shall be set to zero when the Multiple N_Port_ID Support bit in the FLOGI request is zero or to indicate that the F_Port is not capable of assigning multiple N_Port IDs to the attached N_Port when the Multiple N_Port ID Support bit in the FLOGI request is one. This bit is only meaningful in the FLOGI LS_ACC, it is not meaningful in the FLOGI request.

NOTE 14 – The definition above has been modified from previous revisions of the standard.

6.6.2.4.8 N_Port/F_Port

0 = Nx_Port
1 = Fx_Port

An Nx_Port shall set tThe N_Port/F_Port bit (word 1, bit 28) to zero for PLOGI, PLOGI LS_ACC and FLOGI. If an Nx_Port is connected in a Fabric topology, the Fx_Port shall set the N_Port/F_Port bit to one in the FLOGI LS_ACC. If an Nx_Port is connected in a point-to-point topology, the N_Port shall set the N_Port/F_Port bit to zero in the FLOGI LS_ACC.

6.6.2.4.9 BB_Credit Management

0 = BB_Credit management specified in FC-FS-2 shall be used.
1 = Alternate BB_Credit management specified in FC-AL-2 shall be used.

The BB_Credit Management bit (word 1, bit 27) specifies the type of BB_Credit Management to be used.

6.6.2.4.10 E_D_TOV Resolution

0 = 1 millisecond
1 = 1 nanosecond

The E_D_TOV resolution bit (word 1, bit 26) indicates the resolution of the E_D_TOV timer. If the bit is set to zero, the timer shall be in increments of 1 millisecond. If the bit is set to one, the timer shall be in increments of 1 nanosecond. See FC-FS-2 for the definition of E_D_TOV.

6.6.2.4.11 Multicast

0 = Multicast not supported by the Fabric
1 = Multicast supported by the Fabric

The Multicast bit (word 1, bit 25) indicates whether multicast is supported by the Fabric or not. It is only meaningful in the FLOGI LS_ACC. For multicast requirements see FC-FS-2.

6.6.2.4.12 Broadcast

0 = Broadcast not supported by the Fabric
1 = Broadcast supported by the Fabric

The Broadcast bit (word 1, bit 24) indicates whether broadcast is supported by the Fabric or not. It is only meaningful in the FLOGI LS_ACC. For broadcast requirements see FC-FS-2.

6.6.2.4.13 Hunt Group

0 = Hunt Groups not supported.
1 = Hunt Groups supported.

The Hunt Group bit (word 1, bit 23) indicates whether or not the Fabric supports Hunt Group routing. If it is set to zero, the Fabric shall not support Hunt Group routing. If it is set to one, the Fabric shall support Hunt Group routing (see FC-FS-2).

6.6.2.4.14 Query Buffer Conditions

0 = No buffer conditions to report.
1 = Buffer conditions to report.

The Query Buffer Conditions bit (word 1, bit 22) indicates whether or not the FC_Port has unusual buffer conditions to report. A Report Port Buffer Conditions (RPBC) ELS may be issued to gather the buffer conditions. An FC_Port shall only set the Query Buffer Conditions to 1 if the FC_Port supports the RPBC ELS, and any of the following conditions are true:

a) The ELS Receive Data Field Size field is different that the Buffer-to-buffer Receive Data_Field Size field in the common service parameters, or

b) multi-frame ELSs are not supported.

6.6.2.4.15 Clock Synchronization Primitive Capable

0 = not Clock Synchronization Primitive Capable
1 = Clock Synchronization Primitive Capable

The Clock Synchronization Primitive Capable bit (word 1, bit 20) indicates support for the Primitive method of Clock Synchronization (see FC-FS-2). If the bit is set to zero, the Primitive method of Clock Synchronization is not supported. If the bit is set to one, the meaning is as defined in table 154.

Table 154 – Clock Synchronization Applicability

Type	Meaning if bit set to one
Clock Synchronization Server (N_Port Login only)	The Clock Synchronization Server is capable of generating clock synchronization Primitive Signals (see FC-FS-2).
Other FC_Ports (N_Port Login only)	The FC_Port is capable of receiving the clock synchronization Primitive Signals (see FC-FS-2) and acting upon them.
Fabric (FLOGI LS_ACC only)	The Fabric is capable of receiving the clock synchronization Primitive Signals (see FC-FS-2) and acting upon them.

6.6.2.4.16 R_T_TOV value

0 = Default value of 100 milliseconds.
1 = Short value of 100 microseconds.

The R_T_TOV value (word 1, bit 19) indicates support for the short value of R_T_TOV. If this bit is set to zero, the default value of 100 milliseconds is specified. If it is set to one, the value of 100 microseconds is specified.

6.6.2.4.17 Dynamic Half Duplex Supported

0 = DHD not supported
1 = DHD supported

The Dynamic Half Duplex Supported bit (word 1, bit 18) indicates support for Dynamic Half Duplex. If it is set to zero, Dynamic Half Duplex is not supported. If it is set to one, the FC_Port supports the reception of the DHD primitive.

NOTE 15 – DHD is applicable to FC-AL topologies. See FC-AL-2 for a description of DHD behavior.

6.6.2.4.18 SEQ_CNT

0 = Normal rules apply to SEQ_CNT
1 = Continuously Increasing SEQ_CNT shall be used.

SEQ_CNT (word 1, bit 17) indicates the requirement on SEQ_CNT. If the bit is set to zero, normal rules shall apply to SEQ_CNT usage. If the bit is set to one, the Nx_Port is guaranteeing that it shall transmit all frames within an Exchange using a continuously increasing SEQ_CNT. Each Exchange shall start with SEQ_CNT set to zero in the first frame, and every frame transmitted after that shall increment the previous SEQ_CNT by one, even across transfers of Sequence Initiative. Any frames received from the other Nx_Port in the Exchange shall have no effect on the transmitted SEQ_CNT (see FC-FS-2).

6.6.2.4.19 Payload Bit

0 = Payload length is 116 bytes
1 = Payload length in bytes is 256 plus four times the value of the Login Extension Length field

The Payload Bit (word 1 bit 16) indicates the length of the FLOGI or PLOGI Payload. If it is set to zero, the Payload length shall be 116 bytes. If it is set to one, the Payload length in bytes shall be 256 plus four times the value of the Login Extension Length field.

If Payload Bit is 0 in PLOGI or FLOGI, then LS_ACC sent in response shall have the Payload Bit set to 0.

6.6.2.5 BB_SC_N

The Buffer-to-buffer State Change Number (BB_SC_N) field (word 1, bits 15-12) specifies the Buffer-to-buffer State Change Number. It indicates that the sender of the PLOGI or FLOGI frame is requesting $2^{BB\_SC\_N}$ number of frames to be sent between two consecutive BB_SCs primitives, and $2^{BB\_SC\_N}$ number of R_RDY primitives to be sent between two consecutive BB_SCr primitives. See FC-FS-2 for a description of the BB_Credit recovery process.

6.6.2.6 Buffer-to-buffer Receive Data_Field size

The buffer-to-buffer Receive Data_Field Size field (word 1, bits 11-0) specifies the largest frame Data_Field Size that may be received by the Nx_Port supplying the Service Parameters as a Sequence Recipient for:

a) a connect-request (SOF_{c1}),

b) a Class 2 Data frame, or

c) a Class 3 Data frame

The value shall be a multiple of four bytes. Values less than 256 or greater than 2 112 are invalid. An Fx_Port shall support a Data Field size of at least 256 bytes.

6.6.2.7 Total Concurrent Sequences

Total Concurrent Sequences field (word 2, bits 23 - 16) specifies the total number of Concurrent Sequences for all classes that the Nx_Port is capable of supporting as a Recipient.

The Total Concurrent Sequences specified by an Nx_Port shall be less than or equal to the sum of the Concurrent Sequences supported on a Class by Class basis (e.g., an Nx_Port may specify that it is capable of supporting ten Concurrent Sequences in Class 2 and ten Concurrent Sequences in Class 3. However, the total number of Concurrent Sequences when both Class 2 and 3 are open may be fifteen).

6.6.2.8 Relative offset by category

The relative offset by category field (word 2, bits 15 - 0) shall indicate on a bit-position basis, whether or not relative offset shall be supported for the corresponding Information Category (e.g., if bit 14 = 1 and bit 2 = 1 and the others are set to zero, Information Category 1110b and 0010b frames shall be capable of using relative offset as a Sequence Recipient or a Sequence Initiator). See FC-FS-2 for definition of the Information Category field.

6.6.2.9 R_A_TOV

The R_A_TOV value shall be specified as a count of 1 ms increments. Therefore, a value of 0000000Ah specifies a time period of 10 milliseconds.

6.6.2.10 E_D_TOV

When the E_D_TOV Resolution bit (word 1, bit 26) is set to zero, the E_D_TOV value shall be specified as a count of 1 millisecond increments. When the E_D_TOV Resolution bit is set to one, the E_D_TOV value shall be specified as a count of 1 nanosecond increments (e.g., based on the setting of the E_D_TOV Resolution bit, a value of 0000000Ah specifies a time period of either 10 milliseconds or 10 nanoseconds).

For PLOGI, the E_D_TOV value in the LS_ACC to the PLOGI shall be greater than or equal to the value in the PLOGI. The E_D_TOV value in the LS_ACC shall be the value used by each Nx_Port. See FC-FS-2 for definition of E_D_TOV.

6.6.3 Port_Name

The Port_Name is an eight-byte field (words 5-6) that identifies an FC_Port. Each FC_Port shall provide a Name_Identifier that is unique within the Fibre Channel interaction space of the FC_Port. Bits 63-60 specify the format of the Name_Identifier. The formats are defined in FC-FS-2.

6.6.4 Node_ or Fabric_Name

Node_Name is applicable to PLOGI, PLOGI LS_ACC and FLOGI. Fabric_Name is applicable to FLOGI LS_ACC.

The Node_Name or Fabric_Name is an eight-byte field (words 7-8) that labels a Node or Fabric for identification purposes, such as diagnostics., The Node_Name and Fabric_Name are independent of and unrelated to network addressing. Each Node_Name or Fabric_Name shall be unique within the Fibre Channel interaction space . Bits 63-60 specify the format of the name. The formats are defined in FC-FS-2.

6.6.5 Class Service Parameters

6.6.5.1 Applicability

Table 155 defines the applicability, by class as well as by PLOGI, FLOGI, PLOGI LS_ACC and FLOGI LS_ACC, of the Class Service Parameters to N_Port and Fabric Login. The Class 1 and Class 6 Service Parameters are given in words 9 - 12. The Class 2 Service Parameters are given in words 13 - 16. The Class 3 Service Parameters are given in words 17 - 20. The words given in the second column and in the following subclauses are relative to the start of the specific class service parameters field (see table 155). The Default Login Value column (see table 155) refers to the Login values to be used prior to a sucessful Login.

Table 155 – Class Service Parameters Applicability

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
Class Validity	0	31	0	y	y	y	y	y	y	y	y	y
Service Options	0	30-16										
Intermix Mode	0	30	0	y	n	n	y	n	n	y	n	n
Stacked Connect-Requests	0	29-28	0	n	n	n	n	n	n	y	n	n
Sequential delivery	0	27	0	n	n	n	n	y	y	n	y	y
Simplex dedicated connection - obsolete	0	26	0	n	n	n	n	n	n	n	n	n
Camp-On - obsolete	0	25	0	n	n	n	n	n	n	n	n	n
Buffered Class 1 - obsolete	0	24	0	n	n	n	n	n	n	n	n	n

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

Table 155 – Class Service Parameters Applicability (Continued)

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
Priority/Preemption	0	23	0	y	y	y	y	y	y	y	y	y
Preference	0	22	0	n	y	y	n	y	y	n	y	y
DiffServ QoS	0	21	0	n	y	y	n	y	y	n	y	y
Reserved	0	20-16	0	n	n	n	n	n	n	n	n	n
Initiator Control	0	15-0										
X_ID Reassignment - obsolete	0	15-14	0	n	n	n	n	n	n	n	n	n
Initial Responder Process_Associator	0	13-12	0	y	y	y	n	n	n	n	n	n
ACK_0 capable	0	11	0	y	y	n	n	n	n	n	n	n
ACK_N Capable - obsolete	0	10	0	n	n	n	n	n	n	n	n	n
ACK generation assistance	0	9	0	y	y	n	n	n	n	n	n	n
Data compression capable - obsolete	0	8	0	n	n	n	n	n	n	n	n	n
Data compression history buffer size - obsolete	0	7-6	0	n	n	n	n	n	n	n	n	n
Data Encryption Capable - obsolete	0	5	0	n	n	n	n	n	n	n	n	n
Clock Synchronization ELS capable	0	4	0	y	y	y	y	y	y	y	y	y
Reserved	0	3-0	0	n	n	n	n	n	n	n	n	n
Recipient Control	1	31-16										
ACK_0 Capable	1	31	0	y	y	n	n	n	n	n	n	n
ACK_N Capable - obsolete	1	30	0	n	n	n	n	n	n	n	n	n
X_ID interlock	1	29	1	y	y	n	n	n	n	n	n	n
Error policy support	1	28-27	0	y	y	y	n	n	n	n	n	n
Reserved	1	26	0	n	n	n	n	n	n	n	n	n

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

Table 155 – Class Service Parameters Applicability (Continued)

Service Parameter	Word	Bits	Default Login Value	PLOGI and PLOGI LS_ACC Parameter applicability			FLOGI Parameter applicability			FLOGI LS_ACC Parameter applicability		
				Class			Class			Class		
				1[a]	2	3	1[a]	2	3	1[a]	2	3
Categories per Sequence	1	25-24	1	y	y	y	n	n	n	n	n	n
Data compression capable - obsolete	1	23	0	n	n	n	n	n	n	n	n	n
Data compression history buffer size - obsolete	1	22-21	0	n	n	n	n	n	n	n	n	n
Data decryption capable – obsolete	1	20	0	n	n	n	n	n	n	n	n	n
Clock Synchronization ELS capable	1	19	0	y	y	y	y	y	y	y	y	y
Reserved	1	18-16	0	n	n	n	n	n	n	n	n	n
Reserved	1	15-12	0	n	n	n	n	n	n	n	n	n
Receive Data Field Size	1	11-0	128	y	y	y	n	n	n	n	n	n
Reserved	2	31-24	0	n	n	n	n	n	n	n	n	n
Concurrent Sequences	2	23-16	1	y	y	y	n	n	n	n	n	n
Nx_Port end-to-end Credit	2	15-0	1	y	y	n	n	n	n	n	n	n
Reserved	3	31-24	0	n	n	n	n	n	n	n	n	n
Open Sequences per Exchange	3	23-16	1	y	y	y	n	n	n	n	n	n
Reserved	3	15-0	0	n	n	n	n	n	n	n	n	n
CR_TOV	3	31-0	0	n	n	n	n	n	n	y	n	n

Legend:
"y" indicates yes, applicable (i.e., has meaning);
"n" indicates no, not applicable (i.e., has no meaning)

[a] The Class 1 Service Parameters shall be used for Class 6. Each has the same applicability as Class 1.

6.6.5.2 Payload

The Payload Class Service Parameters using FLOGI is shown in table 156.

Table 156 – Class Service Parameters - FLOGI

Bits Word	31 .. 24	23 .. 16	15 .. 12	11 .. 08	07 .. 00
0	Service Options		Initiator Control		
1	Recipient Control		Reserved		
2	Reserved	Total Concurrent Sequences	Nx_Port End-to-end Credit		
3	Reserved	Open Sequences per Exchange	Reserved		

The Payload Service Parameters using PLOGI and PLOGI LS_ACC is shown in table 157.

Table 157 – Class Service Parameters - PLOGI and PLOGI LS_ACC

Bits Word	31 .. 24	23 .. 16	15 .. 00	
0	Service Options		Initiator Control	
1	Recipient Control		Reserved	Receive Data Field Size
2	Reserved	Total Concurrent Sequences	Nx_Port End-to-end Credit	
3	Reserved	Open Sequences per Exchange	Reserved	

The Payload Parameters using FLOGI LS_ACC is shown in table 158.

Table 158 – Class Service Parameters - FLOGI LS_ACC

Bits Word	31 .. 16	15 .. 00
0	Service Options	Reserved
1	Recipient Control	Reserved
2	Reserved	Reserved
3	CR_TOV	

6.6.5.3 Class validity

0 = Invalid - Class not supported
1 = Valid - Class supported

The Class validity bit (word 0, bit 31) shall indicate whether this Class is supported or not. If the Class validity bit is set to zero, this set of sixteen bytes shall be ignored. If the Class validity bit is one, this Class shall be supported.

The Class 1 and Class 6 Service Parameters are given in words 9 - 12. The Class 2 Service Parameters are given in words 13 - 16. The Class 3 Service Parameters are given in words 17 - 20.

There is no separate set of class service parameters for Class 6. The Class 1 service parameters are used for Class 6.

6.6.5.4 Service options

6.6.5.4.1 Introduction

The service options shall specify optional features of a class of service supported by the port supplying the service parameters.

6.6.5.4.2 Intermix Mode

0 = Intermix not requested
1 = Intermix requested

The Intermix Mode bit (word 0, bit 30) only has meaning in Class 1 and 6. It has no meaning in Class 2, and Class 3.

All N_Ports and Fabrics supporting Class 1 shall support exclusive connections. An N_Port supporting exclusive connections may only transmit and receive frames from the N_Port to which an existing Class 1 Connection is pending or established. Exclusive connections require that the Fabric transmit an F_BSY frame, as appropriate, in response to Class 2 frames and connect-request Data frames (SOFc1) issued by a third N_Port targeted for one of the two N_Ports engaged in a Class 1 Connection.

An Intermixed dedicated connection specifies that the Fabric may insert or extract Class 2 or Class 3 frames while a Class 1 Connection is established. Support for Intermix is optional by both N_Ports and Fabrics. When an N_Port performs Login with a Fabric, it shall request support for Intermix by setting the Intermix Mode bit to one. If the Fabric responds with bit 30 set to one in the LS_ACC, Intermix shall be functional.

For Fabric Login, table 159 specifies the meaning of the combination of the Intermix Mode bit for the requesting N_Port and the applicable F_Port.

Table 159 – Intermix Mode Support

Nx_Port	Fx_Port	Meaning
0	0	Neither supports
0	1	Fabric is capable of supporting, Intermix not functional
1	0	Nx_Port support requested, Fabric does not support
1	1	Nx_Port requested, Fabric is capable of supporting, Intermix is functional

For N_Port Login, this bit indicates that Intermix is functional between the N_Port setting this bit and the port to which it is attached. In a point-to-point topology if both N_Ports indicate Intermix support, then Intermix is functional. Otherwise, Class 1 dedicated connections shall be removed before transmission of Class 2 or Class 3 frames.

See FC-FS-2 for Intermix requirements.

6.6.5.4.3 Stacked Connect-requests

The Stack Connect-request bits (word 0, bits 29 - 28) are used in the Fabric Login procedure. They are only meaningful for Class 1 in the FLOGI LS_ACC. They are not meaningful for other classes and other Class 1 login frames. Table 160 specifies the meaning of the combination of word 0 bits 29 and 28.

Table 160 – Stacked Connect-request support Login Bits

Word 0, bits 29 - 28	Meaning
00b	Stacked Connect-request not supported
01b	Lock-Down Mode
10b	Transparent Mode
11b	Reserved

Support for stacked connect-requests is optional in both a Fabric and Nx_Port. Both an Nx_Port's and Fx_Port's behavior change if stacked connect-requests are functional (see FC-FS-2).

6.6.5.4.4 Sequential delivery

0 = Out of order delivery allowed
1 = Sequential delivery requested

The Sequential delivery bit (word 0, bit 27) is only meaningful for the class 2 and 3 N_Port Class Service Parameters in Fabric Login. Out of order frame delivery in class 2 and 3 is the default function by a Fabric. It is not meaningful for Class 1, or Class 6 or for N_Port Login.

If this bit is set to one by an Nx_Port, it is requesting that all frames delivered to the Nx_Port requesting this function be delivered in the same order in which the frames were transmitted by the source Nx_Port. If this bit is set to one by the Fx_Port in the LS_ACC, the Fx_Port shall deliver Class 2 and 3 frames in the same order as transmitted from any one Nx_Port in the absence of Fabric events (e.g., Fabric reconfiguration or zoning changes).

A Fabric supporting the sequential delivery feature routes Class 2 and 3 frames via a fixed route through the Fabric to provide in-order frame delivery. This feature does not imply any other alteration to the normal class of service functions (e.g., F_BSY responses are still possible in Class 2 and Class 3 frames may still be discarded by the Fabric based on normal Class 2 and 3 rules).

If this bit is set to one, the Fabric attempts to maintain the order of delivery of both Data and Link_Control (Class 2 only) frames to the Nx_Port requesting this feature in the same order in which the frames were transmitted. Table 161 specifies the meaning of the combination of the Sequential delivery bit for the requesting Nx_Port and the applicable Fx_Port.

Table 161 – Sequential delivery support

Nx_Port	Fx_Port	Meaning
0	0	Neither supports
0	1	Fabric is capable of supporting, Sequential delivery is functional
1	0	Nx_Port support requested, Fabric does not support
1	1	Nx_Port requested, Fabric is capable of supporting, Sequential delivery is functional

6.6.5.4.5 Priority/Preemption

0 = Priority/Preemption is not supported
1 = Priority/Preemption is supported

The Priority/Preemption bit (word 0, bit 23) has meaning in Class 1, 2, 3, and 6.

When an Nx_Port performs Login with a Fabric, it shall request support for Priority and Preemption by setting the Priority and Preemption bit (word 0, bit 23) to one. If is set to one in the LS_ACC, then both the Nx_Port and Fabric have agreed that Priority and Preemption are available for use.

The set of values specified in table 162 give the meaning of the combination of the Priority and Preemption bit.

Table 162 – Fabric Login Priority and Preemption Support

Nx_Port	Fx_Port	Meaning
0	0	Neither supports Priority and Preemption
0	1	Fabric is capable of supporting Priority and Preemption
1	0	Nx_Port support requested, Fabric does not support Priority and Preemption
1	1	Nx_Port requested, Fabric is capable of supporting Priority and Preemption, available for use

6.6.5.4.6 Preference

6.6.5.4.6.1 Nx_Port

0 = non-zero CS_CTL may be tolerated
1 = non-zero CS_CTL shall be tolerated

When an Nx_Port performs Login with another Nx_Port, it shall indicate tolerance for non-zero CS_CTL within the Class of Service by setting the Preference bit (word 0, bit 22) to one. The other Nx_Port indicates tolerance for non-zero CS_CTL by setting this bit to one in the LS_ACC. An Nx_Port that tolerates a non-zero CS_CTL shall not reject or otherwise deprecate a frame solely because the CS_CTL field is non-zero.

NOTE 16 – Even if an Nx_Port never intends to set the PREF bit to any value other than zero, the Nx_Port may still have reason to set the login Preference bit to one. Setting the bit to one indicates to the other Nx_Port that the Nx_Port shall accept frames with a non-zero CS_CTL field value.

In Class 2 and 3, if this bit is set to one, the Nx_Port shall tolerate the PREF field in the CS_CTL field of the Frame_Header. Tolerance for CS_CTL as a Sequence Initiator means that the PREF field may specify Preference to the Fabric. Tolerance for CS_CTL as a Sequence Recipient means that the Nx_Port shall ignore the PREF field (see FC-FS-2).

This Preference Bit has no meaning in Class 1, and Class 6.

6.6.5.4.6.2 Fx_Port

0 = Normal delivery
1 = Preferred delivery functional

If the Preference bit (word 0, bit 22) is set to one by an Nx_Port, then it is requested that all frames transmitted by the Nx_Port requesting this function be delivered according to the setting of the PREF field in the CS_CTL field of the Frame_Header. If this bit is set to one by the Fx_Port, the Fx_Port is indicating that it shall deliver Class 2 and 3 frames transmitted by the requesting Nx_Port according to the setting of the PREF field.

NOTE 17 – An Fx_Port that responds with bit 22 set to zero may not itself support Preferred delivery, but other Fabric Elements in the path to the destination may support it. An Nx_Port may attempt Preferred delivery even if the Fx_Port does not indicate support.

If this bit is set to one, the Fabric shall deliver both Data and Link_Control (class 2 only) frames according to the setting of the PREF field in the CS_CTL field of the frame header.

The Preference bit is not meaningful for Class 1, and Class 6.

Table 163 summarizes the function of the PREF bit for both Class 2 and Class 3.

Table 163 – Class 2 and 3 Preference Bit Function

Nx_Port Word 0, Bit 22	Fx_Port Word 0, Bit 22	Meaning
0	0	Preferred delivery by the Fabric may be functional
0	1	Preferred delivery by the Fabric shall be functional
1	0	Nx_Port support requested, Preferred delivery by the Fabric may be functional
1	1	Nx_Port requested, Fabric agrees, Preferred delivery by the Fabric shall be functional

Table 164 summarizes the relationship between Preferred delivery and sequential delivery for both Class 2 and Class 3.

Table 164 – Relationship between Preferred delivery and sequential delivery

Preference Functional	Sequential delivery Functional	Meaning
0	0	Frames may be delivered in any order
0	1	Frames shall be delivered to a destination in the same order received from the source, PREF is ignored
1	0	Frames may be delivered in any order, but frames with PREF set to one may be delivered prior to frames with PREF set to zero
1	1	Frames with PREF set to one shall be delivered to a destination in the same order received from the source relative to each other, and may be delivered prior to frames with PREF set to zero; frames with PREF set to zero shall also be delivered to a destination in the same order received from the source relative to each other

6.6.5.4.7 DiffServ QoS

6.6.5.4.7.1 N_Port Login

0 = DiffServ QoS not supported
1 = DiffServ QoS supported

When an Nx_Port performs Login with another Nx_Port, it shall indicate support for Differentiated Services QoS by setting the DiffServ QoS bit (word 0, bit 21) to one. The other Nx_Port indicates support for Differentiated Services QoS by setting this bit to one in the LS_ACC. Support of Differentiated Services QoS as an Exchange Originator means that the CS_CTL/Priority Enable bit (F_CTL bit 17) is set to zero to indicate that the DSCP field of the CS_CTL field in the frame header (word 1, bits 29-24) specifies the Differentiated Services QoS policy. Support of Differentiated Services QoS as an Exchange Responder means that the CS_CTL/Priority Enable bit (F_CTL bit 17) is set to zero, indicates that the DSCP field of the CS_CTL field in the frame header (word 1, bits 29-24) specifies the Differentiated Services QoS policy (see FC-FS-2).

The DiffServ QoS bit only has meaning for Classes 2 and 3.

6.6.5.4.8 F_Port Login

0 = DiffServ QoS not Supported
1 = DiffServ QoS Supported

When doing Fabric Login, an Nx_Port shall request support for Differentiated Services QoS by setting the DiffServ QoS bit (word 0, bit 21) to one. If the LS_ACC reply from the Fx_Port has this bit set to one, both the Nx_Port and Fx_Port have agreed that Differentiated Services QoS is available for use.

The set of values specified in table 165 give the meaning of the combination of Word 0, bit 21 between the requesting Nx_Port and the responding Fx_Port (see FC-FS-2).

The DiffServ QoS bit only has meaning for Classes 2 and 3.

Table 165 – DiffServ QoS bit definition

Nx_Port	Fx_Port	Description
0	0	Neither supports Differentiated Services QoS
0	1	Fx_Port is capable of supporting Differentiated Services QoS
1	0	Nx_Port support requested, Fx_Port does not support Differentiated Services QoS
1	1	Nx_Port requested, Fx_Port is capable of supporting Differentiated Services QoS, Differentiated Services QoS is available for use

6.6.5.5 Initiator control

6.6.5.5.1 Introduction

The Initiator Control Flags shall specify which protocols, policies or functions the Sequence Initiator function in the Nx_Port supplying the Service Parameters requests of the recipient or is capable of as a Sequence initiator.

6.6.5.5.2 Initial Process_Associator

The definition of the Initial Process_Associator bits (word 0, bits 13-12) is shown in table 166.

Table 166 – Initial Process_Associator Bits Definition

Word 0, bits 13-12	Meaning
00b	Initial Process_Associator not supported
01b	Initial Process_Associator supported
10b	Reserved
11b	Initial Process_Associator required (and supported)

Initial Process_Associator required indicates that the Nx_Port supplying this parameter requires an Association_Header at certain Sequence boundaries (see FC-FS-2) that contains a specific initial value in the Process_Associator field. An Nx_Port that supports Initial Process_Associator shall supply an Association_Header with an initial Responder Process_Associator value at certain Sequence boundaries, such as when it originates an Exchange. If an Initial Process_Associator is required or supported, then X_ID interlock also is required in Class 1 and 2.

If the Responder Nx_Port to the PLOGI request requires an Initial Process_Associator and the Originator of the PLOGI request does not support an Initial Process_Associator, the Responder shall transmit an LS_RJT indicating the Initiator Control bits are in conflict. If the Responder Nx_Port to the PLOGI request does not support an Initial Process_Associator and the Originator of the PLOGI request has indicated that Initial Process_Associator is required, the Responder shall transmit an LS_RJT indicating the Initiator Control bits are in conflict. In either of these cases, the Nx_Ports are unable to communicate.

These bits only have meaning for PLOGI and PLOGI LS_ACC.

6.6.5.5.3 ACK_0 capability

0 = ACK_0 incapable
1 = ACK_0 capable

The ACK_0 capability bit (word 0, bit 11) specifies if the Nx_Port supplying these Class Service Parameters is capable of support for ACK_0 as a Sequence Initiator for acknowledgement of an entire Sequence in either Discard or Process Exchange Error Policies. As a Sequence Initiator an Nx_Port receives and processes ACK frames in response to Data frame transmission. ACK_0 support is applicable to acknowledged class of service Sequences (see FC-FC-2).

The conditions under which ACK_0 is supported are defined in table 167 and described in the following text.

Table 167 – ACK_0 Support Conditions (Initiator Control)

Nx_Port A Word 0, Bit 11	Nx_Port B Word 1, Bit 31	Nx_Port A as Sequence Initiator
0	0	ACK_0 not supported
0	1	ACK_0 not supported
1	0	ACK_0 not supported
1	1	ACK_0 supported

If one Nx_Port (e.g., Nx_Port A) is capable of receiving ACK_0 as a Sequence Initiator (word 0, bit 11 set to one) and the other Nx_Port (e.g., Nx_Port B) is capable of transmitting ACK_0 as a Sequence Recipient (word 1, bit 31 set to one), ACK_0 is supported when Nx_Port A is the Sequence Initiator and Nx_Port B is the Sequence Recipient. Otherwise, ACK_0 shall not be supported while Nx_Port A is the Sequence Initiator and Nx_Port B is the Sequence Recipient. ACK_0 usage shall take precedence over ACK_1.

ACK_0 capability may be asymmetrical for a single Nx_Port (i.e., an Nx_Port may be capable processing ACK_0 as a Sequence Initiator, but not be capable of ACK_0 transmission as a Sequence Recipient). Similarly, an Nx_Port may be capable of generating ACK_0 as a Sequence Recipient, but not be capable of ACK_0 reception as a Sequence Initiator.

6.6.5.5.4 ACK generation assistance

0 = No ACK generation assistance is provided to Sequence Recipient.
1 = ACK generation assistance is provided to Sequence Recipient.

Usage of the ACK generation assistance bit (word 0, bit 9) is specified in FC-FS-2.

6.6.5.5.5 Clock synchronization ELS capable

0 = Initiator does not have clock synchronization ELS capability
1 = Initiator has clock synchronization ELS capability

The Clock synchronization ELS capable bit (word 0, bit 4) is only meaningful from the Clock Synchronization Server well-known address (i.e., FFFFF6h). This bit indicates support for the ELS method of Clock Synchronization. If this bit is set to zero, the Nx_Port does not support the ELS method of Clock Synchronization. If this bit is set to one, the Nx_Port is capable of generating the CSU ELS frames. See FC-FS-2.

6.6.5.6 Recipient control

6.6.5.6.1 Introduction

The Recipient Control Flags shall specify which protocols, policies or functions are supported by the Recipient Initiator function in the Nx_Port supplying the Service Parameters when acting as a recipient of Data frames.

6.6.5.6.2 ACK_0 capability

0 = ACK_0 incapable
1 = ACK_0 capable

The ACK_0 capability bit (word 1, bit 31) specifies that the Nx_Port supplying these Class Service Parameters may or may not be capable of support for ACK_0 as a Sequence Recipient for acknowledgement of an entire Sequence in either Discard or Process Exchange Error Policies. As a Sequence Recipient an Nx_Port shall support infinite buffering and be capable of transmitting ACK_0 frames in response to Data frame transmission. ACK_0 support is applicable to acknowledged class of service Sequences (see FC-FS-2).

The conditions under which ACK_0 is supported are defined in table 168 and described in the following text.

Table 168 – ACK_0 Support Conditions (Recipient Control)

Nx_Port A Word 0, Bit 11	Nx_Port B Word 1, Bit 31	Nx_Port A as Sequence Recipient
0	0	ACK_0 not supported
0	1	ACK_0 not supported
1	0	ACK_0 not supported
1	1	ACK_0 supported

If one Nx_Port (e.g., Nx_Port A) is capable of receiving ACK_0 as a Sequence Initiator (Word 0, Bit 11 set to one) and the other Nx_Port (e.g., Nx_Port B) is capable of transmitting ACK_0 as a Sequence Recipient (Word 1, Bit 31 set to one), then ACK_0 may be used when Nx_Port A is the Sequence Initiator and Nx_Port B is the Sequence Recipient. Otherwise, ACK_0 shall not be supported while Nx_Port A is the Sequence Initiator and Nx_Port B is the Sequence Recipient.

ACK_0 capability may be asymmetrical for a single Nx_Port (i.e., an Nx_Port may be capable processing ACK_0 as a Sequence Initiator, but not be capable of ACK_0 transmission as a Sequence Recipient. Similarly, an Nx_Port may be capable of generating ACK_0 as a Sequence Recipient, but not be capable of ACK_0 reception as a Sequence Initiator). If an Nx_Port sets both Word 0, bit 11 and Word 1, bit 31 to one, then it is capable of ACK_0 support as either a Sequence Initiator or a Sequence Recipient.

6.6.5.6.3 X_ID interlock

0 = X_ID interlock not required
1 = X_ID interlock required

X_ID interlock (word 1, bit 29) only applies to Class 1 and Class 2. This bit indicates that the Nx_Port supplying this parameter requires that an interlock be used during X_ID assignment in Class 1 and 2. In X_ID assignment, the Sequence Initiator shall set the Recipient X_ID value to FFFFh in the first Data frame of a Sequence and the Recipient shall supply its X_ID in the ACK frame corresponding to the first Data frame of a Sequence. The Sequence Initiator shall not transmit additional frames until the corresponding ACK is received. Following reception of the ACK, the Sequence Initiator continues transmission of the Sequence using both assigned X_ID values (see FC-FS-2).

6.6.5.6.4 Error policy supported

The definition of the Error policy supported bits (word 1, bits 28-27) is shown in table 169.

Table 169 – Error Policy Bits Definition

Word 1, bits 28-27	Meaning
00b	Only discard policy supported
01b	Reserved
10b	Both discard and process policies supported
11b	Reserved

These bits are set to specify the types of support possible for missing frame conditions processed by the destination Nx_Port. The policy used for a given Exchange shall be specified as discard or process by the Exchange Originator (see FC-FS-2).

6.6.5.6.5 Categories per Sequence

The definition of the Categories per Sequence bits (word 1, bits 25-24) is shown in table 170.

Table 170 – Categories per Sequence Bits Definition

Word 1, bits 25-24	Meaning
00b	1 Category/Sequence
01b	2 Categories/Sequence
10b	Reserved
11b	More than 2 Categories/Sequence

The setting of these bits shall specify that the Recipient is capable of processing one, two, or more than two Information Categories (R_CTL bits 27-24 in the Frame_Header) in a single Sequence. Bits 25-24 are applicable to each Class of Service since support for an individual Class may offer different capabilities in the same Nx_Port.

When an Nx_Port is acting as a Sequence Initiator, it shall restrict the number of Information Categories per Sequence based on the Sequence Recipient's capability as specified during N_Port Login. An Nx_Port's capability for processing Information Categories in a single Sequence may prohibit that Nx_Port from communicating in certain FC-4 protocols.

Each FC-4 should allow the ability to communicate using only one Information Category per Sequence but always provide the ability to communicate using multiple Information Categories per Sequence where possible, and when performance may be enhanced.

6.6.5.6.6 Clock synchronization ELS capable

0 = Recipient does not have clock synchronization ELS capability
1 = Recipient has clock synchronization ELS capability

The Clock synchronization capable bit (word 1, bit 19) indicates support for the ELS method of Clock Synchronization. If this bit is set to zero, the Nx_Port or Fabric does not support the ELS method of Clock Synchronization. If this bit is set to one, the Nx_Port or Fabric is capable of receiving CSU ELS frames and acting upon them (see FC-FS-2).

6.6.5.7 Receive Data_Field Size

The Receive Data_Field Size is a value (word 1, bits 11-0) that specifies the largest Data_Field Size for a frame (see FC-FS-2) that may be received by the Nx_Port supplying the Service Parameters as a Sequence Recipient. Values less than 256 or greater than 2 112 are invalid. Values shall be a multiple of four bytes. An Nx_Port shall support a Data Field size of at least 256 bytes.

In Class 1 and 6 the Receive Data_Field size represents the largest Data_Field size that an Nx_Port is able to receive after a dedicated connection is established. The connect-request Data_Field size is specified in the Buffer-to-Buffer Receive Data_Field size in Common Service Parameters (see 6.6.2.6).

The Receive Data_Field size for Class 2, and Class 3 shall be equal to or less than the Buffer-to-Buffer Receive Data_Field size specified in the Common Service Parameters.

6.6.5.8 Concurrent Sequences

Concurrent Sequences (word 2, bits 23-16) shall specify the number of Sequence Status Blocks available in the Nx_Port supplying the Service Parameters for tracking the progress of a Sequence as a Sequence Recipient. The maximum number of Concurrent Sequences that may be specified is 255 per Nx_Port as a Recipient that may be allocated across all classes. The total number of Concurrent Recipient Sequences that may be open across all classes by a single Nx_Port is specified in the Common Service Parameter field (see 6.6.2.7). Allowable values for this field is 01h - FFh. The value 00 is reserved.

NOTE 18 – The maximum number of open Sequences between two Nx_Ports is the sum of the Concurrent Sequences fields reported in the PLOGI and LS_ACC of the PLOGI.

IN Class 1 and 6, the SEQ_ID values shall range from 0 to L, inclusively, where L is the value of the Concurrent Sequence field. During a Class 1 Connection an Nx_Port shall support the maximum number of Concurrent Sequences specified during Login.

In Class 2 and 3, the SEQ_ID values shall range from 0 to 255. In Class 2 an Nx_Port may respond with a P_BSY to a frame initiating a new Sequence if Nx_Port resources are not available.

6.6.5.9 end-to-end Credit

The Nx_Port End-to-end Credit field (word 2, bits 14-0) is the maximum number of Data frames that may be transmitted by an Nx_Port without receipt of an accompanying ACK or Link_Response frames. The minimum value of the Nx_Port End-to-end Credit field is one. The Nx_Port End-to-end Credit field specified is associated with the number of buffers available for holding the Data_Field of a frame and processing the contents of that Data_Field by the Nx_Port supplying the Service Parameters. The Nx_Port End-to-end Credit field is not applicable to Class 3 since ACK frames are not used.

In order to ensure frame identification integrity, the Nx_Port end-to-end Credit field is defined as a 15-bit field while SEQ_CNT is a 16-bit field. This ensures that end-to-end Credit never exceeds one-half of the maximum SEQ_CNT. Bit 15 shall be set to zero.

Valid values for the Nx_Port End-to-end Credit field are 1 to 32767. The value 0 is reserved.

6.6.5.10 Open Sequences per Exchange

The value of open Sequences per Exchange field (word 3, bits 23 - 16) shall specify the maximum number of Sequences that may be open at the Recipient at one time between a pair of Nx_Ports for one Exchange. The value of X+2 specifies the number of instances of Sequence Status that shall be maintained by the Recipient for a single Exchange in the Exchange Status Block. This value is used for Exchange and Sequence tracking. The value of X limits the link facility resources required for error detection and recovery. The value of X is specified in bits 23-16 (see FC-FS-2).

NOTE 19 – The number of SSBs specified at X+2 to be retained in the ESB ensures that if Sequence streaming rules are followed, the ESB shall contain at least one "good" Sequence that ended normally. Another SSB position was allocated in order to allow for any race or timing conditions that might impact that "good" Sequence.

The open Sequences per Exchange field is valid for PLOGI and PLOGI LS_ACC only.

6.6.5.11 CR_TOV

The CR_TOV value (word 3) shall be specified as a count of 1 ms increments (e.g., a value of 0000000Ah specifies a time period of 10 ms). See FC-FS-2 for CR_TOV usage. CR_TOV is applicable to Class 1 and 6. CR_TOV is not applicable to other Classes. CR_TOV is only meaningful in FLOGI LS_ACC.

6.6.6 Vendor Version Level

Vendor Version Level field (words 25-28) specifies vendor-specific information. If the Valid Version Level bit in the Common Service Parameters field (word 1, bit 29) is set to one, the Vendor Version Level field contains valid information. If the Valid Version Level bit is set to zero, the Vendor Version Level field is not meaningful.

6.6.7 Services Availability

6.6.7.1 Introduction

This field returns information regarding the Fabric's ability to route to the defined well-known addresses. It is meaningful only for FLOGI LS_ACC. Only bits 10 - 3 of word 30 are meaningful. Word 29 and bits 31 - 11 and 2 - 0 of word 30 are reserved (see FC-FS-2).

6.6.7.2 Multicast Server

When set to one, the Multicast Server bit (word 30, bit 10) shall indicate that the Fabric supports routing to the well-known Multicast Server address identifier (i.e., FFFFF5h). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Multicast Server address identifier. See FC-FS-2 for the specification of this server.

6.6.7.3 Clock Synchronization Server

When set to one, the Clock Synchronization Server bit (word 30, bit 9) shall indicate that the Fabric supports routing to the well-known Clock Synchronization Server address identifier (FFFFF6h). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Clock Synchronization Server address identifier. See FC-FS-2 for the specification of this server.

6.6.7.4 Security Key Distribution Server

When set to one, the Security Key Distribution Server bit (word 30, bit 8) shall indicate that the Fabric supports routing to the well-known Key Distribution Server address identifier (FFFFF7h). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Key Distribution Server address identifier.

6.6.7.5 Alias Server

When set to one, the Alias Server bit (word 30, bit 7) shall indicate that the Fabric supports routing to the well-known Alias Server address identifier (FFFFF8h). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Alias Server address identifier.

6.6.7.6 Management Server

When set to one, the Management Server bit (word 30, bit 5) shall indicate that the Fabric supports routing to the well-known Management Server address identifier (i.e., FFFFFAh). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Management Server address identifier. See FC-GS-5 for the specification of this server.

6.6.7.7 Time Server

When set to one, the Time Server bit (word 30, bit 4) shall indicate that the Fabric supports routing to the well-known Time Server address identifier (i.e., FFFFFBh). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Time Server address identifier.

6.6.7.8 Directory Server

When set to one, the Directory Server bit (word 30, bit 3) shall indicate that the Fabric supports routing to the well-known Directory Server address identifier (i.e., FFFFFCh). When set to zero, this bit shall indicate that the Fabric does not support routing to the well-known Directory Server address identifier. See FC-GS-5 for the specification of this server.

6.6.8 Login Extension

6.6.8.1 General

If a port does not support a Login request with the Payload Bit set to one, the port shall reject the Login request with an LS_RJT. The reason code shall be set to "Logical error" with a reason code explanation of "Invalid Payload length".

If a port does not support a Login request with a non-zero Login Extension Data Length field, the port shall reject the Login request with an LS_RJT. The reason code shall be set to "Logical error" with a reason code explanation of "Login Extension not supported".

If a port receives a Login request containing a page code that it does not support, the port shall reject the Login request with an LS_RJT. The reason code shall be set to "Logical error" with a reason code explanation of "Login Extension not supported".

If a port does not support a LS_ACC reply Sequence with the Payload Bit set to one, the port shall perform an explicit Logout with the port that sent the reply.

6.6.8.2 Login Extension Data Length

If the Login Extension Data Length field (word 31) is non-zero, a Login Extension follows the normal payload. The Login Extension Data Length field indicates the length of the Login Extension field in words. The Payload Bit (see 6.6.2.4.19) shall be set to one if this field is non-zero.

6.6.8.3 Login Extension format

The Login Extension field is a sequence of zero or more Login Extension Pages. The length in words of the sequence of Login Extension Pages shall be equal to the value of the Login Extension Length field. The format of a Login Extension Page is given in Table 171. Word 0 of the first Login Extension Page, if present, is word 64 of the FLOGI/PLOGI/ACC payload.

Table 171 – Login Extension Page format

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Page Length (n)		Reserved	Page Code
1	Page Code Specific Data			
...				
n - 1				

Page Length Field: The length in words of the following page, including the word containing the page length and page code fields.

Page Code Field: The Page Code field specifies the type of page as shown in table 172.

Table 172 – Page Code Definitions

Page Code	Meaning
00h - EFh	Reserved
F0h	Vendor Specific
F1h - FFh	Reserved

Vendor Specific Page: The format of the Vendor Specific Page is shown in table 173.

Table 173 – Vendor Specific Page format

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
0	Page Length (n)		Reserved	Page Code (F0h)
1	(MSB)	Vendor Identification Data		
2				(LSB)
3	Vendor Specific Data			
...				
n - 1				

Vendor Identification field: The value of the Vendor Identification field shall be a T10 Vendor ID. The format and interpretation of the Vendor Specific Data field is vendor specific to the vendor identified by the value of the Vendor Identification field.

Vendor Specific Data Field: The Vendor Specific Data field contains vendor specific data and shall be padded to a word boundary.

6.6.9 Clock Synchronization Quality of Service

6.6.9.1 N_Port Login

6.6.9.1.1 Applicability

The Clock Synchronization Quality of Service (QoS) field in PLOGI ELS or LS_ACC (words 62-63) is only meaningful when sent to or received from the Clock Synchronization Server (i.e., FFFFF6h). This field contains meaningful information only if either the Clock Synchronization Primitive Capable bit of the Common features field (word 1, bit 20) is set to one; or if the Clock Synchronization ELS capable bit of one of the N_Port Class Service Parameter Recipient control fields (word 1, bit 19) is set to one. If this field does not contain meaningful information, it shall be set to zero (see FC-FS-2).

The Clock Synchronization QoS field is defined in table 174.

Table 174 – N_Port Clock Synchronization QoS

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
62	CS_QoS_Request	CS_Accuracy	CS_Implemented_MSB	CS_Implemented_LSB
63	CS_Update_Period			

6.6.9.1.2 CS_QoS_Request

For PLOGI and FLOGI Request, the meaning is defined in table 175. This field is not meaningful for PLOGI LS_ACC and shall be set to zero.

Table 175 – FLOGI/PLOGI CS_QoS_Request

Word 62, Bits 31-24	Meaning
00h	The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields are not meaningful in the FLOGI/PLOGI Request.
01h	The CS_Accuracy, CS_Implemented_MSB, CS_Implemented_LSB, and CS_Update_Period fields contain the requested Quality of Service Parameters.
02h – FFh	Reserved

6.6.9.1.3 CS_Accuracy (Mantissa and Exponent)

This field contains the CS_Accuracy_Mantissa (word 62, bits 23-21) and CS_Accuracy_Exponent (bits word 62, 20-16).

When sent to the Fabric during FLOGI, these bits indicate the accuracy that the Fabric is requested to maintain in passing along to the clients the clock synchronization value it receives from the Clock Synchronization Server (FFFFF6h).

When sent to the Clock Synchronization Server (FFFFF6h), these bits indicate the requested accuracy of the clock synchronization value as it leaves the server port.

When received from the Clock Synchronization Server (i.e., FFFFF6h), these bits indicate the accuracy of the clock synchronization value as it leaves the server port. Specifically, the server shall supply a CS_Accuracy value such that the Clock Synchronization value is always within the range of:

$$T\_reference \pm (0.5 + CS\_Accuracy\_Mantissa * 2^{-4}) * 2^{(CS\_Accuracy\_Exponent-30)},$$

where

a) T_reference is the clock reference value internal to the server

b) CS_Accuracy_Mantissa is a value from 000b to 111b'

c) CS_Accuracy_Exponent is a value from 00000b to 11111b'

Example #1, if CS_Accuracy Mantissa and Exponent are set to 001b and 01011b, respectively, the Clock Synchronization value as it exits the server shall always be within the range of:

T_reference ± 1,073 µsec

Example #2, if CS_Accuracy Mantissa and Exponent are set to 111b and 11000b, respectively, the Clock Synchronization value as it exits the server shall always be within the range of:

T_reference ± 14,65 msec

6.6.9.1.4 Clock Synchronization Implemented MSB

The Clock Synchronization Implemented MSB field (word 62, bits 13 - 8) is a 6-bit value. Word 62, bits 15-14 are reserved and shall be set to zero.

When sent to the Clock Synchronization Server (i.e., FFFFF6h) during PLOGI, these bits indicate the requested most significant bit position within the 64-bit Clock Count field in the CSU ELS Payload.

When received from the Clock Synchronization Server (i.e., FFFFF6h) this field represents the most significant bit position within the 64-bit Clock Count field that contains meaningful information.

NOTE 20 – The value in the Clock Count field shall wrap around to zero when an overflow occurs from the Clock Synchronization Implemented MSB.

(e.g., a value of 110111b indicates that the MSB of byte 1 of the Clock Count field is the highest bit that contains meaningful information).

6.6.9.1.5 Clock Synchronization Implemented LSB

The Clock Synchronization Implemented LSB field (word 62, bits 13 - 8) field is a 6-bit value. Word 62, bits 7-6 are reserved and shall be set to zero.

When sent to the Clock Synchronization Server (i.e., FFFFF6h) during PLOGI, these bits indicate the requested least significant bit position within the 64-bit Clock Count field in the CSU ELS Payload.

When received from the Clock Synchronization Server (i.e., FFFFF6h), this field represents the least significant bit position within the 64-bit Clock Count field that contains meaningful information (e.g., a value of 001000b indicates that the LSB of byte 6 of the Clock Count field is the lowest bit that contains meaningful information).

6.6.9.1.6 Clock Synchronization Update Period

When sent to the Clock Synchronization Server (i.e., FFFFF6h), the Clock Synchronization Update Period field (word 63) indicates the requested time, in microseconds, between consecutive updates from the Clock Synchronization server.

When received from the Clock Synchronization Server (i.e., FFFFF6h), it represents the time, in microseconds, between consecutive updates from the Clock Synchronization server.

This field is not meaningful for FLOGI and shall be set to zero.

6.6.9.2 Fabric Login

6.6.9.2.1 Applicability

The Clock Synchronization Quality of Service field contains meaningful information only if either Word 1, bit 20 - Clock Synchronization Primitive Capable of the Common features field is set to one, or Word 1, bit 19 - Clock Synchronization ELS capable of the Recipient control field is set to one. If this field does not contain meaningful information, it shall be set to zero (see FC-FS-2).

The Fx_Port Clock Synchronization Quality of Service field is illustrated in table 176.

Table 176 – Fx_Port Clock Synchronization QoS

Bits Word	31 .. 24	23 .. 16	15 .. 08	07 .. 00
62	Reserved	CS_Transfer_Accuracy	CS_Implemented_MSB	CS_Implemented_LSB
63	Reserved			

6.6.9.2.2 CS_Transfer_Accuracy

The CS_Transfer_Accuracy field contains CS_Transfer_Accuracy_Mantissa (word 62, bits 23-21) and CS_Transfer_Accuracy_Exponent (word 62, bits 20-16).

These bits indicate the accuracy that the Fabric maintains in passing along to the clients the clock synchronization value it receives from the Clock Synchronization Server. Specifically, the Fabric shall supply a CS_Transfer_Accuracy value such that the Clock Synchronization value supplied to the clients is always within the range of:

$$(T\_server + T\_fabric\_delay) \pm (0.5 + CS\_Accuracy\_Mantissa * 2^{-4}) * 2^{(CS\_Accuracy\_Exponent-30)}$$

where:

a) T_server is the value received from the Clock Synchronization Server

b) T_fabric_delay is the time from when a given value was received from the server until the corresponding value is delivered to the client

c) CS_Accuracy_Mantissa is a value from 000b to 111b'

d) CS_Accuracy_Exponent is a value from 00000b to 11111b'

Example #1, if CS_Transfer_Accuracy Mantissa and Exponent are set to 001b and 01011b, respectively, the Clock Synchronization value supplied to the clients shall always be within the range of:

(T_server + T_fabric_delay) ± 1,073 µsec

Example #2, if CS_Transfer_Accuracy Mantissa and Exponent are set to 111b and 11000b, respectively, the Clock Synchronization value supplied to the clients shall always be within the range of:

(T_server + T_fabric_delay) ± 14,65 msec

6.6.9.2.3 Clock Synchronization Implemented MSB

The Clock Synchronization Implemented MSB field (word 62, bits 13 - 8) is a 6-bit value that represents the most significant bit position within the 64-bit Clock Count field that contains meaningful information (e.g., a value of 110111b indicates that the MSB of byte 1 of the Clock Count field is the highest bit that contains meaningful information). Word 62, bits 15-14 are reserved and shall be set to zero.

This field refers to the capabilities of the Fabric in transferring the clock synchronization value that was received from the Clock Synchronization Server (i.e., FFFFF6h) to the clients. It does not refer to the capabilities of the Clock Synchronization Server itself.

6.6.9.2.4 Word 0, Bits 7-0 Clock Synchronization Implemented LSB

This Clock Synchronization Implemented LSB field (word 62, bits 5 - 0) is a 6-bit value that represents the least significant bit position within the 64-bit Clock Count field that contains meaningful information (e.g a value of 001000b indicates that the LSB of byte 6 of the Clock Count field is the lowest bit that contains meaningful information). Word 62, bits 7-6 are reserved and shall be set to zero.

This field refers to the capabilities of the Fabric in transferring the clock synchronization value that was received from the Clock Synchronization Server (i.e., FFFFF6h) to the clients. It does not refer to the capabilities of the Clock Synchronization Server itself.

7 Process Login/Logout

7.1 Process Login

7.1.1 Introduction

The Process Login (PRLI) ELS request shall be used to establish the operating environment between a group of related processes at the originating Nx_Port and a group of related processes at the responding Nx_Port.

Establishing the operating environment may include the establishment of image pairs and the exchange of Service Parameters. The establishment of image pairs is FC-4 independent and is system structure dependent. The exchange of Service Parameters is FC-4 dependent, and if required by a particular FC-4, shall be specified in the corresponding FC-4 standard.

A Process Login remains in effect until a process logout occurs. The number of concurrent Process Logins in effect at an Nx_Port is a function of the Nx_Port facilities available. Process Login is separate from N_Port Login. Process Login may be either implicit or explicit.

There are 2 types of Process Login:

a) Implicit Process Login is a method of establishing an operating environment by means other than the explicit use of the PRLI Exchange. Specific methods of Implicit Process Login are not defined in this standard.

b) Explicit Process Login is accomplished by using the PRLI ELS Sequence within a separate Exchange to establish an operating environment.

A group of related processes is known as an image and is identified by the Process_Associator (see figure 4). The combination of the D_ID, Responder Process_Associator, S_ID and Originator Process_Associator identify the image pair (see figure 5). Either a single group or multiple groups of related processes may exist behind an Nx_Port. A single group of related processes behind an Nx_Port may be denoted by either an N_Port_ID only or N_Port_ID and Process_Associator.

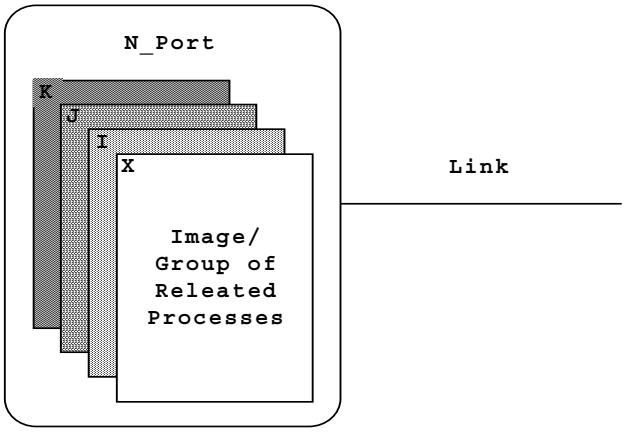


Figure 4 – Image/Group of Related Processes

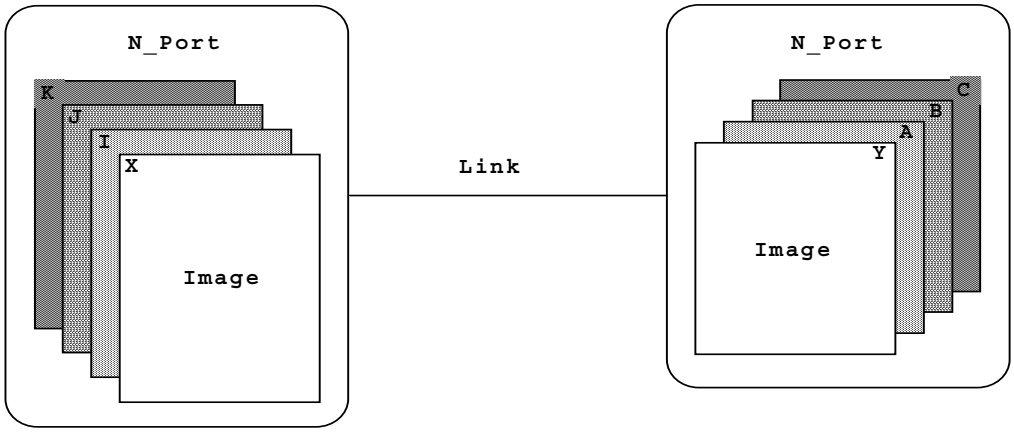


Figure 5 – Image pairs

PRLI, if required, is performed after N_Port Login is successful and prior to other FC-4 transfers. Examples of use of the Process Login function may include image initialization, image re-configuration, or when the Nx_Port receives an indication that the image pair no longer exists. PRLI allows each image behind an Nx_Port to separately manage its resources.

PRLI may be used to establish an operating environment between any of the following combinations of Nx_Port facilities:

a) two Nx_Ports

b) one Nx_Port and one Nx_Port image

c) two Nx_Port images

An image pair may be established or modified with a PRLI request and LS_ACC reply Sequence set. Failure to establish a particular image pair does not affect existing image pairs or the ability to establish other image pair.

PRLI may also be used to exchange Service Parameters without establishing image pairs. However, if an image pair is currently established, a subsequent PRLI request targeted to the same Nx_Port pair shall identify an image pair in order to modify Service Parameter settings for that image pair.

If a PRLI request is received for an established image pair, the established image pair is unaffected and the PRLI request is processed normally. This allows the exchange of Service Parameters for a FC-4 not specified when the original image pair was established. PRLO shall be used to remove an established image pair.

It shall be the responsibility of the ULPs to ensure that all active operations over an image pair have been properly terminated prior to issuing a PRLI request that replaces Service Parameters. If the replacement of Service Parameters affects any active operations, all open Sequences and Exchanges shall be terminated by invoking Abort Sequence (ABTS). Whether or not the replacement of Service Parameters affects an active operation shall be specified for each Service Parameter by the associated FC-4.

The Nx_Port originating the PRLI request shall not consider the image pair to be established until it has taken the necessary action to establish the image pair, and has received an LS_ACC reply Sequence indicating that the image pair has been established. The Nx_Port responding to the PRLI request does not consider the image pair to be established until the necessary action is taken at the Nx_Port to establish the image pair, and an LS_ACC reply Sequence is sent.

If a link error is detected when a PRLI request is received, the appropriate response, if any, is made, and the image pair is not established. If the recipient Nx_Port is not logged in with the requesting port it shall reply with a LOGO ELS Sequence, or with an LS_RJT ELS Sequence with a reason code of "Unable to perform command request" and a reason code explanation of "N_Port Login required". If an LS_RJT is sent in response to a PRLI request for an image pair that is already established, the existing image pair is unaffected. If an LS_RJT, P_BSY, F_BSY, P_RJT, or F_RJT response is received to a PRLI request, the PRLI request may be retried until the image pair is established. The number of retries is system dependent. In the case of LS_RJT, whether or not the PRLI is retried depends on the LS_RJT reason code.

In the event that there is an error in the response to establish an image pair, the originating Nx_Port shall not assume that the requested action has or has not taken place. If the Nx_Port that originates a PRLI request receives no valid response, the Nx_Port should retry the request. The number of retries is system dependent.

7.1.2 PRLI/PRLO Relationships

7.1.2.1 Introduction

Process_Associator (PA) images may exist in the following relationships. Any of these relationships may be established as a default condition using mechanisms not specified by this standard.

7.1.2.2 PA not supported

If one or both of the Originator and Responder do not support PAs, no valid PA is specified in any frame of any exchange.

The PRLI/PRLO should allow control over the enabling and disabling the specified services for the entire Nx_Port.

7.1.2.3 PA required by originator, supported by responder

If the Originator requires PAs, the Originator is expected to communicate only when a valid PA is included in the initial Association_Header. The Responder provides a final Association_Header and provides other Association_Headers as required. The PA establishes a routing to a particular Originator process (or group of related processes). There is no relationship between PAs identified through one Nx_Port of a host system and another Nx_Port from the same host. The PA may additionally be used by the FC-4 in a FC-4 dependent manner.

The PRLI request pages have valid Originator PA values and invalid Responder PA values. This PRLI informs the Responder of the Originator requirements and capabilities for each TYPE of FC-4.

The PRLI and PRLO may allow control over the enabling and disabling the access of each Originator Process to the Responder Nx_Port. Communication with image pairs that have not been established is not allowed, even if both PAs exist and have the proper requirements and capabilities.

7.1.2.4 PA required by responder, supported by originator

If the Responder requires PAs, the Responder is expected to communicate only when a valid Responder PA is included in the initial Association_Header. The Responder provides a final Association_Header and provides other Association_Headers as required. The PA establishes a routing to a particular Responder process. There is no relationship between PAs identified through one Nx_Port of a host system and another Nx_Port from the same host. The PA may additionally be used by the FC-4 in a FC-4 dependent manner.

The PRLI request pages have valid Responder PA values and invalid Originator PA values. The Responder PA values may be obtained through an informative PRLI operation or by other methods not specified.

The PRLI and PRLO may allow control over the enabling and disabling the access of each Responder Process to the Originating Nx_Port. Communication with image pairs that have not been established is not allowed, even if both PAs exist and have the proper requirements and capabilities.

7.1.2.5 PA required by originator and responder

Communication should only take place between an Originator and a Responder when valid PAs are specified. The PA may additionally be used by the FC-4 in a FC-4 dependent manner.

The PRLI request pages shall have valid Originator and Responder PA values defined and shall have the Establish Image Pair bit set to one in order to create image pairs in an binding manner. The Responder PA values may be obtained through an informative PRLI operation or by other methods not specified.

PRLI and PRLO pages with complete Originator PA and Responder PA information enable or disable communication between the specified image pair. PRLI pages with incomplete Originator PA and Responder PA information are invalid. Communication with image pairs that have not been established is not allowed, even if both PAs exist and have the proper requirements and capabilities.

7.1.3 Mode of operation

7.1.3.1 Informative mode

Service Parameter information is exchanged enabling subsequent negotiation for image pair establishment.

7.1.3.2 Binding mode

Information is exchanged that explicitly establishes a relationship between processes in the communicating Nx_Ports. The relationship does not allow any communication types or paths other than those established by the PRLI.

The use of a Binding PRLI page requires that the Originator have precise and detailed knowledge of the PAs and capabilities available in the Responder. That information may be obtained from Directory Services, implicitly from configuration information obtained outside the scope of FC, or by performing an Informative PRLI.

Binding or Informative mode is determined by the setting of the Establish Image Pair bit in the PRLI request page.

The Service Parameters included in a page may be either requirements or capabilities. Capabilities indicate those FC-4 properties that describe the role and state of the node in the FC-4 (e.g., channel or device for FC-SB-3, initiator or target for FCP-2, and similar values). Requirements indicate those FC-4 properties that shall be agreed upon by both nodes for operation with a FC-4.

7.1.4 Protocol

7.1.4.1 PA required by originator and responder

For each PRLI request page the Originator and Responder PA validity bits are set to one and valid Originator and Responder PAs are specified. Service Parameter requirements are set to those that correspond to the combined understanding expected to be agreed to by the Responder, given the knowledge that the Originator PA has of the Responder PA. Service Parameter capabilities are those of the Originator only. The specification of Service Parameters as either requirements or capabilities is specified in the corresponding FC-4 standard.

For each LS_ACC response page, the Originator and Responder PA validity bits are set to one and valid Originator and Responder PAs are specified. Service Parameter requirements are set to those that are agreed to by the Responder. Service Parameter capabilities are those of the Responder only. Error responses are possible.

Each page identifies a Binding mode PRLI operation between one image at the Originator Nx_Port and one image at the Responder Nx_Port.

7.1.4.2 PA required by originator, supported by responder

For each PRLI request page the Originator PA validity bit is set to one and the Responder PA validity bit is set to zero. A valid Originator PA is specified. Service Parameter requirements are set to those that correspond to the combined understanding expected to be agreed to by the Responder, given the knowledge that the Originator PA has of the Responder PA. Service Parameter capabilities are those of the Originator only. The specification of Service Parameters as either requirements or capabilities is specified in the corresponding FC-4 standard.

For each LS_ACC response page the Originator PA validity bit is set to one and the Responder PA validity bit is set to zero. The Originator PA is returned. Service Parameter requirements are set to those that are agreed to by the Responder. Service Parameter capabilities are those of the Responder only. Error responses are possible.

Each page identifies a Binding mode PRLI operation between one image at the Originator Nx_Port and the Responder Nx_Port.

7.1.4.3 PA supported by originator, required by responder

For each PRLI request page, the Originator PA validity bit is set to zero and the Responder PA validity bit is set to one. A valid Responder PA is specified. Service Parameter requirements are set to those that correspond to the combined understanding expected to be agreed to by the Responder, given the knowledge that the Originator PA has of the Responder PA. Service Parameter capabilities are those of the Originator only. The specification of Service Parameters as either requirements or capabilities is specified in the corresponding FC-4 standard.

For each LS_ACC response page, the Originator PA validity bit is set to zero and the Responder PA validity bit is set to one. The Responder PA is returned. Service Parameter requirements are set to those that are agreed to by the Responder. Service Parameter capabilities are those of the Responder only. Error responses are possible.

Each page identifies a Binding mode PRLI operation between the Originator Nx_Port and one image at the Responder Nx_Port.

7.2 Process Logout

The Process Logout (PRLO) ELS request shall be used to request invalidation of the operating environment between an image at the initiating Nx_Port and an image at the recipient Nx_Port. PRLO frees resources committed by a previous PRLI function. ULP behavior following successful execution of the PRLO function is specified in the corresponding FC-4 standard.

Examples of PRLO usage include image re-configuration and TYPE-specific reset of Process Login Service Parameters.

TYPE-specific Service Parameter settings may be reset or image pairs removed with a PRLO request and LS_ACC reply Sequence set. Other TYPE-specific Service Parameter settings or image pairs associated with the same or different image pairs or Nx_Ports shall be unaffected. After TYPE-specific Service Parameter settings are reset or image pair is removed, Information Units may not be sent or received for the specified FC-4 TYPE using that image pair and Nx_Port combination specified in the PRLO request.

If a PRLO request is received for an image pair or FC-4 TYPE that does not exist, the request is accepted, provided that no link errors are detected, and the LS_ACC response is sent.

The Nx_Port originating the PRLO request shall not consider an image pair to be removed until it receives an LS_ACC reply Sequence. The Nx_Port responding to the PRLO request shall not consider an image pair to be removed or TYPE-specific Service Parameter settings to be reset, as appropriate, until the LS_ACC reply Sequence is sent. An Nx_Port that receives a P_BSY, F_BSY, P_RJT, or F_RJT reply in response to a PRLO request may retry the PRLO request. The number of retries is system dependent.

Unless the requesting Nx_Port receives a valid response to a PRLO request, that Nx_Port shall not assume that the requested action has or has not taken place. If the Nx_Port that originates a PRLO request receives no valid response, the Nx_Port should retry the request. The number of retries is vendor unique.

A PRLO page identifies a particular image pair to logout by marking either or both the Originator Process Associator and the Responder Process Associator. Only that image pair is logged out. No further communication for the affected FC-4(s) is possible between these two images. It is the responsibility of the ULPs to ensure that all active operations over an image pair have been orderly and properly terminated prior to issuing a PRLO request. Following PRLO execution, all active Sequences and Exchanges shall be terminated by invoking Abort Sequence (ABTS). On-going operations and states for other image pairs are not affected.

If a ULP attempts to communicate over an image pair that has not been established or has been abnormally terminated, the communication shall be acknowledged in the normal manner. The Originator may then perform a PRLO operation for the affected image pair in order to properly terminate the operating environment at both the Originator and Responder.

8 Virtual Fabrics N_Port Support

8.1 Overview

The Virtual Fabric Tagging Header (VFT_Header, see FC-FS-2) allows Fibre Channel frames to be tagged with the Virtual Fabric Identifier (VF_ID) of the Virtual Fabric (VF) to which they belong. Tagged frames (i.e., frames with a VFT_Header) belonging to different Virtual Fabrics may be transmitted over the same physical link. The VFT_Header may be supported by N_Ports, F_Ports and E_Ports (see FC-FS-2).

8.2 Enabling VFT Tagging on N_Ports

The use of Virtual Fabrics is negotiated when FLOGI is performed via the Virtual Fabrics bit of the FLOGI Common Service Parameters (see table 150).

When set to one in the FLOGI request, the Virtual Fabrics bit indicates that the sending N_Port may negotiate Virtual Fabrics parameters. When set to one in the FLOGI LS_ACC reply, the Virtual Fabrics bit indicates that the Fabric requires the N_Port to initiate an EVFP transaction (see 4.2.43). Table 177 shows the usage of the Virtual Fabrics bit.

Table 177 – Virtual Fabrics Bit Usage

Requesting Nx_Port	F_Port Configuration	Behavior
Virtual Fabrics Bit = 0b	Virtual Fabrics Not Allowed	LS_ACC with Virtual Fabrics Bit = 0b
Virtual Fabrics Bit = 1b	Virtual Fabrics Not Allowed	LS_ACC with Virtual Fabrics Bit = 0b
Virtual Fabrics Bit = 0b	Virtual Fabrics Allowed	LS_ACC with Virtual Fabrics Bit = 0b
Virtual Fabrics Bit = 1b	Virtual Fabrics Allowed	LS_ACC with Virtual Fabrics Bit = 1b

When the F_Port requests the N_Port to initiate an EVFP transaction, the D_ID of the FLOGI LS_ACC shall be set to 000000h. In this manner the link flow control parameters (e.g., Buffer-to-buffer Credit and Buffer-to-buffer Receive Data Field size) are negotiated, but no N_Port_ID is assigned to the N_Port. The N_Port may continue the initialization process by using the N_Port Controller Well Known Address (i.e., FFFFF0h, see FC-FS-2) as S_ID to perform an Authentication transaction or an

EVFP transaction. Figure 6 shows the initialization process to enable Virtual Fabrics and Logical N_Ports.

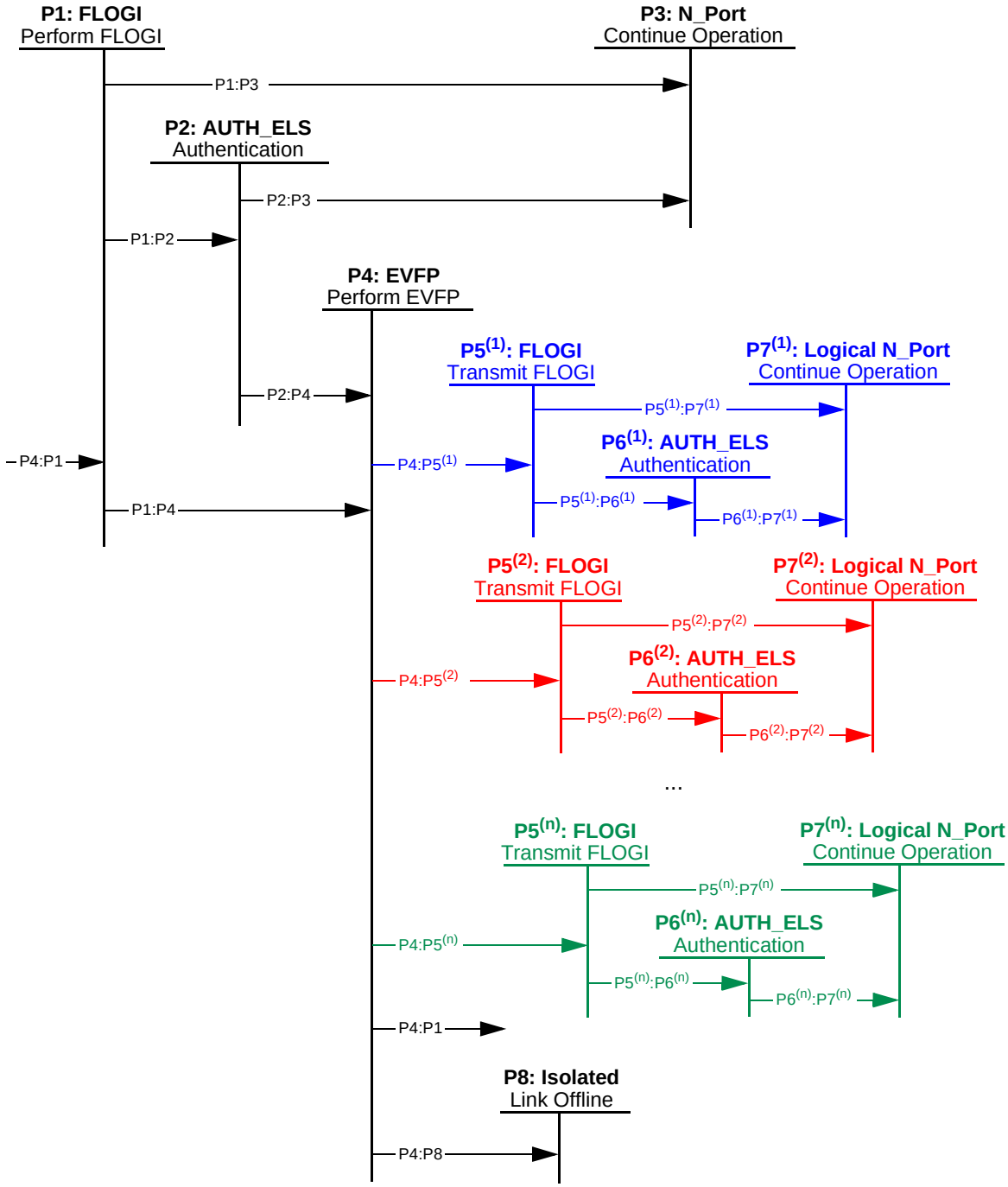


Figure 6 – Logical N_Port Initialization

State P1: FLOGI. The N_Port performs FLOGI. The N_Port_Name of the Logical N_Port associated with the Port VF_ID shall be used by the N_Port in the FLOGI request; the Fabric_Name of the Virtual Fabric associated with the Port VF_ID shall be used by the F_Port in the FLOGI LS_ACC.

State P2: AUTH_ELS. In this state an Authentication transaction shall be performed (see FC-SP). If the FLOGI LS_ACC had the Virtual Fabrics bit set to one and the D_ID set to 000000h, then the N_Port shall use the N_Port Controller WKA as S_ID, otherwise the N_Port shall use the assigned Address Identifier as S_ID.

State P3: N_Port. The N_Port continues its operations. The N_Port may acquire additional N_Port_IDs by following the N_Port_ID virtualization procedure.

Transition P1:P2. Occurs when the FLOGI LS_ACC has the Security bit set to one. If the FLOGI LS_ACC has also the Virtual Fabrics bit set to one and the D_ID set to 000000h, then the N_Port shall use the N_Port Controller WKA as S_ID for the Authentication transaction performed in state P2.

Transition P1:P3. Occurs when the FLOGI LS_ACC has both the Security bit and the Virtual Fabrics bit set to zero.

Transition P2:P3. Occurs when the Authentication transaction performed in state P2 completes successfully and the FLOGI LS_ACC had the Virtual Fabrics bit set to zero.

Transition P1:P4. Occurs when the FLOGI LS_ACC has the Security bit set to zero and the Virtual Fabrics bit set to one.

Transition P2:P4. Occurs when the Authentication transaction performed in state P2 completes successfully and the FLOGI LS_ACC had the Virtual Fabrics bit set to one.

State P4: Process EVFP. The N_Port shall initiate the EVFP processing as described in 8.4.1.

Transition P4:P5$^{(k)}$. Occurs when the EVFP processing determined that VFT tagging is performed. There is a different state for each Virtual Fabric negotiated to be used on the link. The state for Virtual Fabric K is denoted P5$^{(k)}$.

State P5$^{(k)}$: FLOGI. In this state the FC frames transmitted by the N_Port are tagged with the VFT_Header carrying VF_ID K. An FLOGI request, tagged with VF_ID K, is transmitted. This FLOGI request shall carry the N_Port_Name of the Logical N_Port associated with VF_ID K and the operational parameters (e.g., timeout values, Classes of service) of Virtual Fabric K. The FLOGI LS_ACC assigns an N_Port_ID in Virtual Fabric K to the Logical N_Port associated with VF_ID K. All parameters of the FLOGI request and the FLOGI LS_ACC transmitted in this state are used as specified in clause 6, except that the following parameters in the Common Service Parameters are ignored and the values transmitted in state P1 are used instead:

a) Buffer-to-buffer Credit (see 6.6.2.3);

b) BB_Credit Management (see 6.6.2.4.9);

c) BB_SC_N (see 6.6.2.5); and

d) Buffer-to-buffer Receive Data_Field size (see 6.6.2.6).

Transition P5$^{(k)}$:P6$^{(k)}$. Occurs when the FLOGI processing in state P5 is completed, if the FLOGI LS_ACC has the Security bit set to one.

State P6$^{(k)}$: AUTH_ELS. In this state the FC frames transmitted by the N_Port are tagged with the VFT_Header carrying VF_ID K. The Logical N_Port associated with VF_ID K performs an Authenti-

cation transaction (see FC-SP) in Virtual Fabric K, by using its N_Port_Name or any other appropriate identity. The corresponding Logical F_Port authenticates by using the Switch_Name of the Virtual Switch associated with VF_ID K or any other appropriate identity.

Transition P5$^{(k)}$:P7$^{(k)}$. Occurs when the FLOGI processing in state P5 is completed, if the FLOGI LS_ACC has the Security bit set to zero.

Transition P6$^{(k)}$:P7$^{(k)}$. Occurs when the Authentication transaction performed in state P6$^{(k)}$ completes successfully.

State P7$^{(k)}$: Logical N_Port. In this state the N_Port operates as VFT tagging N_Port. FC frames transmitted by the N_Port are tagged with the VFT_Header carrying VF_ID K. The Logical N_Port continues its operations. The Logical N_Port may acquire additional N_Port_IDs in Virtual Fabric K by following the N_Port_ID virtualization procedure.

Transition P4:P1. Occurs when the EVFP processing determined that VFT tagging is not performed and the N_Port and F_Port have the same Port VF_ID. In state P1 the N_Port shall repeat the FLOGI process with the Virtual Fabrics bit set to zero in the FLOGI request, in order to acquire an N_Port_ID in the Virtual Fabric identified by the Port VF_ID.

Transition P4:P8. Occurs when the EVFP processing determined that VFT tagging is not performed and the N_Port and F_Port do not have the same Port VF_ID.

State P8: Isolated. In this state the N_Port is offline.

When VFT tagging is enabled on a link, a Link Reset (see FC-FS-2) shall not change the tagging process, while a Link Initialization (see FC-FS-2) shall stop the tagging process and reinitialize the link.

8.3 Configuration Information

A VF capable N_Port shall maintain the following configuration parameters:

a) Tagging Administrative Status, used to negotiate the VFT tagging operational mode of the N_Port (see 4.2.43.2.2);

b) Port VF_ID (see 4.2.43.2.3); and

c) Locally-Enabled VF_ID List, used to negotiate the list of Virtual Fabrics operational over the N_Port (see 4.2.43.2.4).

8.4 Exchange Virtual Fabrics Parameters Processing

8.4.1 Overview

The Exchange Virtual Fabrics Parameters ELS (EVFP) protocol allows a VF capable N_Port and a VF capable F_Port to:

a) Negotiate the VFT Tagging operational mode;

b) Verify the consistency of the two Port VF_IDs; and

c) Establish the list of operational Virtual Fabrics across the link.

An EVFP transaction occurs between an EVFP Initiator and an EVFP Responder. An EVFP transaction (see figure 7) is identified by a unique Transaction Identifier (T_ID), and consists of a synchronizing phase (EVFP_SYNC) followed by a commit phase (EVFP_COMMIT).

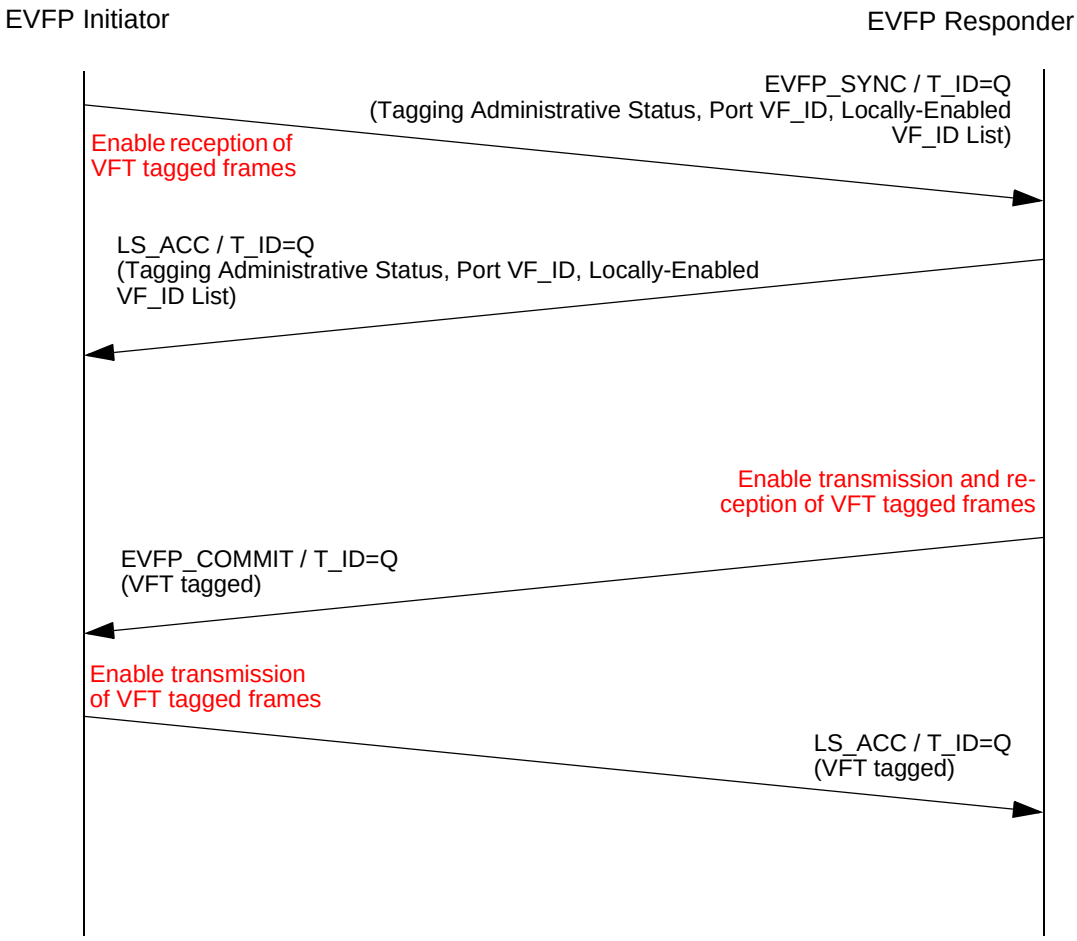


Figure 7 – A Generic EVFP Transaction

The VF_ID value FEFh is used by the EVFP protocol for certain operations and is referred to as Control VF_ID. The EVFP protocol, during the N_Port Initialization, proceeds as follows:

1) The EVFP Initiator shall start the EVFP transaction by sending the EVFP_SYNC message (see 4.2.43.2) to the EVFP Responder. In the EVFP_SYNC message, the EVFP Initiator shall specify the Transaction Identifier, and shall send its Core N_Port_Name if N_Port or its Core Switch_Name if F_Port, together with its Tagging Administrative Status (see 4.2.43.2.2), Port VF_ID (see 4.2.43.2.3) and Locally-Enabled VF_ID List (see 4.2.43.2.4). On sending the EVFP_SYNC message the EVFP Initiator enables the reception of VFT tagged frames;

2) The EVFP Responder shall reply with an LS_ACC carrying its Core Switch_Name if F_Port or its Core N_Port_Name if N_Port, together with its Tagging Administrative Status, Port VF_ID and Locally-Enabled VF_ID List. Then the EVFP Responder shall determine if VFT Tagging has to be enabled on the link, according to table 126. If VFT Tagging has to be enabled, the EVFP Responder shall go to step 3. If VFT Tagging has not to be enabled, the EVFP Responder shall check the received peer's Port VF_ID:

A) if the peer's Port VF_ID is not equal to the local Port VF_ID, on completion of the Exchange the EVFP protocol terminates and the EVFP Responder goes in Isolated state (transition P4:P8, see 8.2); or

B) if the peer's Port VF_ID is equal to the local Port VF_ID, on completion of the Exchange the EVFP protocol terminates and the EVFP Responder goes in state P1 (transition P4:P1, see 8.2).

On receiving the EVFP_SYNC LS_ACC, the EVFP Initiator shall determine if VFT Tagging has to be enabled on the link, according to table 126. If VFT Tagging has to be enabled, on completion of the Exchange the EVFP Initiator shall go to step 4. If VFT Tagging has not to be enabled, the EVFP Initiator disables the reception of VFT tagged frames and shall check the received peer's Port VF_ID:

A) if the peer's Port VF_ID is not equal to the local Port VF_ID, on completion of the Exchange the EVFP protocol terminates and the EVFP Initiator goes in Isolated state (transition P4:P8, see 8.2); or

B) if the peer's Port VF_ID is equal to the local Port VF_ID, on completion of the Exchange the EVFP protocol terminates and the EVFP Initiator goes in state P1 (transition P4:P1, see 8.2);

3) On completion of the EVFP_SYNC Exchange, the EVFP Responder shall enable both transmission and reception of VFT tagged frames for the Virtual Fabrics operational on the link, computed as explained in 4.2.56.2.4. Transmission and reception of VFT tagged frames for the Control VF_ID shall be implicitly enabled. Transmission and reception of VFT tagged frames for the EVFP Initiator's Port VF_ID shall be also enabled on the link, to allow a successful completion of the EVFP protocol. Then the EVFP Responder shall send an EVFP_COMMIT message (see 4.2.56.3), tagged with the EVFP Initiator's Port VF_ID; and

4) On receiving the VFT tagged EVFP_COMMIT, the EVFP Initiator shall enable both transmission and reception of VFT tagged frames for the Virtual Fabrics operational on the link, computed as explained in 4.2.56.2.4. Transmission and reception of VFT tagged frames for the Control VF_ID shall be implicitly enabled. Transmission and reception of VFT tagged frames for the EVFP Initiator's Port VF_ID shall be also enabled on the link, to allow a successful completion of the EVFP protocol. Then the EVFP Initiator shall send an EVFP_COMMIT LS_ACC message tagged with its Port VF_ID.

When tagging is enabled the EVFP transaction completes successfully on completion of the EVFP_COMMIT Exchange, for both the EVFP Initiator and EVFP Responder. If the computed set of VF_IDs operational on the link does not include the EVFP Initiator's Port VF_ID, transmission and reception of VFT tagged frames for such VF_ID shall be disabled on the link upon completion of the EVFP transaction. When the EVFP transaction is completed the processing continues independently for each Virtual Fabric operational on the link, as shown by transitions P4:P5(k) (see 8.2). If the computed set of VF_IDs operational on the link is NULL, the involved FC_Ports remain in state P4 (see 8.2) until a new EVFP transaction is performed in the Control VF_ID.

If an N_Port and an F_Port start an EVFP transaction at the same time, or if an FC_Port is acting as an EVFP Initiator and receives an EVFP_SYNC message from the designated EVFP Responder, one of the two EVFP transactions shall be aborted. The N_Port shall remain the EVFP Initiator, while the F_Port shall become the EVFP Responder. The FC_Port that remains the EVFP Initiator shall reply to the received EVFP_SYNC message with an 'EVFP collision' LS_RJT (see 4.2.43.1.2). The FC_Port that becomes the EVFP Responder shall reply to the received EVFP_SYNC message and abort its own transaction upon receipt of the LS_RJT.

The EVFP protocol is used also when some N_Port or F_Port configuration information (see 8.3) are changed by a management action. The EVFP messages may be carried in FC frames tagged with the Port VF_ID if the EVFP protocol begins while the link is not performing VFT tagging (see 8.4.1). The EVFP messages are carried in FC frames tagged with the Control VF_ID if the EVFP protocol begins while the link is performing VFT tagging (see 8.4.2 and 8.4.3).

8.4.2 Changing the VFT Tagging Mode

When a management action changes the Administrative Tagging Mode of a VF capable N_Port or F_Port that determined during initialization the peer supports the EVFP protocol, the FC_Port shall determine if the link has to change its VFT Tagging mode (i.e., if it has to transition from tagging to untagging mode or from untagging to tagging mode) by acting as EVFP Initiator as follows. If the N_Port or F_Port is currently performing tagging, all EVFP protocol messages shall be tagged with the Control VF_ID. If the N_Port or F_Port is currently not performing tagging, all EVFP protocol messages shall be untagged.

1) The EVFP Initiator shall start the EVFP transaction by sending the EVFP_SYNC message to the EVFP Responder. The EVFP_SYNC message shall carry the updated Tagging Administrative Status (see 4.2.43.2.2), Port VF_ID, and the Locally-Enabled VF_ID List; and

2) The EVFP Responder shall reply with an LS_ACC carrying its Tagging Administrative Status, Port VF_ID and Locally-Enabled VF_ID List. The EVFP Responder shall determine if VFT Tagging has to be changed on the link, according to table 126. The EVFP Responder:

   A) if VFT Tagging has not to be changed, on completion of the Exchange terminates the EVFP protocol; or

   B) if VFT Tagging has to be changed, on completion of the Exchange shall perform a link initialization.

   On receiving the EVFP_SYNC LS_ACC, the EVFP Initiator shall determine if VFT Tagging has to be changed on the link, according to table 126. The EVFP Initiator:

   A) if VFT Tagging has not to be changed, on completion of the Exchange terminates the EVFP protocol; or

   B) if VFT Tagging has to be changed, shall participate in the link initialization initiated by the EVFP Responder.

8.4.3 Adding or Removing Virtual Fabrics

When a management action changes the Locally-Enabled VF_ID List over a tagging N_Port or F_Port, the FC_Port shall initiate the EVFP protocol by acting as EVFP Initiator as follows. All EVFP protocol messages shall be tagged with the Control VF_ID.

1) The EVFP Initiator shall start the EVFP transaction by sending the EVFP_SYNC message to the EVFP Responder. The EVFP_SYNC message shall carry the Tagging Administrative Status, Port VF_ID, and the updated Locally-Enabled VF_ID List (see 4.2.43.2.4);

2) The EVFP Responder shall reply with an LS_ACC carrying its Tagging Administrative Status, Port VF_ID and Locally-Enabled VF_ID List. The EVFP Responder, depending on the resulting operational VF_ID List (see 4.2.43.2.4):

A) if the operational VF_ID List did not change, on completion of the Exchange in the Control VF_ID terminates the EVFP protocol; or

B) if the operational VF_ID List did change, on completion of the Exchange in the Control VF_ID goes to step 3.

On receiving the EVFP_SYNC LS_ACC in the Control VF_ID, the EVFP Initiator, depending on the resulting operational VF_ID List:

A) if the operational VF_ID List did not change, on completion of the Exchange in the Control VF_ID terminates the EVFP protocol; or

B) if the operational VF_ID List did change, on completion of the Exchange in the Control VF_ID goes to step 4.

3) On completion of the EVFP_SYNC Exchange in the Control VF_ID, the EVFP Responder shall apply the updated operational VF_ID List, enabling the added Virtual Fabrics and disabling the removed Virtual Fabrics. The removal of a Virtual Fabric should be treated as an implicit logout. Then the EVFP Responder shall send an EVFP_COMMIT message; and

4) On receiving the EVFP_COMMIT message, the EVFP Initiator shall apply the updated operational VF_ID List, enabling the added Virtual Fabrics and disabling the removed Virtual Fabrics. The removal of a Virtual Fabric should be treated as an implicit logout. Then the EVFP Initiator shall send an EVFP_COMMIT LS_ACC message.

When the operational VF_ID List changes, the EVFP transaction completes successfully on completion of the EVFP_COMMIT Exchange for both the EVFP Initiator and EVFP Responder. When the EVFP transaction is completed, the updated operational VF_ID List is operative.

8.4.4 Changing the Port VF_ID

When a management action changes the Port VF_ID of a tagging N_Port or F_Port, no changes are applied to the link.

When a management action changes the Port VF_ID of a non tagging N_Port or F_Port, the FC_Port shall perform a link initialization.

When a management action changes the Port VF_ID of an N_Port or F_Port in Isolated state (i.e., state P8), the FC_Port shall go in state P1 (see 8.2).