Overview of Network Hardware and Software

CS158a

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Jan 29, 2007.

Outline

- Scales of Networks
- Protocol Hierarchies

Scales of Networks

- Last day, we talked about broadcast versus point-to-point networks.
- Today, we will consider classifying networks based on scale.

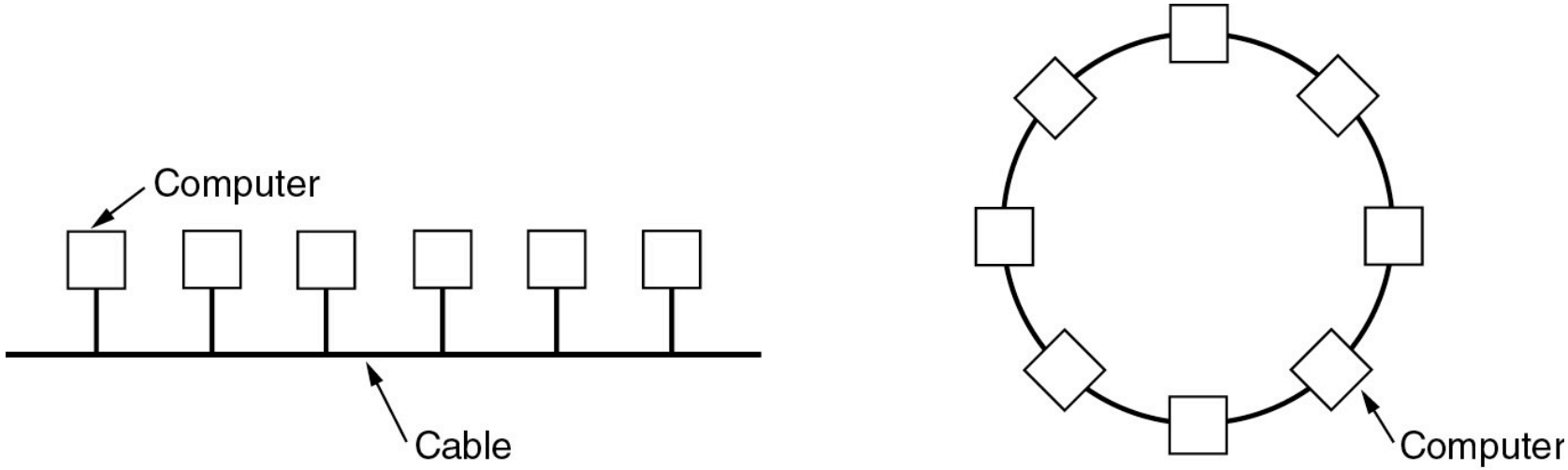
Different Scales of Networks

- **Personal Area Networks** -- 1m radius, maybe consists of smart phones, smart clothing, headset, etc.
- **Local Area Networks (LANs)** -- 10m to 1km radius, could be a network for a room, building, or campus.
- **Metropolitan Area Networks (MANs)** -- 10km, for example, city-wide wireless network.
- **Wide Area Networks (WANs)** -- 100km to 1000 km, networks for continents or countries.
- **The Internet** -- whole planet.

Local Area Networks

- Let's look at some of the hardware involved at these different scales…
- LANs are generally privately owned, and are used to share resources such as internet connection, printers, etc within a group of machines.
- Three characteristic distinguish a LAN: (1) size, (2) transmission technology, (3) topology.
- Restricted size means that the worst case transmission times for a LAN are known.
- Restricted size also simplifies management.

LAN Transmission Technologies



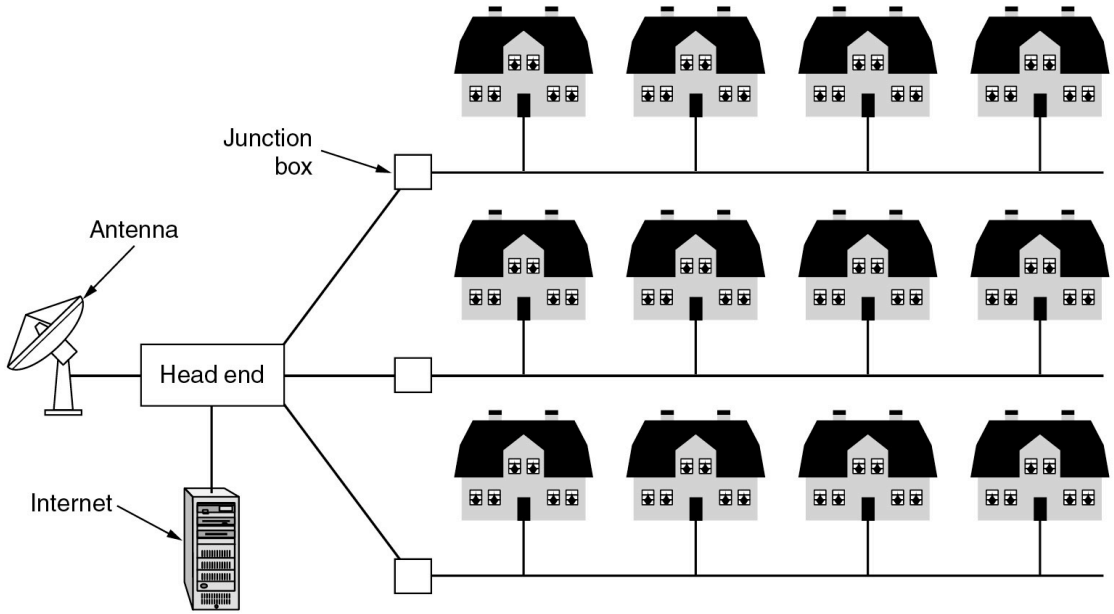
- Ethernet, IEEE 802.3, is an example of (a). Operates between 10Mbps, and 10Gbps. Ethernet is a broadcast network. A machine can transmit whenever it wants. If two machines try to transmit each waits a random time and then retransmits.
- IBM token ring, IEEE 802.5, is an example of (b). Operates between 4Mbps and 16Mbps. Each bit propagates around the ring on its own. Some bits will have gone completely around the ring before the whole packet is sent. Different arbitration mechanisms are used to decide who can transmit in a ring. (Next slide)

Static versus Dynamic Allocation of Channel

- **Static** - typically divide time into discrete intervals and use a round-robin algorithm, allowing each machine to broadcast only when its time slot comes up.
  - This wastes capacity if some machines have nothing to say.
- **Dynamic** - has two flavors: **centralized** and **decentralized**. In centralized allocation there is a single bus arbitration unit that decides who gets to go next.In decentralized channel allocation, each machine must decide whether or not to transmit.

Metropolitan Area Networks

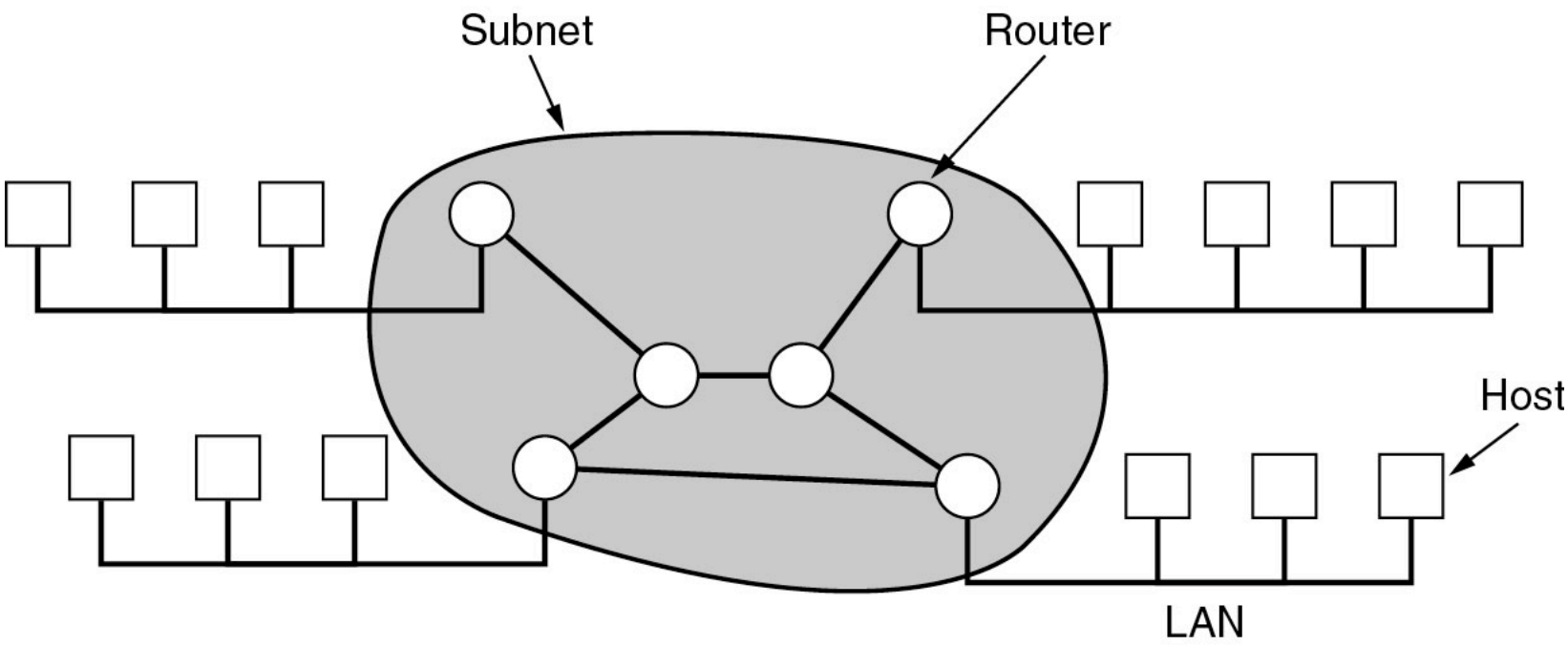
- Examples of MANs include cable television, and new city-wide wireless networks (IEEE 802.16).
- Such a cable network might support both cable, internet, and phone service and have a topology that looks like:



Wide Area Networks

- A wide area network contains a collection of machines intended for running applications.
- These machines are called **host**.
- These hosts are connected by a communication **subnet**.
- The subnet consists of two distinct components: transmission lines and switching elements.
- **Transmission Lines** move bits between machines. They can be made of copper wire, optical fibre, or radio links.
- **Switching elements** are specialized computers that connect three or more transmission lines. Commonly, they are now called **routers**.
- A router determines on which transmission line to forward incoming data.

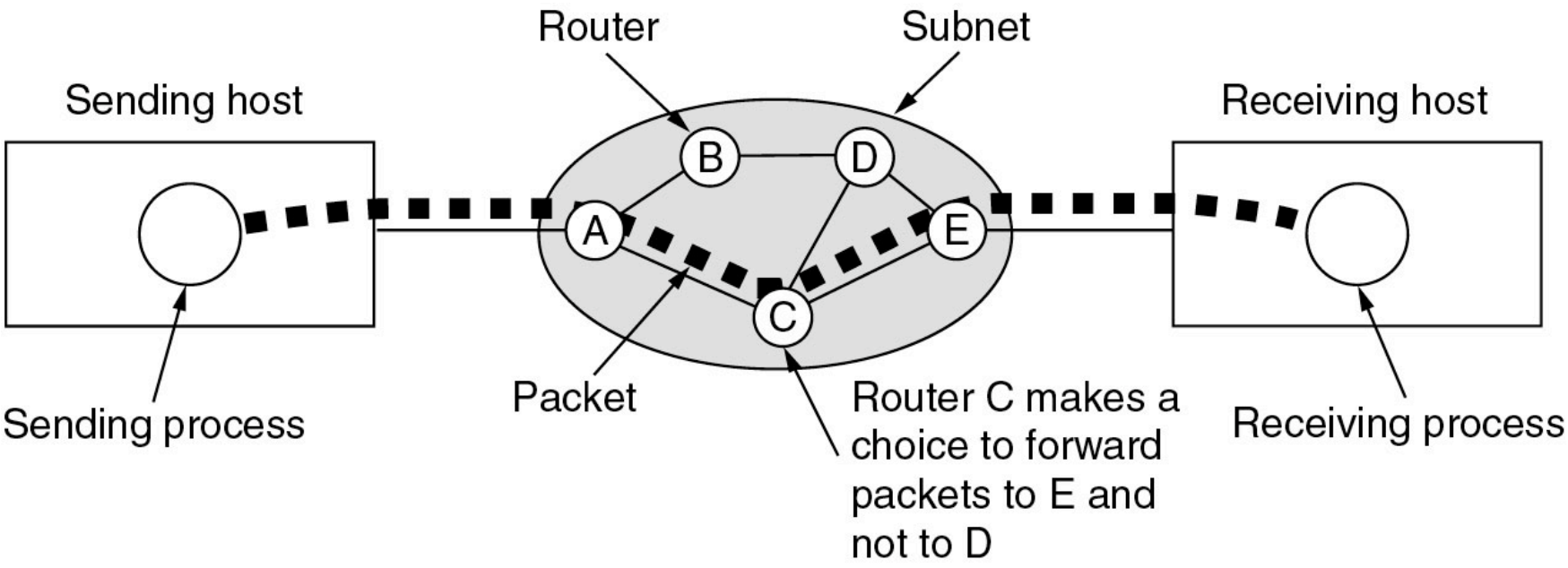
Example WAN



More on WANs

- Most WANs contain many transmission lines each connecting a pair of routers.
- If two routers that do not share a transmission line wish to communicate, they have to send a packet via intermediate routers.
- When a packet is completely received at an intermediate router, it is stored until the required output line is free and then it is forwarded.
- This is called a **store and forward** or **packet-switched** network.
- Typically the source computer sends a stream of packets, say ABCDE, each having a sequence number.
- These packets might not all follow the same route to the destinations.
- An intermediate router might choose different transmission lines to use for different packets depending on which line is currently free. (i.e., a **routing algorithm** is used).
- At the target computer the message is assembled using the sequence numbers of the packets to get the order right.

Example of Routing



Wireless Networks

- Wireless networks fall into three main categories:
  1. System interconnection -- used to connect components of a computer together. For example, computer and keyboard, mouse, and printer; smart phone and headset. **Bluetooth** is one technology for this. These networks use a master slave paradigm: the master tells the slave what addresses to use, when they can broadcast, etc.
  2. Wireless LANs -- in these setups each computer has its own radio with which it can communicate with other systems. There is typically a base station which each machine communicate and which route messages between machines (IEEE 802.11). One can also have **peer-to-peer** set-ups.
  3. Wireless WANs -- have already mentioned 802.16

Network Software-- Protocol Hierarchies

- We now switch to talking about the software used in connection with networks.
- To reduce design complexity this software is typically arranged into **layer**s or **levels**.
- Each levels is built on top of the layer below and offers services to the layer above.
- The rules and conventions **(interface)** for a given layer on one machine (a **peer)** to communicate with the same layer on another machine are called **protocols**.

Example of Protocol Hierarchy