Introduction



Computer Networks Term B10

Introduction Outline

- Preliminary Definitions
 Internet Components
- Network Application Paradigms
- . Classifying networks
 - -by transmission technology
 - -by size/scale
 - -by topology



Definitions

computer network ::

[Tan] a collection of "autonomous" computers interconnected by a single technology.

[LG&W] communications network :: a set of equipment and facilities that provide a service.

In a distributed system the collection of independent computers appears to its users as a single coherent system.



Internet Access and Flows





The Internet: "nuts and bolts" view







Networking Application Paradigms



Introduction

Client-Server Applications



Figure 1.1 A network with two clients and one server.



Client-Server Model



Figure 1-2. The client-server model involves requests and replies.



Peer-to-Peer Applications



Figure 1.3 In a peer-to-peer system there are no fixed clients and servers.



A Closer Look at Network Structure

- network edge: applications and hosts
 access networks, physical media: wired, wireless communication links
- network core:
 - interconnected routers
 - network of networks





The Network Edge

- end systems (hosts):

- run application programs
- e.g. Web, email
- at "edge of network"
- client/server model
 - client host requests, receives service from always-on server
 - e.g. Web browser/server; email client/server
- peer-peer model:
 - minimal (or no) use of dedicated servers
 - e.g. Skype, BitTorrent





Wireless versus Mobile Applications

- Wireless involves transmissions through the air (type depends on frequency).
 - Residential access networks
 - Residential access points
 - Institutional access networks
 - Institutional and corporate access points or mesh networks
 - Public access networks
 - e.g., Cities, towns, libraries and coffee shops
 - Cellular networks
 - 2.5G, 3G and 4G



Wireless versus Mobile Applications

- . Mobile can refer to the Hosts.
 - Laptops can be moveable and wired.
 - Laptops can be moveable and wireless.
 - Cell phones, smart phones, PDAs and devices in vehicles are mobile and wireless.
- . Mobile Ad Hoc NETworks (MANETs)::
 - wireless devices are both Hosts and subnet nodes (routers).
 - The distinction is that MANET nodes may relay traffic intended for other nodes (multi-hop traffic).



Network Classifications





Classifying by Transmission Technology

broadcast :: a single communications channel shared by all machines (addresses) on the network. Broadcast can be both a logical or a physical concept (e.g. Media Access Control (MAC) sublayer).

multicast :: communications to a specified group.
This requires a group address (e.g. - multimedia
multicast).

unicast :: a communication involving a single sender and a single receiver.

point-to-point :: connections made via links between
pairs of nodes.



Classification by Size

Interprocessor distance	Processors located in same	Example	
1 m	Square meter	Personal area network	(PAN)
10 m	Room]]	
100 m	Building	├ Local area network	(LAN)
1 km	Campus		
10 km	City	Metropolitan area network	(MAN)
100 km	Country		
1000 km	Continent		(WAN)
10,000 km	Planet	The Internet	

Figure 1-6. Classification of interconnected processors by scale.



Classification by Size

- PANS {Personal Area Networks}
 - Used for communication among computer devices, including smart phones and PDA's in proximity to an individual's body [Wikipedia].
 - Reach up to meters.
 - Includes 'wearable' devices and protocols such as Bluetooth, Zigbee and UWB (Ultra Wide Band)
 - IEEE 802.15 Working Group for Wireless PANs (WPANs).



PANs



[Brunell University West London]



Classification by Size

- LANs {Local Area Networks}
 - Wired LANs: typically physically broadcast at the MAC layer (e.g., Ethernet, Token Ring)
 - Wireless LANs (WLANs)
 - Wireless Sensor Networks (WSNs)
- MANs {Metropolitan Area Networks}
 - campus networks connecting LANs logically or physically.
 - often have a **backbone** (e.g., FDDI, ATM and mesh) to connect campus networks.



Wired LANs





Ethernet bus

Ethernet hub

Leon-Garcia & Widjaja: Communication Networks



Wireless LANs (WLANs)



Figure 1-35. (a) Wireless networking with a base station. (b) Ad hoc networking.



Wireless Sensor Networks (WSNs)



WSNs can have mobile or fixed nodes but require a routing algorithm and normally have power concerns.



Metropolitan Area Networks (MANs)



Figure 1-8. A metropolitan area network based on cable TV.



MANs within a Hierarchical Topology



Metropolitan network A consists of access subnetworks: a, b, c, d.

Hierarchical Network Topology



National network consists of regional subnetworks: α, β, γ.

Metropolitan network A is part of regional subnetwork α .



Network Classification by Size

- . WANs {Wide Area Networks}
 - also referred to as "point-to-point" networks.
 - ARPANET \rightarrow Internet
 - usually hierarchical with a backbone.
 - Enterprise Networks, Autonomous Systems (ASs)
 - VPNs (Virtual Private Networks).



ARPAnet circa 1972



Leon-Garcia & Widjaja: *Communication Networks*



Wide Area Networks (WANs)



Figure 1-10.A stream of packets from sender to receiver.



internet









Note - A ring implies <u>unidirectional</u> flow.







Tree Topology



Tree Topology



WSN end-to-end routing often employs a spanning tree for routing.





Star Topology



Wireless Infrastructure



Star Topology



Introduction Summary

- Define: network, distributed system, subnet, host, node, flow, channel and link.
- Paradigms: Client-Server, Peer-to-Peer, Wireless and Mobile.
- Classifications and Acronyms:
 - Broadcast, multicast, unicast
 - PAN, LAN, MAN, WAN, WLAN, WSN
 - The Internet versus an internet
 - Hierarchical, bus, ring, tree, and star topology

