

# ST over Fibre Channel

## Content for T11.1/Project 1245-D

### Annex A (Fibre Channel as Lower Layer)

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#### A.1 Fibre Channel as LLP

*Fibre Channel Physical Interface*, X3.230-1994 and X3.230/AM1: 1996 describes the FC-PH link and protocol. Within the Fibre Channel Physical Interface document, Annex S describes the model for using the FC-PH service interface, which is used as the basis for FC-LE. FC-LE specification in turn is the basis for mapping ST as the ULP.

*Fibre Channel Link Encapsulation (FC-LE)*, X3.287-1996 specifies generic protocol encapsulation for Fibre Channel networks. Class 1, class 2, or class 3 service may be used for ST encapsulation using FC-LE services on one or more FC-PH links.

Although FC-LE encapsulation of ST permits bridging and routing, no attempt is made to describe bridging or routing beyond a fabric region as described for FC-LE. A fabric region is equivalent to a LAN segment.

Mapping ST on FC-LE is similar to ST on HIPPI-FP. The LLP header has two parts, the FC-PH Frame header and the optional Network header, which includes the MAC header, as defined for FC-PH, and the SNAP header, as defined for FC-LE. The optional Network header is required for the first FC-PH Frame, but is not included with subsequent FC-PH Frames in an FC-PH Sequence. The ST header appears once for each control operation and once for each STU in a data operation.

Figure 1 depicts the ST header following the FC-PH Frame and Network headers.

Because FC-PH physical addresses are used for the network routing within the FC region (LAN segment), address resolution services are also provided with the FC-PH and FC-LE standards. The implementation of these services is outside the scope of this description. However, the Network header format is depicted in Figure 2.

**Figure 1. Frame Content**

The LLC/SNAP header is an 8-byte header as defined by 802.3 LLC-SNAP with the following field assignments:

- LLC DSAP byte shall contain (1010 1010) or 0xAA
- LLC SSAP byte shall contain (1010 1010) or 0xAA
- LLC CTL byte shall contain (0000 0011) or 0x03 for Unnumbered Info
- SNAP Organization Code (24 bits) shall be zero
- SNAP Type or Ethertype field (16 bits) shall be set as defined in Assigned Numbers (ST = 0x8181)

The ST Request\_Port process establishes virtual connections in the ULP using CCI parameters to provide destination and source addresses. FC-LE services may be used to establish address resolution within the FC-LE region. These services provide FC-PH Port addressing for the FC-PH routing.

The FC-LE layer shall use the destination address and the source address to discover, and include in the FC-PH frame, the destination and source ids, respectively. Additionally, the network destination and source addresses shall be included in the network destination and source address fields of the Network header when required. The FC-LE layer shall also use the ethertype field from the CCI information to include in the SNAP header when required.

Each ST transfer uses one or more FC-PH Exchanges. An FC-PH Exchange consists of one or more related non-concurrent FC-PH Sequences, hence an ST transfer will use more than one FC-PH Exchange to permit concurrency for Block transfers. Each ST Block will use one FC-PH Sequence.

Each STU may use up to  $2^{16}$  FC-PH Frames within an FC-PH Sequence, the FC-PH Frame quantity within an FC-PH Sequence is limited by the 16-bit SEQ CNT field. Each FC-PH Frame may contain up to  $2^{11}$  bytes of STU payload. Consequently, the max-STU size is limited to  $2^{27}$  bytes.

Neither FC-PH Class 1, Class 2, nor Class 3 service provides virtual circuits or virtual channels, therefore both Control and Data Operations are queued and processed in fifo order when a single Class of service and one fibre channel is employed.

Class 1 may be used with the Intermix option to permit interleaving either Class 2 or Class 3 frames within a Class 1 Sequence. Class 2 and Class 3 services multiplex frames on frame boundaries. Hence, more than one Class of service may be used to create behavior similar to virtual channels. In this case, Control Operations and Data Operations may be interleaved or multiplexed: there is no requirement for all the STUs of a multi-STU block to be transmitted contiguously on the medium.

Although operations are transmitted in order, for Class 3, the fabric may not deliver them in the same order. ST requires in-order transmission and delivery of STUs, but it is expected that many implementations will handle out-of-order Blocks. So, if the FC-LE service cannot preserve ordering, then the Blocksize should be set to equal the STU size.

Fabric Loop Attachment has been profiled in T11/Project 1235-DT/Rev 2.6. When the Fabric Loop Attachment profile is used as a part of the topology employed for ST protocol, Class 1 is prohibited.

When more than one fibre channel is employed, striping should follow principles provided in Annex B.