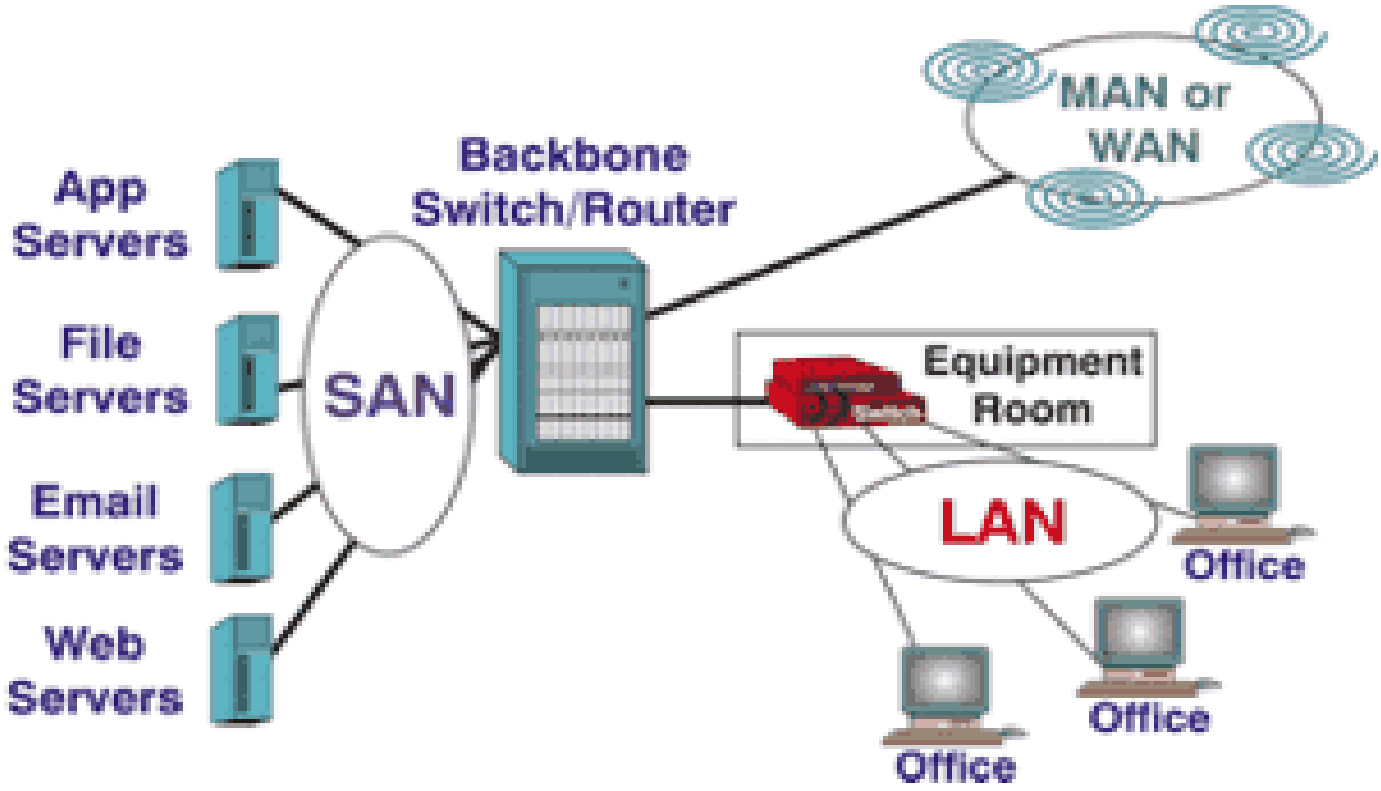
Fiber Optic Network Topologies for ITS and Other Systems

All networks involve the same basic principle: information can be sent to, shared with, passed on, or bypassed within a number of computer stations (nodes) and a master computer (server). Network applications include LANs, MANs, WANs, SANs, intrabuilding and interbuilding communications, broadcast distribution, intelligent transportation systems (ITS), telecommunications, supervisory control and data acquisition (SCADA) networks, etc. In addition to its oft-cited advantages (i.e., bandwidth, durability, ease of installation, immunity to EMI/RFI and harsh environmental conditions, long-term economies, etc.), optical fiber better accommodates today's increasingly complex network. architectures than copper alternatives. Figure 1 illustrates the interconnection between these types of networks.

Figure 1 — Interconnections Between Different Network Types



Networks can be configured in a number of topologies. These include a bus, with or without a backbone, a star network, a ring network, which can be redundant and/or self-healing, or some combination of these. Each topology has its strengths and weaknesses, and some network types work better for one application while another application would use a different network type. Local, metropolitan, or wide area

networks generally use a combination, or "mesh" topology.

Bus Network

Figure 2 — Bus Network Topology

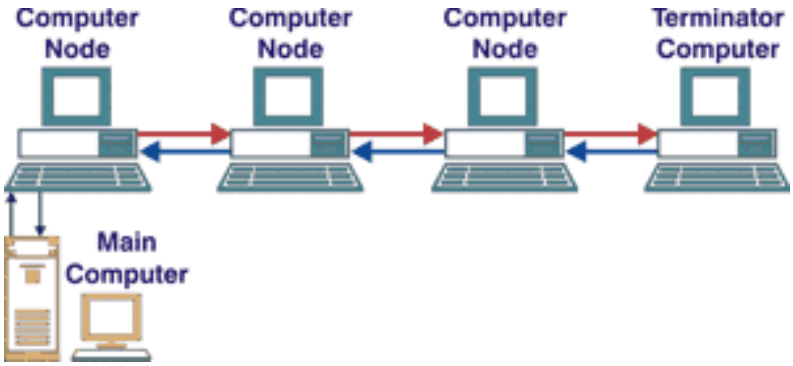
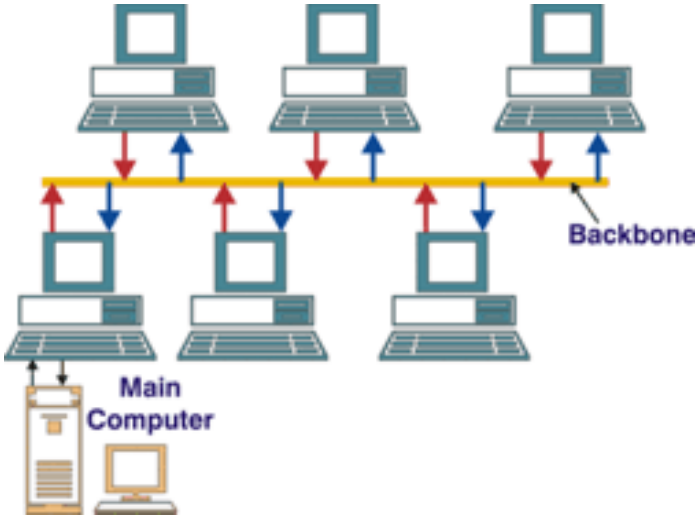


Figure 3 — Bus Network with Backbone

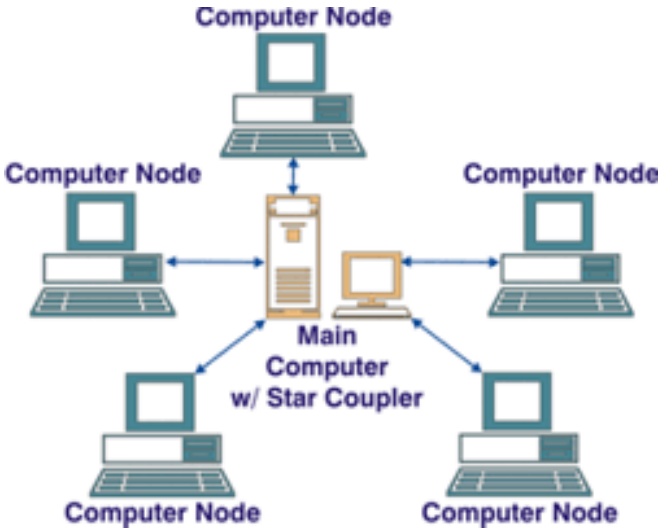


A bus network topology, also called a daisy-chain topology has each computer directly connected on a main communication line. One end has a controller, and the other end has a terminator. Any computer that wants to talk to the main computer must wait its turn for access to the transmission line. In a straight network topology, only one computer can communicate at a time. When a computer uses the network, the information is sent to the controller, which then sends the information down the line of computers until it reaches the terminating computer. Each computer in the line receives

the same information. Figure 2 illustrates a bus network topology. A bus network with a backbone operates in the same fashion, but each computer has an individual connection to the network. A bus network with a backbone offers greater reliability than a simple bus topology. In a simple bus, if one computer in the network goes down, the network is broken. A backbone adds reliability in that the loss of one computer does not disrupt the entire network. Figure 3 illustrates this topology with a backbone.

Star Network

Figure 4 - Star Network Topology

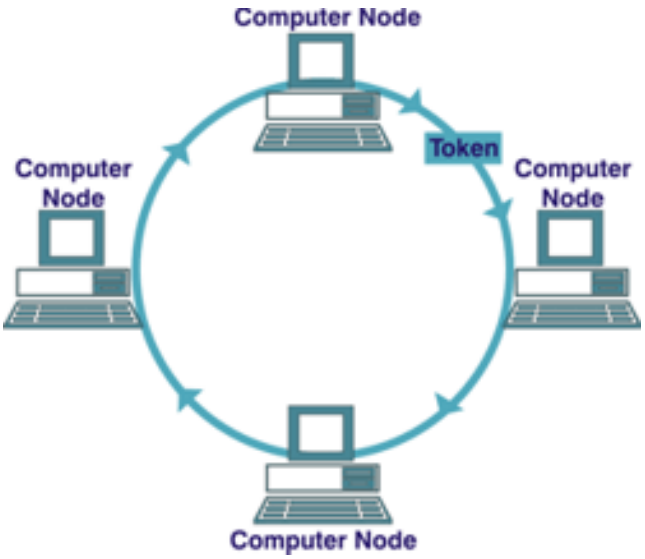


Star networks incorporate multiport star couplers in to achieve the topology. Once again, a main controlling computer or computer server interconnects with all the other computers in the network. As with the bus topology with a backbone, the failure of one computer node does not cause a failure in the network. Figure 4 illustrates a star network topology. Both the bus and the star networktopologies use a central computer that controls the system inputs and outputs. Also called a server, this computer has external connections, to the Internet for example, as well as connections to the computer nodes in the network.

Ring Networks

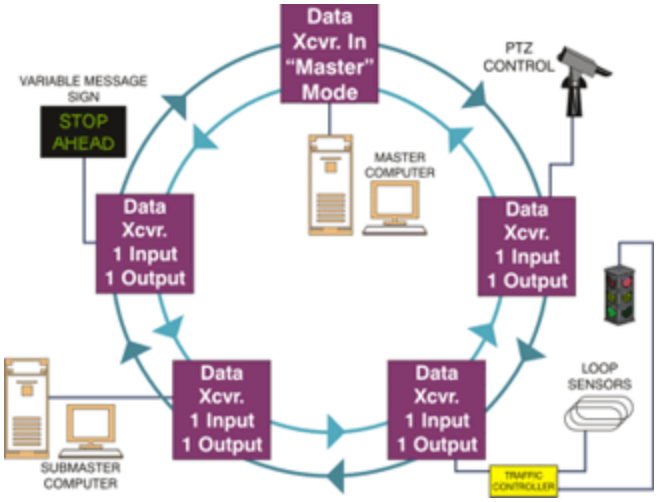
Ring networks operate like bus networks with the exception of a terminating computer. In this configuration, the computers in the ring link to a main communication cable. The network receives information via a "token" containing information requested by one or more computers on the network. The token passes around the ring until the requesting computer(s) have received the data. The token uses a packet of information that serves as an address for the computer that requested the information. The computer then "empties" the token, which continues to travel the ring until another computer requests information to be put into the token. Figure 5 illustrates this topology.

Figure 5 - Token Ring Network Topology



An advanced version of the ring network uses two communication cables sending information in both directions. Known as a counter-rotating ring, this creates a fault tolerant network that will redirect transmission in the other direction, should a node on the network detect a disruption. This network uses fiber optic transceiver, one controlling unit in set in "master" mode along with several nodes that have been set as "remote" units. The first remote data transceiver receives the transmission from the master unit and retransmits it to the next remote unit as well as transmitting it back to the master unit. An interruption in the signal line on the first ring is bypassed via the second ring, allowing the network to maintain integrity. Figure 6 illustrates this configuration as it might be used in a ITS installation.

Figure 6 — Self-healing Ring Topology



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