The Fibre Channel standard defines three different topologies: fabric, arbitrated loop and point-to-point (Figure 3.9). Point-to-point defines a bi-directional connection between two devices. Arbitrated loop defines a unidirectional ring in which only two devices can ever exchange data with one another at any one time. Finally, fabric defines a network in which several devices can exchange data simultaneously at full bandwidth. A fabric basically requires one or more Fibre Channel switches connected together to form a control centre between the end devices. Furthermore, the standard permits the connection of one or more arbitrated loops to a fabric. The fabric topology is the most frequently used of all topologies, and this is why more emphasis is placed upon the fabric topology than on the two other topologies in the following sections.

Common to all topologies is that devices (servers, storage devices and switches) must be equipped with one or more Fibre Channel ports. In servers, the port is generally realized by means of so-called HBAs (for example, PCI cards) that are also fitted in the server.A port always consists of two channels, one input and one output channel.

The connection between two ports is called a link. In the point-to-point topology and in the fabric topology the links are always bi-directional: in this case the input channel and the output channel of the two ports involved in the link are connected together by a cross, so that every output channel is connected to an input channel. On the other hand, the links of the arbitrated loop topology are unidirectional: each output channel is connected to the input channel of the next port until the circle is closed. The cabling of an arbitrated loop can be simplified with the aid of a hub. In this configuration the end things for the larger devices (Figure 3.4).

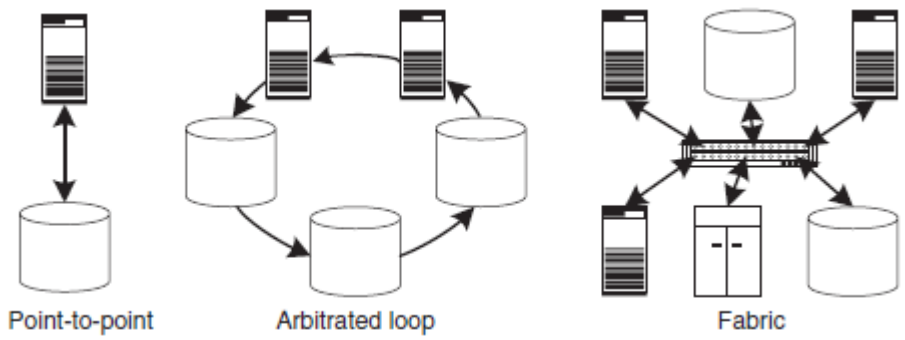


**Figure 4.9** The fabric topology is the most flexible and scalable Fibre Channel topology.

A server can be equipped with several  devices are bi-directionally connected to the hub; the wiring within the hub ensures that the unidirectional data flow within the arbitrated loop is

maintained. The fabric and arbitrated loop topologies are realised by different, incompatible protocols.

We can differentiate between the following port types with different capabilities:

• N-Port (Node Port): Originally the communication of Fibre Channel was developed around N-Ports and F-Ports, with ‘N’ standing for ‘node’ and ‘F’ for ‘fabric’. An N-Port describes the capability of a port as an end device (server, storage device), also called node, to participate in the fabric topology or to participate in the point-to-point topology as a partner.

• F-Port (Fabric Port): F-Ports are the counterpart to N-Ports in the Fibre Channel switch. The F-Port knows how it can pass a frame that an N-Port sends to it through the Fibre Channel network on to the desired end device.

• L-Port (Loop Port): The arbitrated loop uses different protocols for data exchange than the fabric. An L-Port describes the capability of a port to participate in the arbitrated loop topology as an end device (server, storage device). More modern devices are now fitted with NL-Ports instead of L-Ports. Nevertheless, old devices that are fitted with an L-Port are still encountered in practice.

• NL Port (Node Loop Port): An NL-Port has the capabilities of both an N-Port and an L-Port. An NL-Port can thus be connected both in a fabric and in an arbitrated loop. Most modern HBA cards are equipped with NL-Ports.

• FL-Port (Fabric Loop Port): An FL-Port allows a fabric to connect to a loop. However, this is far from meaning that end devices in the arbitrated loop can communicate with end devices in the fabric. More on the subject of connecting fabric and arbitrated loop can be found in Section 3.4.3.

• E-Port (Expansion Port): Two Fibre Channel switches are connected together by E-Ports. E-Ports transmit the data from end devices that are connected to two different Fibre Channel switches. In addition, Fibre Channel switches smooth out information over the entire Fibre Channel network via E-ports.

• G-Port (Generic Port): Modern Fibre Channel switches configure their ports automatically.Such ports are called G-Ports. If, for example, a Fibre Channel switch is connected to a further Fibre Channel switch via a G-Port, the G-Port configures itself as an E-Port.

• B-Port (Bridge Port): B-Ports serve to connect two Fibre Channel switches together via

Asynchronous Transfer Mode (ATM), SONET/SDH (Synchronous Optical Networking/ Synchronous Digital Hierarchy) as well as Ethernet and IP. Thus Fibre Channel SANs that are a long distance apart can be connected together using classical Wide Area Network (WAN) techniques.

Some Fibre Channel switches have further, manufacturer-specific port types over and above those in the Fibre Channel standard: these port types provide additional functions. When using such port types, it should be noted that you can sometimes bind yourselfto the Fibre Channel switches of a certain manufacturer, which cannot subsequently be replaced by Fibre Channel switches of a different manufacturer.

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