The Need for Fibre Channel Standards

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In the world of information technology, companies investing in Fibre Channel (FC) SANs must ensure that they use products and product components that work interchangeably with other products from other companies. Having multiple suppliers is often considered essential for business continuity purposes.

In other words, there is a business-critical demand for standards that document requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.

International Standards Organization (ISO) standards are developed according to strict rules to ensure that they are transparent and fair. It can take time to develop consensus among the materially interested parties and for the resulting agreements to go through the public review process in the ISO member countries. However, the resulting standards underpin the deployment of FC SAN technologies.

For some users of standards, particularly those working in fast-changing information technology sectors, it may be more important to agree on a technical specification and publish it quickly, before going through the various checks and balances needed to win the status of a full international standard. Therefore, to meet such needs, ISO has developed a new range of deliverables defined by four different categories of specifications.

These four categories allow for publication of a specification at intermediate stages (with associated adoption risks of development) before full consensus is reached:

1. Publicly Available Specification (PAS)
2. Technical Specification (TS)
3. Technical Report (TR)
4. International Workshop Agreement (IWA)

It must also be noted that not all technology standards we talk about are issued by ISO or one of its Technical Committees. There are a few different standards settings organizations (SSOs), which may have differing structures and rules with implied levels of adoption risk.

The Fibre Channel Industry Association (FCIA) supports, participates, and promotes FC T11 standard developments because full consensus standardization is an integral part of FC technologies. FC standards help companies realize many benefits because of the provided measurable conformance criteria. Standardization improves efficiency in design, development, and material acquisition. Products built using FC standards facilitate interchangeability and compatibility. This results in FC SAN technologies being the right choice for business critical demands and provides increased business continuity, reduced inventory, reduced number of supply sources, increased worker productivity and economies of scale operations.

Because of FC standards, FC SAN designers can be confident that they are designing with products that embody recognized and measurable practices. Standards allow technology to work seamlessly and establish trust so that technical risks are minimized by using components that are proven to work for the intended application. Full consensus-based standardized FC SAN technologies are mature, well known, and provide qualified solutions for high-speed storage communications. Additionally, consumers (and producers!) of FC standards have the added knowledge that a breach of these standards can mean answering to the representative standards bodies.

In summary, FC standards:
- Provide a common language to measure and evaluate performance,
- Make interoperability of components made by different companies possible, and
- Protect users by ensuring predictable behaviors, reliability, and performance.

What is INCITS?

INCITS -- the InterNational Committee for Information Technology Standards – colloquially pronounced as "Insights" -- is the central U.S. forum dedicated to creating technology standards for the next generation of innovation. INCITS members combine their expertise to create the building blocks for globally transformative technologies. The T11 Technical Committee is governed by the INCITS standards development platforms.

INCITS T11 is the parent committee of Task Groups T11.2 and T11.3. INCITS T11 coordinates the work of the Task Groups and retains overall responsibility for work area. INCITS T11 held its first meeting in February, 1994 and continues to hold FC standards development meetings six times a year.

INCITS T11 Technical Committee relies on the expertise of member engineers, entrepreneurs, developers, and other top-notch professionals to create consensus-driven, market-relevant FC standards that are at the heart of the FC SAN industry. Participation in the T11 Committee is open to anyone materially and directly affected by the work of these Task Groups. The diagram below provides context for how INCITS T11 is organized under the direction of the ISO American National Standards (ANS) process and governance.
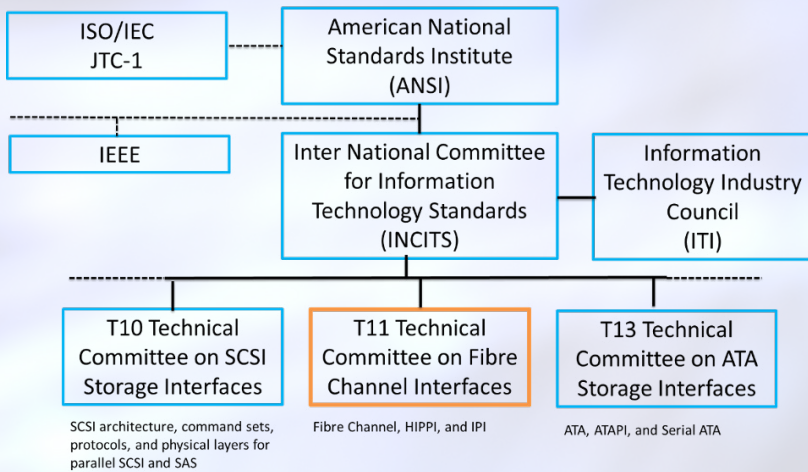
The physical variants Task Group T11.2 is the Task Group within the T11 Technical Committee responsible for all projects and parts of projects dealing with physical variants i.e. media, connector, transmitter, and receiver requirements. T11.2 held its first meeting on August 5, 1997 and continues to develop FC technologies today. It recently standardized FC-PI-7 which includes 64GFC single link and parallel links 256GFC, and is developing the next generation of transport speedup.

T11.3 is the Task Group within the T11 Technical Committee responsible for all FC projects which define Fibre Channel Interconnection Schemes. T11.3 held its first meeting on April 23, 1998. The primary focus of T11.3 activities has been directed towards the FC family of transport standards. It should be noted that included in the FC family are mappings which allow protocols from the IP, HIPPI, and NVM Express™ (NVMe™) standards families to be transported across FC.

The three INCITS committees, T10, T11, and T13 are aligned with focus on T10 and SCSI, T11 and FC, and T13 and ATA. These three committees support each other and work jointly to embrace new technologies and advance current technologies. For example, T10 and T11 have actively contributed to, and added support for the NVMe specifications.

ISO/IEC JTC-1	American National Standards Institute (ANSI)	
IEEE	Inter National Committee for Information Technology Standards (INCITS)	Information Technology Industry Council (ITI)
T10 Technical Committee on SCSI Storage Interfaces	T11 Technical Committee on Fibre Channel Interfaces	T13 Technical Committee on ATA Storage Interfaces
SCSI architecture, command sets, protocols, and physical layers for parallel SCSI and SAS	Fibre Channel, HIPPI, and IPI	ATA, ATAPI, and Serial ATA

FCIA is a mutual benefit, non-profit international organization of manufacturers, system integrators, developers, vendors, industry professionals and end users and provides market direction to the INCITS T11 Task Groups and committees. FCIA members contribute to the marketing of FC solutions.

As an example of the INCITS T11 standardization process, in 2018 there was a need for higher-speed FC networks, faster uplinks, and faster Inter-Switch links. A proposal to do just this, called FC-PI-7, was developed through the work of the INCITS technical committees, T11, T11.2, and T11.3 with market guidance from the FCIA.

Two of the most important aspects of FC are backwards compatibility and "plug and play" to utilize existing infrastructure with new speeds. In FC terms, these are "must-haves," and so they were defined in the FC-PI-7 scope of work along with the requirement to use existing cable assemblies and realize reach goals of 100 meters. The technical requirements of backward compatibility with 32GFC and 16GFC versions of the FC-PI-7 standard were addressed by experts in specific disciplines.

The need for FC to operate over long and short distances is also critical, so the scope of work included a 10KM optical variant and an electrical variant for backplane and adapter applications. The FC-PI-7 standards for 64GFC enabled twice the throughput of 32GFC. Now, of course, you can't just have long links – you also need to have high-quality links as well.

To that end, then, FC-PI-7 also included a corrected bit-error-rate (BER) target of 1e-15 and utilized advanced bit error recovery achieved through use of forward error correction (FEC). FEC is a method of obtaining error control in data transmission in which the source (transmitter) sends redundant data and the destination (receiver) recognizes only the portion of the data that contains no apparent errors.

Once the FC-PI-7 standard writing and reviewing was complete, inclusive of a public review, the standard was forwarded and then approved by the INCITS Executive Board for ANSI/ISO publication. The Executive Board is the INCITS consensus body and has the ultimate responsibility for standards developed and approved by INCITS. When the process was complete, this 5th revision of the FC physical layer standard was published, having evolved to 6400MB/s per port from 1/2/4GFC to 64GFC, or 100MB/s.

A second example is the update and enhancement of an INCITS standard which was ratified in 2017, FC-NVMe. The FC-NVMe INCITS standard defines the mapping of

NVMe™ over Fabrics (NVMe-oF™) to the FC interface. FC-NVMe-2 is also a ratified standard, having been completed by the T11-3 Technical Committee and approved by the INCITS Executive Board.

Published INCITS T11 FC standards are maintained on a periodic review cycle, and may be amended. This is a major benefit to those who have materially invested in FC SAN standards and technologies and plan to continue those investments with standards-based technology refreshes.

For more information on how FC standards are made, read my blog series here where I discuss these topics in more detail.