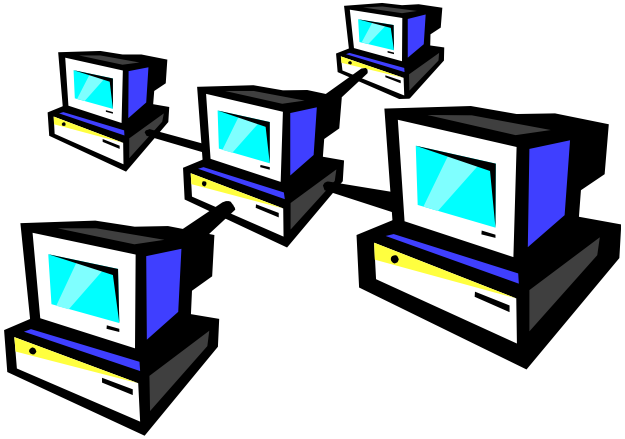
Computer Networks (IN 2510)



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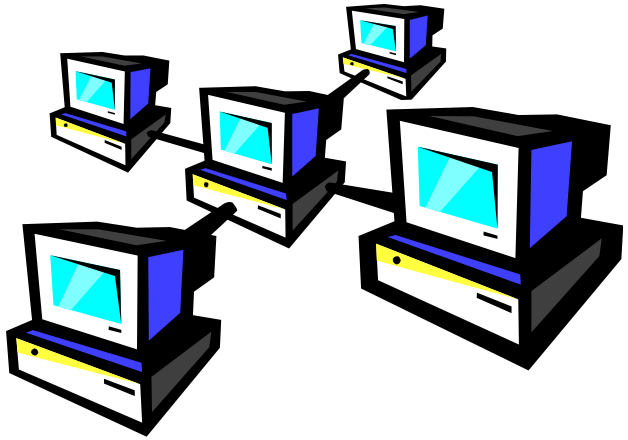
Lecture 1:

Networking Fundamentals



Outline

- Introduction
- Benefits/Risks of Networking
- Data Transmission
  - Circuit Switching
  - Packet Switching
- Categorizing Networks
- Types of Networks
  - LANs
  - WANs

Recommended reading List:

- Computer Networks;
  Andrew S Tanenbaum,
  Pearson Education Ltd.

- Computer networking: a top-down approach;
  James F Kuross & Keith W Ross;
  Pearson Education Ltd.

What is a Computer Network?

What is a Computer NETWORK?

A Computer *Network* is simply two or more computers that are linked together.

Note: A single computer system with its peripherals such as printers, scanners etc. is not considered as a network.

End User Devices & Networking Devices

End User Devices	
PC 	Printer 
MAC 	File Server 
Laptop 	IBM Mainframe 

Network Devices	
Repeater 	Bridge 
Small Hub (10BASE-T) 	Workgroup Switch 
100BASE-T Hub 	Router 
Hub 	Network Cloud 

Computer Networking

- The generic term **node** refers to any device on a network

  (usually the term **host** refers to a computer)

- **Data transfer rate**
  - The speed with which data is moved from one place on a network to another
- Data transfer rate is a key issue in computer networks

Computer Network

A Computer Network is a collection of autonomous computing devices that are interconnected in various ways in order to exchange information by common conventions, called protocols, over a shared communication medium.

Why Computer Networking?

- **The greatest advancement in technology and communication over the past 20 years has been the development and advancement of the Computer Network.**
- **From emailing a friend to on-line bill paying to downloading data off the Internet to e-commerce, networking has made our world much smaller and changed the way we communicate forever.**

Advantages of Computer Networks

- **Accessing databases, transferring, processing and retrieval of data can be done on-line**
- **Online credit card checking, e-commerce and Electronic Fund Transfer are possible**
- **Easily administered**
- **Provides an efficient means of communication such as e-mail, Voice mail, and Video conferencing.**

Advantages of Computer Networks (Cont.)

- **Users can be easily added or removed.**
- **Tasks of distributed nature can be processed by distributed computer systems by exchanging data.**
- **Provides a way to share data, programs, peripherals, computing power and information.**
- **Provides data security (Comparing to other communication devices).**

Benefits of a Network

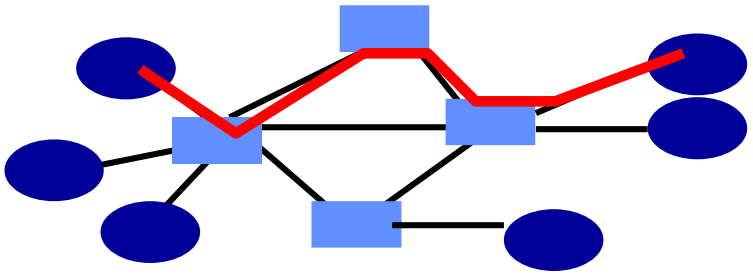
- *Information sharing:* Authorized users can use other computers on the network to access and share information and data.
- *Hardware sharing:* One device connected to a network, such as a printer or scanner, can be shared by many users.
- *Software sharing:* Instead of purchasing and installing a software program on each computer, it can be installed on the server. All of the users can then access the program from a single location.
- *Collaborative environment:* Users can work together on group projects by combining the power and capabilities of diverse equipment.

Risks of Network Computing

- The security of a computer network is challenged everyday by:
  - Computer hackers
  - Malicious software (e.g. : Viruses, Worms, Trojan Horse etc.) attacks
- Costs Money to have the network setup and to maintain the network
- more complex and harder to maintain (comparing to standalone computers)
  - Equipment malfunctions
  - System failures

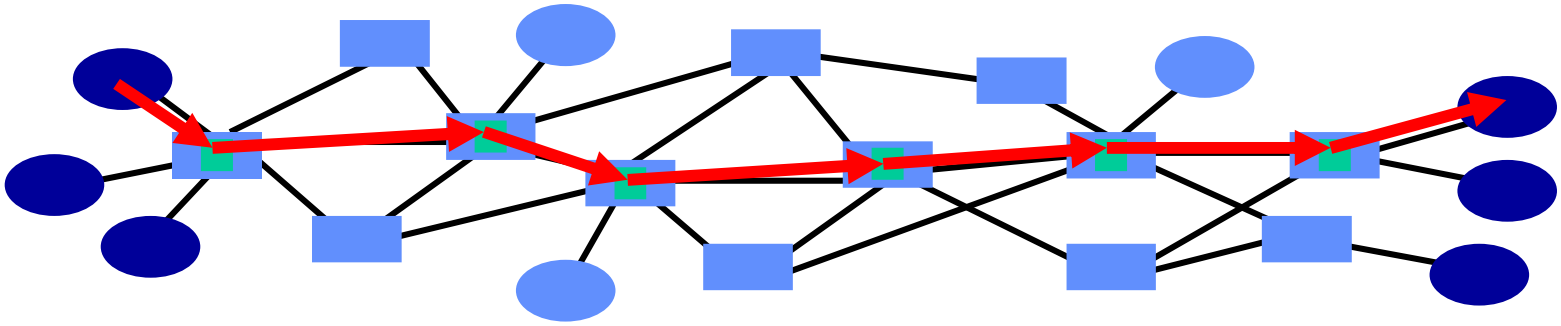
Circuit Switching

- Source first establishes a connection (circuit) to the destination.
  - Each router or switch along the way may reserve some bandwidth for the data flow
- Source sends the data over the circuit.
  - No need to include the destination address with the data since the routers know the path
- The connection is closed after the transmission
- Example: telephone network (analog).



Packet Switching

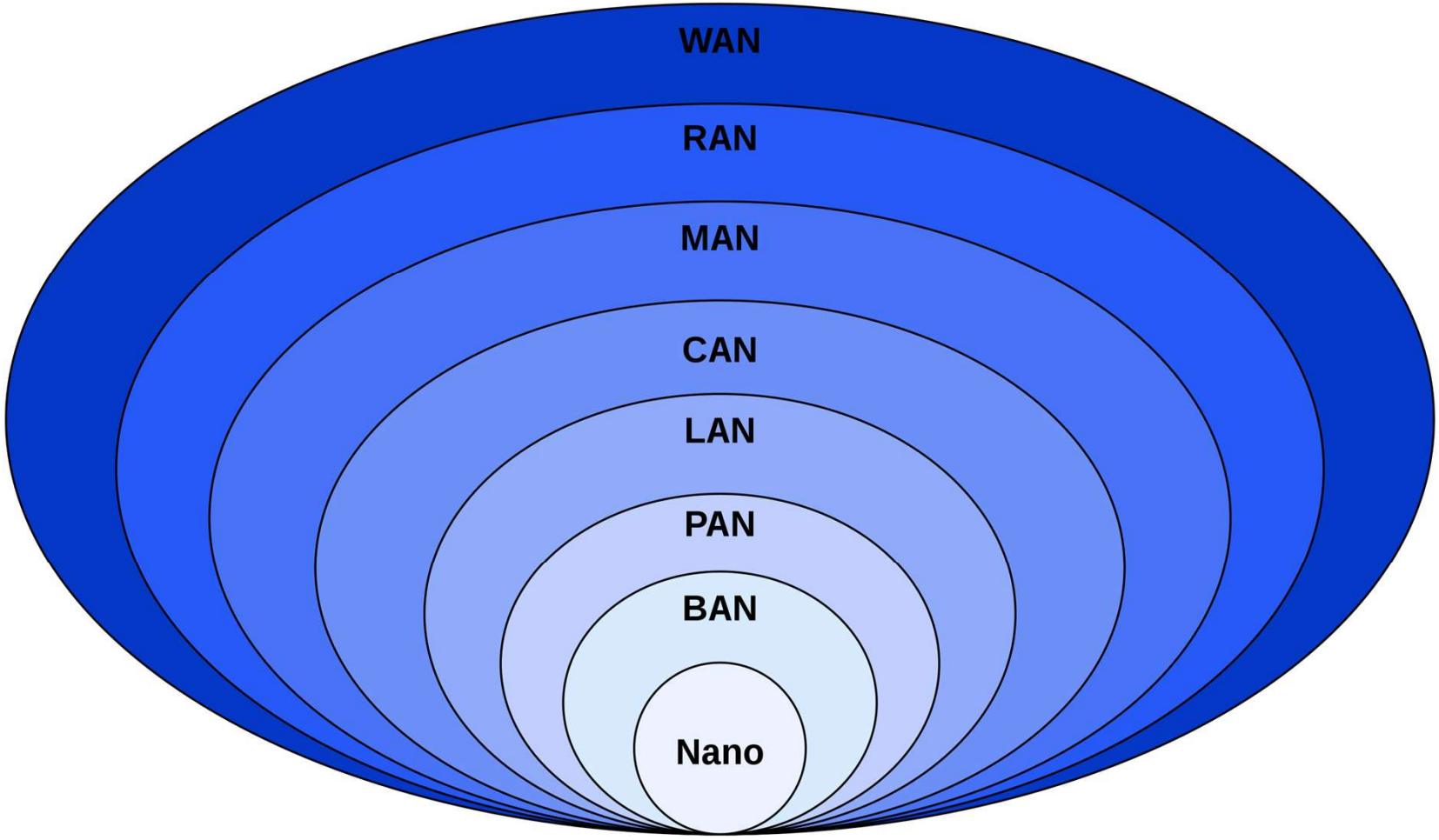
- Source sends information as self-contained packets that have an address.
  - Source may have to break up single message in multiple
- Each packet travels independently to the destination host.
  - Routers and switches use the address in the packet to determine how to forward the packets
- Analogy: a letter in an envelope.



Network Types

- The most common types of networks are:
  - *Local Area Networks (LANs)* and
  - *Wide Area Networks (WANs)*
- The primary difference between the two is that a *LAN* is generally confined to a limited geographical area, whereas a *WAN* covers a large geographical area. Most *WANs* are made up of several connected *LANs*.

Network Types



Computer network types by spatial scope

Local-area Networks (LANs)

- A Local Area Network spans a relatively small area
- LAN are usually confined to one building or a group of buildings
- Usually privately owned
- Provides high data rates
- The most common type of Local Area Network is called Ethernet
  - **Optical module**s for optical fiber

Local Area Networks (LANs)

- Benefits of being "local":
  - Lower cost
  - Short distance = faster links, low latency
    - Efficiency less pressing
  - One management domain
  - More homogenous

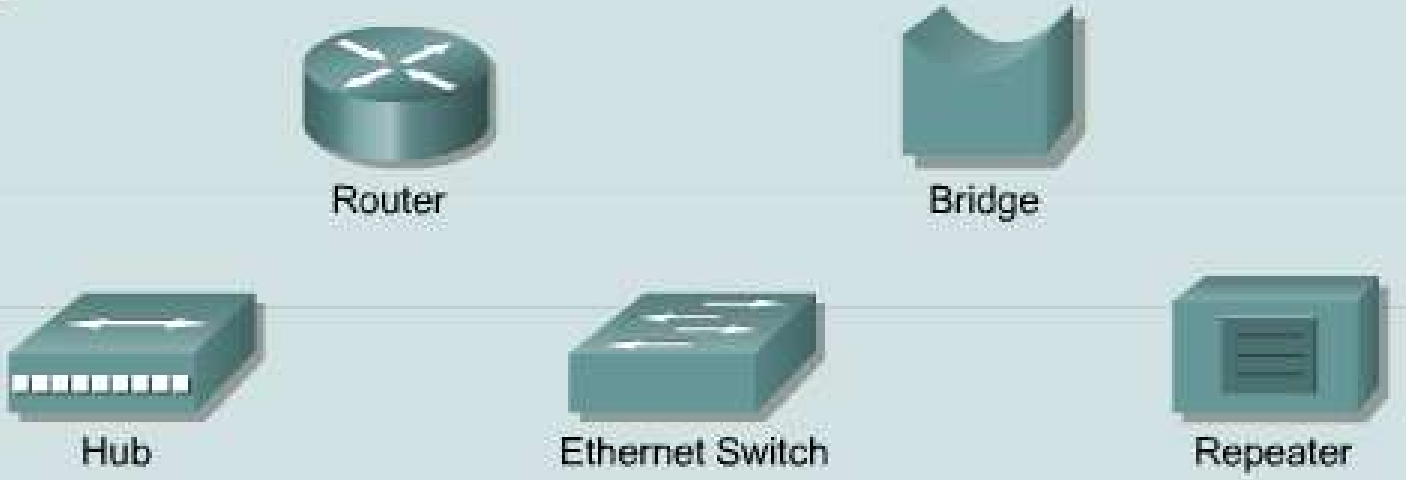
- Examples:
  - Ethernet
  - *Token ring*
  - *FDDI*
  - 802.11 wireless

Local-area Networks (LANs)

LANS are designed to:

- Operate within a limited geographic area
- Allow multi-access to high-bandwidth media
- Control the network privately under local administration
- Provide full-time connectivity to local services
- Connect physically adjacent devices

Using:



Wide-area Networks (WANs)

- A network which covers a very large geographical area such as a country, continent or even the whole world
- Provides long distance communication of data or information
- Operating at low speeds (compare to LANs)

Wide-area Networks (WANs)

WANS are designed to:

- Operate over a large geographical area
- Allow access over serial interfaces operating at lower speeds
- Provide full-time and part-time connectivity
- Connect devices separated over wide, even global areas

Using:

Wide Area Networks

Distance makes things harder:

- High(er) delays and cost → Need efficiency
- Larger size → Need scalability
- Heterogeneity:
  - Traffic types
  - Host needs
- Administrative diversity → Management harder

Let's look at one prominent example:

"The Internet"

- An inter-net: a network of networks.
  - A set of networks that are connected with each other
  - Networks are connected using routers that support communication in a hierarchical fashion
  - Often need other special devices at the boundaries for security, accounting, ..
- The Internet: the interconnected set of networks of the Internet Service Providers (ISPs) providing data communications services.
  - Tens of thousands of different networks make up the Internet
- In order to inter-operate, all participating networks have to follow a common set of rules.

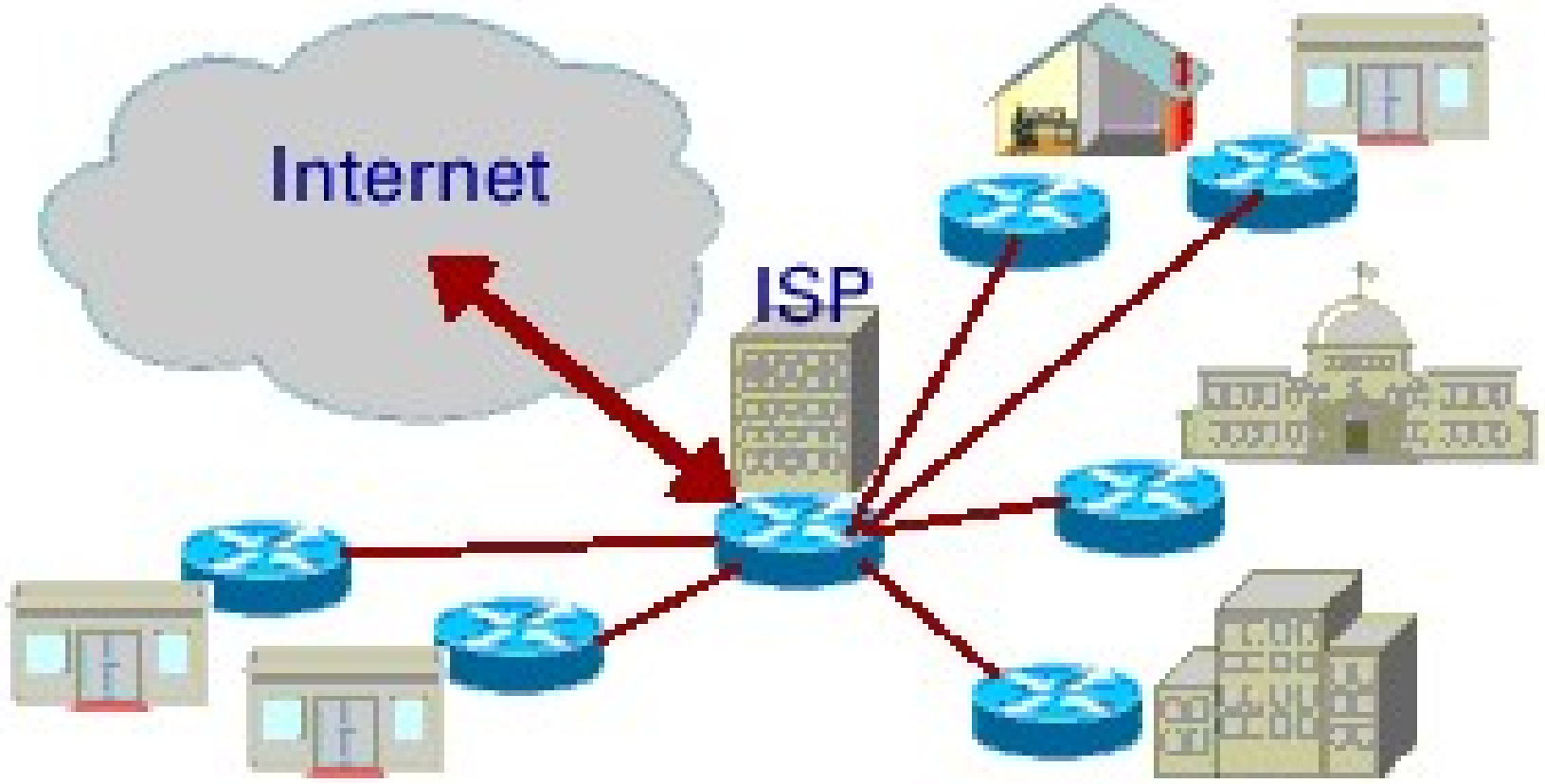
Types of WANs

- *Wide Area Network (WAN)* – a network that spans a wide geographical area; there are several types of WANS
  - Metropolitan area network (MAN)
  - Public access network (PAN)
  - Value added network (VAN)
  - Virtual private network (VPN)

Metropolitan Area Network (MAN)

- **A network which covers medium geographical area such as a town or a city.**
- **Provides high speed connectivity for Internet through DSL / ADSL lines and other services such as cable TV.**

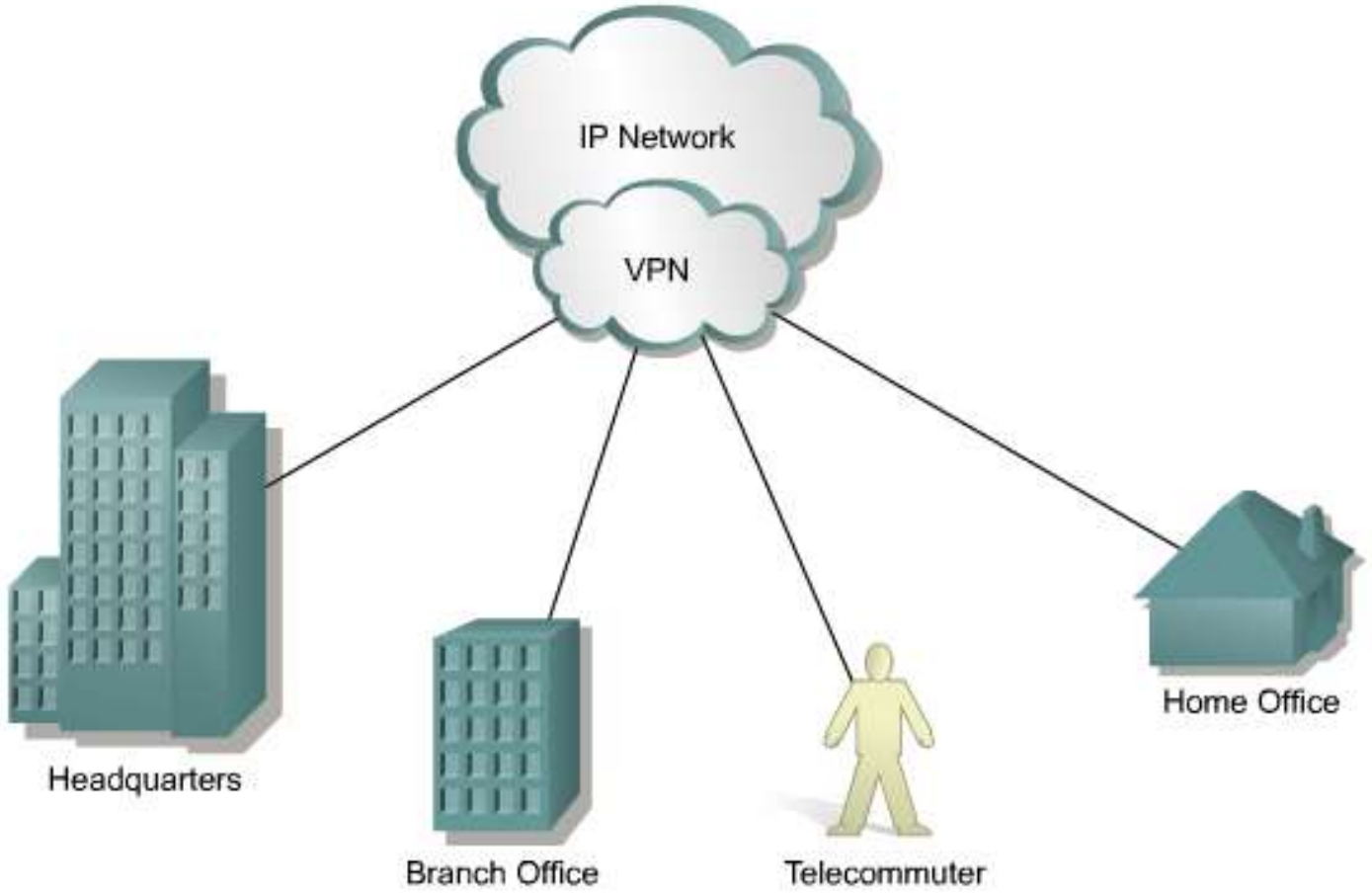
Metropolitan-Area Network (MANs)



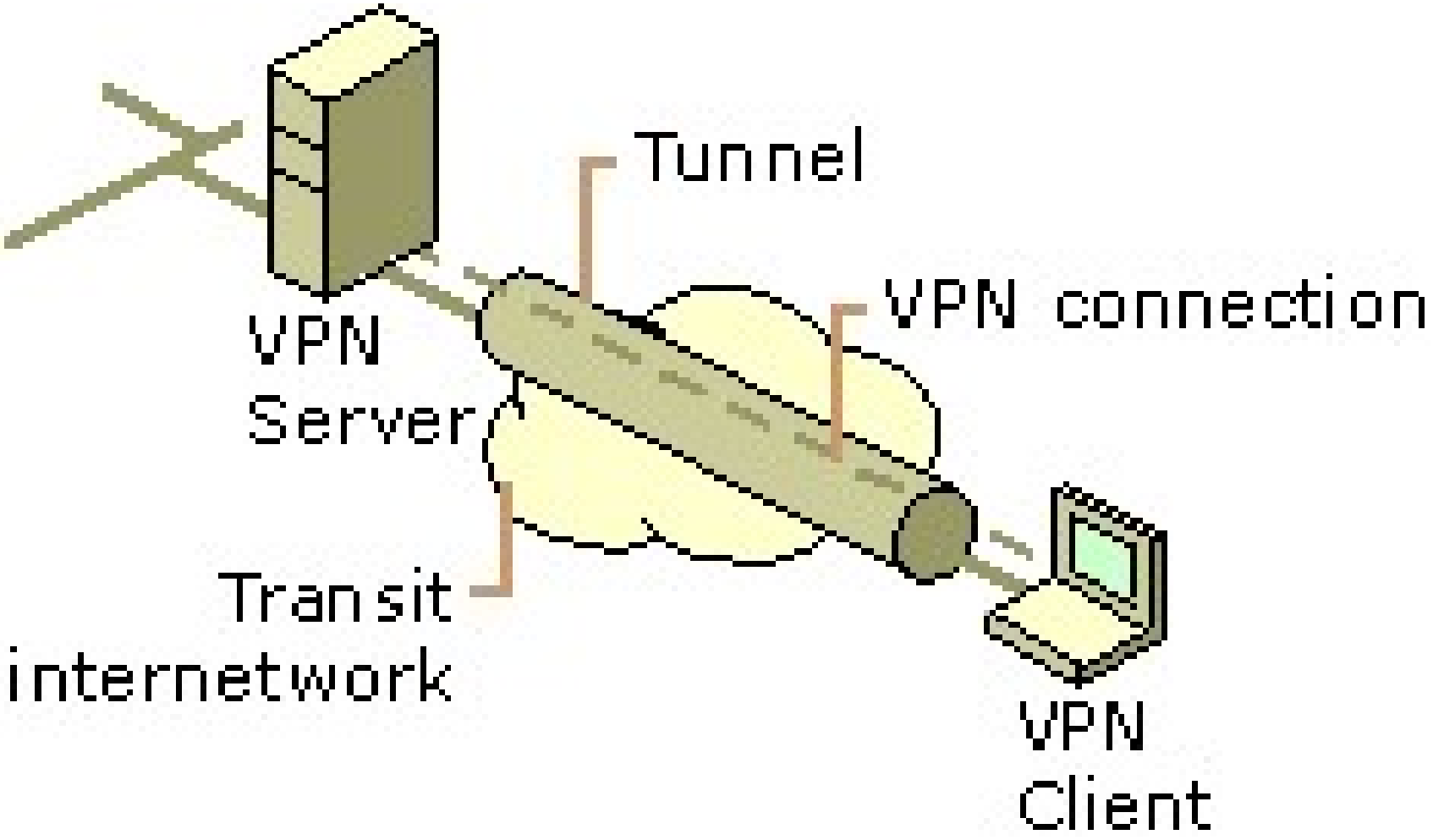
Virtual Private Network (VPNs)

A Virtual Private Network (VPN) is a network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network.

Virtual Private Networks (VPNs)



Typical VPN Connection



Virtual Private Networks (VPNs)

- Became popular as more employees worked in remote locations
- Employees can access the network (Intranet) from remote locations
- The Internet is used as the backbone for VPNs
- Reduces cost tremendously from reduction of equipment and maintenance costs
- Scalability

Virtual Private Networks (VPNs)

- Secured networks
- These systems use encryption and other security mechanisms to ensure that only authorized users can access the network and that the data cannot be intercepted
- Terminologies to understand how VPNs work.

Internetwork

- A network formed by connecting two or more networks. (Heterogeneous)
- The largest is the Internet.