SAE Aerospace
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AEROSPACE STANDARD

SAE AS5653

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High Speed Network for MIL-STD-1760

RATIONALE

This standard defines a High Speed Fibre Channel Network to improve the capability of MIL-STD-1760 to transfer information. This activity was initiated at the request of the US Navy in 2001.

FOREWORD

AS5653 makes extensive reference to Fibre Channel standards. In the context of the MIL-STD-1760 interfaces, AS5653 is referred to as a "bus". In the context of Fibre Channel, AS5653 is referred to as a "network". To aid comprehension of AS5653 explanatory text is included, as illustrated below. This explanatory text is for guidance only.

Text in this font is explanatory, for the reader's guidance and does not form a part of the standard.

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1. SCOPE

AS5653 may be applied to Air Vehicles and Stores implementing MIL-STD-1760 Interface Standard for Aircraft/Store Electrical Interconnection System.

1.1 Purpose

This standard defines the characteristics and requirements for a high speed data bus incorporated within a MIL-STD-1760 interface to provide improved transfer capabilities and an alternative command and control path. The high speed data bus is based on Fibre Channel standards. This document (AS5653) is a profile of Fibre Channel standards.

This standard contains the minimum interoperability requirements necessary to define a standardized transport mechanism for video, audio, data files, and command and control transfers. The addition of the high speed data bus to the interface currently defined in MIL-STD-1760D requires changes to be incorporated into that standard (MIL-STD-1760), as defined in Appendix A of this standard (AS5653).

This standard assumes a knowledge of Fibre Channel communication concepts – reference should be made to the Fibre Channel standards where appropriate.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The specified issue of other publications shall be used. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 Government Publications

Available from Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/

MIL-STD-1760D INTERFACE STANDARD FOR AIRCRAFT/STORE ELECTRICAL INTERCONNECTION SYSTEM, as amended by Appendix A herein.

Despite MIL-STD-1760 being the parent document, reference is made to it for connector details.

2.1.2 ANSI Publications

For electronic copies of ANSI standards listed here: http://www.ansi.org. For paper copies, contact: Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704.

FC-AE-1553 ANSI T11.3 Project 1648-DT Fibre Channel - Avionics Environment Protocol for MIL-STD-1553B Notice 2 (FC-AE-1553)

FC-AV ANSI INCITS 356-2002 Fibre Channel - Audio Video

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FC-PI ANSI INCITS 352-2002 Fibre Channel - Physical Interfaces

FC-SW-4 ANSI T11.3 Project 1674-D Fibre Channel - Switched Fabric - 4

FC-FS ANSI INCITS 373-2003 Fibre Channel - Framing and Signalling

2.1.3 Usage of References

This standard profiles existing Fibre Channel standards. Table 1 describes the purpose of each referenced document.

TABLE 1 - PURPOSE OF REFERENCED DOCUMENTS

Referenced Document	Purpose
MIL-STD-1760	This is the parent document defining the aircraft store interface. Referenced by this document for signal assignments, connector details and contact details.
FC-SW-4	FC-SW-4 defines the switched fabric topology used, the means of assigning addresses, network initialization and Fast Fabric Initialization. AS5653 selects the Fast Fabric Initialization protocol defined in FC-SW-4 Annex D.
FC-PI	FC-PI defines the physical layer.
FC-AV	Profiled to provide specific means to transfer Audio and Video information.
FC-AE-1553	Profiled to provide a file transfer, command and control mechanism.
FC-FS	Defines the Fibre Channel Framing and Signalling.

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2.2 Definitions

The following definitions are used in Fibre Channel profiling documentation and are adopted for consistency.

Required: If a feature or parameter value is Required, it means that it shall be used between compliant implementations. Compliant implementations are required to implement the feature. Interoperability is not guaranteed if Required features are not implemented.

Invocable: If a feature or parameter value is Invocable, it means that compliant implementations are required to implement the feature. Invocable is different than Required in that an implementation may invoke (i.e. use) the feature if needed, but it is not required to invoke it.

Allowed: If a feature or parameter value is Allowed, it means that it may be used between compliant implementations. Compliant implementations are not required to implement the feature. Typically, the potential user of an Allowed feature may determine if an implementation supports it via an Invocable discovery process.

Prohibited: If a feature is Prohibited, it means that it shall not be used between compliant implementations.

Table 2 summarizes the above definitions.

TABLE 2 - SUMMARY OF IMPLEMENTATION AND USE OF FEATURES

Term	Implementation	Use
Required	Shall	Shall
Invocable	Shall	May
Allowed	May	May
Prohibited	May	Shall Not

These definitions are re-used from Fibre Channel to give a consistent approach.

2.3 Abbreviations

AE	Avionics Environment
AE_Port	Avionics Environment Fibre Channel Port
ASI	Aircraft Store Interface
BB_Credit	Buffer-to-Buffer Credit
CSI	Carriage Store Interface
CSSI	Carriage Store Station Interface
DFC	Down Fibre Channel
E_D_TOV	Error_Detect_Timeout value
ELP	Exchange Link Parameters
FC	Fibre Channel
FFI	Fast Fabric Initialization
FLOGI	Fabric Login
F_Port	Fibre Channel Fabric Port
Gbaud	Giga Baud
MSI	Mission Store Interface
NC	Network Controller
N_Port	Fibre Channel Node Port
NT	Network Terminal
PLOGI	N_Port Login
R_A_TOV	Resource_Allocation_Timeout value
R_T_TOV	Receiver_Transmitter_Timeout value
RDMA	Remote Direct Memory Access
UFC	Up Fibre Channel

C-S/D_TX_TOV End of command or status sequence transmission to start of data sequence transmission timeout value

C-S/D_RX_TOV End of command or status sequence reception to start of data sequence reception timeout value

NC_C-D/S_BURST _TOV Network Controller command or data transmission to status reception indicating burst size timeout value

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NC_C/S _TOV Network Controller command or data transmission to status reception timeout value

NT_C-D/S_BURST _TOV Network Terminal command or data reception to status transmission indicating burst size timeout value

NT_C/S_TOV Network Terminal command or command plus data reception to status transmission timeout value

UI Unit Interval

3. GENERAL REQUIREMENTS

3.1 Port Designation

The ASI, MSI, CSI & CSSI shall provide 1.0625 Gbaud Fibre Channel Port functionality as defined in FC-FS and FC-SW-4 and allocated in Table 3. Examples are given in Figures 1 and 2.

TABLE 3 - MIL-STD-1760 INTERFACE TO FIBRE CHANNEL PORT FUNCTIONALITY MAPPING

MIL-STD-1760 Connector	Fibre Channel Port Functionality
ASI	AE_Port or F_Port
MSI	N_Port
CSI	AE_Port
CSSI	AE_Port or F_Port

A Fibre Channel Port may be capable of multiple functionalities. The functionality used depends upon the initialization sequence followed, and is determined by responses to link initialization commands. After initialization, a Fibre Channel port has a single functionality. In this profile, an ASI connected to an MSI is an F-port, and an ASI connected to a CSI is an AE_Port. The same logic applies for a CSSI.

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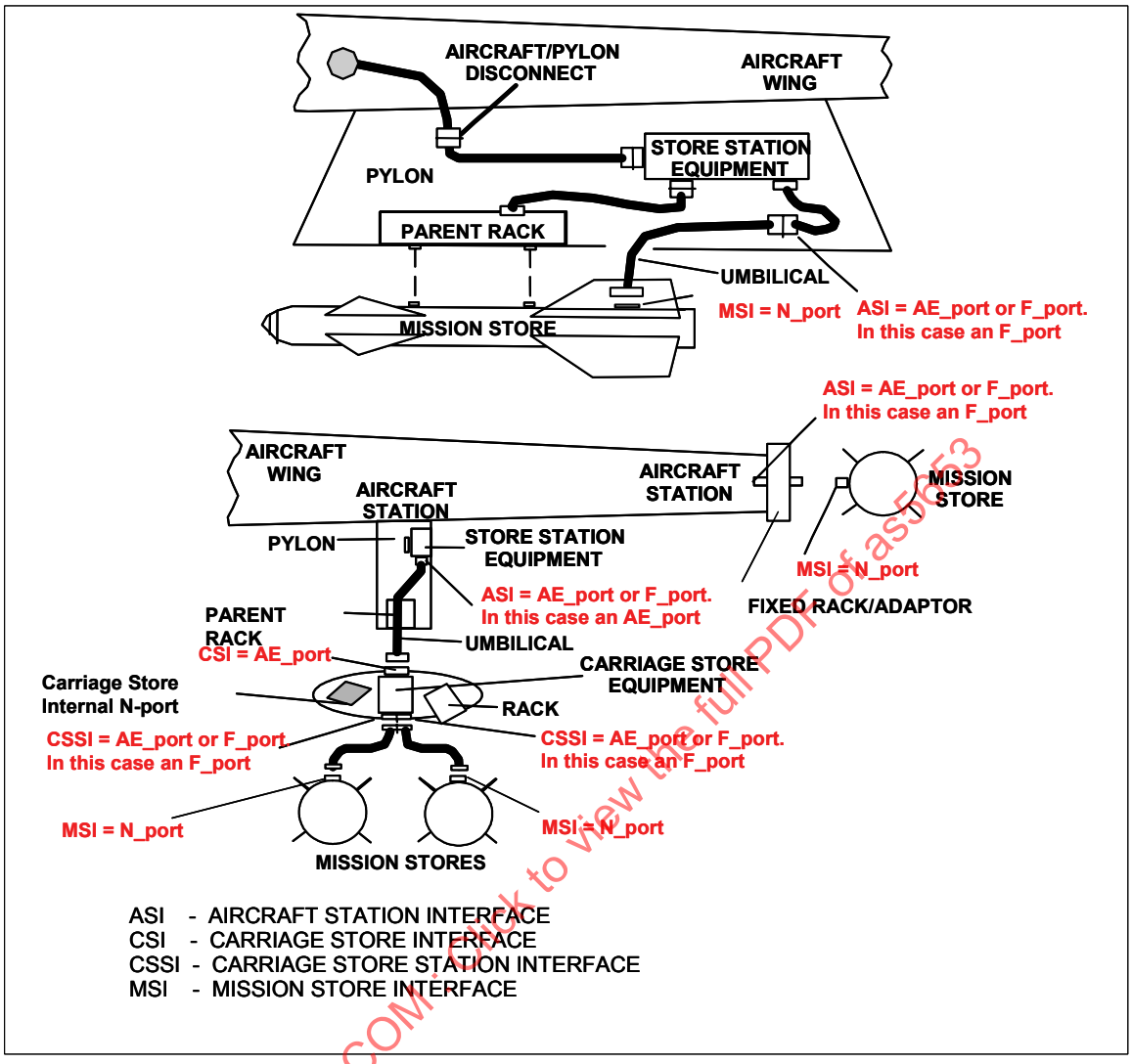

FIGURE 1 - AIRCRAFT STORE CONFIGURATION EXAMPLE 1 WITH FIBRE CHANNEL PORT NOTATION

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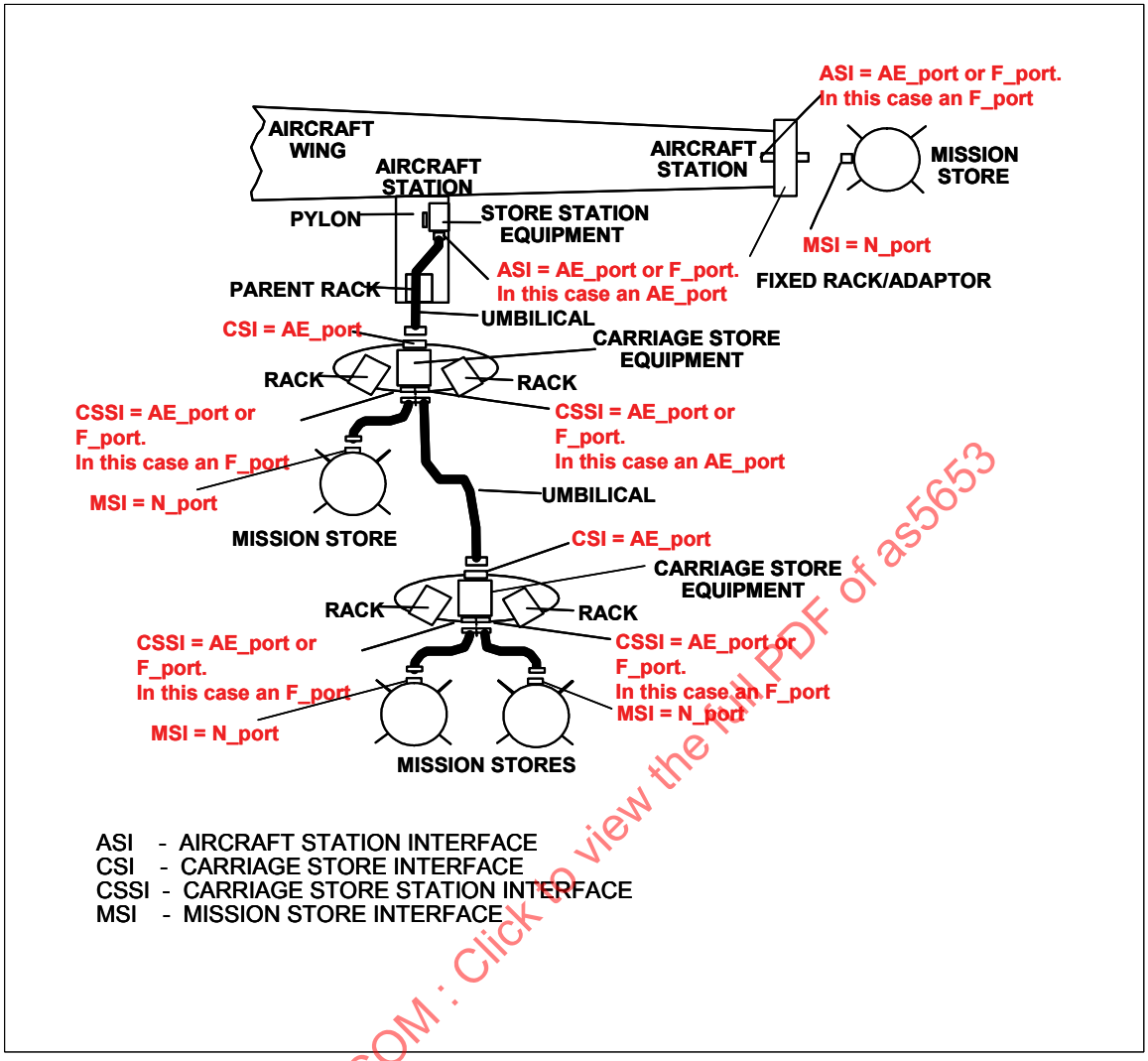

FIGURE 2 - AIRCRAFT STORE CONFIGURATION EXAMPLE 2 WITH FIBRE CHANNEL PORT NOTATION

Below lists the potential communication paths that system designers need to consider for the application of the DFC interface details.

Transmitter	Receiver
Mission Store (MSI)	Carriage Store (CSSI)
Carriage Store (CSI)	Carriage Store (CSSI)
Cariage Store (CSI)	Platform (ASI)
Mission Store (MSI)	Platform (ASI)

Below lists the potential communication paths that system designers need to consider for the application of the DFC interface details.

Transmitter	Receiver
Platform (ASI)	Carriage Store (CSI)
Carriage Store (CSSI)	Carriage Store (CSI)
Carriage Store (CSSI)	Mission Store (MSI)
Platform (ASI)	Mission Store (MSI)

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3.2 Topology

The topology shall be a switched fabric as defined in FC-FS. The use of Arbitrated Loop topology and Point-to-Point topology is prohibited.

Although Fibre Channel standards allow multiple topologies, created from a series of point-to-point links, this profile excludes the use of loop topologies and associated initialization protocol as they are not suited to applications where nodes (stores) leave (release or jettison, power down) the network. Point-to-Point topologies are also prohibited because they complicate the initialization of the network.

3.3 Upper Level Protocols

Only the following protocols shall be used.

- FC-AE-1553 - for file transfer & command and control.
- Frame Header Control Protocol (FHCP) - for video and audio defined in FC-AV.

Fibre Channel provides many Upper Layer Protocols. This paragraph limits the Upper Layer Protocols to those required to satisfy the needs of an aircraft stores system. An indication of the use is given in Table 1. Not all of the Upper Layer Protocol is necessarily adopted.

4. DETAILED REQUIRMENTS

4.1 Fibre Channel Level 4

4.1.1 Video Transfer

Video data shall be transferred using the methods defined in the Simple Parametric Digital Video (SPDV) profile in FC-AV Annex A.

A single protocol with multiple formats is used for the transfer of video information.

4.1.2 Audio Transfer

Audio data shall be transferred using the methods defined in FC-AV.

A single protocol is used for the transfer of audio information. The Fibre Channel specifications lack detail for audio transport. The purpose of this paragraph is to provide an alternate means to transfer audio other than the LB signal line. If audio over Fibre Channel is required then further standardisation activity may be required.

4.1.3 File Transfer

File based information shall be transferred as defined in 4.1.5.

This defines the protocol for file transfer as an alternative to (or replacement of) MIL-STD-1760 Mass Data Transfer, one of the limiting features of MIL-STD-1760. File transfer can be achieved by using either long messages in FC-AE-1553 or the mass data transfer protocol running over FC-AE-1553. The latter option is inefficient and using long messages in FC-AE-1553 is the better alternative.

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4.1.4 Command and Control

Command and control information shall be transferred as defined in 4.1.5.

This defines FC-AE-1553 as the command and control protocol. This provides an alternate command and control path to MIL-STD-1760 MUX A and MUX B.

4.1.5 FC-AE-1553 Profiling

Required, Invocable & Prohibited FC-AE-1553 features shall be implemented as per FC-AE-1553. The FC-AE-1553 Allowed features shall be used as per Table 4 and Table 5. The Process login shall be implicit using the parameters defined in Table 5. The FC-AE-1553 timer values shall be set as specified in Table 5.

At least one of the N-ports above the ASI shall have the functionality of a Network Controller. An N_Port for a carriage store's internal computer may have NC functionality, NT functionality, or both. An N_Port in a mission store must have NT functionality.

This ensures the host platform has one Fibre Channel node functioning as a Network Controller (NC). Mission stores must be capable of functioning as Network Terminals (NT). Table 5 provides time out values for FC-AE-1553. These numeric values and allowed options profile FC-AE-1553 to give a standard set of parameters for use in AS5653.

NC commands and NT Status responses with less than or equal to 2048 bytes (1024 words) shall be transmitted as single-frame sequences.

This will minimize the time to process short command and control type exchanges.

For file transfers using either the NC-to-NT or NT-to-NT exchange formats, the command word bit "NT Burst Size Request" shall have a value of logic "1", while the command word bit "Delayed NT Burst Size Request" shall have a value of logic "0".

Using this option, no data bytes will be transmitted to the receiving NT prior to the receiving NT indicating the maximum number of data bytes that it can receive in the first Data Sequence.

TABLE 4 - USE OF FC-AE-1553 ALLOWED FEATURES.

Feature	Requirement
NT –to- NT Transfers	Invocable
NC to monitor NT-to-NT transfers	Prohibited
Broadcast	Invocable
Multicast	Prohibited
NT status response to broadcast exchanges	Prohibited

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TABLE 5 - FC-AE-1553 PRLI SERVICE PARAMETERS FOR AS5653

FC-AE-1553 PRLI SERVICE PARAMETER	WORD	BIT(S)	VALUE FOR NC	VALUE FOR NT	NOTES
FC-AE-1553 TYPE CODE (48H)	0	31–24	48H	48H	
RESERVED FOR TYPE CODE EXTENSION	0	23–16	00H	00H	
ORIGINATOR PROCESS_ASSOCIATOR VALID	0	15	0B	0B	
RESPONDER PROCESS_ASSOCIATOR VALID	0	14	0B	0B	
ORIGINATOR: ESTABLISH IMAGE PAIR RESPONDER: IMAGE PAIR ESTABLISHED	0	13	1B	1B	FOR AS5653, NC IS PRLI ORIGINATOR, NT IS PRLI RESPONDER.
RESERVED	0	12	0B	0B	
ORIGINATOR: RESERVED RESPONDER: ACCEPT RESPONSE CODE	0	11-8	0000B	0001B	FOR AS5653, NC IS PRLI ORIGINATOR, NT IS PRLI RESPONDER.
RESERVED	0	7-0	00H	00H	
ORIGINATOR PROCESS_ASSOCIATOR	1	31–0	00 00 00 00H	00 00 00 00H	
RESPONDER PROCESS_ASSOCIATOR	2	31–0	00 00 00 00H	00 00 00 00H	
NC FUNCTION	3	31	1B	X	NC MAY OPTIONALLY HAVE NT CAPABILITY.
NT FUNCTION	3	30	X	1B	NT MAY OPTIONALLY HAVE NC CAPABILITY.
NC: NC-TO-NT TRANSFER (USING NT BURST SIZE REQUEST)	3	29	1B	X	
NC: NC-TO-NT TRANSFER (USING DELAYED NT BURST SIZE REQUEST)	3	28	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NC: NT-TO-NT TRANSFER (USING NT BURST SIZE REQUEST)	3	27	1B	X	
NC: NT-TO-NT TRANSFER, WHERE THE NC IS THE RECEIVING NT (USING NT BURST SIZE REQUEST)	3	26	1B	X	
NC: NT-TO-NT TRANSFER (USING DELAYED NT BURST SIZE REQUEST)	3	25	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NC: NT-TO-NT TRANSFER, WHERE THE NC IS THE RECEIVING NT (USING DELAYED NT BURST SIZE REQUEST)	3	24	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NC: NC-TO-NT RDMA	3	23	0B	0B	PROHIBITED FEATURE FOR AS5653
NC: NT-TO-NC RDMA	3	22	0B	0B	PROHIBITED FEATURE FOR AS5653

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FC-AE-1553 PRLI SERVICE PARAMETER	WORD	BIT(S)	VALUE FOR NC	VALUE FOR NT	NOTES
NC: NT-TO-NT RDMA	3	21	0B	0B	PROHIBITED FEATURE FOR AS5653
NC: DYNAMIC NETWORK CONTROL MODE COMMAND – NON-BROADCAST	3	20	0B	0B	PROHIBITED MODE COMMAND FOR AS5653
NC: TRANSMIT RT ADDRESS MODE COMMAND – NON-BROADCAST	3	19	1B	X	
NC: TRANSMIT NT_CS_BURST_TOV MODE COMMAND – NON-BROADCAST	3	18	1B	X	
NC: USE OF ABTS BASIC LINK SERVICE AND RRQ EXTENDED LINK SERVICE TO ABORT ERRONEOUS EXCHANGES.	3	17	0B	0B	PROHIBITED FEATURE FOR AS5653
NC: NC MONITOR FOR NT-TO-NT TRANSFER	3	16	0B	0B	PROHIBITED FEATURE FOR AS5653
NC: MULTICAST	3	15	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NC: TRANSMITTER SHUTDOWN – NON-BROADCAST	3	14	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: TRANSMITTER SHUTDOWN – BROADCAST	3	13	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: OVERRIDE TRANSMITTER SHUTDOWN – NON-BROADCAST	3	12	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: OVERRIDE TRANSMITTER SHUTDOWN – BROADCAST	3	11	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: SELECTED TRANSMITTER SHUTDOWN – NON-BROADCAST	3	10	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: SELECTED TRANSMITTER SHUTDOWN – BROADCAST	3	9	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: OVERRIDE SELECTED TRANSMITTER SHUTDOWN – NON-BROADCAST	3	8	0B	0B	PROHIBITED MODE CODE FOR AS5653
NC: OVERRIDE SELECTED TRANSMITTER SHUTDOWN – BROADCAST	3	7	0B	0B	PROHIBITED MODE CODE FOR AS5653
RESERVED	3	6-0	000 0000B	000 0000B	
NT: NC-TO-NT TRANSFER (USING NT BURST SIZE REQUEST)	4	31	X	1B	
NT: NC-TO-NT TRANSFER (USING DELAYED NT BURST SIZE REQUEST)	4	30	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NT: NT-TO-NT TRANSFER (USING NT BURST SIZE REQUEST)	4	29	X	1B	
NT: NT-TO-NT TRANSFER, WHERE THE NC IS THE RECEIVING NT (USING NT BURST SIZE REQUEST)	4	28	X	1B	
NT: NT-TO-NT TRANSFER (USING DELAYED NT BURST SIZE REQUEST)	4	27	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653

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FC-AE-1553 PRLI SERVICE PARAMETER	WORD	BIT(S)	VALUE FOR NC	VALUE FOR NT	NOTES
NT: NT-TO-NT TRANSFER, WHERE THE NC IS THE RECEIVING NT (USING DELAYED NT BURST SIZE REQUEST)	4	26	0B	0B	PROHIBITED FEATURE FOR AS5653
NT: NT-TO-MULTIPLE NTS	4	25	X	1B	BROADCAST IS INVOCABLE, MULTICAST IS PROHIBITED
NT: RECEIVE MODE CODE, WITH DATA TO MULTIPLE NTS	4	24	X	1B	BROADCAST IS INVOCABLE, MULTICAST IS PROHIBITED
NT: NC-TO-NT RDMA	4	23	0B	0B	PROHIBITED FEATURE FOR AS5653
NT: NT-TO-NC RDMA	4	22	0B	0B	PROHIBITED FEATURE FOR AS5653
NT: NT-TO-NT RDMA	4	21	0B	0B	PROHIBITED FEATURE FOR AS5653
NT: NO RESPONSE BY MIL-STD-1553 RT = “1B”	4	20	0B	0B	NO PROVISION IN AS5653 TO BRIDGE TO 1 MB/S 1553/1760 RTS
NT: MIL-STD-1553 FORMAT ERROR = “1B”	4	19	0B	0B	NO PROVISION IN AS5653 TO BRIDGE TO 1 MB/S 1553/1760 RTS
NT: BURST SIZE ACKNOWLEDGE = “1B”	4	18	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: PORT LOGIN REQUIRED = “1B”	4	17	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: SERVICE REQUEST = “1B”	4	16	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: BUSY = “1B”	4	15	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: SUBSYSTEM FLAG = “1B”	4	14	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: TERMINAL FLAG = “1B”	4	13	X	1B	INVOCABLE NT STATUS SEQUENCE BIT
NT: NC MONITOR FOR NT-TO-NT TRANSFER	4	12	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NT: MULTICAST	4	11	0B	0B	PROHIBITED TRANSFER FORMAT FOR AS5653
NT: TRANSMITTER SHUTDOWN – NON-BROADCAST	4	10	0B	0B	PROHIBITED MODE CODE FOR AS5653
NT: TRANSMITTER SHUTDOWN – BROADCAST	4	9	0B	0B	PROHIBITED MODE CODE FOR AS5653

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FC-AE-1553 PRLI SERVICE PARAMETER	WORD	BIT(S)	VALUE FOR NC	VALUE FOR NT	NOTES
NT: OVERRIDE TRANSMITTER SHUTDOWN – NON-BROADCAST	4	8	0B	0B	PROHIBITED MODE CODE FOR AS5653
NT: OVERRIDE TRANSMITTER SHUTDOWN – BROADCAST	4	7	0B	0B	PROHIBITED MODE CODE FOR AS5653
RESERVED	4	6-0	000 0000B	000 0000B	
NT: DYNAMIC NETWORK CONTROL MODE COMMAND – NON-BROADCAST	5	31	0B	0B	PROHIBITED MODE CODE FOR AS5653
NT: SYNCHRONIZE (WITHOUT DATA WORD) MODE COMMAND – NON-BROADCAST	5	30	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: SYNCHRONIZE (WITHOUT DATA WORD) MODE COMMAND – BROADCAST	5	29	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: INITIATE SELF-TEST MODE COMMAND – NON-BROADCAST	5	28	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: INITIATE SELF-TEST MODE COMMAND – BROADCAST	5	27	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: INHIBIT TERMINAL FLAG MODE COMMAND – NON-BROADCAST	5	26	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: INHIBIT TERMINAL FLAG MODE COMMAND – BROADCAST	5	25	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: OVERRIDE INHIBIT TERMINAL FLAG MODE COMMAND – NON-BROADCAST	5	24	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: OVERRIDE INHIBIT TERMINAL FLAG MODE COMMAND – BROADCAST	5	23	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: TRANSMIT VECTOR WORD MODE COMMAND – NON-BROADCAST	5	22	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: SYNCHRONIZE (WITH DATA WORD) MODE COMMAND – NON-BROADCAST	5	21	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: SYNCHRONIZE (WITH DATA WORD) MODE COMMAND – BROADCAST	5	20	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: TRANSMIT LAST COMMAND SEQUENCE MODE COMMAND – NON-BROADCAST	5	19	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: TRANSMIT BIT WORD MODE COMMAND – NON-BROADCAST	5	18	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: SELECTED TRANSMITTER SHUTDOWN MODE COMMAND – NON-BROADCSAT	5	17	0B	0B	PROHIBITED MODE COMMAND FOR AS5653

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FC-AE-1553 PRLI SERVICE PARAMETER	WORD	BIT(S)	VALUE FOR NC	VALUE FOR NT	NOTES
NT: SELECTED TRANSMITTER SHUTDOWN MODE COMMAND – BROADCAST	5	16	0B	0B	PROHIBITED MODE COMMAND FOR AS5653
NT: OVERRIDE SELECTED TRANSMITTER SHUTDOWN MODE COMMAND-NON-BROADCAST	5	15	0B	0B	PROHIBITED MODE COMMAND FOR AS5653
NT: OVERRIDE SELECTED TRANSMITTER SHUTDOWN MODE COMMAND – BROADCAST	5	14	0B	0B	PROHIBITED MODE COMMAND FOR AS5653
NT: TRANSMIT RT ADDRESS MODE COMMAND – NON-BROADCAST	5	13	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: TRANSMIT NT_CS_BURST_TOV MODE COMMAND – NON-BROADCAST	5	12	X	1B	INVOCABLE MODE COMMAND FOR AS5653
NT: USE OF ABTS BASIC LINK SERVICE AND RRQ EXTENDED LINK SERVICE TO ABORT ERRONEOUS EXCHANGES	5	11	0B	0B	PROHIBITED FEATURE FOR AS5653
RESERVED	5	10-0	000 0000 0000B	000 0000 0000B	
MAXIMUM NUMBER OF BYTES TO RECEIVE FOR FIRST DATA SEQUENCE WITH DELAYED NT BURST SIZE REQUEST = 1	6	31-0	00 00 00 00H	00 00 00 00H	PROHIBITED FEATURE FOR AS5653
NT_C/S_TOV	7	31-16	X	00A0H	NT TIMER; VALUE = 10 µS
NT_C-D/S_BURST_TOV	7	15-0	X	7FF3H	NT TIMER; DEFAULT VALUE = 8.38 S (MAX) [3].
NC_C/S_TOV	8	31-16	0640H	X	NC TIMER; VALUE = 100 µS
NC_C-D/S_BURST_TOV	8	15-0	7FF3H	X	NC TIMER; DEFAULT VALUE = 8.38 S (MAX) [3].
C-S/D_TX _TOV	9	31-16	0190H	0190H	NC AND NT TIMER; VALUE = 25 µS
C-S/D_RX_TOV	9	15-0	0320H	0320H	NC AND NT TIMER; VALUE = 50 µS

FOR AS5653, THE PRLI ORIGINATOR IS AN NC, WHILE AN NT WILL BE A PRLI RESPONDER.

"X" = DON'T CARE. HOWEVER, FOR AN NT WITH NC CAPABILITY, THE VALUE OF "X" FOR A GIVEN PRLI PARAMETER IN THE "NT" COLUMN SHALL MATCH THE CORRESPONDING VALUE INDICATED IN THE "NC" COLUMN. SIMILARLY, FOR AN NC WITH NT CAPABILITY, THE VALUE OF "X" FOR A GIVEN PRLI PARAMETER IN THE "NC" COLUMN SHALL MATCH THE CORRESPONDING VALUE INDICATED IN THE "NT" COLUMN.

[3] THE 8.38 S VALUE OF AN NT'S NT_C-D/S_BURST_TOV TIMER IS THE MAXIMUM VALUE SET AS A DEFAULT. THE NC CAN INTERROGATE AN NT, BY MEANS OF A TRANSMIT NT_C-D/S_BURST_TOV MODE COMMAND, TO ESTABLISH THE ACTUAL VALUE BEING USED BY THE NT. THE NC MAY ADJUST THE VALUE OF ITS NC_C-D/S_BURST_TOV TO CORRESPOND.

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4.2 Fibre Channel Level 3 Common Services

No profiling needs to be done at Fibre Channel Level 3.

4.3 Fibre Channel Level 2 Framing Protocol & Flow Control

4.3.1 Switch Fabric Type

The switch fabric shall be non-blocking.

```
A non-blocking switch fabric is specified to ensure minimal transport delays.
```

4.3.2 Order of Delivery

The fabric shall ensure in-order delivery of frames

4.3.3 Fabric Initialization

The ASI, MSI, CSI & CSSI shall use the Fast Fabric Initialization process defined in FC-SW-4 Annex D. The AE_Principal switch function shall be provided at the ASI or above. At the ASI and CSSI, the switch port type shall be determined explicitly via the Exchange Link Parameters (ELP) command.

```
This states that Fibre Channel Fast Fabric Initialization is to be used to start the
network and track the available nodes.

The switch port type (AE_Port or F_Port) at the ASI and CSSI must be determined explicitly
because it cannot be known ahead of time if the port is connected to an N_Port or another
AE_Port.  The CSI will always be an AE_Port.
```

4.3.4 Domain Identity Storage

Fabric switching elements that are part of carriage store or carriage system shall

a) discard their Domain_ID when power is removed.

b) not have implicit knowledge of its Domain_ID.

```
Some Fibre Channel Switches can remember their address.  This explicitly prohibits storage
of Domain Identity in a carriage store, or carriage system.
```

4.3.5 Address Assignment

The fabric shall provide address identifiers to attached N_Ports during Fabric Login.

4.3.6 N_Port and Store Initialization

Within 150 ms of power application an MSI or Carriage Store internal N_port shall be capable of accepting PLOGI Request and transmitting either a PLOGI Accept or PLOGI Reject.

```
This requirement aims to mimic the initialization provided by MIL-STD-1760.
```

4.3.7 Fibre Channel Login

ASI, MSI, CSI, CSSI & Carriage store internal N-ports shall initiate and respond to login sequences as detailed in Table 6.

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4.3.7.1 Fabric Login

ASI (when acting as an F_Port), MSI, CSSI, & Carriage Store Internal N_ports shall only use explicit Fabric Login (FLOGI) as defined in FC-FS. FLOGI is initiated by the attached N_Port. When initiating FLOGI, the attached N_Ports shall use an address identifier (Source_ID) of “000000h”.

```
Fabric Login is how the N_Port learns a) that a Fabric is present, and b) its address identifier.
```

4.3.7.2 N_Port Login

N_Ports above the ASI, MSI & Carriage Store internal N_Ports shall only use explicit N_Port Login (PLOGI) described in FC-FS. PLOGI shall be initiated by an N_Port above the ASI.

```
N_Port Login must be initiated by an N_Port above the ASI because the N_Ports below the ASI do not know the address identifiers of N_Ports above the ASI until login occurs.
```

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