SAPIENZA
UNIVERSITÀ DI ROMA

Network Infrastructures

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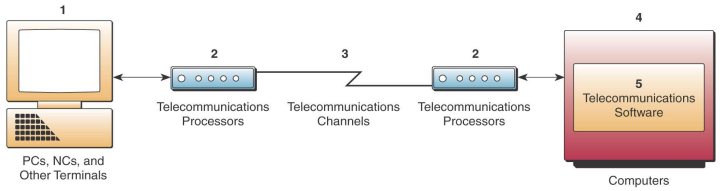
Introduction

A Telecommunications Network Model

- Consists of five basic components
  - Terminals
    - » Any input/output device that uses telecommunication networks to transmit or receive data
  - Telecommunication processors
    - » Support data transmission and reception between terminals and computers



A Telecommunications Network Model

- Telecommunications channels
  - » The medium over which data are transmitted and received
- Computers/Phones
  - » Interconnected by telecommunications networks
- Telecommunications control software
  - » Control telecommunications activities & manage the functions of telecommunications networks

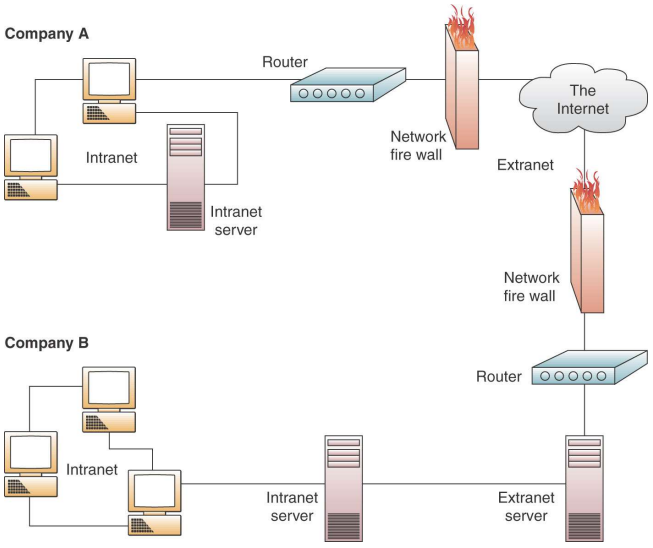
Types of Telecommunications Networks

- Wide Area Networks (WAN)
  - Cover a large geographic area.
- Metropolitan Area Networks (MAN)
  - Cover a metropolitan area.
  - Typically connect multiple geographically nearby LANs to one another (over an area of up to a few dozen kilometres) at high speeds
- Local Area Networks (LAN)
  - Connect computers & other information processing devices within a limited physical area.
  - Connected via ordinary telephone wiring, coaxial cable, or wireless radio & infrared systems

Types of Telecommunications Networks

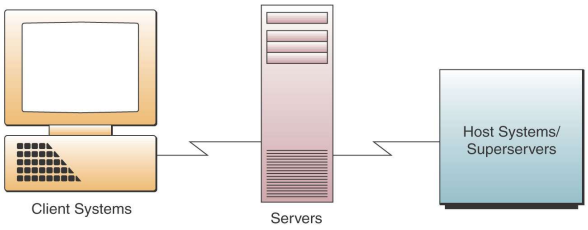
- Virtual Private Networks
  - A secure network that uses the Internet as its main backbone network, but relies on firewalls and other security features
  - A VPN Enabling Technology is IPSec (SVPN)
    - » It is an open architecture for IP-packet encryption and authentication, thus it is located in the network layer.
    - » IPSec adds additional headers/trailers to an IP packet and can encapsulate (tunnel) IP packets in new ones.

Types of Telecommunications Networks



Types of Telecommunications Networks

- Client/Server Networks
  - Clients – end user PCs
  - Server – helps with application processing and also manages the network



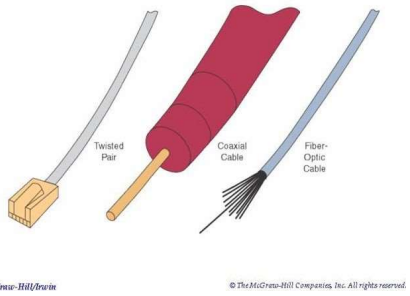
- Types: PCs, Network Computers, Workstations, Macintoshes.
- Functions: Provide user interface, perform some/most processing on an application.

- Types: Servers, Workstations, or Midrange Systems.
- Functions: Shared computation, application control, distributed databases.

- Types: Mainframes and Midrange Systems.
- Functions: Central database control, security, directory management, heavy-duty processing.

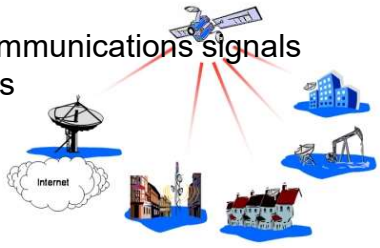
Telecommunications Media

- Twisted-pair wire
- Coaxial cable
  - Minimizes interference and distortion
  - Allows high-speed data transmission
- Fiber optics
  - Glass fiber that conducts pulses of light generated by lasers
  - Size and weight reduction
  - Increased speed and carrying capacity



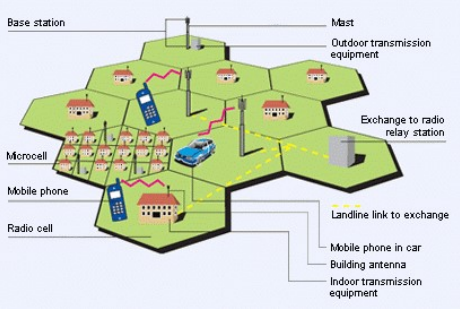
Wireless Technologies – Long Range

- Terrestrial Microwave
  - Line-of-sight path between relay stations spaced approximately 40 km apart
- Communications Satellites
  - Geosynchronous orbits
  - Serve as relay stations for communications signals transmitted from earth stations



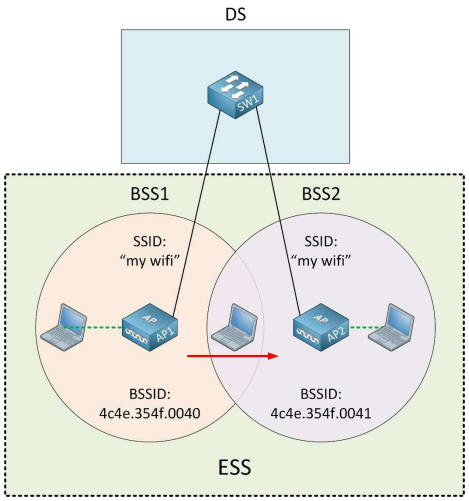
Wireless Technologies – Medium Range

- Cellular Systems
  - Each cell is typically from one to several square miles in area.
  - Each cell has its own low-power transmitter or radio relay antenna.
  - Computers & other communications processors coordinate & control the transmissions to/from mobile users as they move from one cell to another

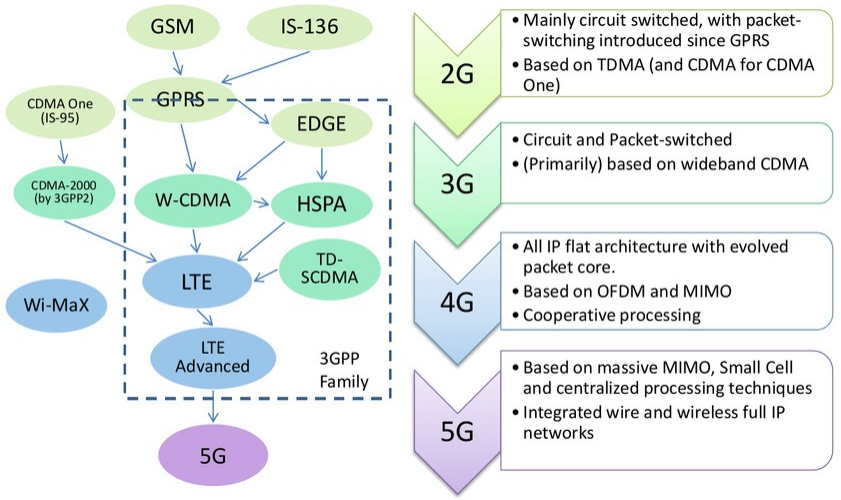


Wireless Techologies – Medium Range

Standard	Maximum Speed	Frequency
802.11 (legacy)	1.2 Mbps	2.4 GHz
802.11a	54 Mbps	5.8 GHz
802.11b	11 Mbps	2.4 GHz
802.11g	54 Mbps	2.4 GHz
802.11n	150 Mbps	2.4 & 5 GHz
802.11ac	800 Mbps	5 GHz

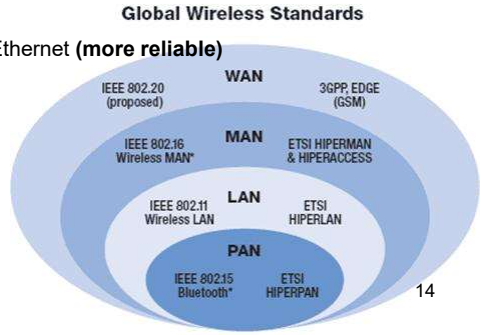


Standard evolution in Cellular networks

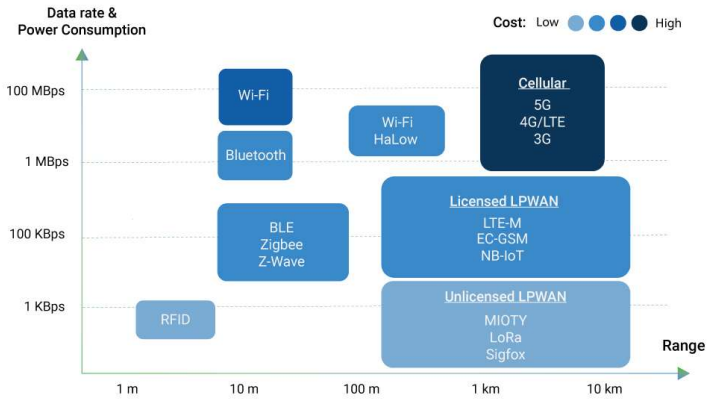


Personal Area Networks

- Connection of computer to peripherals or other computers
- Connect PDA and desktop computer
- Several connection methods:
  - Bluetooth **(radio frequency – up to 100 m)**
  - IrDA (Infrared) **(cheap)**
  - Wireless LAN 802.11b – wireless Ethernet **(more reliable)**



Low Power Area Networks



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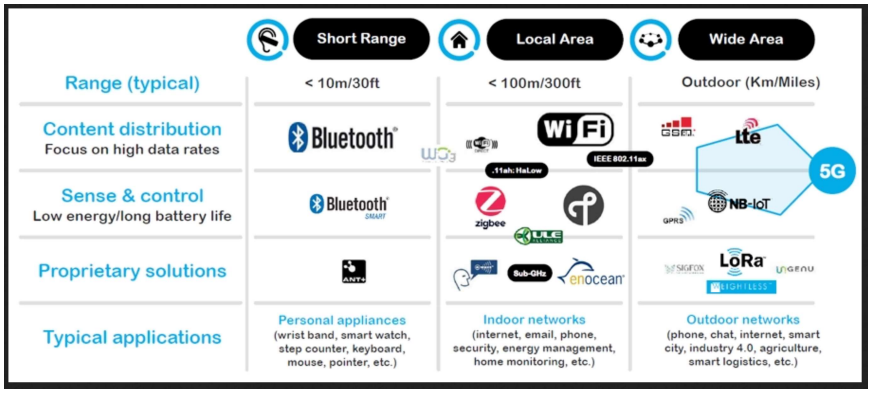


Telecommunications Processors

- Modems (modulation/demodulation)
  - Changes signals from analog to digital and back to analog

- Multiplexers
  - Allows a single communication channel to carry simultaneous data transmissions from many terminals

Telecommunications Processors

- Internetwork Processors
  - Switches
    - » Makes connections between telecomm circuits so a message can reach its intended destination
  - Router
    - » Interconnects networks based on different rules or protocols
  - Hub
    - » Port switching communications processor
  - Gateway
    - » A processor that interconnects networks that use different communications architecture

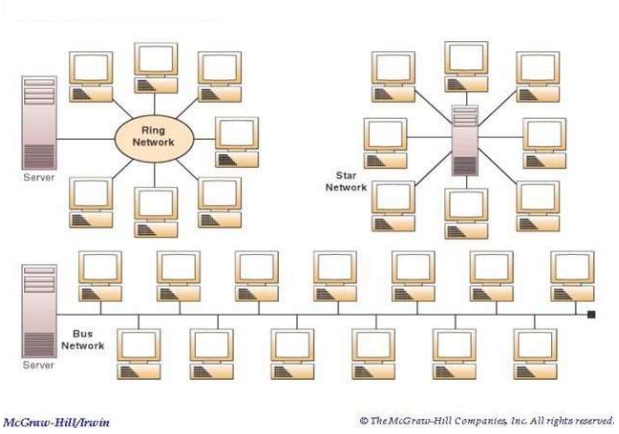
Telecommunications Software

- Provides a variety of communications support services including connecting & disconnecting communications links & establishing communications parameters such as transmission speed, mode, and direction
- Network Management
  - Traffic management
  - Security
  - Network monitoring
  - Capacity planning

Network Topologies

- Star
  - Ties end user computers to a central computer
  - Considered the least reliable
- Ring (sometimes called Token Ring)
  - Ties local computer processors together in a ring on a more equal basis.
  - Considered more reliable & less costly
- Bus
  - Local processors share the same bus, or communications channel
  - Tree is a variation which ties several bus networks together

Network Topologies



Network Architectures & Protocols

- Protocols
  - A standard set of rules & procedures for the control of communications in a network
  - Standards for the physical characteristics of cables and connectors
- Network Architecture
  - Goal is to promote an open, simple, flexible, efficient telecommunications environment

Network Architectures and Protocols