THE FIBRE CHANNEL PROTOCOL STACK

Fibre Channel is currently (2009) the technique most frequently used for implementing storage networks. Interestingly, Fibre Channel was originally developed as a backbone technology for the connection of LANs. The original development objective for Fibre Channel was to supersede Fast-Ethernet (100 Mbit/s) and Fibre Distributed Data Interface (FDDI). Meanwhile Gigabit Ethernet and 10-Gigabit Ethernet have become prevalent or will become prevalent in this market segment.

By coincidence, the design goals of Fibre Channel are covered by the requirements of a transmission technology for storage networks such as:

• Serial transmission for high speed and long distances;

• Low rate of transmission errors;

• Low delay (latency) of the transmitted data;

• Implementation of the Fibre Channel Protocol (FCP) in hardware on HBA cards to free up the server CPUs

In the early 1990s, Seagate was looking for a technology that it could position against IBM's SSA. With the support of the Fibre Channel industry, Fibre Channel was expanded by the arbitrated loop topology, which is cheaper than the originally developed fabric topology. This led to the breakthrough of Fibre Channel for the realisation of storage networks.

Fibre Channel is only one of the transmission technologies with which storage area networks (SANs) can be realised. Nevertheless, the terms 'Storage Area Network' and 'SAN' are often used synonymously with Fibre Channel technology. In discussions, newspaper articles and books the terms 'storage area network' and SAN are often used to mean a storage area network that is built up using Fibre Channel. The advantages of storage area networks and server-centric IT architectures can, however, also be achieved using other technologies for storage area networks, for example, iSCSI and FCoE. In this book we have taken great pains to express ourselves precisely. We do not use the terms 'storage area network' and 'SAN' on their own. For unambiguous differentiation we always also state the technology, for example, 'Fibre Channel SAN' or 'iSCSI SAN'. In statements about storage area networks in general that are independent of a specific technology we use the term 'storage network'. We use the term 'Fibre Channel' without

the suffix ‘SAN’ when we are referring to the transmission technology that underlies a Fibre Channel SAN.

For the sake of completeness we should also mention that the three letters ‘SAN’ are also used as an abbreviation for ‘System Area Network’. A System Area Network is a network with a high bandwidth and a low latency that serves as a connection between computers in a distributed computer system. In this book we have never used the abbreviation SAN in this manner. However, it should be noted that the VIA standard, for example, does use this second meaning of the abbreviation ‘SAN’.

The Fibre Channel protocol stack is subdivided into five layers (Figure 3.8). The lower four layers, FC-0 to FC-3 define the fundamental communication techniques, i.e. the physical levels, the transmission and the addressing. The upper layer, FC-4, defines how application protocols (upper layer protocols, ULPs) are mapped on the underlying Fibre Channel network. The use of the various ULPs decides, for example, whether a real Fibre

Channel network is used as an IP network, a Fibre Channel SAN (i.e. as a storage network) or both at the same time. The link services and fabric services are located quasi-adjacent to the Fibre Channel protocol stack. These services will be required in order to administer and operate a Fibre Channel network. Basic knowledge of the Fibre Channel standard helps to improve understanding of the possibilities for the use of Fibre Channel for a Fibre Channel SAN. This section (Section 3.3) explains technical details of the Fibre Channel protocol. We will restrictthe level of detail to the parts of the Fibre Channel standard that are helpful in the administration or the design of a Fibre Channel SAN. Building upon this, the next section (Section 3.4) explains the use of Fibre Channel for storage networks.

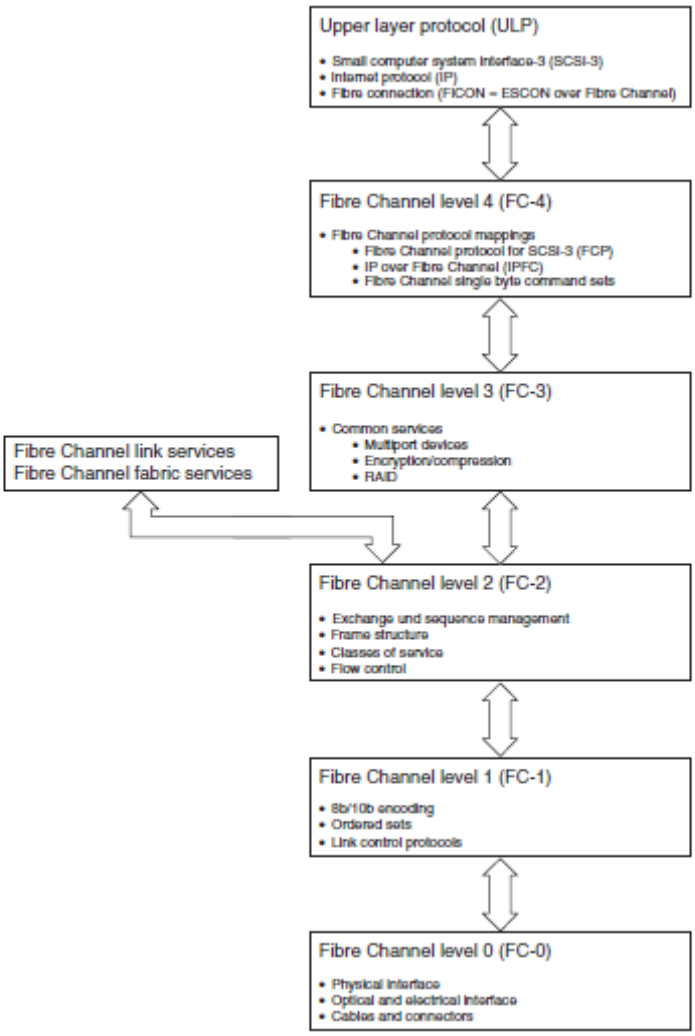

Figure 4.8 The Fibre Channel protocol stack is divided into two parts: the lower four layers (FC-0 to FC-3) realise the underlying Fibre Channel transmission technology. The link services and the fabric services help to administer and configure the Fibre Channel network. The upper layer (FC-4) defines how the application protocols (for example, SCSI and IP) are mapped on a Fibre Channel network.

Source : http://elearningatria.files.wordpress.com/2013/10/cse-viii-storage-area-networks-06cs833-notes.pdf