Chapter 2: Networking and topologies

2.1 Introduction

The physical layout (or topology) of a network is usually implemented as one of four forms: bus (or multi-drop), star, ring or mesh.

2.2 Bus topology

In a bus topology (see Figure 2.1), all nodes connect to a common media – often called the backbone. Only one node can transmit at a time. All nodes 'hear' all communications and thus while one node is transmitting all the others are listening. However, only the station to which the data is addressed will take notice of the message.

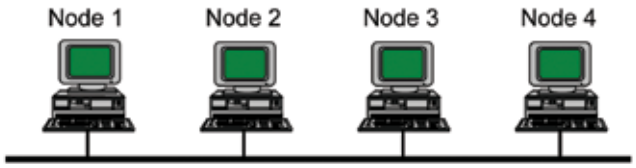

Figure 2.1: In a bus topology all nodes connect to a common media and only one node can transmit at a time.

Variations in the bus topology include: daisy chain, tree, and mainline/trunkline as shown in Figure 2.2.

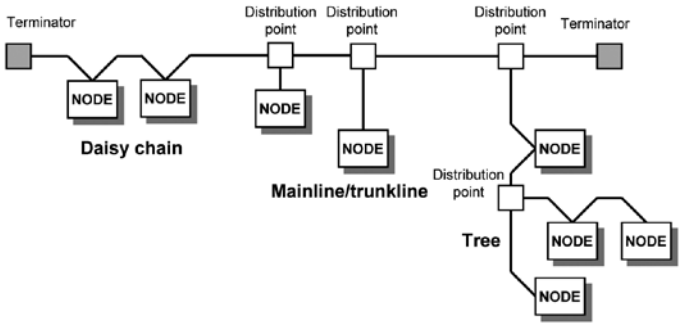

Figure 2.2: Daisy chain, mainline/trunkline and tree configurations.

Since any of the nodes on the bus network can send data at any time, a number of protocols have been developed to regulate access of the devices onto the bus and thus avoid data collisions.

A major benefit of the bus topology is that it is relatively easy to install and nodes are easily added or removed. On the downside, a break in the cable will affect the whole bus.

A major consideration in a bus network is the need to prevent reflections through the use of terminators.

2.3 Star topology

In the star topology, each node has its own network segment that links it back to a central host, called the hub, which controls all communications (see Figure 2.3).

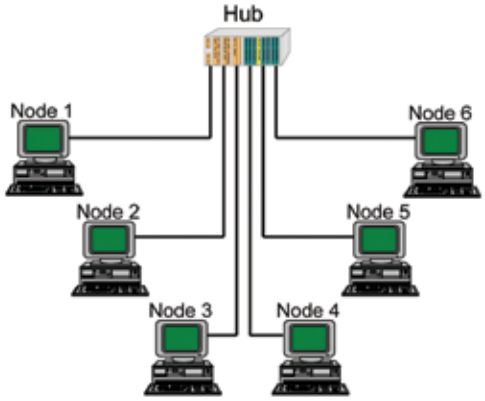

Figure 2.3: In star topology, each node has its own network segment that links it back to a central hub, which controls all communications.

Like star networks, only one node can transmit at a time and each node must look at the data to see if that data has been addressed to it. In a star network, a cable break will only affect the node attached to that cable and all the other nodes will still be able to communicate. Unfortunately, if the hub fails then the entire network fails.

The star network is generally more expensive than the bus configuration because of the need for the hub. In addition, it requires more cabling.

2.4 Ring (or loop) topology

In the ring topology, all the nodes are connected to a single cable that forms a closed loop or ring (see Figure 2.4). Data flows only in one direction – with each node passing the data onto the next node on the line. Each node must, therefore, be capable of regenerating the data before passing it on. Further, the destination node must be capable of removing the data from the network.

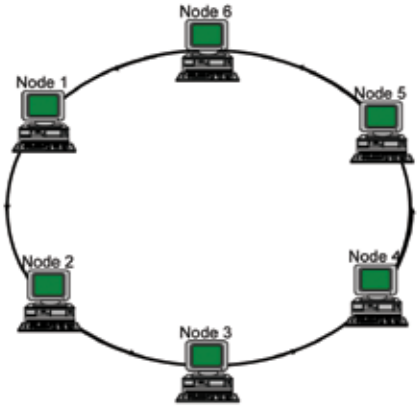

Figure 2.4: In the ring topology, all nodes are connected to a single cable that forms a closed loop or ring, with data flowing in one direction.

Although the most economical, as far as cable is concerned, a major drawback of ring topology is that a break anywhere in the cable will cause the entire network to fail as will the failure

of any node. In practice, the ring network is usually a collapsed ring that looks like a physical star (see Figure 2.5).

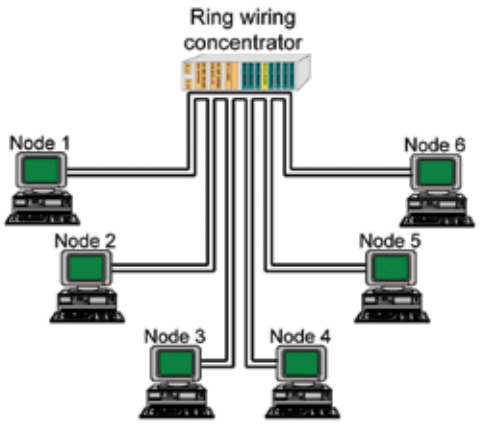

Figure 2.5: Ring network collapsed to look like a physical star.

2.5 Tree topology

A tree topology (see Figure 2.6) combines the characteristics of star and bus topologies. In its simplest form, a hub connects directly to the bus – with each functioning as the root of a tree of devices. The main advantage of this hybrid approach is that it supports future expandability of the network much better than a bus (that is limited in number of devices due to the broadcast traffic it generates) or a star (that is limited by the number of hub connection points) alone.

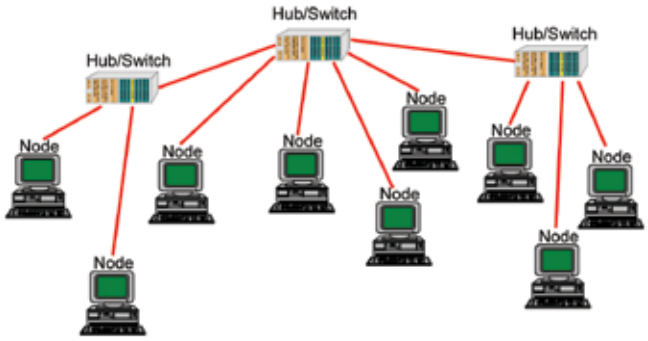

Figure 2.6: A tree topology combines the characteristics of both star and bus topologies.

2.6 Mesh topology

In a mesh network, each node is connected to several others and involves the concept of routes – such that a message can take any of several possible paths from source to destination (see Figure 2.7).

A major feature of mesh networking is that it is self-healing, catering for continued communication in the event that a path should fail. Thus, the most direct route to the hub/switch for Node 1 would be Link D. However, in the event of its failure, the transmission might be routed through Link A to Node 2; Link B to Node 3; and then Link E to the hub/switch.

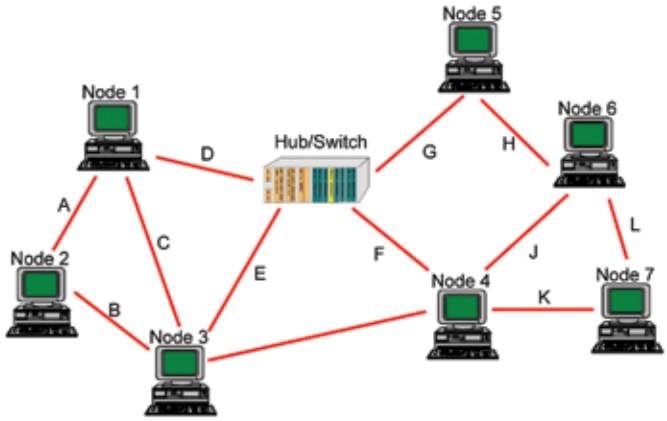

Figure 2.7: In a mesh network, each node is connected to several others and involves the concept of routes – such that a message can take any of several possible paths from source to destination.

The real advantage of mesh networks is that they improve data reliability by providing multiple redundant paths in areas where a lot of nodes are in use. They are not designed, however, for every application. It takes time for paths to form and devices to associate, and additional system delays occur as messages must be forwarded on through the network.

Because mesh networks involve multiple paths, the network protocol must be capable of building and maintaining routing tables to prevent messages from taking 'looped' routes.

We will see how 'looped' routes are avoided in subsequent chapters on spanning tree protocol and its derivatives.