Network Topologies

LAN topologies

WAN topologies

LAN Topologies

- Physical
  - Describes the geometric arrangement of components that make up the LAN
- Logical
  - Describes the possible connections between pairs of networked end-points that can communicate

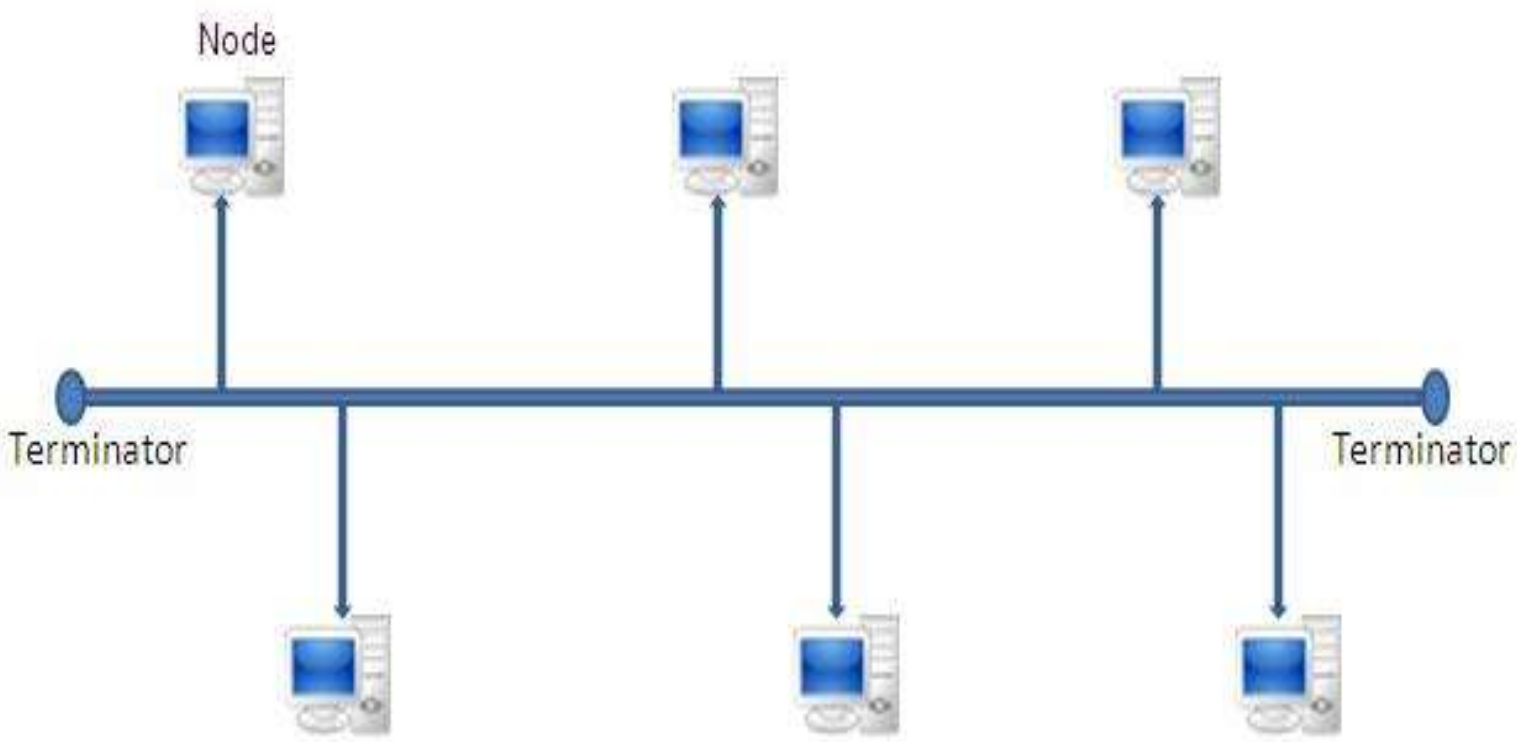
LAN Topologies(Physical)

1) Bus
2) Star
3) Ring
4) Switched
5) Daisy chains
6) Hierarchies

Bus Topology

- All networked nodes are interconnected, peer to peer, using a single, open-ended cable
- Both ends of the bus must be terminated with a terminating resistor to prevent signal bounce

Bus Topology



Advantages of Bus topology

1) Easy to implement and extend
2) Well suited for temporary networks that must be set up in a hurry
3) Typically the least cheapest topology to implement
4) Failure of one station does not affect others

Disadvantages of Bus topology

1) Difficult to administer/troubleshoot
2) Limited cable length and number of stations
3) A cable break can disable the entire network; no redundancy
4) Maintenance costs may be higher in the long run
5) Performance degrades as additional computers are added

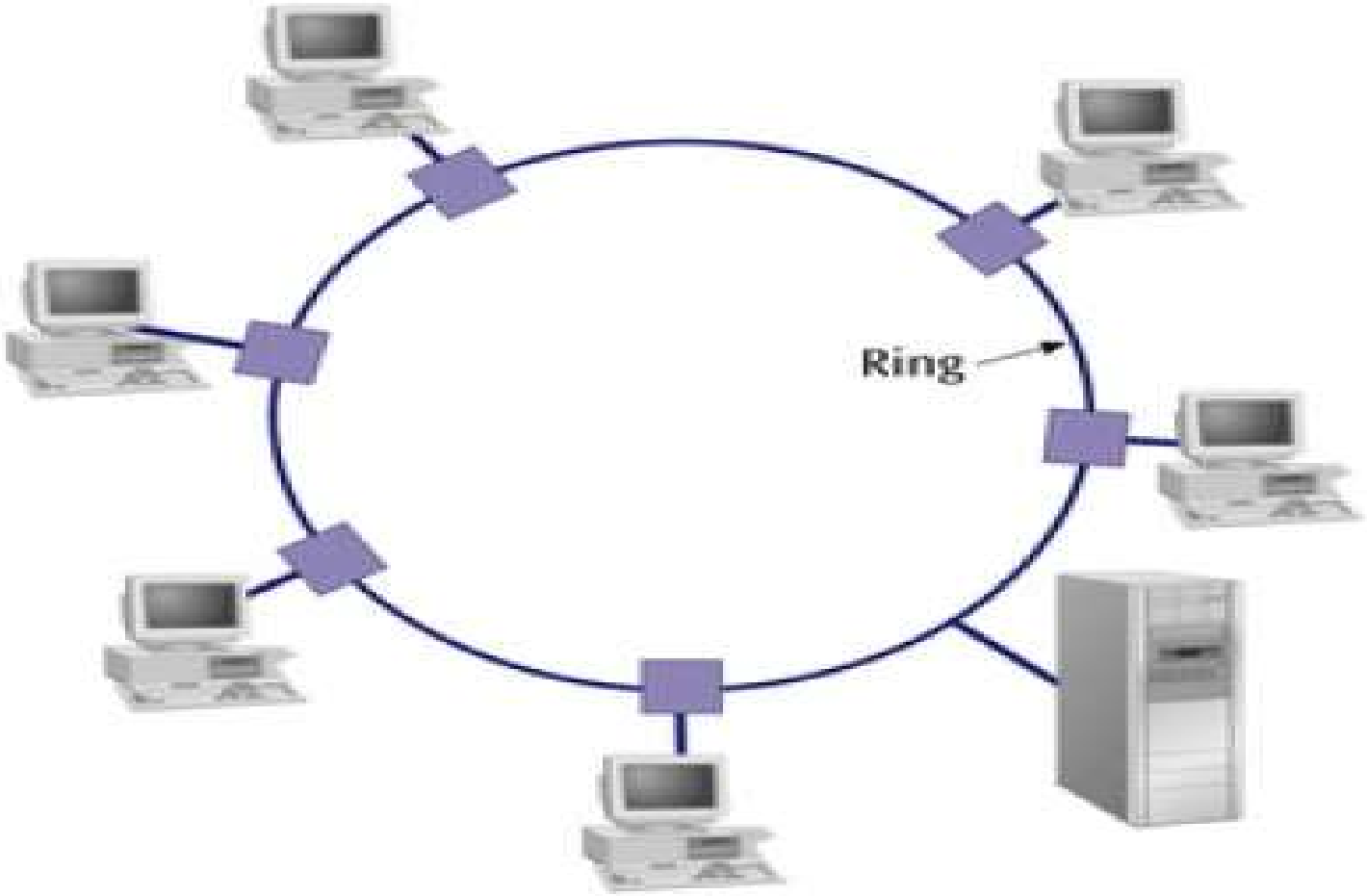
Ring topology

- started out as a simple peer-to-peer LAN topology
- Each networked workstation had two connections: one to each of its nearest neighbors
- Data was transmitted unidirectionally around the ring
- Sending and receiving of data takes place by the help of TOKEN

Token Passing

- Token contains a piece of information which along with data is sent by the source computer
- This token then passes to next node, which checks if the signal is intended to it
  - If yes, it receives it and passes the empty to into the network
  - otherwise passes token along with the data to next node

Ring topology



Advantages of Ring topology

1) This type of network topology is very organized
2) Performance is better than that of Bus topology
3) No need for network server to control the connectivity between workstations
4) Additional components do not affect the performance of network
5) Each computer has equal access to resources

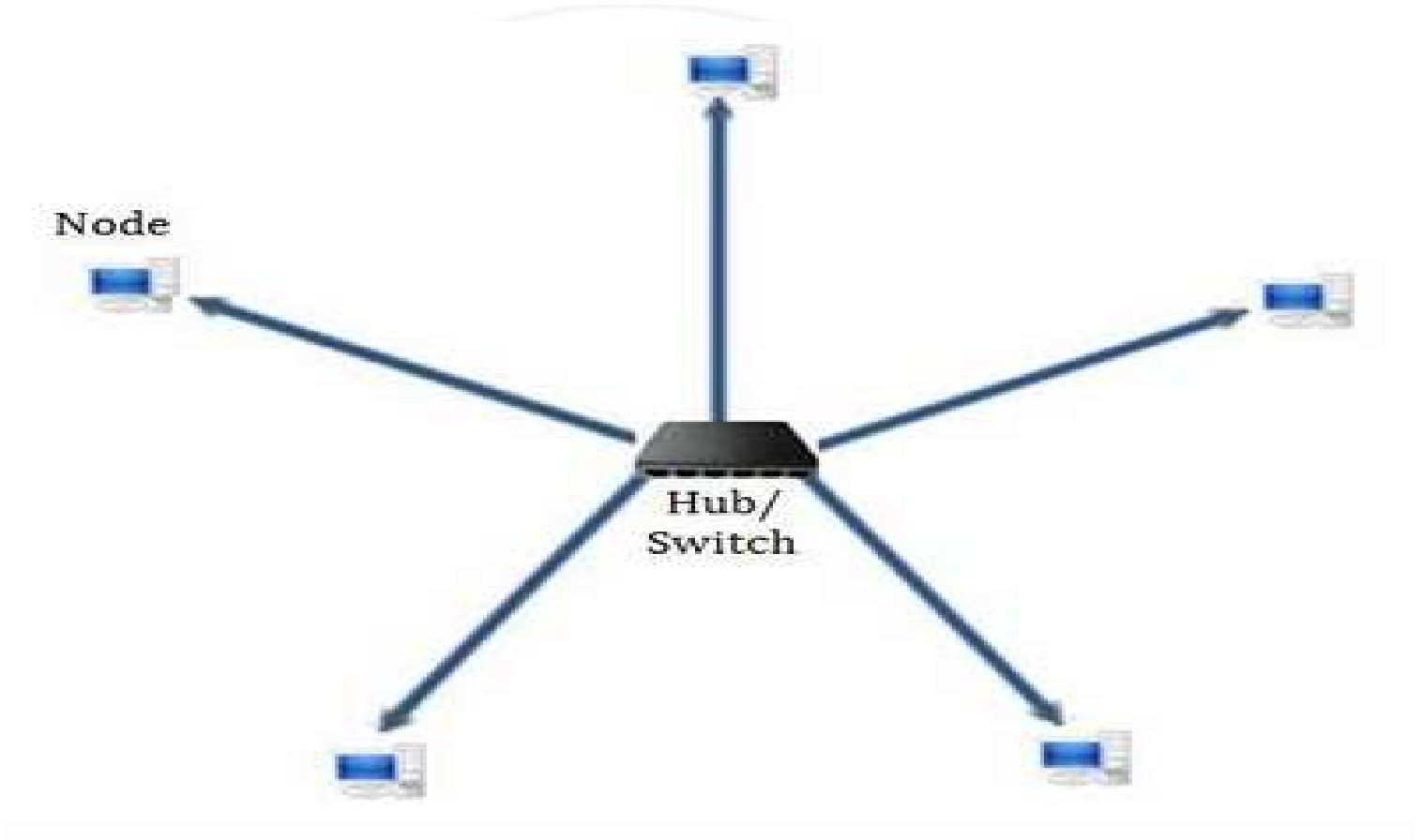
Disadvantages of Ring topology

1) Each packet of data must pass through all the computers between source and destination, slower than star topology
2) If one workstation or port goes down, the entire network gets affected
3) Network is highly dependent on the wire which connects different components

Star topology

- Have connections to networked devices that “radiate” out form a common point
- Each networked device in star topology can access the media independently
- Have become the dominant topology type in contemporary LANs
- Stars have made buses and rings obsolete in LAN topologies

Star topology



Advantages of star topology

1) Compared to Bus topology it gives far much better performance
2) Easy to connect new nodes or devices
3) Centralized management. It helps in monitoring the network
4) Failure of one node or link doesn't affect the rest of network

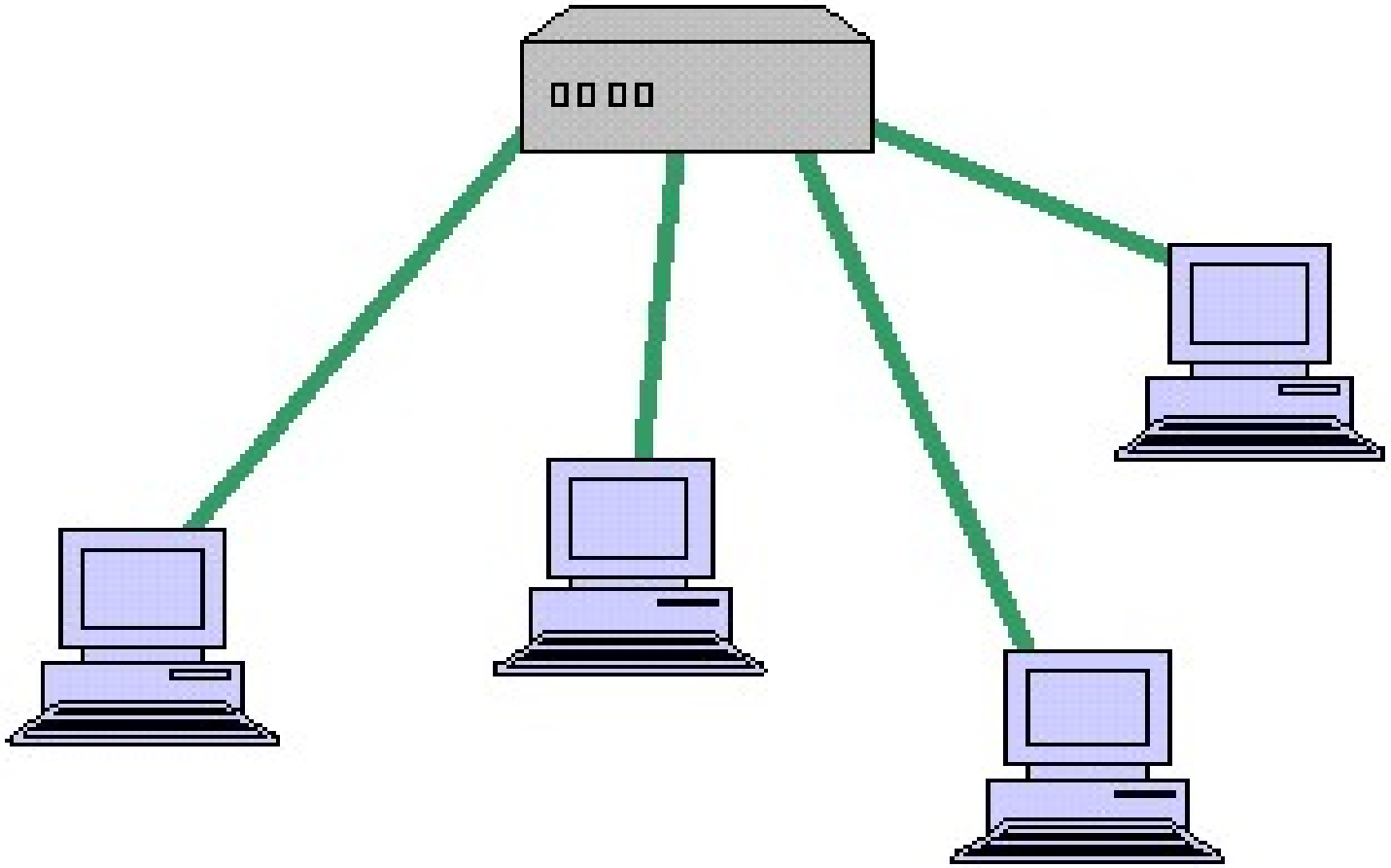
Disadvantages of star topology

1) If central device fails whole network goes down
2) The use of hub, a router or a switch as central device increases the overall cost of the network
3) Performance and as well number of nodes which can be added in such topology is depended on capacity of central device

Switched topology

- A switch is a multiport, Data Link Layer device
- A switch “learns” Media Access Control addresses and stores them in an internal lookup table
- Temporary, switched paths are created between the frame’s originator and its intended recipient, and the frames are forwarded along the temporary path
- Switched topology features multiple connections to a switching hub/Switch
- Each port, and the device to which it connects, has its own dedicated bandwidth

Switched topology



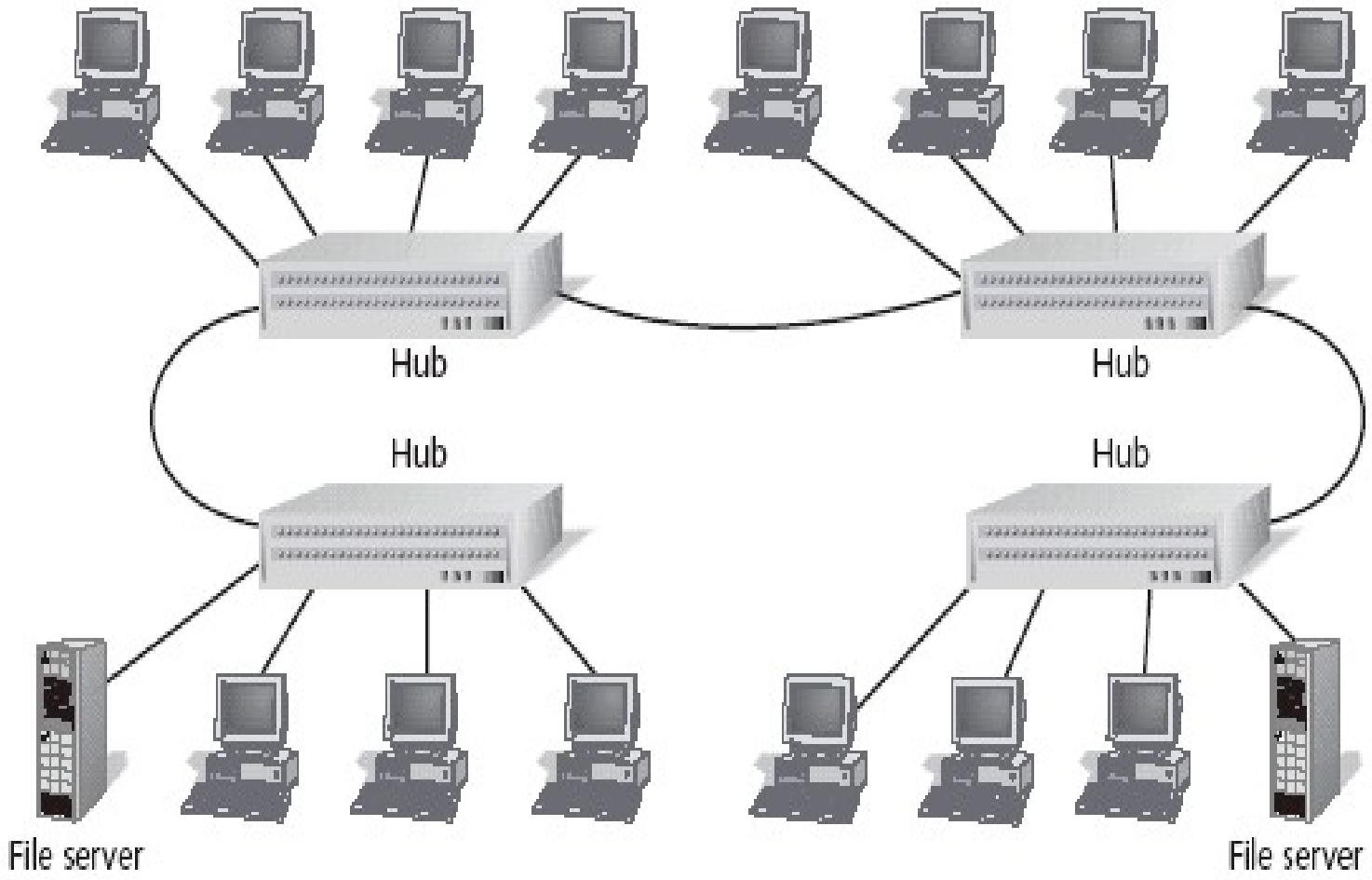
Advantages/Disadvantages of a Switched topology

- Advantage:
  - Can improve LAN performance:
    - increase the aggregate bandwidth available throughout the network
    - reducing the number of devices forced to share each segment of bandwidth
- Disadvantage:
  - Large switched implementations do not isolate broadcasts

Daisy chains

- Developed by serially interconnecting all the hubs of a network
- This simple approach uses ports on existing hubs for interconnecting the hubs
- Daisy chains are easily built and don't require any special administrative skills
- Daisy chains were, historically, the interconnection method of choice for emerging, first-generation LANs

Daisy chains



Disadvantage of Daisy chain

- Increases the number of connections, and therefore the number of devices, on a LAN. Too many devices competing for the same amount of bandwidth can create collisions and quickly incapacitate a LAN

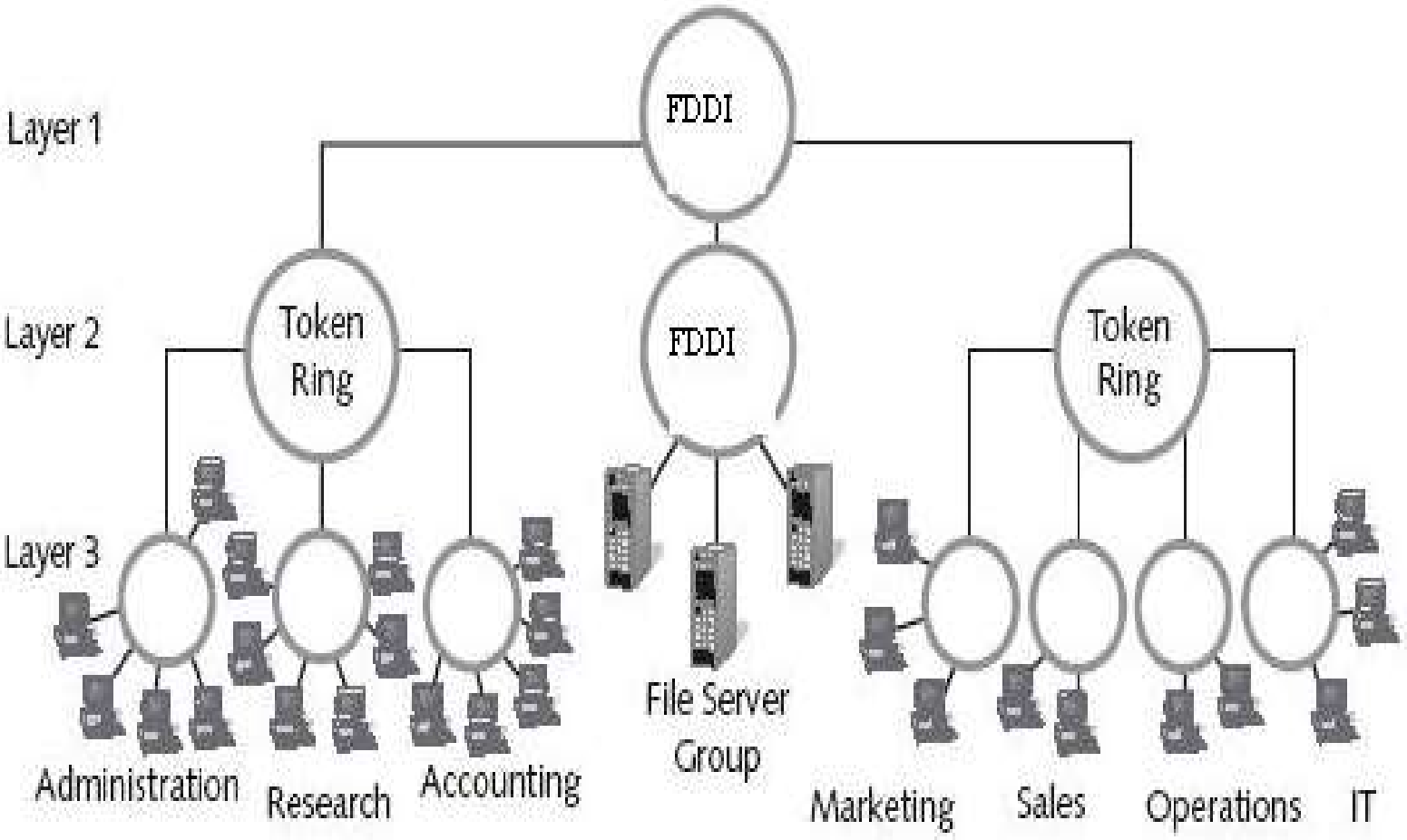
Hierarchies

- Hierarchical topologies consist of more than one layer of hubs. Each layer serves a different network function
- The bottom tier is reserved for user station and server connectivity. Higher-level tiers provide aggregation of the user-level tier
- A hierarchical arrangement is best suited for medium-to-large-sized LANs that must be concerned with scalability of the network and with traffic aggregation

Hierarchical rings

- Ring networks can be scaled up by interconnecting multiple rings in a hierarchical fashion
- User station and server connectivity can be provided by as many limited size rings as are necessary to provide the required level of performance
- A second-tier ring, either Token Ring or FDDI, can be used to interconnect all the user level rings and to provide aggregated access to the Wide Area Network (WAN)

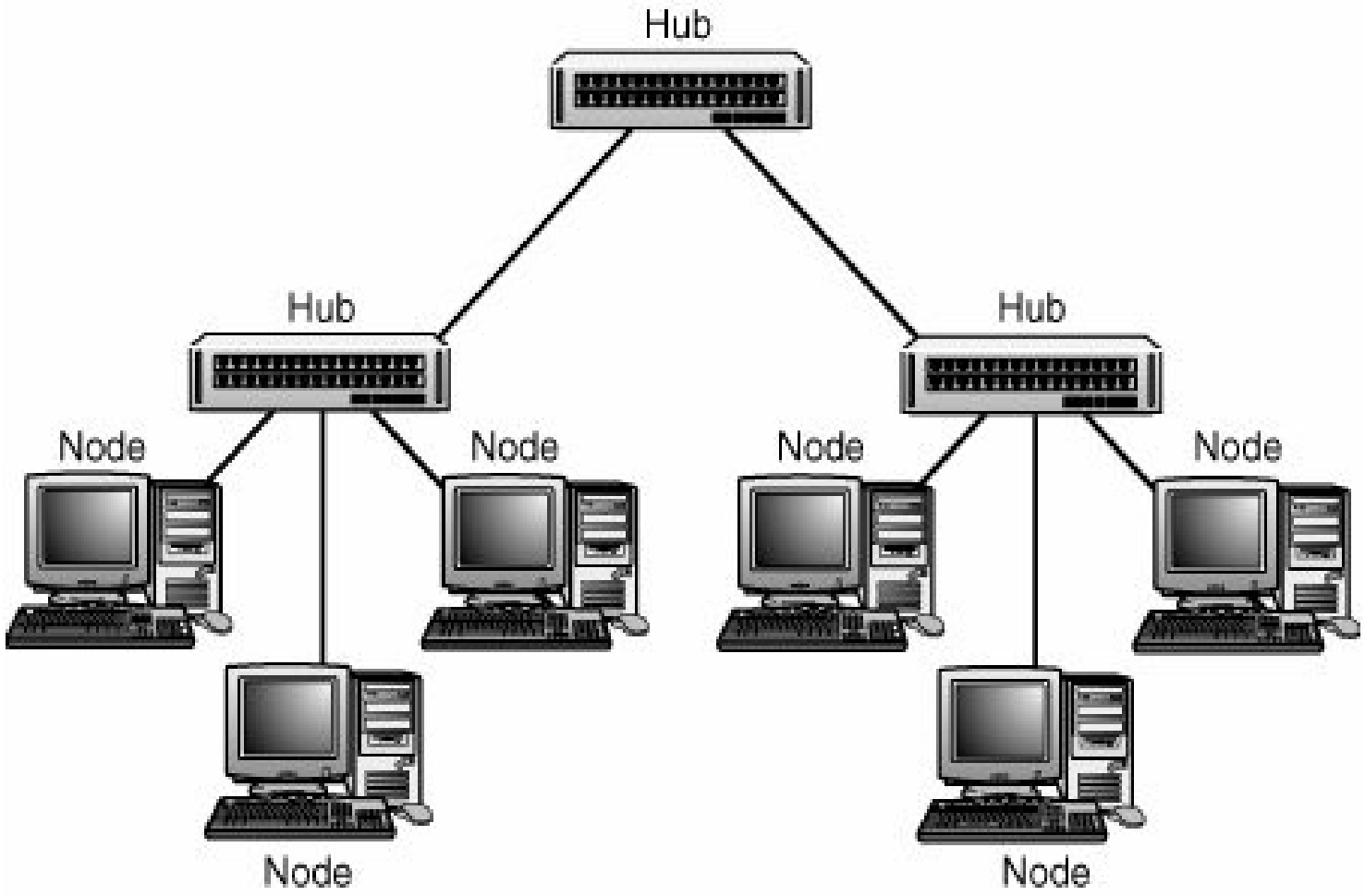
Hierarchical rings



Hierarchical stars

- Star topologies, can be implemented in hierarchical arrangements of multiple stars
- Hierarchical stars can be implemented as a single collision domain or segmented into multiple collision domains using switches, routers or bridges

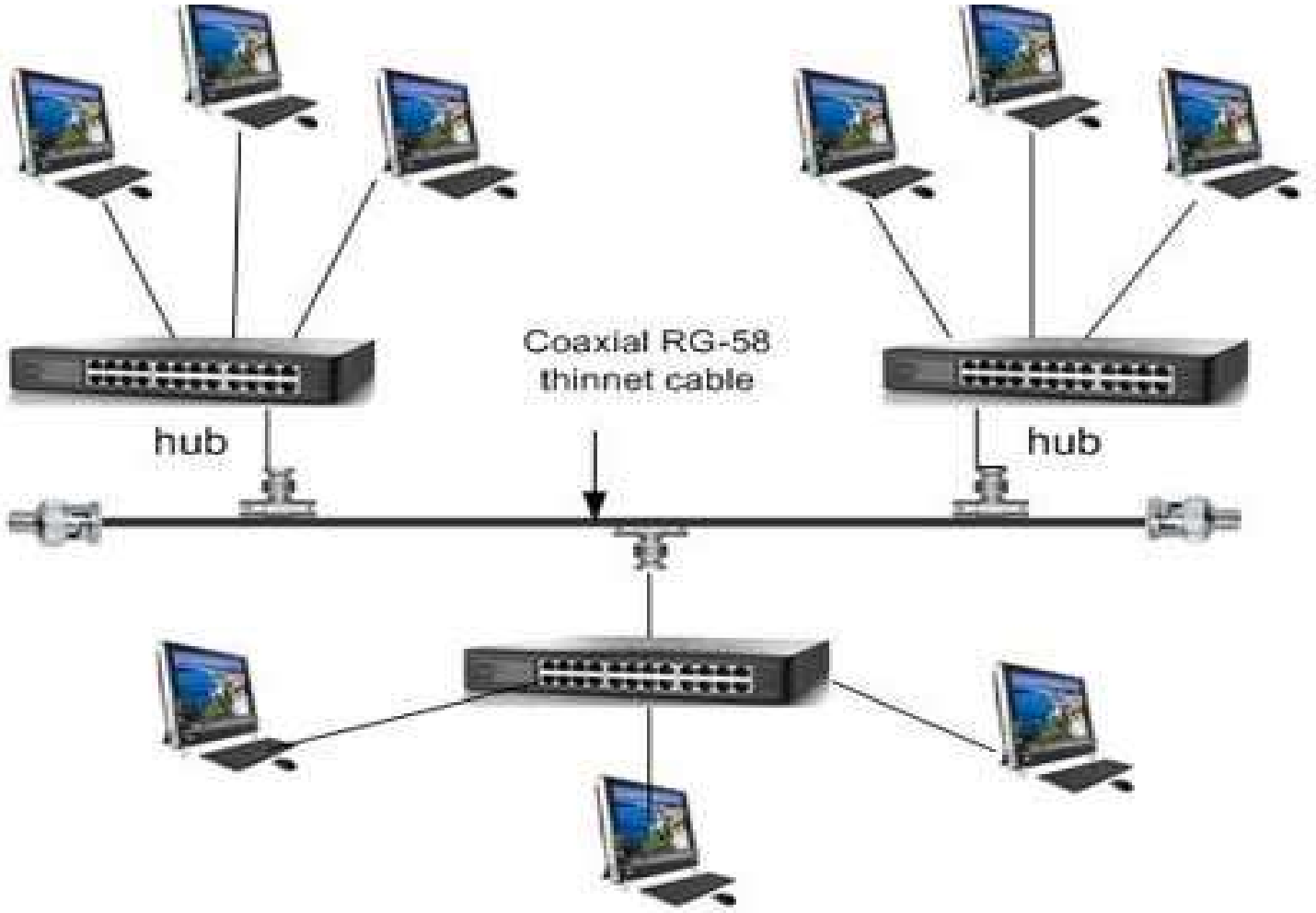
Hierarchical stars



Hierarchical combinations

- Overall network performance can be enhanced by not force-fitting all the functional requirements of the LAN into a single solution
- Today's high-end switching hubs enable you to mix multiple technologies

Hierarchical combinations



WAN Topologies

- The topology of a WAN describes the way the transmission facilities are arranged relative to the locations that they interconnect
- Numerous topologies are possible, each one offering a different mix of cost, performance and scalability

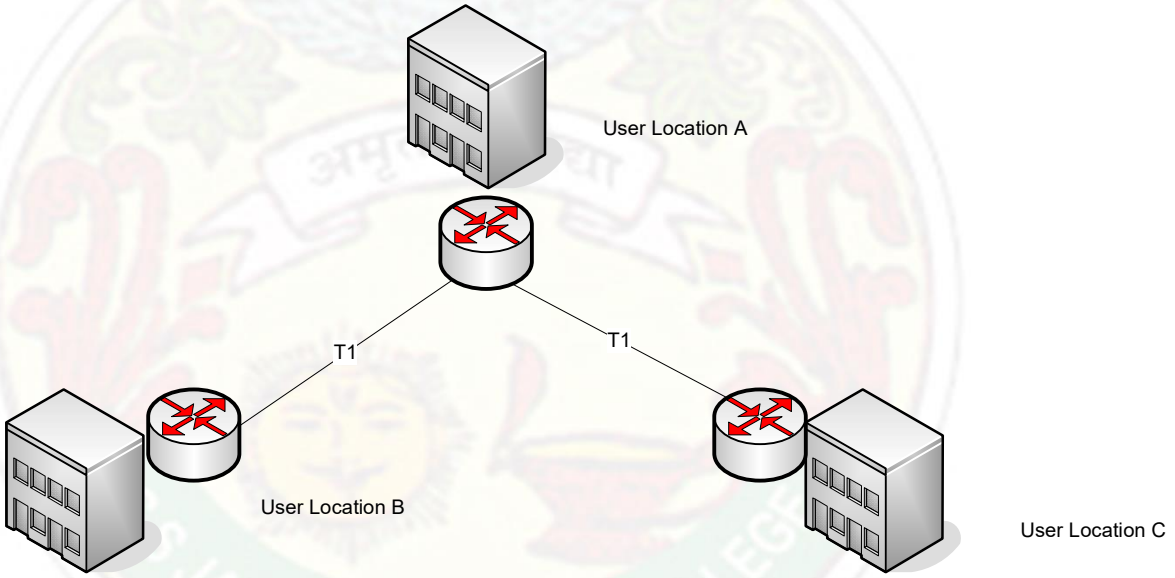
WAN Topologies

1) Peer-to-peer WANs
2) Ring WANs
3) Star WANs
4) Full-mesh WANs
5) Partial-mesh WANs
6) Two-tiered
7) Three-tiered
8) Hybrids

Peer-to-peer topology

- A peer-to-peer WAN can be developed using leased private lines or any other transmission facility
- This WAN topology is a relatively simple way of interconnecting a small number of sites
- Represents the least-cost solution for WANs that contain a small number of internetworked locations

Peer-to-peer



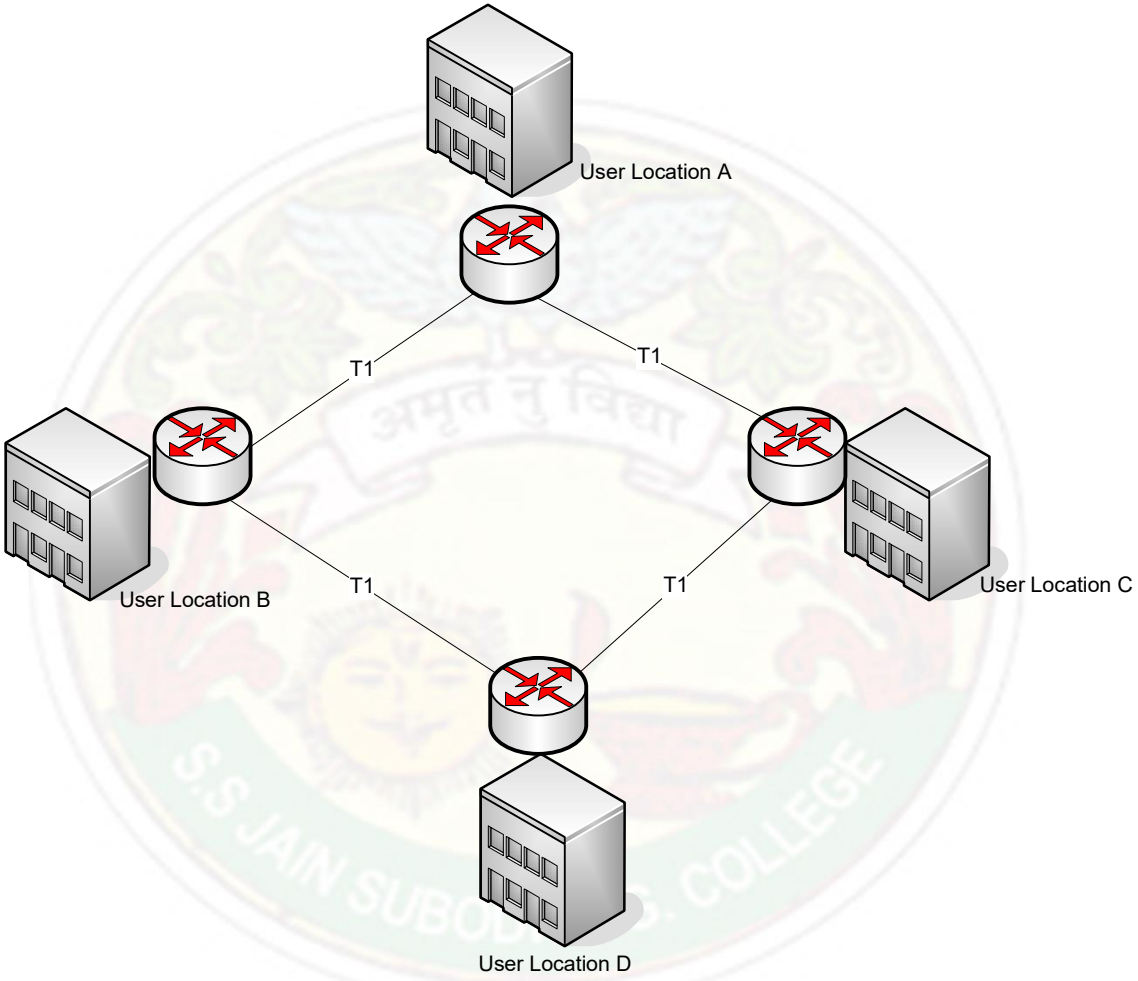
Advantage/Disadvantage of Peer-to-peer

- Advantage:
  - It is inexpensive relative to other options
- Disadvantages:
  - They don't scale very well. As additional locations are introduced to the WAN, the number of hops between any given pair of locations remains highly inconsistent and has an upward trend
  - An equipment or facility failure anywhere in a peer-to-peer WAN can split the WAN

Ring topology

- Can be developed fairly easily from a peer-to-peer network by adding one transmission facility and an extra port on two routers
- A ring-shaped WAN constructed with point-to-point transmission facilities can be used to interconnect a small number of sites and provide route redundancy at a potentially minimal incremental cost
- Can use dynamic routing protocols

Ring topology



Advantages/Disadvantages of Ring topology

- Advantages:
  - It provides alternative routes
  - It is less expensive than all but the peer-to-peer WAN
- Disadvantages:
  - Depending on the geographic dispersion of the locations, adding an extra transmission facility to complete the ring may be cost prohibitive
  - Rings are not very scalable

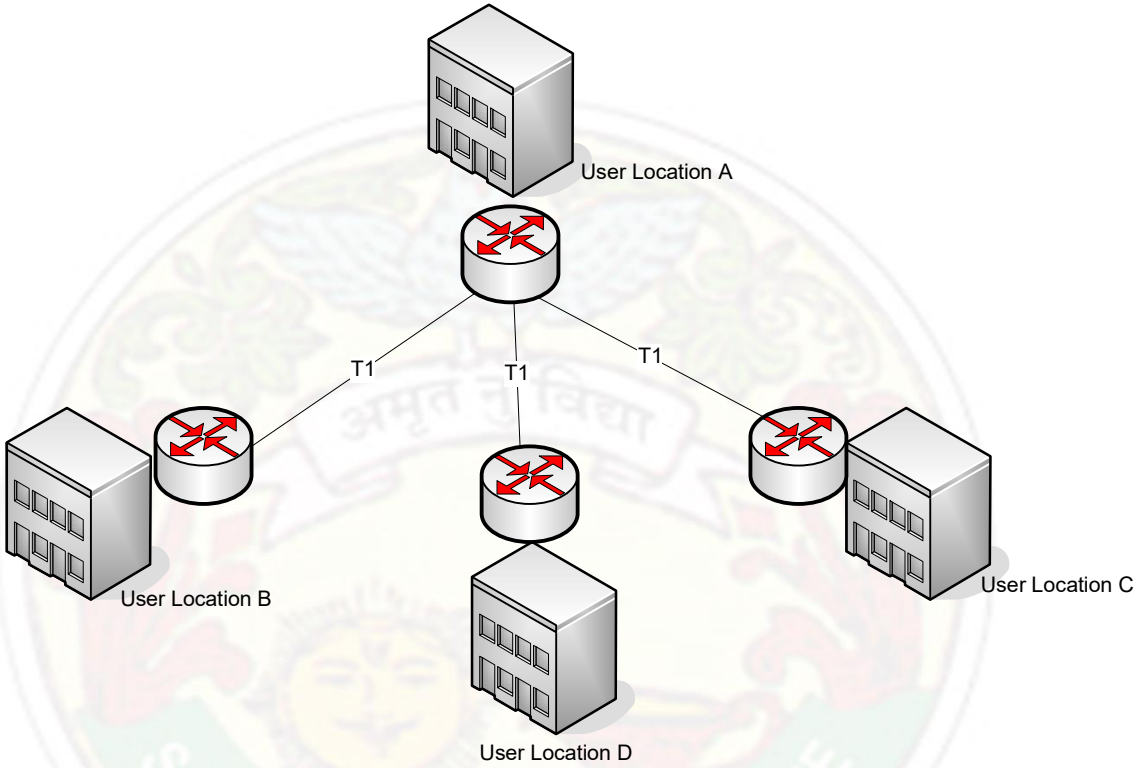
Star network Topology

- constructed by homing all locations into a common location
- The star topology can be constructed using almost any dedicated transmission facility including frame relay and point-to-point private lines

Advantages/Disadvantages of star topology

- Advantages:
  - More scalable than a peer-to-peer or ring network
  - Improved network performance. Hop count of three
- Disadvantages:
  - It creates a single point of failure
  - There is no route redundancy

Star topology



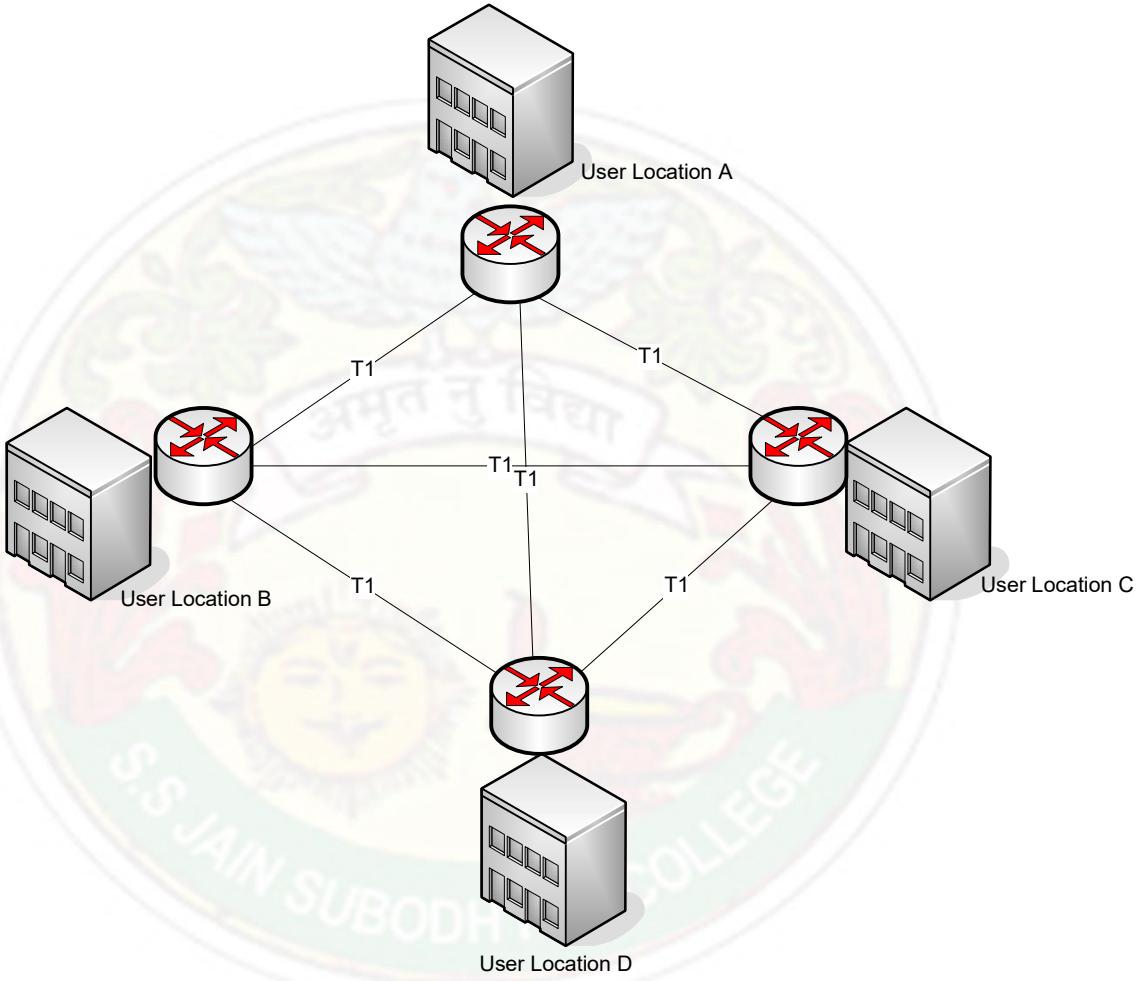
Full-mesh topology

- This topology features the ultimate reliability and fault tolerance
- Every networked node is directly connected to every other networked node
- Redundant routes to each location are plentiful, hence static routing impractical.
- Use dynamic routing protocols
- One application would be to provide interconnectivity for a limited number of routers that require high network availability
- Another potential application is to fully mesh just parts of the WAN, such as the backbone of a multitiered WAN or tightly coupled work centers

Advantages/Disadvantages of full-mesh

- Advantages:
  - Minimizes the number of hops between any two network-connected machines
  - Can be built with virtually any transmission technology
- Disadvantages:
  - These WANs can be fairly expensive to build
  - A finite (although substantial) limit on the scalability of the network

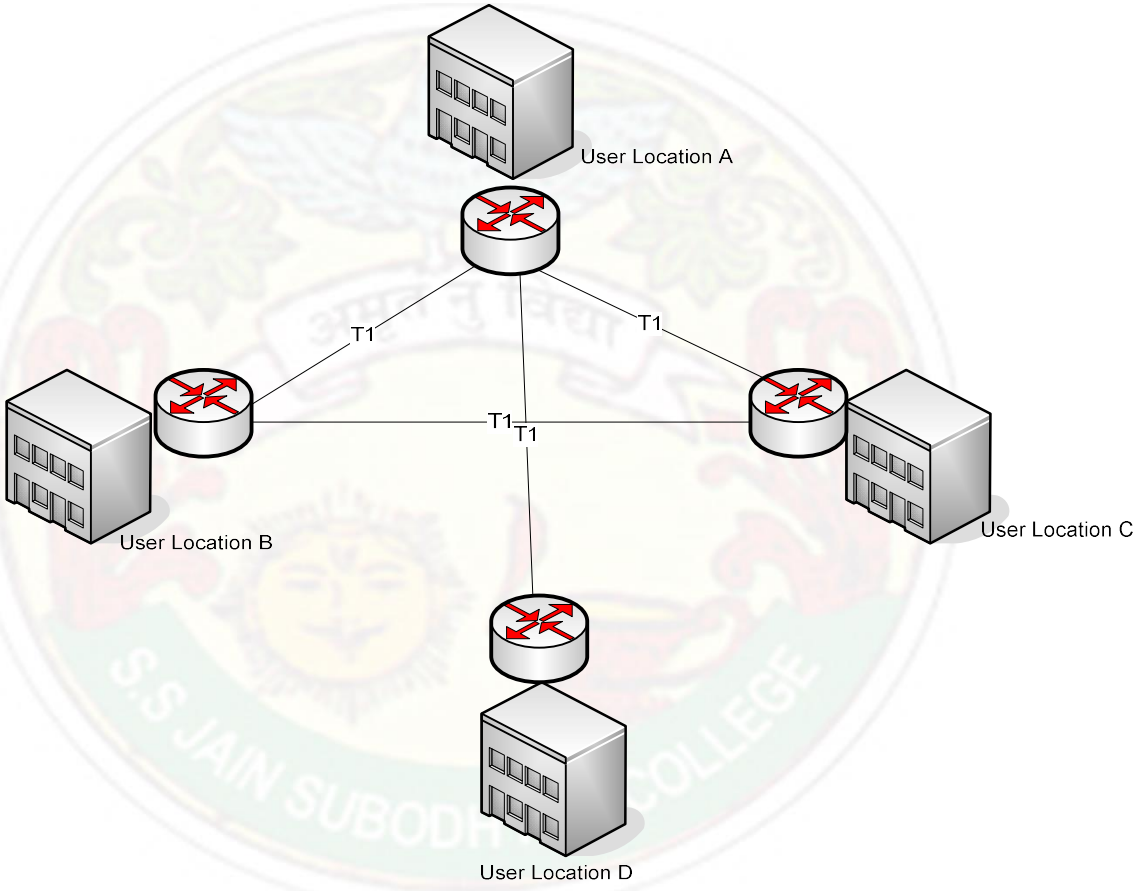
Full-mesh topology



Partial-mesh topology

- Partial meshes are highly flexible topologies that can take a variety of very different configurations
- The routers are much more tightly coupled than any of the basic topologies but are not fully interconnected, as would be the case in a fully meshed network
- A partially meshed WAN topology is readily identified by the almost complete interconnection of every node with every other node in the network

Partial-mesh



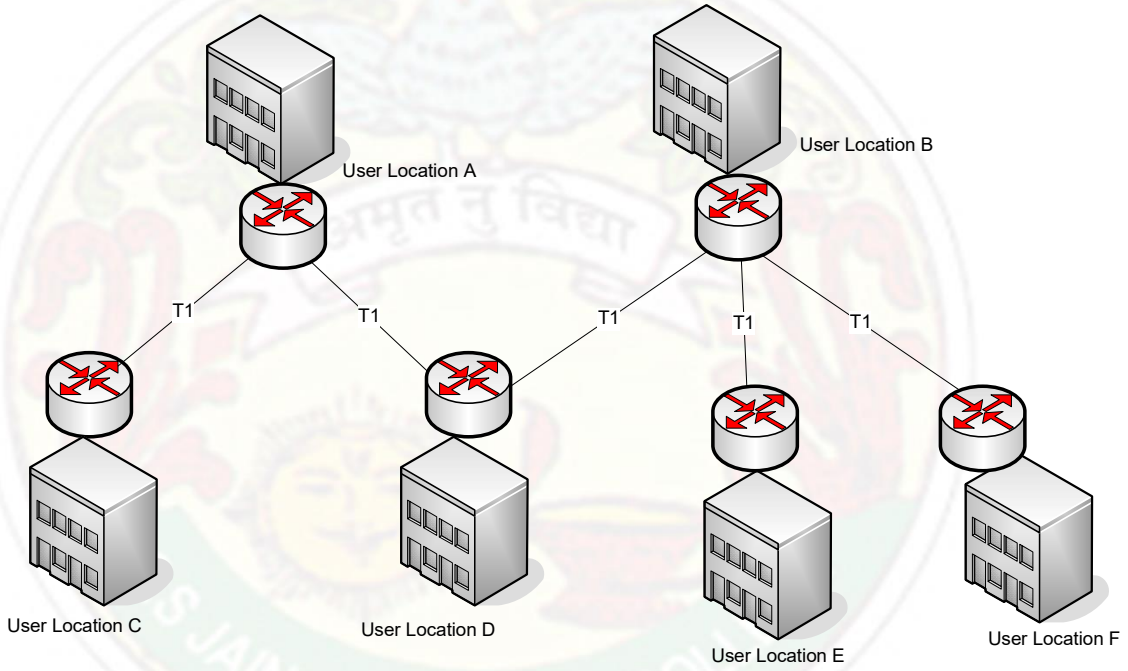
Advantages of partial-mesh

- Partial meshes offer the capability to minimize hops for the bulk of the WAN's users
- Unlike fully meshed networks, a partial mesh can reduce the startup and operational expenses by not interconnecting low-traffic segments of the WAN, hence more affordable and scalable

Two-tiered topology

- A two-tiered topology is a modified version of the basic star topology. Rather than single concentrator routers, two or more routers are used
- A two-tiered WAN constructed with dedicated facilities offers improved fault tolerance over the simple star topology without compromising scalability

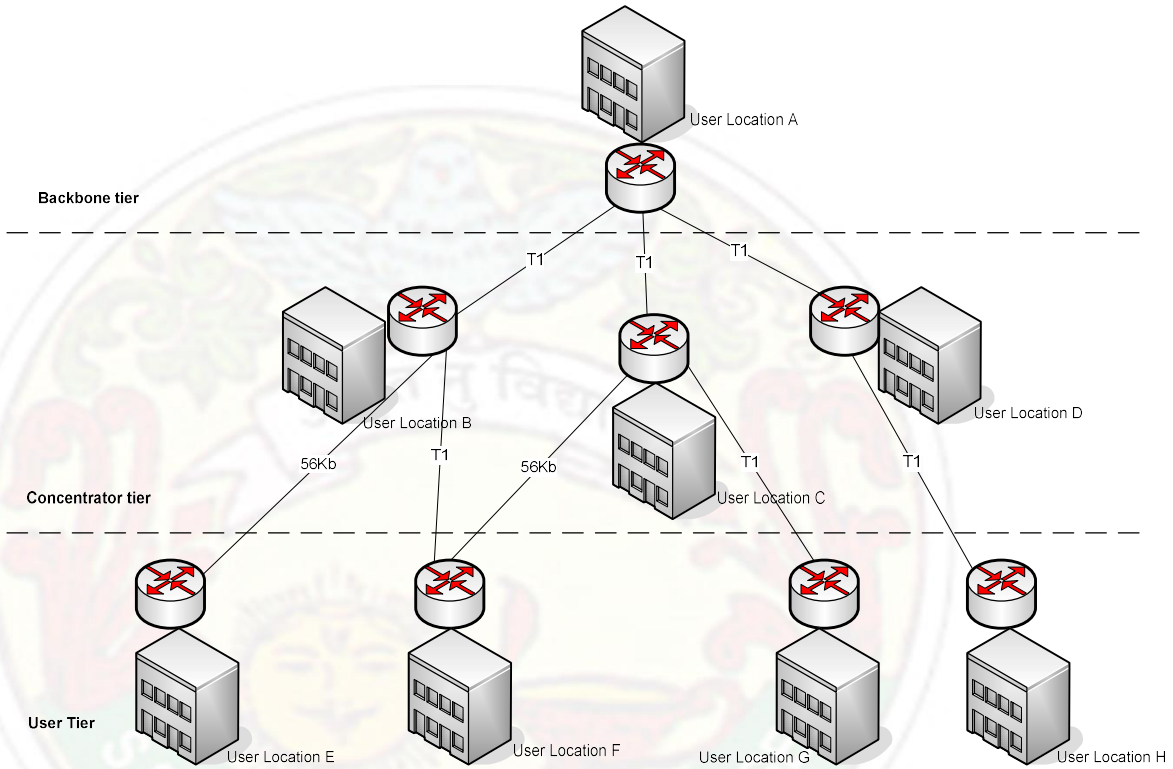
Two-tiered topology



Three-tiered topology

- WANs that need to interconnect a very large number of sites, or are built using smaller routers that can support only a few serial connections, may find the two-tiered architecture insufficiently scalable.
- Therefore, adding a third tier may well provide the additional scalability they require

Three-tiered



Advantage/Disadvantage of three-tiered

- Advantage:
  - A three-tiered WAN constructed with dedicated facilities offers even greater fault tolerance and scalability than the two-tiered topology
- Disadvantage:
  - Three-tiered networks are expensive to build, operate and maintain

Hybrid topologies

- Hybridization of multiple topologies is useful in larger, more complex networks
- Multitiered networks, in particular, lend themselves to hybridization. A multitiered WAN can be hybridized by fully or partially meshing the backbone tier of routers
- An effective hybrid topology may be developed in a multitiered WAN by using a fully meshed topology for the backbone nodes only

Hybrid topology