

Introduction to Switching/Forwarding/Routing

CS 571

Fall 2006

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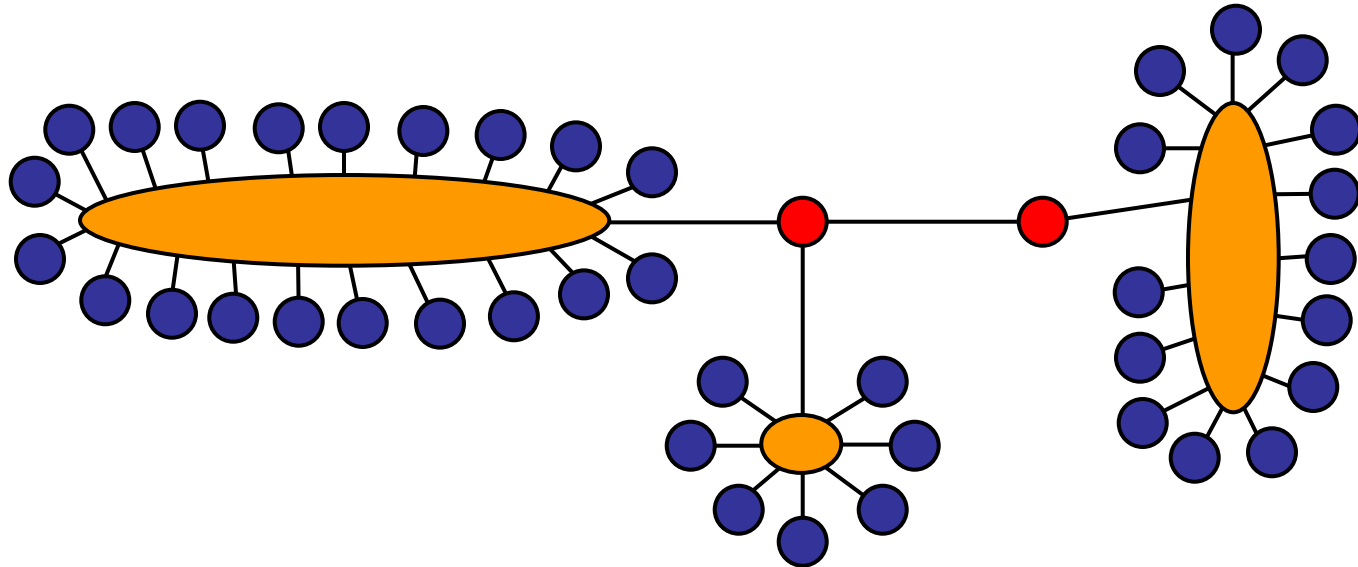
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The Picture So Far

- We have seen how to transmit frames/packets between stations over a **single channel**
 - Point-to-point or shared medium (LAN)
 - Framing, error control, MAC functions
- Problem: single channels **don't scale**
 - Can't build an 802 network to cover all of Kentucky, much less the whole country
 - Why not? **Speed of light limitations**
 - Even as channel capacity grows without limit (**frame xmit time $\rightarrow 0$**)
 - As network covers longer distance, **fraction of capacity wasted** waiting for protocol information to propagate **approaches 1**
 - Polls or equivalent (token-passing)
 - Collisions
 - Note: **power requirements**, increase in **offered load** due to more stations are not the primary reasons!

The Solution

- Add Store-and-forward nodes to connect networks
 - Some stations are connected to multiple channels
 - They receive packets and relay them to other channels
 - Relay nodes are called **Intermediate systems** (ISs)



Store-and-Forward Networks

- The **forwarding challenge**:
 - Each IS needs to make a decision for each packet:
Which channel to relay it to?
 - In general, there may be **several choices of outgoing channel**
 - Requirements: (i) packet arrives at its destination; (ii) packet doesn't go too far "out of the way"
- The Fundamental principle of forwarding:
 - Each packet **must contain information** the IS can use to make this decision
(Exception: random-walk routing: just forward the packet on any link.
In a finite network, it arrives with probability 1.)
 - IS may also store **state information** to use in making the decision

Terminology: Switching vs. Forwarding

- These terms are sometimes used as synonyms
- Switching refers to the operation of connecting channels together to make a single channel
 - Circuit switching: relaying [signals](#)
 - Requires that all channels in network look (more or less) the same at the symbol level
 - Telephone network was originally circuit-switched
 - End-to-end delay is more-or-less fixed and predictable
 - Packet switching: relaying frames or packets
 - Allows different lower layers to be concatenated together
 - Introduces queueing delay
- Forwarding refers to relaying packets from one channel to another
(Note: no such thing as "circuit forwarding")

Parts of the Problem

- Three separable aspects:
 1. Determining **what paths** lead to each destination ("Path discovery")
 2. **Choosing a path** to each destination ("Path selection")
 3. Ensuring that each **packet follows the chosen path** ("Forwarding")
- **How to identify destinations?**

Different channels may use different addressing schemes
- Different approaches assign responsibility for these aspects to different parties

More Terminology

- So what is Routing?
- Refers to the **path discovery** and **path selection** parts of the problem (as opposed to forwarding)
- Typically, "routing" refers to the way the Internet Protocol solves the problem:
 - Global address space, **tied to topology**
 - IS's **exchange information** that enables them to determine the best path to each destination
(More on this later)