NOTES

Chapter 17
Internetworking

Motivation: Universal Service

- The objective of chapter 12 was to design a large-scale wide area network technology
- Howver, we assumed a switch could copy the packet from one network to the other.
- This implies that all the links in a WAN must be of the same type (e.g., all point-to-point, all ethernet, all FDDI, ...).
- This may work for a WAN that connects a single large organization
- But, it we want to build a network that provides Universal Service , we must be able to handle heterogeneity .

Universal Service: (continued)

- Universal Service:
- Heterogeneity

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Internetworking

- Internetworking is the concept of creating large-scale networks by connecting multiple networks of dissimilar (heterogeneous) technologies
- Terminology:
  - An internet (little i):
  - An internetwork :
  - A physical network :
- Internetworking requires:
  1. Hardware : between physical networks to connect them
  2. Software : running on each attached computer to create the illusion of a single large network

So What's New?

- Has the same scalabilty/routing/forwarding problems as homogeneous WANs
- New problem is heterogeneity .
- Must switch packets between heterogeneous networks
- Why is that hard?

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Routers

- internets use routers to connected heterogeneous physical networks together
- have also been called gateways, IMPs, PSNs, Fuzzballs, ...
- routers differ from switches in the fact that the networks they connect, need not be the same.

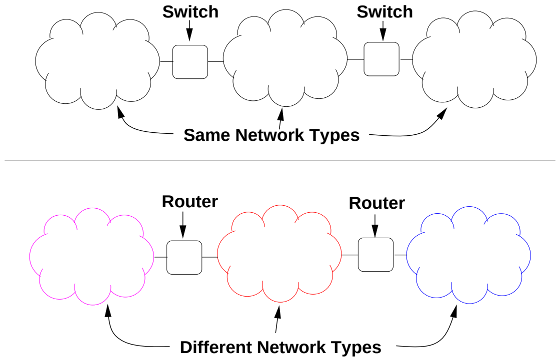

Figure 1: Switches vs. Routers

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Routers: (continued)

- a router is a hardware component (to handle the physical/data link layer protocols) and hardware/software to handle the networking layer protocols
- Routers must somehow transform an incoming packet into the appropriate outgoing packet
- An internetwork is composed of arbitrarily many physical networks interconnected by routers

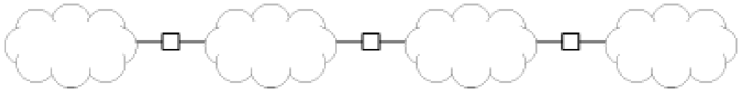

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Figure 2: Multiple Physical Networks connected by Routers

Routers: (continued)

- Routers can have more than two interfaces

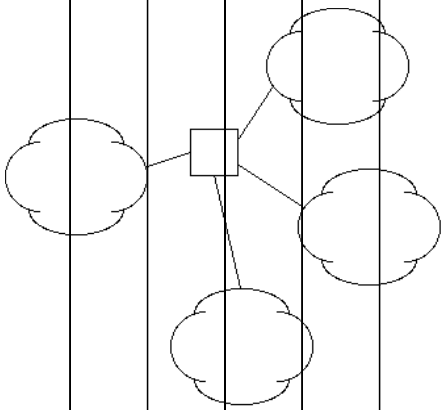

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Figure 3: Router with multiple interfaces

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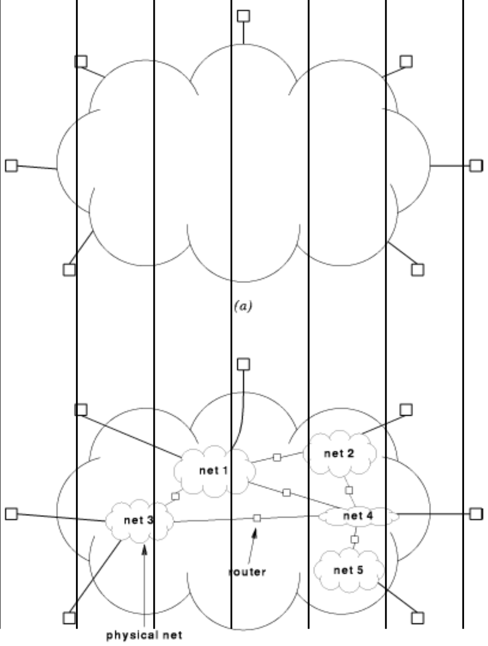
Virtual Networks

- Internetworking software builds a single, seamless virtual network out of multiple physical networks
  - Universal addressing scheme
  - Universal service
- All details of physical networks hidden from users and application programs



(a)

(b)

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Figure 4: The Virtual and Real Network Views

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Methods of Internetworking

- There are many ways to build internets
- Possible ways include the IPX protocol by Novel, the XNS protocol by Xerox, and the IP protocol by ARPA
- IP is by far the most widely used
- IP is vendor and platform independent
- Used in the Internet (big I)

IP Protocol Objectives

1. Connect physical networks of every possible type (even future network technologies not yet developed)
2. Scale to a WAN connecting many hosts

- How many is "many"?

- To succeed, IP had to make minimal assumptions about the physical networks it connects

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Physical Network Assumptions

- IP makes the following assumptions about the physical network technology

- What if the network does not provide this?

The IP Service Model

- Provides a Global Addressing Scheme

- Provides "best effort", connectionless, variable-length, datagram delivery

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The IP Service Model: (continued)

- Advantages of the Model

- Disadvantages of the Model