School of Business
Eastern Illinois University

Internetworking (Part II)

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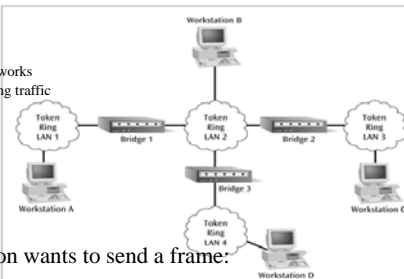

Learning Objectives

- Understand internetworking devices operation
  - Source-routing bridge
  - Remote bridge
  - Router
  - Hubs and switches

Source-routing Bridges

Figure 8-8
A token ring system composed of multiple token ring local area networks

- Found with token ring networks
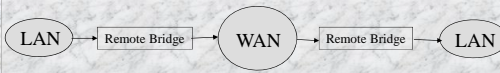- Do not learn from observing traffic

When a workstation wants to send a frame:

➢It must know the exact path of network / bridge / network / bridge / network …

➢If a workstation does not know the exact path, it sends out a discovery frame.

➢The discovery frame makes its way to the final destination, then as it returns, it records the path.
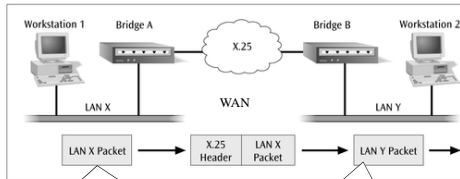
Remote Bridges

- Used to (remotely) connect two LANs
  - separated by a long distance
  - Passing by a Wide Area Network ⭐

LAN → Remote Bridge → WAN → Remote Bridge → LAN

Remote Bridges

Figure 8-9
Two LANs with
intervening X.25 frame
network

Workstation 1   Bridge A   X.25   Bridge B   Workstation 2

LAN X   WAN   LAN Y

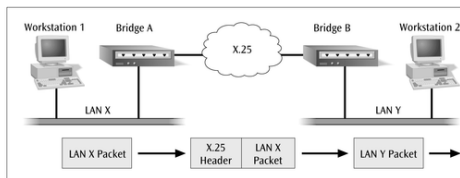LAN X Packet → X.25 Header | LAN X Packet → LAN Y Packet →

A remote bridge takes the frame before it leaves the first LAN and encapsulates it with WAN header and trailer

When the packet arrives at the destination remote bridge, that bridge removes the WAN header and trailer leaving the original frame.

Remote Bridges

Figure 8-9
Two LANs with
intervening X.25 frame
network

Workstation 1   Bridge A   X.25   Bridge B   Workstation 2

LAN X   LAN Y

LAN X Packet → X.25 Header | LAN X Packet → LAN Y Packet →

- Different LANs protocols (100BaseT, 100BaseFX Ethernet, Token Ring, etc.)
- Different WANs standards (X.25, Frame Relay, ATM, etc.)
  - Unique Remote bridge for each pair of LAN-WAN combination ⭐

Question

- Your supervisor at Network Inc. wants you to provide your expertise to help a client decide what kind of bridge is needed to interconnect two LANs located in two separate buildings in town. One of the LANs uses CSMA/CD and the other one is a Token Ring LAN. What will be your recommendation?
  - a) Use a Source-Routing bridge
  - b) Use a Transparent bridge
  - c) Use a Transparent bridge, but check the features to make sure that it has the appropriate conversion function.
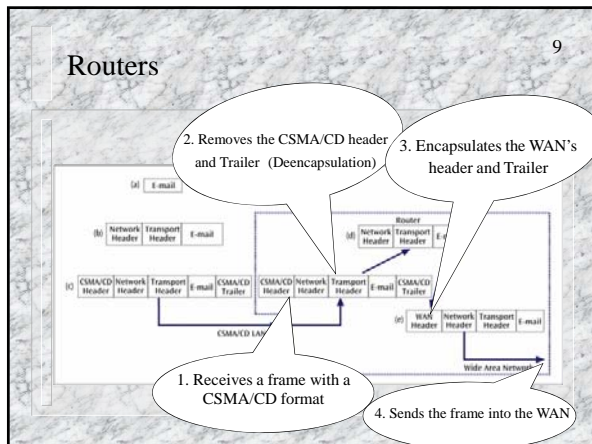 - d) Use a Remote bridge.

Routers

- 3-Layer device that connects:
  - a LAN to a WAN
  - a WAN to a WAN (or used to forward messages in a WAN)
  - LANs to LANs too

- Functions:
  - Conversion between frame formats
  - Forwarding frames
  - Making routing decisions
  - Often firewall functions (protection)

Routers

2. Removes the CSMA/CD header and Trailer (Deencapsulation)

3. Encapsulates the WAN's header and Trailer

1. Receives a frame with a CSMA/CD format

4. Sends the frame into the WAN

Routers

- Like bridges, routers have incoming and outgoing ports
- Frame arrives at incoming port

⭐ • 3-Layer devices

	Network/Internet
Incoming Frame →	Data Link	Data Link

First Router

Routers

- Incoming Data Link on the Router
  - Removes the LAN's Header & Trailer to access the Network/Internet Layer's packet (deencapsulation)
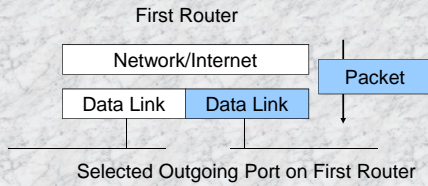 - Passes the removed packet to the router' Network/Internet layer

First Router

Packet	Network/Internet
Incoming Frame →	Data Link	Data Link

Incoming Port on First Router

Routers

- Since the Network/Internet layer is the highest ⭐ layer on a router
  - Network/Internet layer decides where to send the packet next: another router or the destination LAN

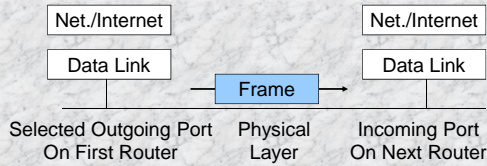| Network/Internet	
Data Link	Data Link

First Router

Layer Cooperation on the First Router

- Network/Internet layer passes Network/Internet packet to Data Link layer on the selected outgoing port that will carry the packet to the next router or the destination LAN
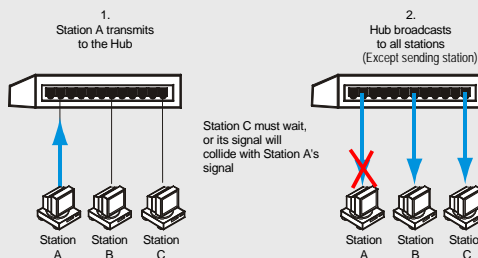
First Router

| Network/Internet | | Packet |
| Data Link | Data Link | |

Selected Outgoing Port on First Router

Layer Cooperation on the First Router

- The Data Link layer on the selected port creates a Frame including the packet, a Header and a Trailer

- The created frame is passed to the Physical layer on the selected port for transmission to the next router (or destination LAN)

| Net./Internet | | Net./Internet |
| Data Link | Frame | Data Link |

Selected Outgoing Port   Physical   Incoming Port
On First Router   Layer   On Next Router

Hub operation

1.
Station A transmits
to the Hub

2.
Hub broadcasts
to all stations
(Except sending station)

Station C must wait, or its signal will collide with Station A's signal

Station   Station   Station
A   B   C

Station   Station   Station
A   B   C

Hubs split available bandwidth among computers, i.e. with a 100 Mbps hub, the network speed will be 100 Mbps / n (where *n* is the number of computers)
Active hubs include repeater capabilities for regenerating signals.
Passive hubs don't regenerate signals. Limited to a 30meter distance apart from computers.

Hubs

- A hub interconnects stations in Star-Bus LANs
- A hub works at the physical layer (Accepts & forward frames)
- A hub broadcasts frames out all connecting links (except sender's link)
- A hub could be used to create logical LAN segments for congestion relief

Switches

- A switch examines the destination address and forwards the frame out the one necessary connection.
- Multiple stations connected to a switch use dedicated segments i.e. each station has a private dedicated connection to the switch
- A hub could be used to create logical LAN segments for congestion relief

Hubs and Switches

Using switches and hub for interconnecting LAN's segments

Crossover cable is used to connect hub and/or switches

Summary Questions

1. How a Source-routing bridge differ from a transparent bridge ?

2. What is the purpose of a discovery frame ?

3. In what situations is a Remote bridge used?

4. What are the basic functions of a router?

5. What is a crossover cable?

Summary Questions

1. The local area network shown in Figure 8-18 (p. 261) has two hubs (X and Y) interconnecting the workstations and servers. What workstations and servers will receive a copy of a packet if the following workstations/servers transmit a message:

Workstation 1 sends a message to workstation 3:

Workstation 2 sends a message to Server 1:

Server 1 sends a message to workstation 3:

2. Replace hub Y with a switch. Now, what workstations and servers will receive a copy of a packet if the following workstations/servers transmit a message:

Workstation 1 sends a message to workstation 3:

Workstation 2 sends a message to Server 1:

Server 1 sends a message to workstation 3:

Summary Questions

3. Do Internetworking Exercise 2