

FIBRE CHANNEL

ENERGY EFFICIENT

(FC-EE)

REV 0.1

INCITS working draft proposed
Technical Report

November 17, 2017

Secretariat: Information Technology Industry Council

NOTE:

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- Initial revision.

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Fibre Channel — Energy Efficient (FC-EE)

Secretariat

Information Technology Industry Council

Approved (not yet approved)

American National Standards Institute, Inc.

Abstract

This standard describes the Link Services requirements. The Physical Interface requirements are described in Fibre Channel-Physical Interfaces - 5 (FC-PI-5). The Framing and Signaling requirements are described in Fibre Channel-Physical Framing and Signaling - 3 (FC-FS-4). This standard is recommended for new implementations but does not obsolete the existing Fibre Channel standards.

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Foreword (This Foreword is not part of Technical Report INCITS TR-53-20xx.)

The Fibre Channel Energy Efficient (FC-EE) technical report describes an overview and references for Energy Efficient Fibre Channel.

This technical report was developed by the INCITS Fibre Channel T11 Technical Committee of Accredited Standards Committee INCITS during 20xx-20xx. The standards approval process started in 20xx.

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, 1101 K Street, NW Suite 610 Washington, DC 20005.

This technical report was processed and approved for submittal to ANSI by the International Committee for Information Technology Standards (INCITS). Committee approval of the technical report does not necessarily imply that all committee members voted for approval.

At the time it approved this technical report, INCITS had the following members:

(to be filled in by INCITS)

Technical Committee T11 on Fibre Channel Interfaces, which reviewed this technical report, had the following voting members:

Steve Wilson, Chair
Craig W. Carlson, Vice-Chair
Richard Johnson, Secretary

Company	Name
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Task Group T11.3 on Fibre Channel Protocols, which developed and reviewed this technical report, had the following voting members:

Craig W. Carlson, Chair
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Patty Driever, Secretary

Company	Name
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Introduction

FC-EE is one of the Fibre Channel family of standards and technical reports. This family includes INCITS 488:2016, FC-FS-4, which specifies the Framing and Signalling Interface. INCITS 511:2016, FC-SW-6, is related to Fabric requirements. INCITS 332:1999, FC-AL-2, specifies the arbitrated loop topology.

FC-EE defines an overview and references for Energy Efficient Fibre Channel.

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Fibre Channel — Energy Efficient (FC-EE)

1 Scope

FC-EE describes an overview and references for Energy Efficient Fibre Channel.

2 Normative References

2.1 Overview

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

Copies of the following documents may be obtained from ANSI, an ISO member organization:

Approved ANSI standards; approved international and regional standards (ISO and IEC); and approved foreign standards (including JIS and DIN).

For further information, contact the ANSI Customer Service Department:

Phone +1 212-642-4900
Fax: +1 212-302-1286
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E-mail: ansionline@ansi.org

or the InterNational Committee for Information Technology Standards (INCITS):

Phone 202-737-8888
Web: <http://www.incits.org>
E-mail: incits@itic.org

Additional availability contact information is provided below as needed.

2.2 Approved references

INCITS 488:2016, *Fibre Channel - Framing and Signaling - 4 (FC-FS-4)*

INCITS 487:2017, *Fibre Channel – Link Services – 3 (FC-LS-3)*

INCITS 511:2016, *Fibre Channel - Switch Fabric - 6 (FC-SW-6)*

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.

INCITS 545, *Fibre Channel - Framing and Signaling - 5 (FC-FS-5)*

INCITS 553, *Fibre Channel – Link Services – 4 (FC-LS-4)*

INCITS 547, *Fibre Channel - Switch Fabric - 7 (FC-SW-7)*

3 Definitions and conventions

3.1 Overview

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

3.2 Definitions

3.2.1 Low Power Idle (LPI)

primitive signal sent in place of Idle which indicates that the transmitter is operating in, or wishes to operate in Low Power mode

Note 1 to entry: See FC-FS-4.

3.2.2 LPI Mode

link state in which the link is operating or wishing to operate in lower power mode by sending LPI

Note 1 to entry: See FC-FS-4.

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/British convention of decimal number representation is used in this standard. Numbers may be separated by single spaces into groups of three digits counting from the decimal position, and a period is used as the decimal marker. A comparison of the ISO/British, ISO/French, and American conventions is shown in table 1.

Table 1 – Comparison of numbering conventions

ISO/British	ISO/French	American
0.6	0,6	0.6
3.14159265	3,141 592 65	3.14159265
1 000	1 000	1,000
1 323 462.9	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.

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 use the style shown in figure 1.

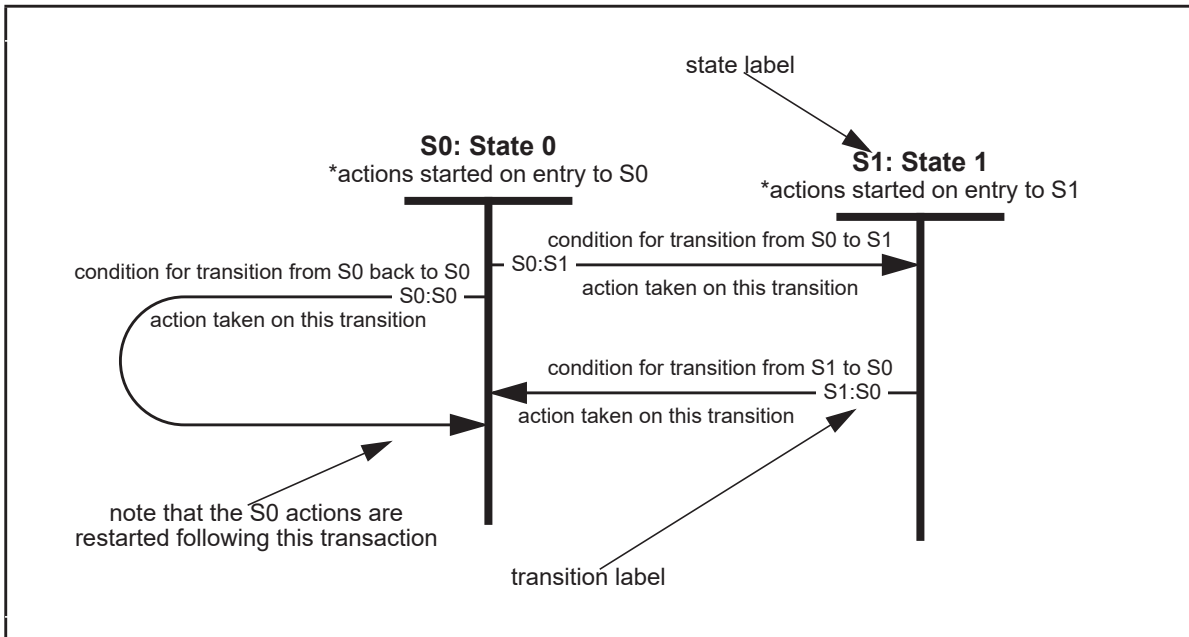


Figure 1 – State Machine Example

These state machines make three assumptions:

- a) Time elapses only within discrete states.
- 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.

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.

LPI Low Power Idle

3.6 Symbols

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

	concatenation
m	micro (e.g., μm = micrometer)

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 successively 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 Energy Efficient Fibre Channel

The Energy Efficient Fibre Channel capability provides a protocol and associated physical layer capabilities to allow a Fibre Channel link to operate at a lower power level. The goal of the Energy Efficient Fibre Channel is:

- a) provide a protocol to allow transitions to and from a lower power level;
- b) allow such transition to occur without changing the link status, dropping, or corrupting frames; and
- c) provide a transition time that is small enough such that it is transparent to the upper level protocols (i.e., minimum impact on link bandwidth and latency).

Energy Efficient operation is negotiated per link using a login bit either in the FLOGI/PLOGI, for N_Ports, and F_Ports, or in the ELP for E_Ports (see FC-LS-3).

Energy Efficient operation is achieved by entering the Low Power Idle (LPI) mode (figure 2). During Low Power Idle mode, the link is still active, but enters periods of lower power level operation. When one of the link partners has data to transmit, a wake-up signal is sent to indicate that the link should return to a full power operation.

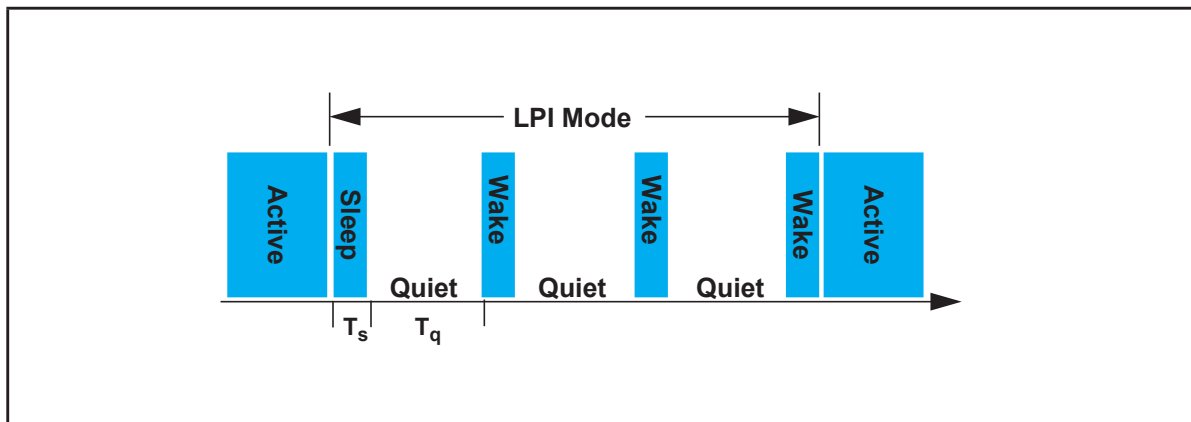


Figure 2 – Overview of LPI Mode operation

For the complete definition of Energy Efficient Fibre Channel see FC-FS-4.