Network Topologies

- LANs and WANs - Geographical coverage
- LANs
  - A single geographical location, such as office building, school, etc
  - Typically High speed and cheaper.
- WANs
  - Spans more than one geographical location often connecting separated LANs
  - Slower
  - Costly hardware, routers, dedicated leased lines and complicated implementation procedures.

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Network Topologies

- Topology - Physical and logical network layout
  - Physical – actual layout of the computer cables and other network devices
  - Logical – the way in which the network appears to the devices that use it.
- Common topologies:
  - Bus, ring, star, mesh and wireless

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Bus topology

- Uses a trunk or backbone to which all of the computers on the network connect.
- Systems connect to this backbone using T connectors or taps.
- Coaxial cablings (10Base-2, 10Base5) were popular options years ago.
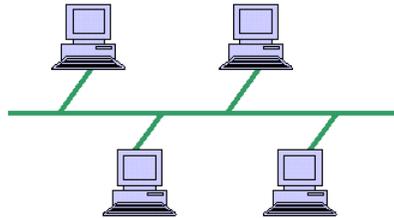
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Bus Topology

Advantages	Disadvantages
Cheap and easy to implement	Network disruption when computers are added or removed
Require less cable	A break in the cable will prevent all systems from accessing the network.
Does not use any specialized network equipment.	Difficult to troubleshoot.

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Ring Topology

- Logical ring
  - Meaning that data travels in circular fashion from one computer to another on the network.
  - Typically FDDI, SONET or Token Ring technology are used to implement a ring network
  - Ring networks are most commonly wired in a star configuration
    - Token Ring has multi-station access unit (MSAU),equivalent to hub or switch. MSAU performs the token circulation internally.

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Ring Topology
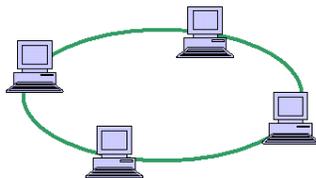
Advantages	Disadvantages
Cable faults are easily located, making troubleshooting easier	Expansion to the network can cause network disruption
Ring networks are moderately easy to install	A single break in the cable can disrupt the entire network.

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Star Topology

- All computers/devices connect to a central device called hub or switch.
- Each device requires a single cable
- point-to-point connection between the device and hub.
- Most widely implemented
- Hub is the single point of failure

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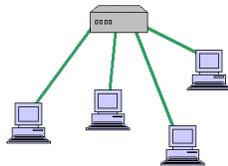
Star Topology

Advantages	Disadvantages
Easily expanded without disruption to the network	Requires more cable
Cable failure affects only a single user	A central connecting device allows for a single point of failure
Easy to troubleshoot and isolate problems	More difficult to implement

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Mesh Topology

- Each computer connects to every other.
- High level of redundancy.
- Rarely used.
  - Wiring is very complicated
  - Cabling cost is high
  - Troubleshooting a failed cable is tricky
  - A variation hybrid mesh – create point to point connection between specific network devices, often seen in WAN implementation.

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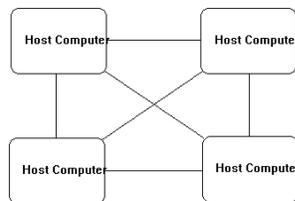
Mesh Topology

Advantages	Disadvantages
Provides redundant paths between devices	Requires more cable than the other LAN topologies
The network can be expanded without disruption to current uses	Complicated implementation

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Wireless networking

- Do not require physical cabling
- Particularly useful for remote access for laptop users
- Eliminate cable faults and cable breaks.
- Signal interference and security issue.

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Wireless networking
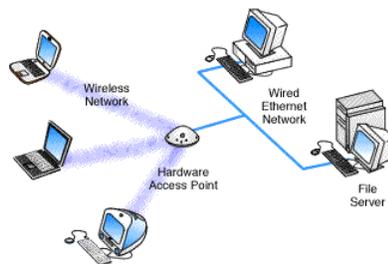
Advantages	Disadvantages
Allows for wireless remote access	Potential security issues associated with wireless transmissions
Network can be expanded without disruption to current users	Limited speed in comparison to other network topologies

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IEEE and Networking standards

- Institute of Electrical and Electronic Engineers (IEEE) developed a series of networking standards
  - Networking technologies developed by manufacturers are Compatible
  - Cabling, networking devices and protocols are all interchangeable under the banner of a specific IEEE

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Specification	Name
802.1	Internetworking
802.2	The LLC(Logincal Link Control) sublayer
802.3	CSMA/CD (Carrier Sense Multiple Access with Collision Detection) for Ethernet networks
802.4	A token passing bus
802.5	Token Ring networks
802.6	Metropolitan Area Network (MAN)
802.7	Broadband Technical Advisory Group
802.8	Fiber-Optic Technical Advisory Group
802.9	Integrated Voice and Data Networks
802.10	Standards for Interoperable LAN/MAN Security (SILS) (Network Security)
802.11	Wireless networks
802.12	100Mbps technologies, including 100BASEVG-AnyLAN

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802.3 IEEE standard

- Defines characteristics for Ethernet networks.
- New additions,
  - 802.3u for Fast Ethernet
  - 802.3z for Gigabit Ethernet, referred to as 802.3x.
  - … …
  - 802.3ac 10gbits/s, expe. 2009
  - … …
- Speed: Original 10Mbps, Fast Ethernet 100Mbps, Gigabit Ethernet 1000Mbps
- Topology: bus or star.
- Media: Coaxial and twisted pair cabling, also fiber optic cable.
- Access method: CSMA/CD

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802.5 IEEE standard

- Specifies the characteristics for Token Ring Networks.
- Introduced by IBM in the mid 80s, network topology of choice until the rise of the popularity of Ethernet.
- Speed: 4 to 16Mbps
- Topology: logical ring and most often a physical star. Logical ring is often created in the Multistation Access Unit (MSAU)
- Media: twisted pair cabling.
- Access method: token passing.

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802.11b IEEE Standard   - Wireless

- Specifies the characteristics of wireless LAN Ethernet networks.
  - Special devices called wireless access points to allow communicate.
  - Also connect to wired networks to create wireless portions of entire networks.
  - Access method: Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA), a variation of CSMA/CD.
  - Topology: physical wireless, logical bus
- Protocol

  - 802.11b 1999 2.4GHz, 11Mbits/s
  - 802.11g 2003 2.4GHz, 54 Mbits/s
  - 802.11n 2008 2.4G,5GHz, 248Mbits/s
  - ... …

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FDDI

- Fiber Distributed Data Interface (FDDI) standard was developed by American National Standards Institute (ANSI)
- Dual ring technology for fault tolerance
- Speed: 100Mbps or higher
- Topology: dual ring topology
- Media: fiber optic cable, > 2 kilometers. Also possible use copper wire as Copper Distributed Data Interface (CDDI).
- Access method: token-passing access method

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Standard	Speed	Physical Topology	Logical Topology	Media	Access Method
802.3	10Mbps		Bus and Star	Coaxial and Twisted pair	CSMA/CD
(802.3u)	100Mbps(Fast Ethernet)	Star	Bus	Twisted pair	CSMA/CD
(802.3z)	1000Mbps	Star	Bus	Twisted pair	CSMA/CD
802.5	4Mbps and 16Mbps	Star	Ring	Twisted pair	Token passing
802.11b	11Mbps	Wireless	Bus	Radio waves	CSMA/CA
FDDI	100Mbps	Dual Ring	Ring	Fiber-optic Twisted pair/CDDI	Token passing

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