Lecture 6

Types of Computer Networks and their Topologies

Three important groups of computer networks: LAN, MAN, WAN

LAN (Local Area Networks)

LANs

- Privately owned networks
- Typical span: single building, plant, campus etc.
  - Restricted in size:
    - worst case transmission time is bounded and known
      - Determines architectural design and data speeds etc.
- Generally Broadcast
  - Bus: e.g. Ethernet
  - Ring: e.g. Token ring

MAN (Metropolitan Area Networks)

Metropolitan Area Networks (MANs)

- LAN type high speeds and access, but over longer distances than LANs (e.g. 10 - 20 km)
  - e.g. DQDB, Distributive Queue Dual Bus (IEEE 802.6); FDDI (Fibre distributed Data Interface); FDDI-II; CDDI
- Own broadband infrastructure
  - transport & switching
  - often 'public', 3rd party infrastructure
    - different ownership, rental, sharing arrangements
- Interconnect LANs

WAN (Wide Area Networks)

WANs
Wide Area Networks

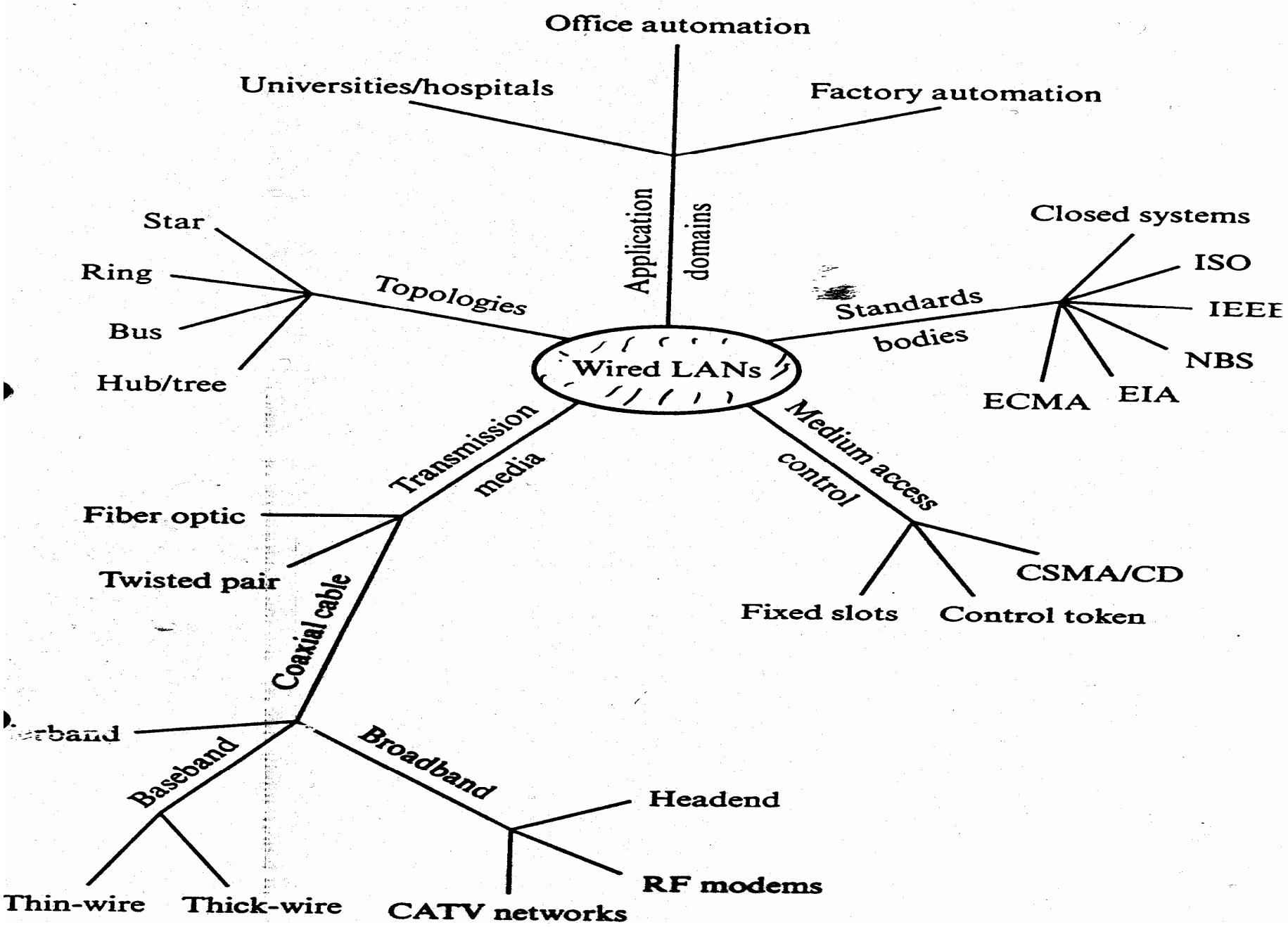
- Spanning any distance (country, continent, global)
  - telephone infrastructure
- not just narrowband
- interconnecting hosts, LANs, MANs etc
  - Fixed, satellite, mobile, narrowband, broadband.
  - Wide range of physical infrastructure

Problems to be discussed when presenting a network:

Sample network: a Wired LAN

Application domain
Standards bodies and their issues
Topologies
Internetworking Protocols
Medium Access Control
Transmission Media

See next slide as example:


Office automation
Universities/hospitals
Factory automation
Application domains
Star
Ring
Bus
Hub/tree
Topologies
Wired LANs
Closed systems
ISO
IEEE
NBS
ECMA
EIA
Standards bodies
Transmission media
Fiber optic
Twisted pair
Coaxial cable
Medium access control
CSMA/CD
Fixed slots
Control token
Baseband
Broadband
Headend
RF modems
Thin-wire
Thick-wire
CATV networks

Network Topologies

Network Topology – Definition:

The specific physical, *i.e.,* real, or logical, *i.e.,* virtual, arrangement of the elements of a network.

Two networks **have the same topology** if the connection configuration is the same, although the networks *may differ* in physical interconnections, distances between nodes, transmission rates, and/or signal types.

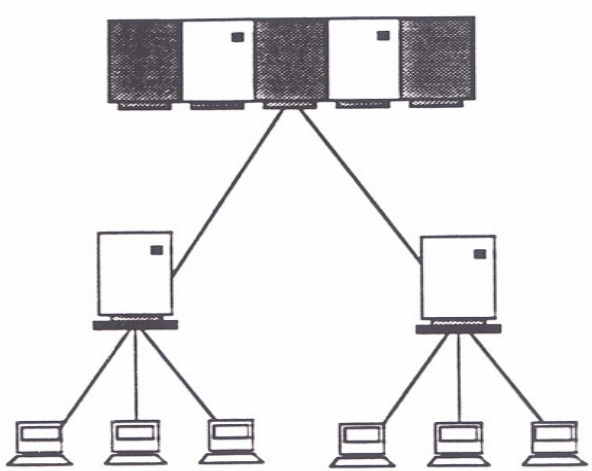
Vertical Topology

- Hierarchical
- Mesh

Horizontal Topology

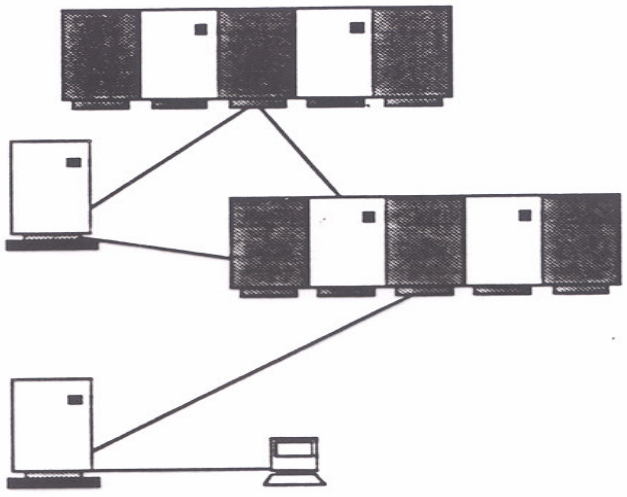
- Star
- Bus
- Tree
- Ring

Vertical Topology



Hierarchical

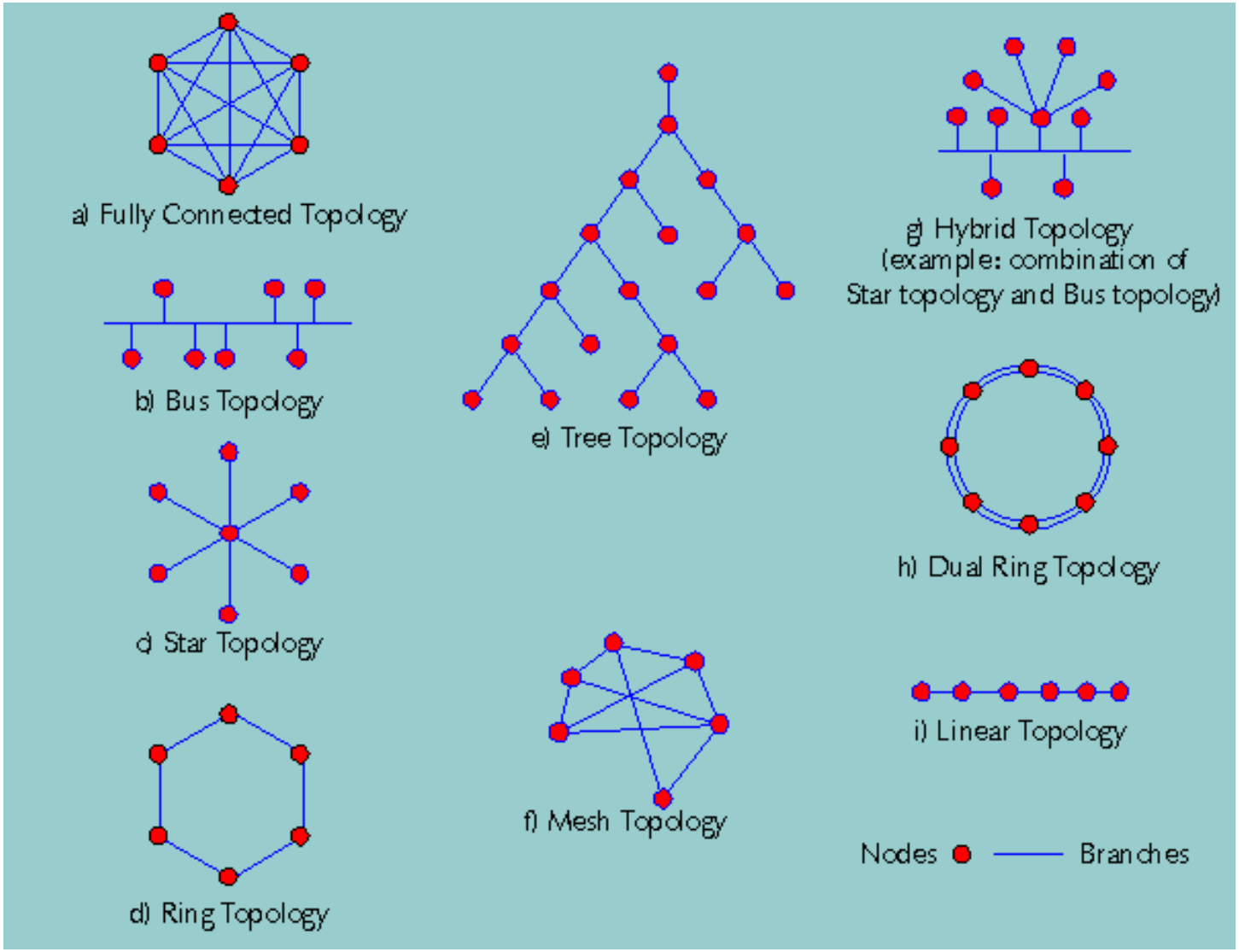
Hierarchical (tree) topology: existence of a **central node** (root) and of various sets of level organized nodes (intermediary nodes); the leaves of the tree are the workstations. The data flow between any two nodes goes up-down using the upper levels nodes.



Mesh

Mesh topology: there are at least two nodes with two or more paths between them.

Various Topologies



‘Main’ Horizontal Topologies

Bus topology: all nodes, *i.e.,* stations, are connected together by a single bus (the main trunk). Stations are connected using interfaces, named transceivers or attachment units (AUI).
Ex: pure Ethernet LAN, Token Bus.

Multipoint medium

Transmission propagates throughout medium

Heard by all stations

- Need to identify target station
  - Each station has unique address

Full duplex connection between station and AUI

- Allows for transmission and reception

Need to regulate transmission

- To avoid collisions and hogging
  - Data in small blocks - frames

Terminator absorbs frames at end of medium

Ring topology: every node has exactly two branches connected to it (a succession of point-to-point links). Stations are connected using interfaces (repeaters).

Ex: Token Ring LAN.

Repeaters joined by point to point links in closed loop

- Receive data on one link and retransmit on another
- Links unidirectional

Data in frames

- Circulate past all stations
- Destination recognizes address and copies frame
- Frame circulates back to source where it is removed

Media access control determines when station can insert frame

- **Dual Ring** – allows for a second (reserve) ring; data flow has here an opposite direction; not all stations linked to both rings

Star topology: there is a central node (switch) and peripheral nodes. The peripheral nodes are connected to the central node, which rebroadcasts all transmissions received from any peripheral nodes to all peripheral nodes on the network, including the originating node. Ex: switched Ethernet LAN.

Extended star: links individual stars together, by linking the centers (hubs/switches); also known as snowflake topology.

Need for more distance between computers => Layer 1 device **repeater**

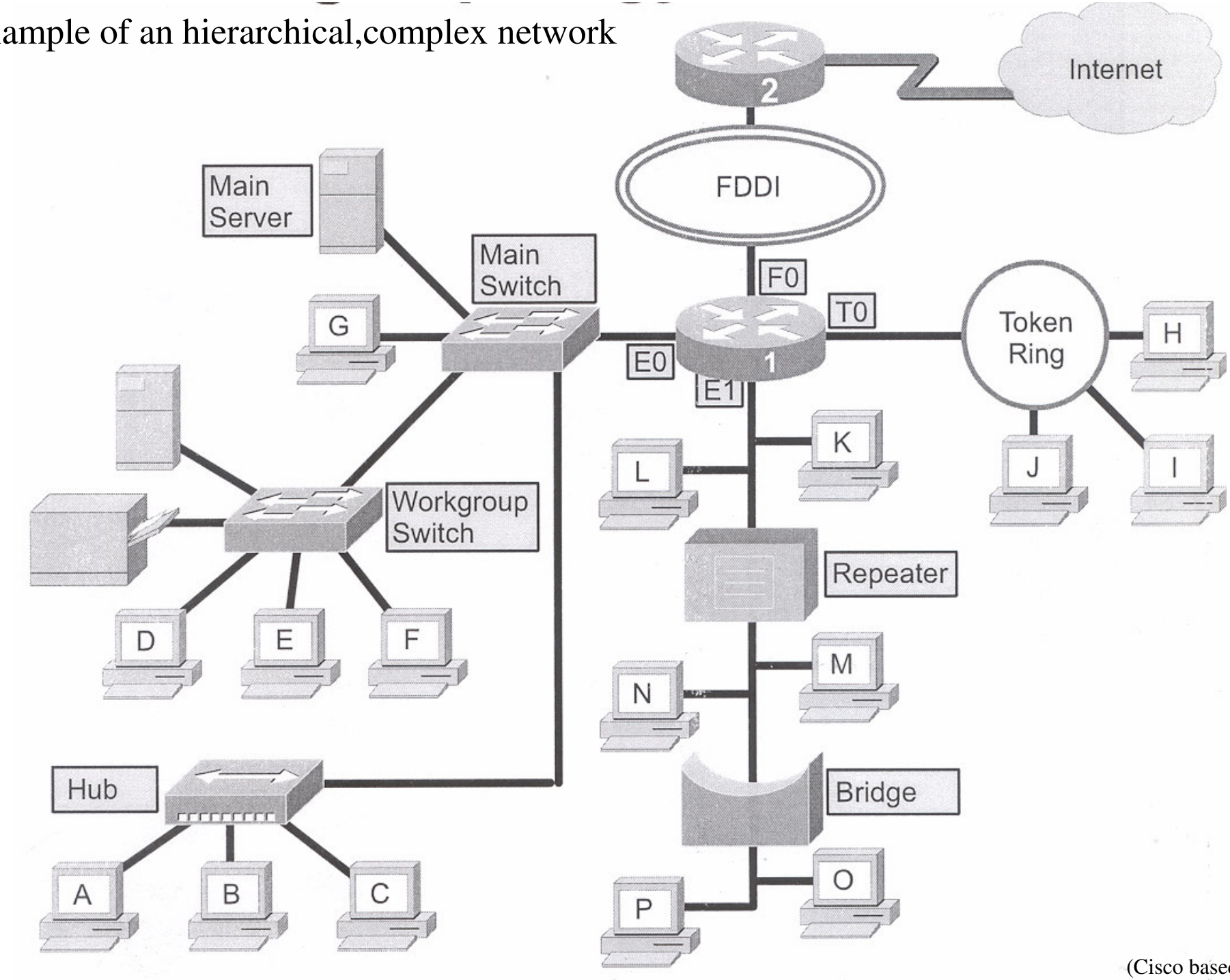
Need for more workgroup connectivity => **multiport repeater**, or **hub**.

Need for traffic filter => **bridge** as a way to filter network traffic into local and non-local traffic (Layer 2 device, based on physical address)

Need for Layer 2 connectivity (port-density) => a **multiport bridge**, or **switch**

As networks grew, the diversity of platforms, protocols, and media, the geographic distance between computers, the number of computers wishing to communicate, and the dynamism inherent in large networks, all necessitated the development of the **router**. Layer 3 device which makes best path and switching decisions based on network addresses.

Example of an hierarchical,complex network



(Cisco based)