FACULTY OF TECHNOLOGY
UNIVERSITY OF COLOMBO
SRI LANKA

Computer Networks

Lecture 3: **Networking Devices**

Department of Information and Communication Technology

Outline of the syllabus

- Week 1 – Introduction to Network
- Week 2 – OSI Model and Media Types
- Week 3 – Devices and their functions
- Week 4 – ISO OSI seven Layer Architecture
- Week 5 – Application Layer
- Week 6 – Presentation layer
- Week 7 – Session layer

Outline of the syllabus

- Week 8 – Transport Layer
- Week 9 – Network Layer
- Week 10 – Data Link layer
- Week 11 – Physical layer.
- Week 12 - Routing techniques
- Week 13– how to setup local area networrk
- Week 14 – Revision

Learning Objectives

After completing this module, you will be able to:

- Understand the types of the networking devoices used for the networks
- Understand the functions of those devices
- Understand the usage of the devices and right usage of those devices

Lecture -3 Outline

- What are internetworking Devices
- Network Devices used in LAN and WAN
- Repeaters, Hubs, Switches, Routers and Bridges
- Comparison of
  - ✓ Hubs and switches
  - ✓ Routers and Switches
  - ✓ Bridges and Routers

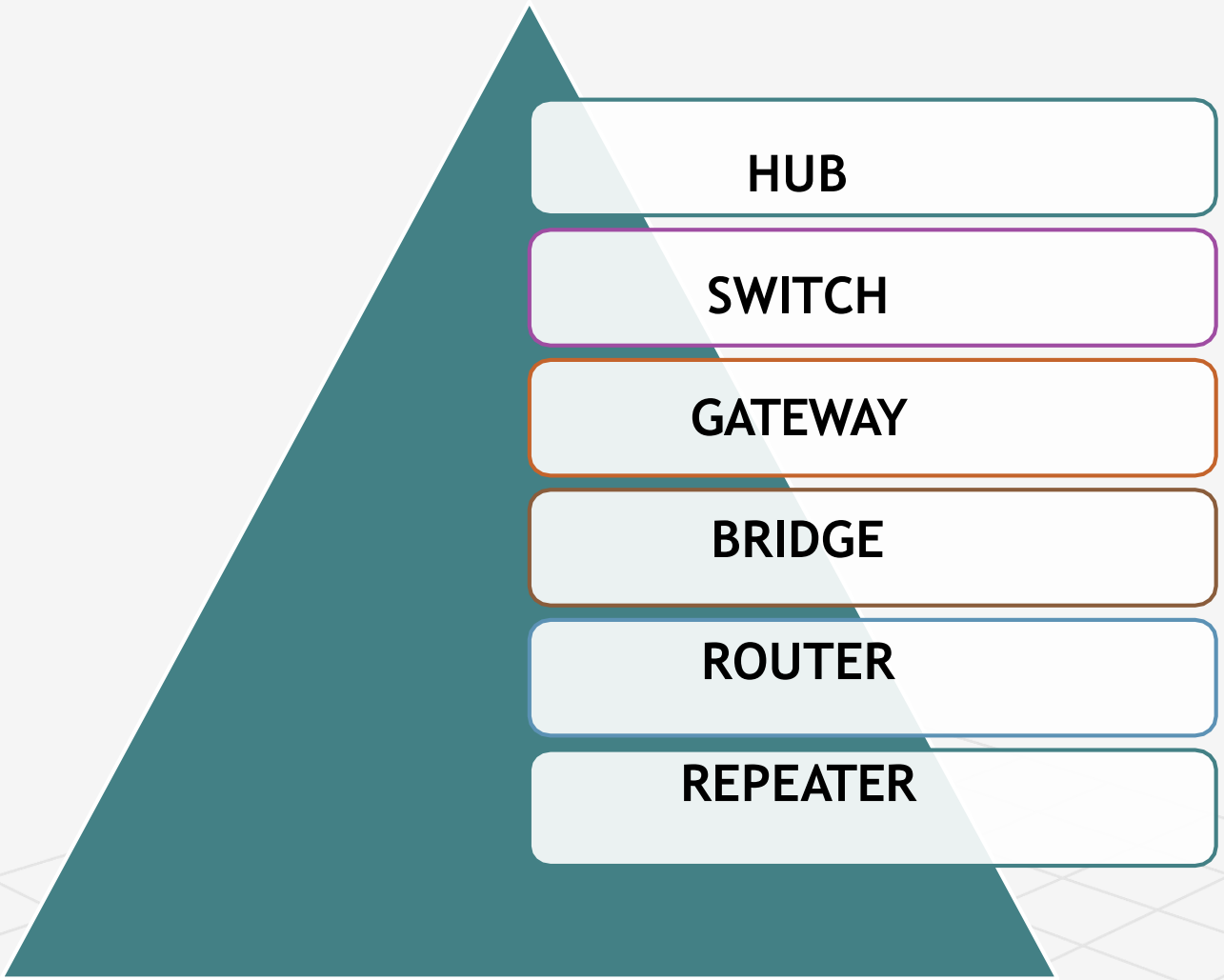
What are internetworking devices?

- Networking Devices are components used to connect the computers or other electronic devices togethers so that they can share file or resources like printers or fax machines.
- With the growing of the computer networks and their complexity, the internetworking devices used to connect them.

What is Domain?

- A domain is a type of computer network in which all user computers, printers accounts, and other devices registered. It is a central database located on single or multiple clusters of central computers, that is known as domain controllers.

Networking Devices

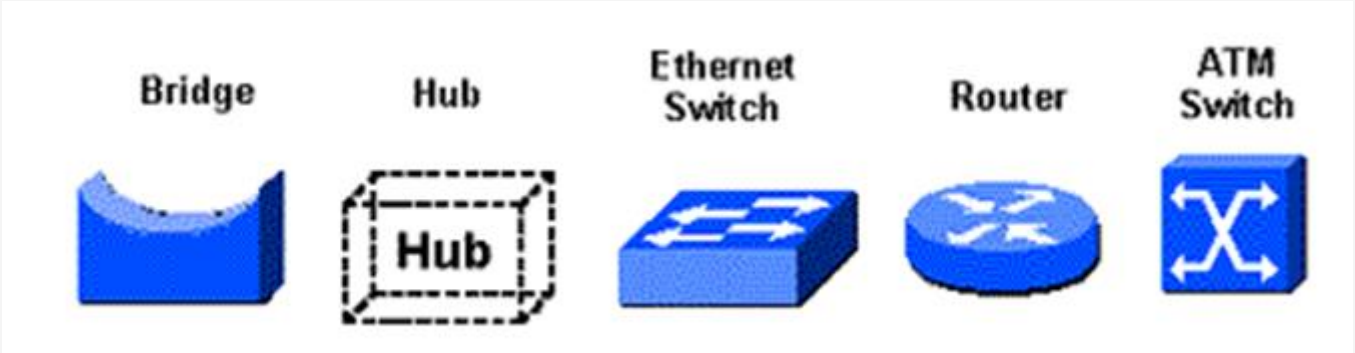


The purposes of having devices

- They allow a greater number of nodes to be connected to the network.
- They extend the distance over which a network can extend.
- They localize traffic on the network.
- They can merge existing networks.
- They isolate network problems so that they can be diagnosed more easily.

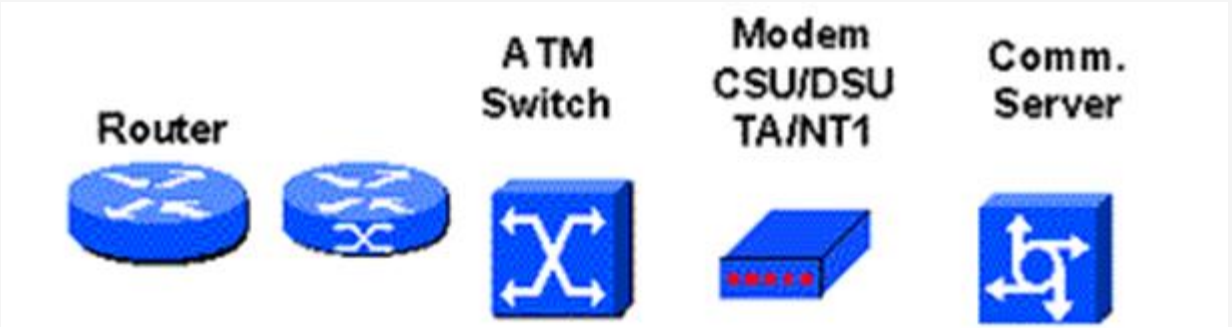
Local Area Network and Devices

- LANs are designed to
  - ✓ Operate within a limited geographic area
  - ✓ Allow multiaccess to high-bandwidth media
  - ✓ Control the network privately under local administration
  - ✓ Provide full-time connectivity to local services
  - ✓ Connect Physically adjacent devices



Wide Area Network and Devices

- WANs are designed to
  - ✓ Operate over geography of telecommunications carriers
  - ✓ Allow access over serial interfaces operating at lower speeds
  - ✓ Control the network subject to regulated public service
  - ✓ Provide full-time and part-time connectivity
  - ✓ Connect devices separated over wide, global area

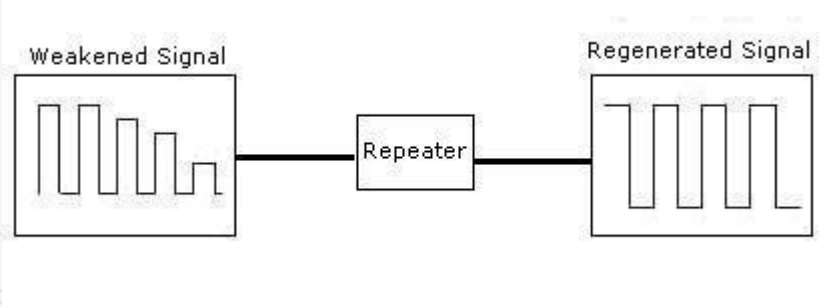


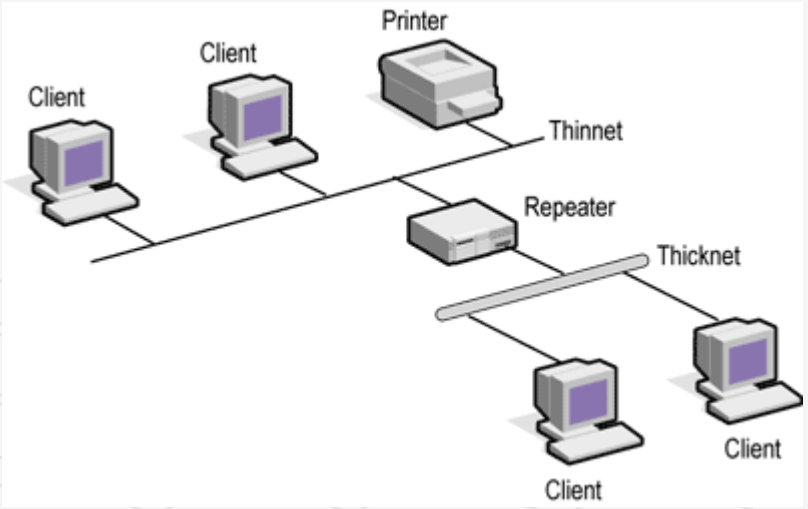
CSU/DSU : Channel Service Unit/ Data Service Unit

What internetworking devices operate at the physical layer (layer 1) of the OSI model?

Repeater

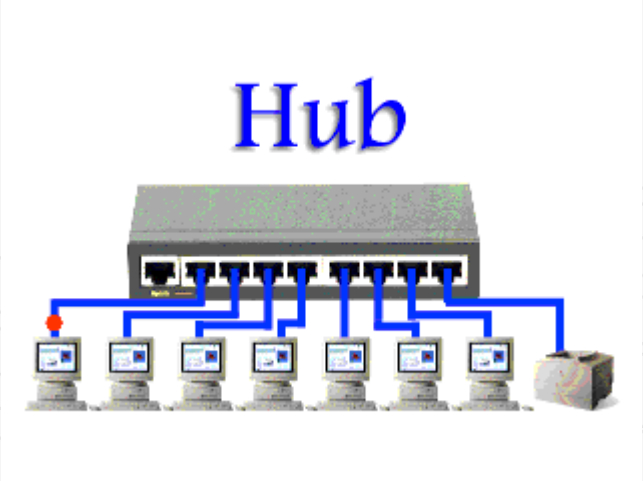
- A repeater can provide a simple solution if either of these two problems exists.
- When signals first leave a transmitting station, they are clean and easily recognizable. However, the longer the cable length, the weaker and more deteriorated the signals become as they pass along the networking media.

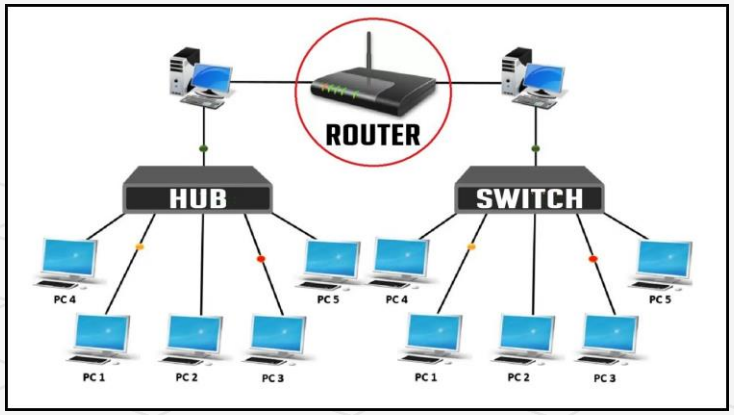




Hub

- Multi-port repeaters are often called hubs and a hub is a common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN.
- The term hub is used instead of repeater when referring to the device that serves as the center of a star topology network
- Hubs are very common internetworking devices, and it contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.



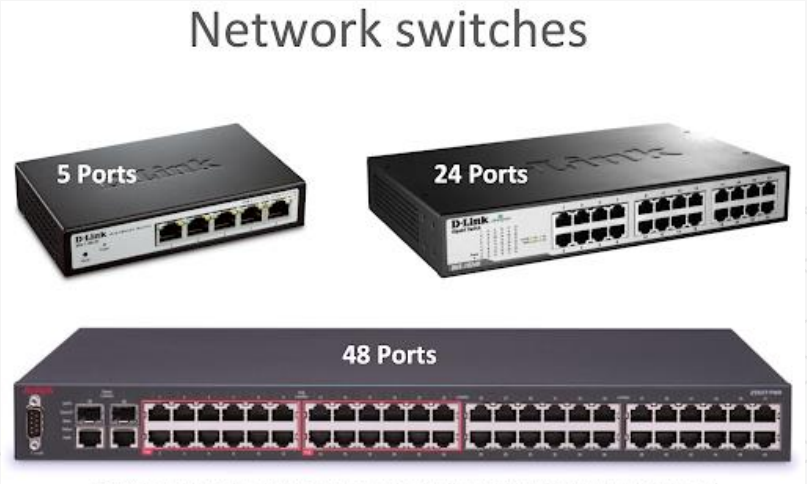


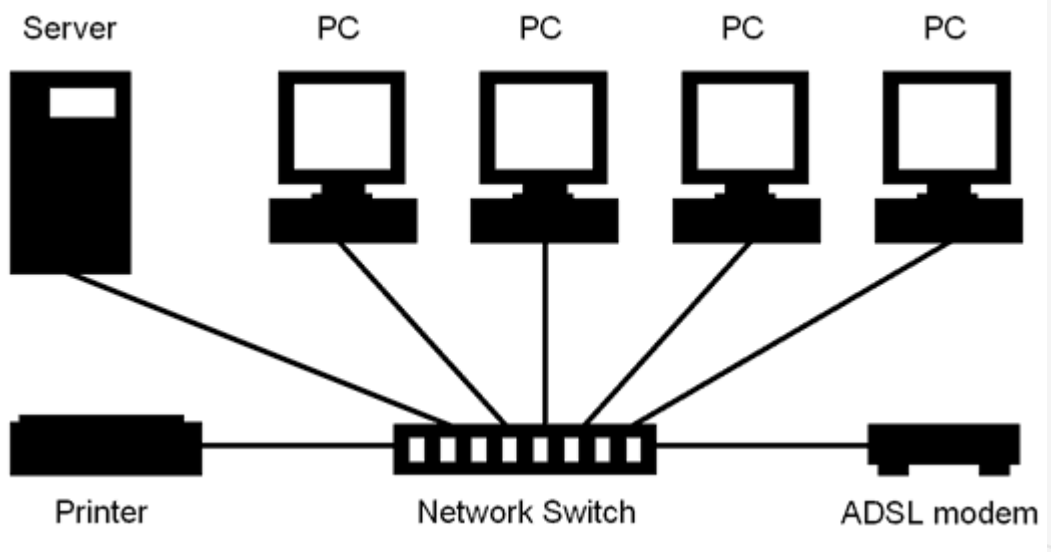
Hub

- Active central element of star layout
- Each station connected to hub by two lines
  - Transmit and receive
- Hub acts as a repeater
- When single station transmits, hub repeats signal on outgoing line to each station
- Line consists of two unshielded twisted pairs
- Limited to about 100 m
  - High data rate and poor transmission qualities of UTP
- Optical fiber may be used
  - Max about 500 m
- Physically star, logically bus
- Transmission from any station received by all other stations
- If two stations transmit at the same time, collision

Switch

- A network switch (also called switching hub, bridging hub, officially MAC bridge) is a computer networking device that connects devices together on a computer network by using packet switching to receive, process, and forward data to the destination device.





Switch vs. Hubs

- Layer 2 switches : operate at Data Link Layer of the OSI Model.
- Layer 3 switches : operates at Network Layer or above of the OSI Model

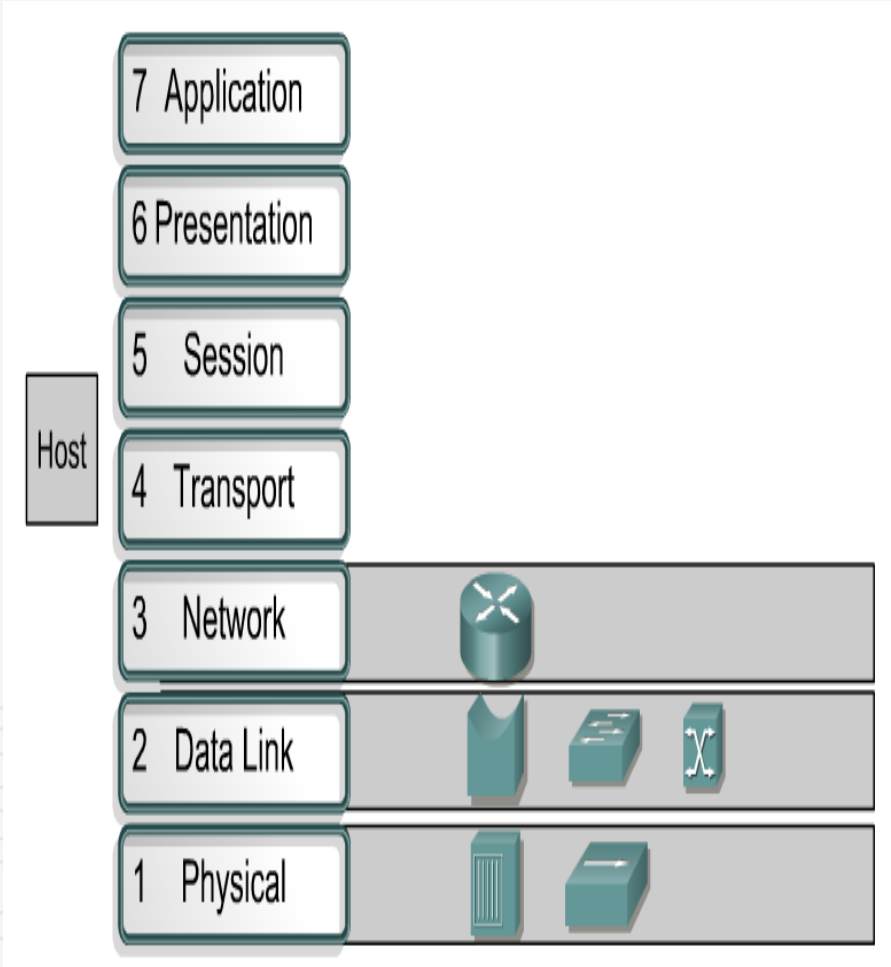
Sr. No.	Key	Hub	Switch
1	Objective	Hub main objective is to transmit the signal to port to respond where the signal was received.	Switch enables connection setting and terminating based on need.
2	Layer	Hub works in Physical Layer.	Switch works in Data Link Layer.
3	Transmission Type	Hub uses broadcast type transmission.	Switch uses unicast, multicast as well as broadcast type transmision.
4	Ports	Hub can have maximum 4 ports.	Switch can have 24 to 28 ports.
5	Collision Domain	Hub has a single collision domain.	In Switch, each port have their own collision domain.
6	Packet Filtering	Hub do not provide packet filtering.	Switch provides packet filtering.
7	Transmission Mode	Hub uses half duplex transmission mode.	Switch uses full duplex transmission mode.

Routers

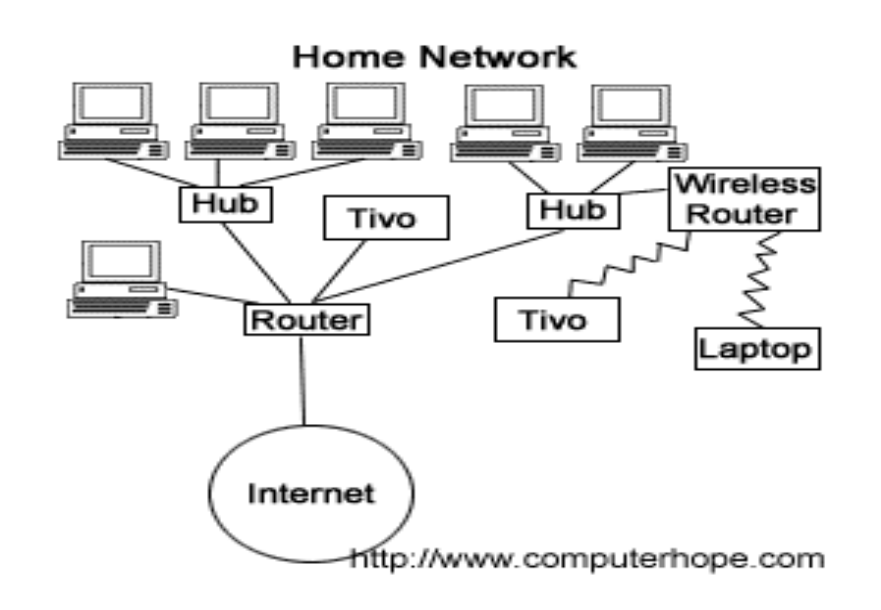
- A router is a networking device that connects different networks –frequently over a large distances.
- Also, it forwards **data packets** between computer networks creating an overlay internetwork .
- Routers perform the traffic directing functions on the Internet. A data packet is typically forwarded from one router to another router through the networks that constitute the internetwork until it reaches its destination node.
- A router is connected to two or more data lines from different IP networks. When a data packet comes in on one of the lines, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its **routing table** or **routing policy**, it directs the packet to the next network on its journey.

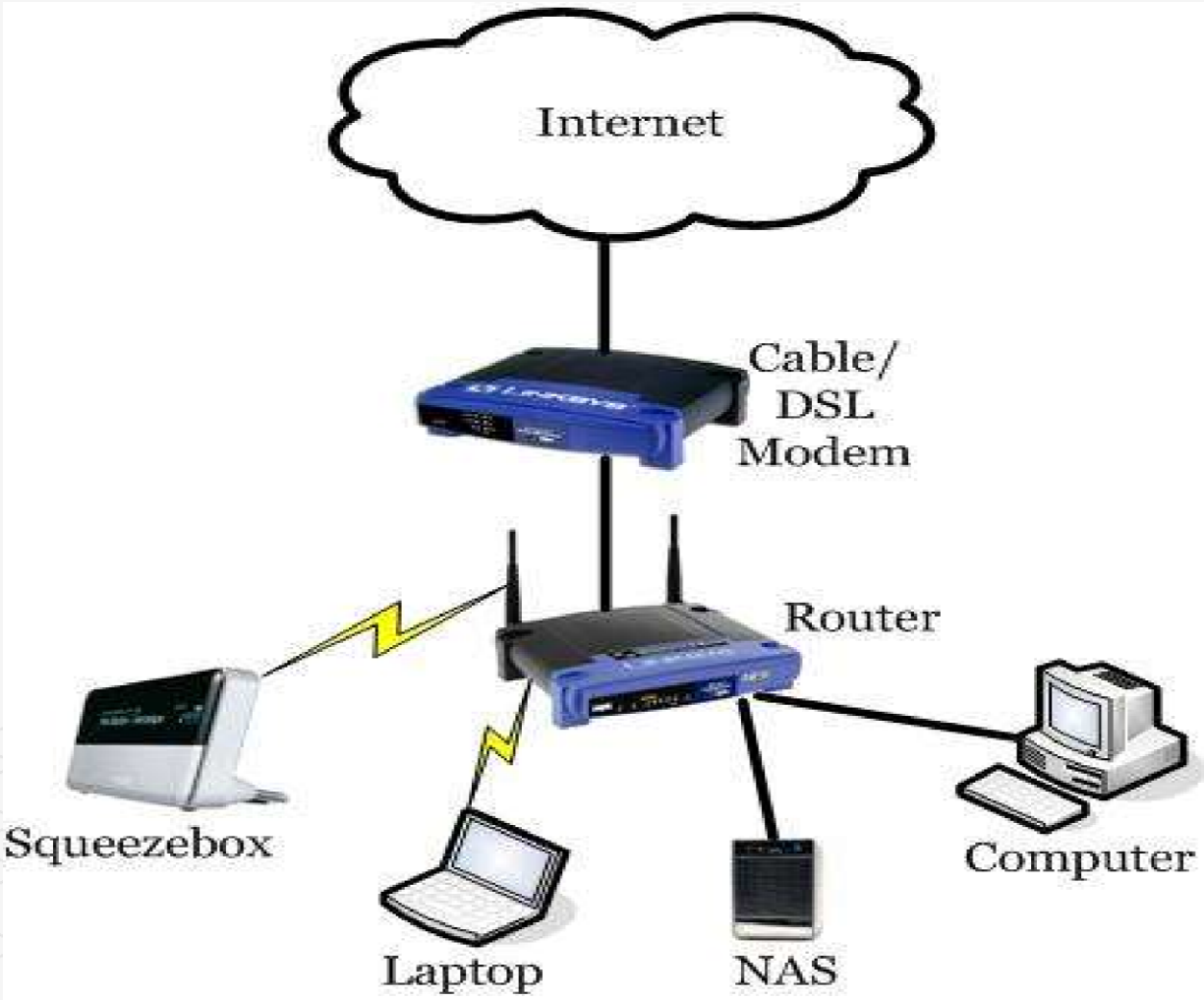
Routers

- A router is a **Layer 3 device.**
- Used to "route" traffic between two or more Layer 3 networks.
- Routers make decisions based on groups of network addresses, or classes, as opposed to individual Layer 2 MAC addresses.
- Routers use routing tables to record the Layer 3 addresses of the networks that are directly connected to the local interfaces and network paths learned from neighboring routers.
- Routers are not compelled to forward broadcasts.



Routers


Home Network
Hub
Tivo
Hub
Wireless Router
Router
Tivo
Laptop
Internet
http://www.computerhope.com

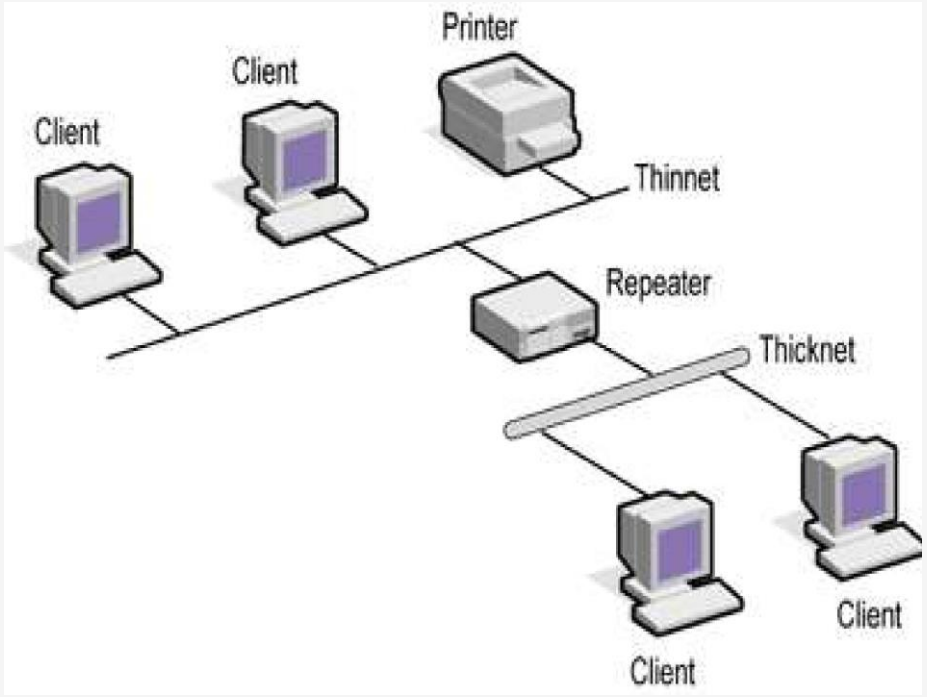

Internet
Cable/ DSL Modem
Router
Squeezebox
Laptop
NAS
Computer

Routers vs Switches

Sr. No.	Key	Router	Switch
1	Objective	Router main objective is to connect various networks.	Switch main objective is to connect various devices in a network.
2	Layer	Router works in Network Layer.	Switch works in Data Link Layer.
3	Usage	Router is used in LAN and MAN.	Switch is used only in LAN.
4	Data Format	Router sends data in form of packets.	Switch sends data in form of packets and frames.
5	Mode of Transmission	Router follows duplex mode of transmission.	Switch also follows duplex mode of transmission.
6	Collision	Less collision in case of Router.	In full duplex mode, no collision happens in switch too.
7	NAT Compatability	Compatible with NAT.	Not compatible with NAT.
8	Type	Routing type is Adaptive and Non-adaptive routing.	Switching type is Circuit, Packet and Message switching.

Repeater

- A network device used to regenerate or replicate a signal. Repeaters are used in transmission systems to regenerate analog or digital signals distorted by transmission loss.



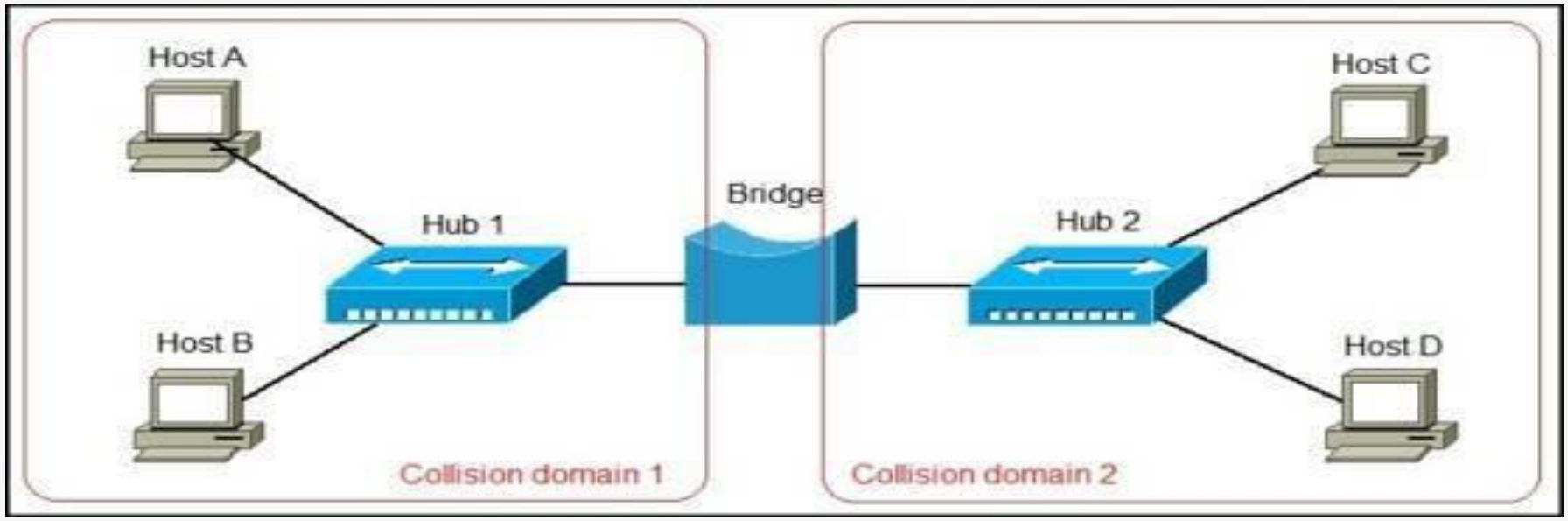
What is the disadvantage associated with using a repeater?

- it can't filter network traffic. Data, sometimes referred to as bits, arriving at one port of a repeater gets sent out on all other ports
- data gets passed along by a repeater to all other LAN segments of a network regardless of whether it needs to go there or no

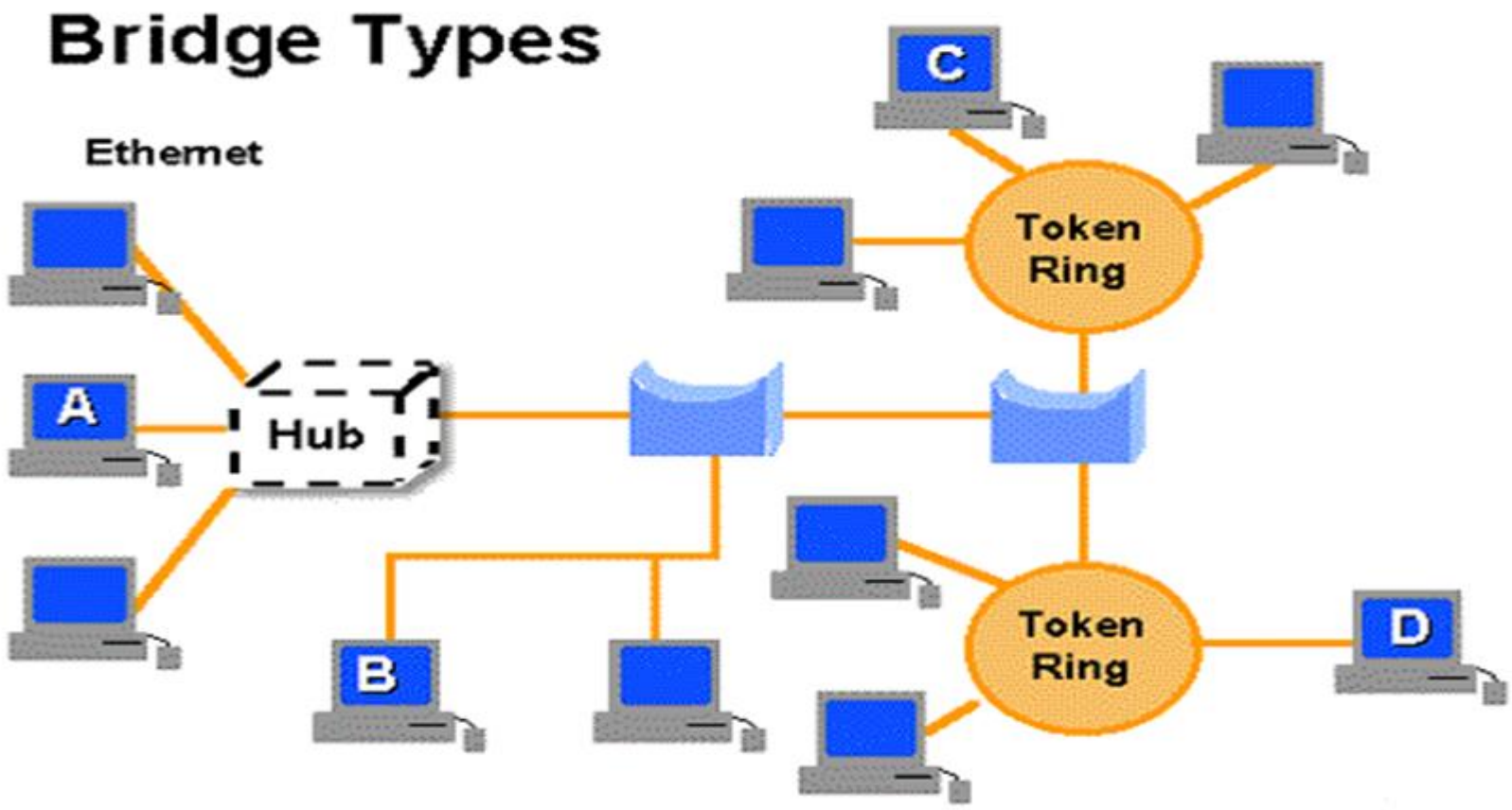
Bridge

- A **network bridge** is a device that divides a network into segments.
- And Device **that connect and passes** packets between two network segments.
- More intelligent than Hub – analyze the income packets and forward (or drops) based on addressing information.
- A bridge works at the Data link layer (Layer 2) of the OSI model.
- It inspects incoming traffic and decide whether to forward it or filter it. Each incoming Ethernet frame is **inspected for destination** MAC address. If the bridge determines that the destination host is on another segment of the network, it forwards the frame to that segment.

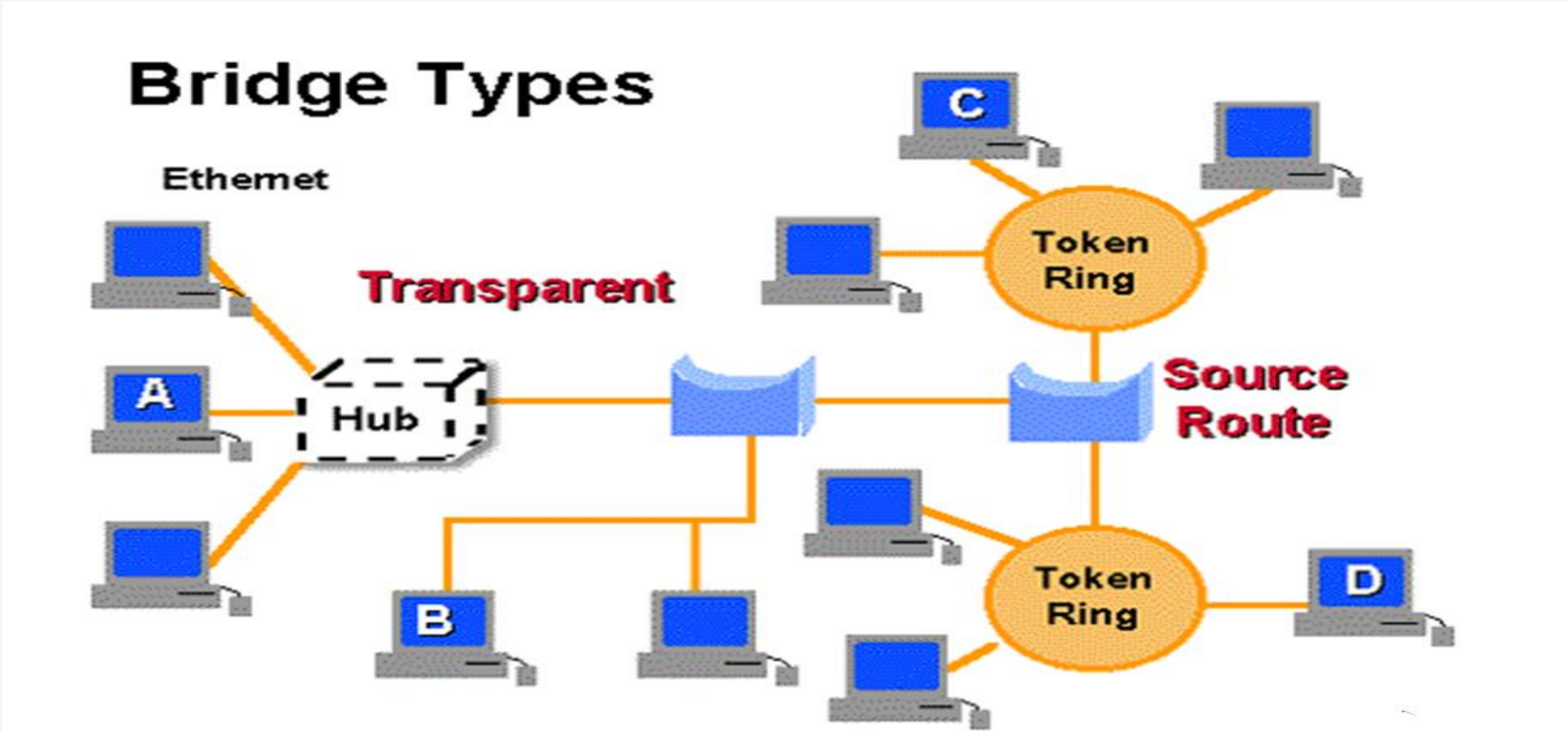
Bridge (Contd.)



Bridge Types



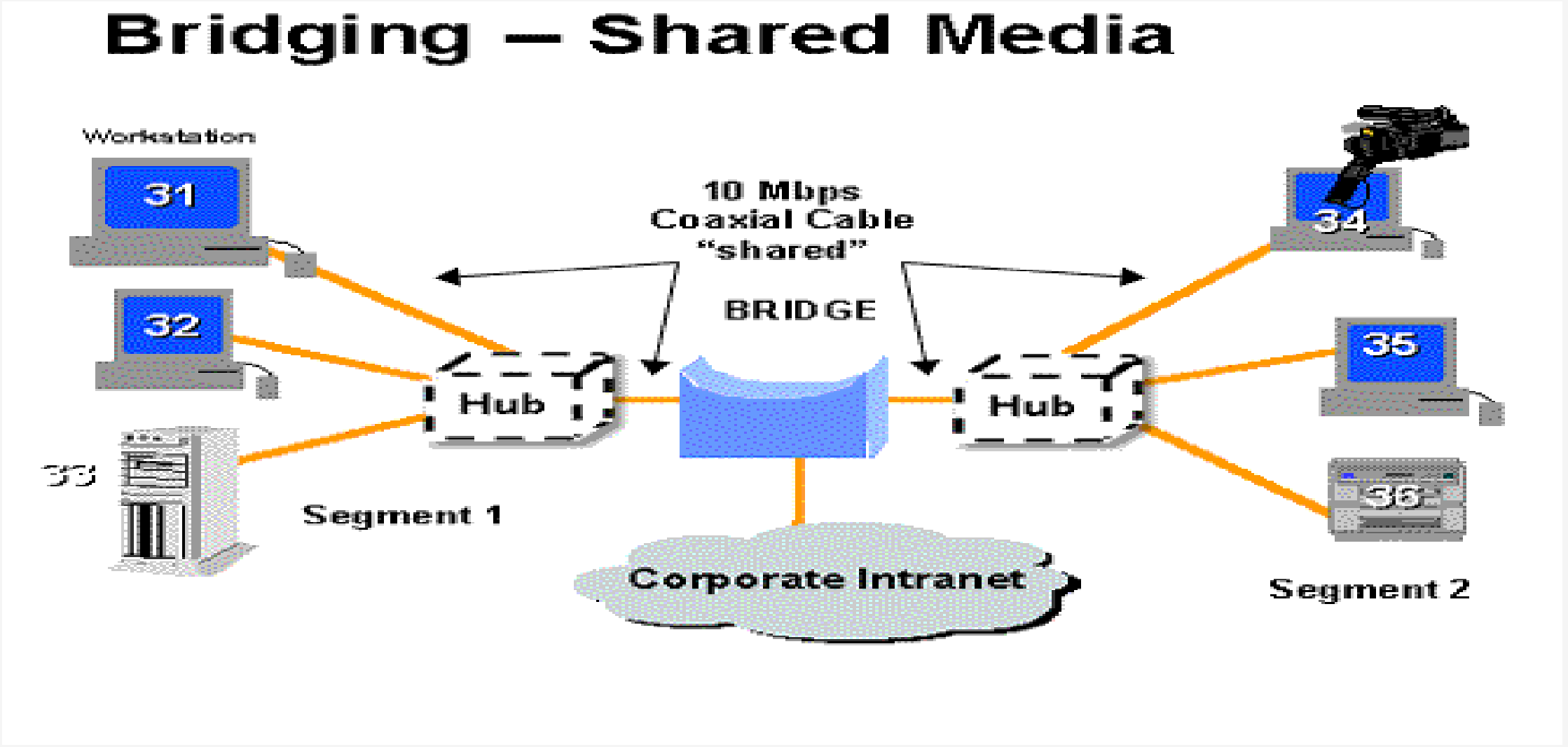
Bridge Types



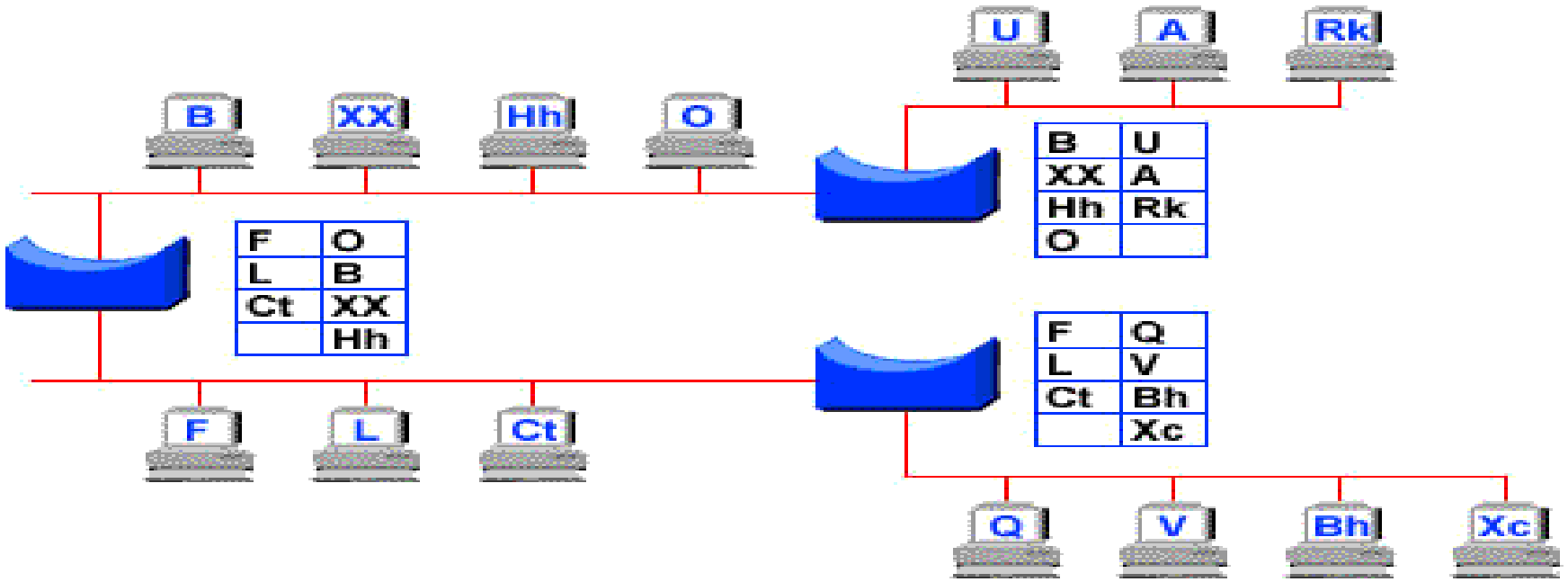
Bridge (Contd.)

- More intelligent than a Hub – can analyze incoming packets and forward (or drop) based on addressing information
- Collect and pass packets between two network segments
- Control broadcasts to the network
- Maintains address table
- Different types of bridges
  - ✓ Transparent
  - ✓ Source Route (used primarily) in Token Ring LANs

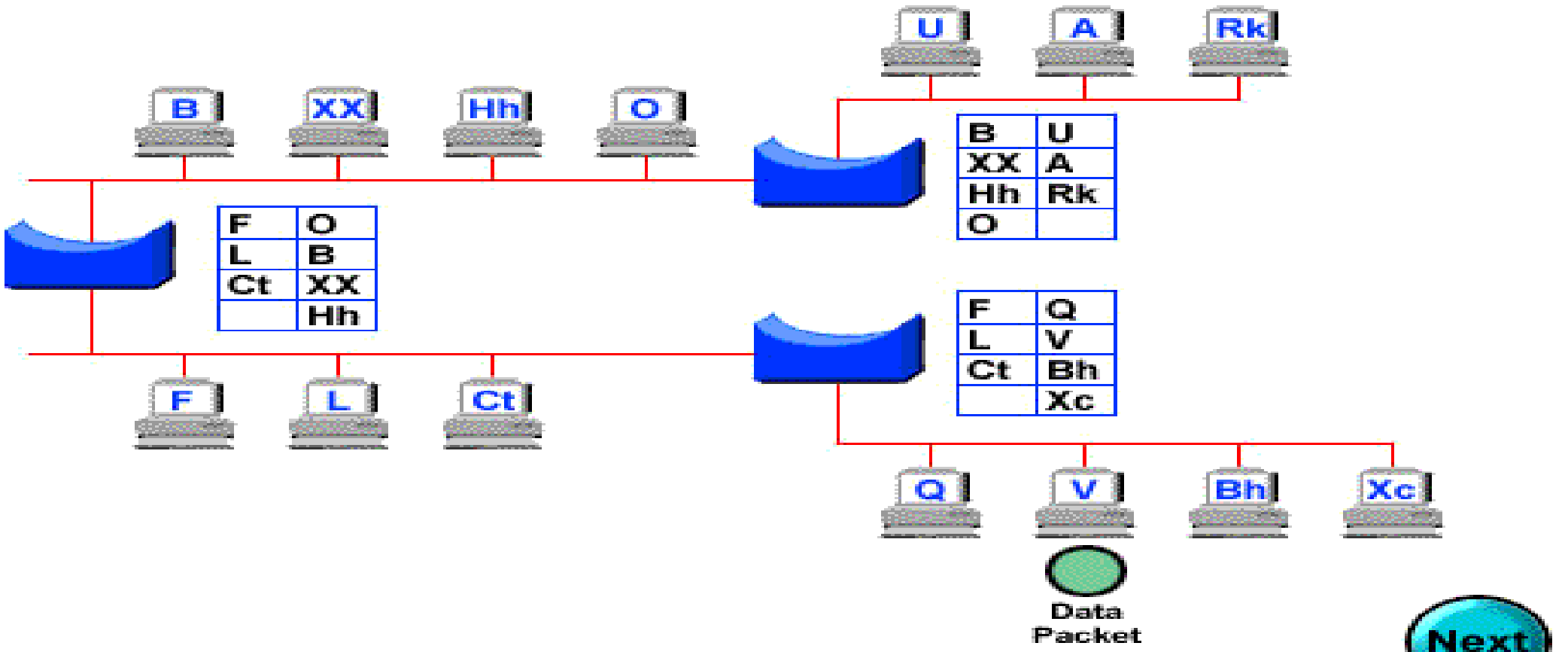
Bridging – Shared Memory



How do bridges filter network traffic?



In this example, a data packet originates from Computer V and its destination is Computer Xc.



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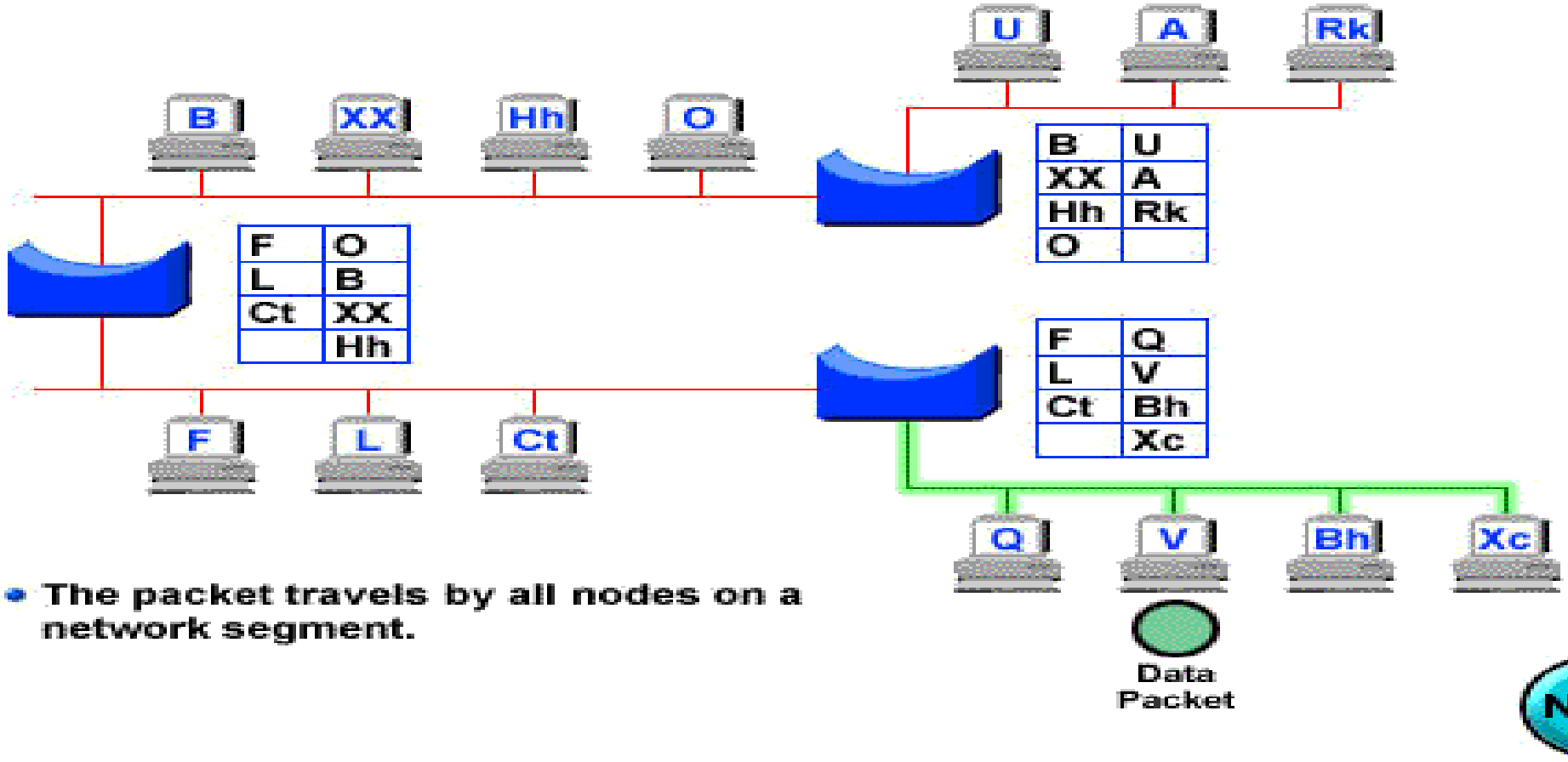
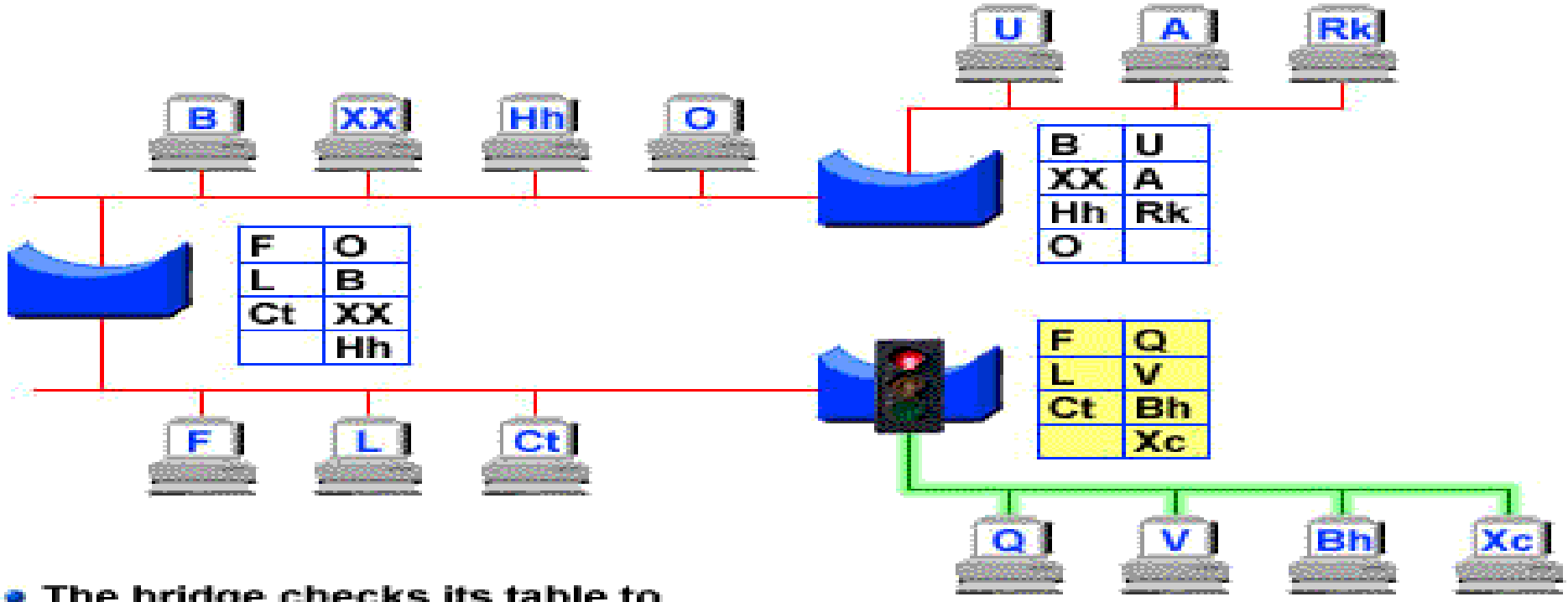


- The packet travels by all nodes on a network segment.

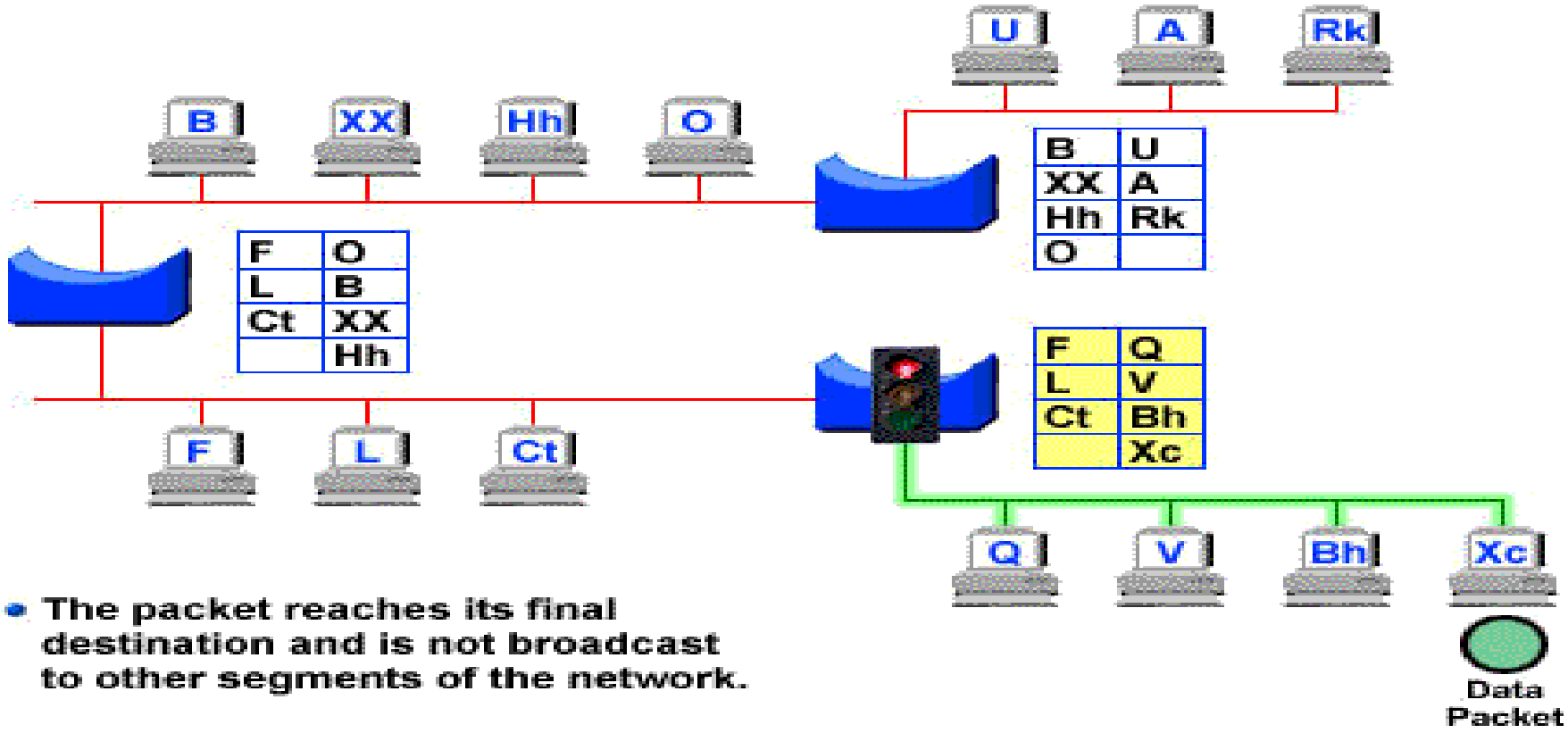
In this example, a data packet originates from Computer V and its destination is Computer Xc.



- The bridge checks its table to determine whether or not to allow the signal to continue to other segments of the network.

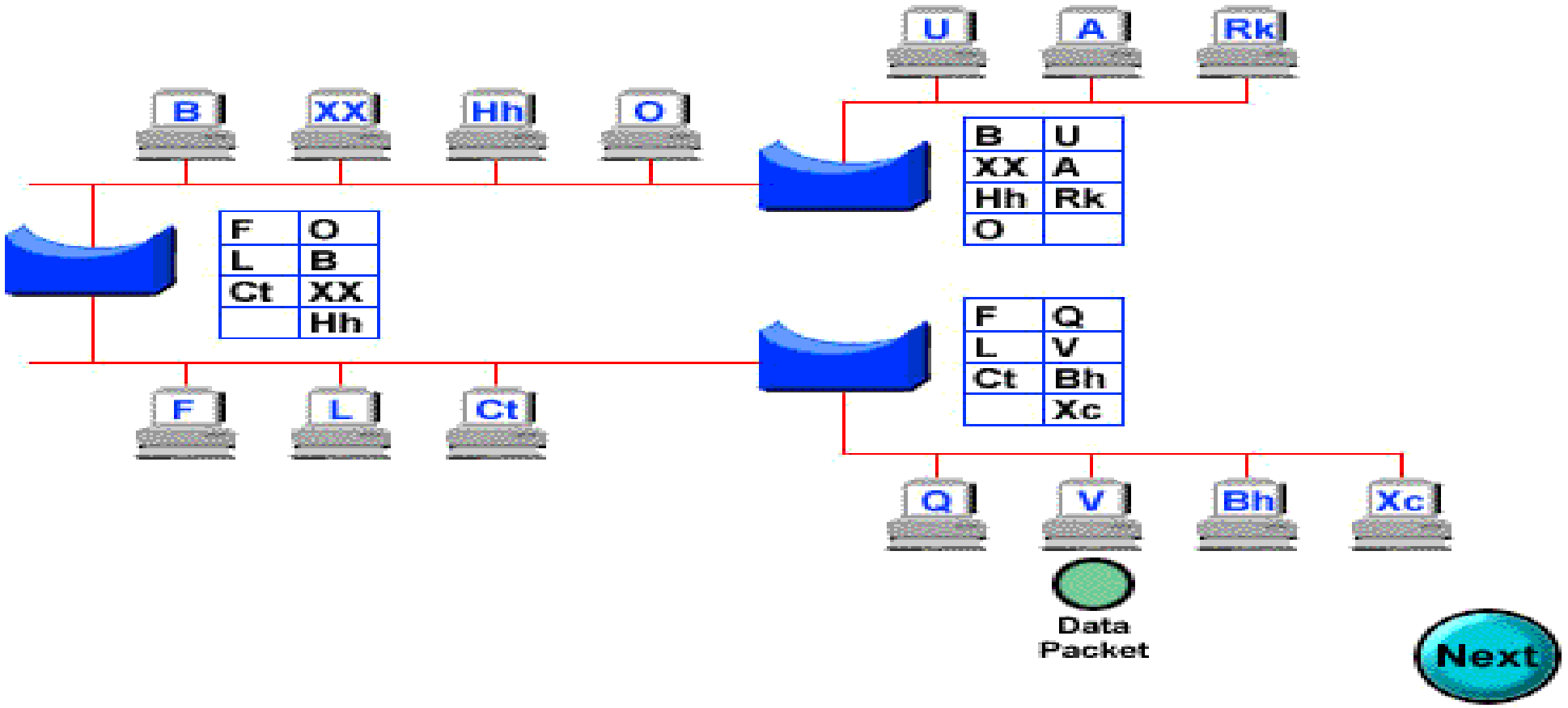
Next

In this example, a data packet originates from Computer V and its destination is Computer Xc.



- The packet reaches its final destination and is not broadcast to other segments of the network.

In this example, a data packet originates from Computer V and its destination is Computer Hh.



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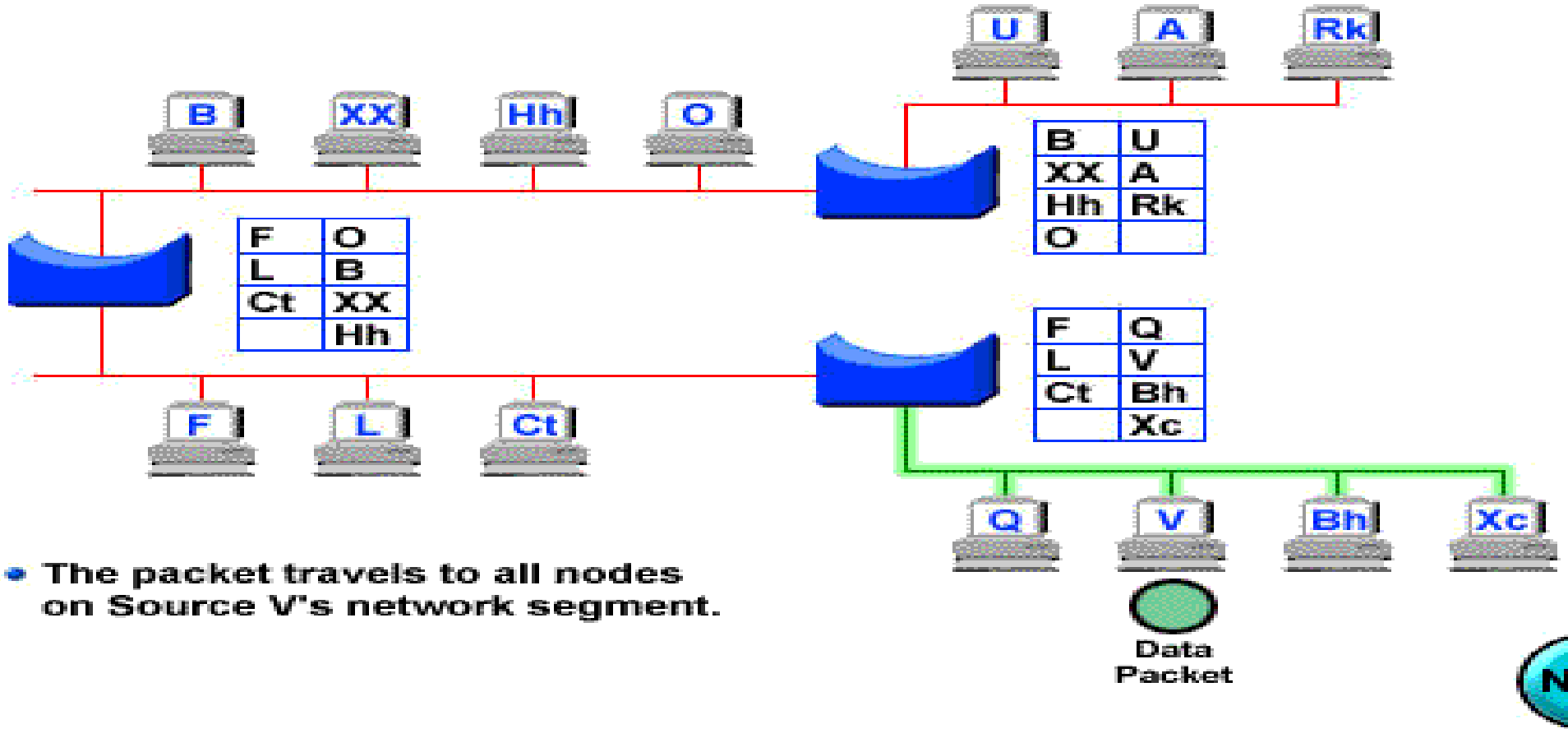
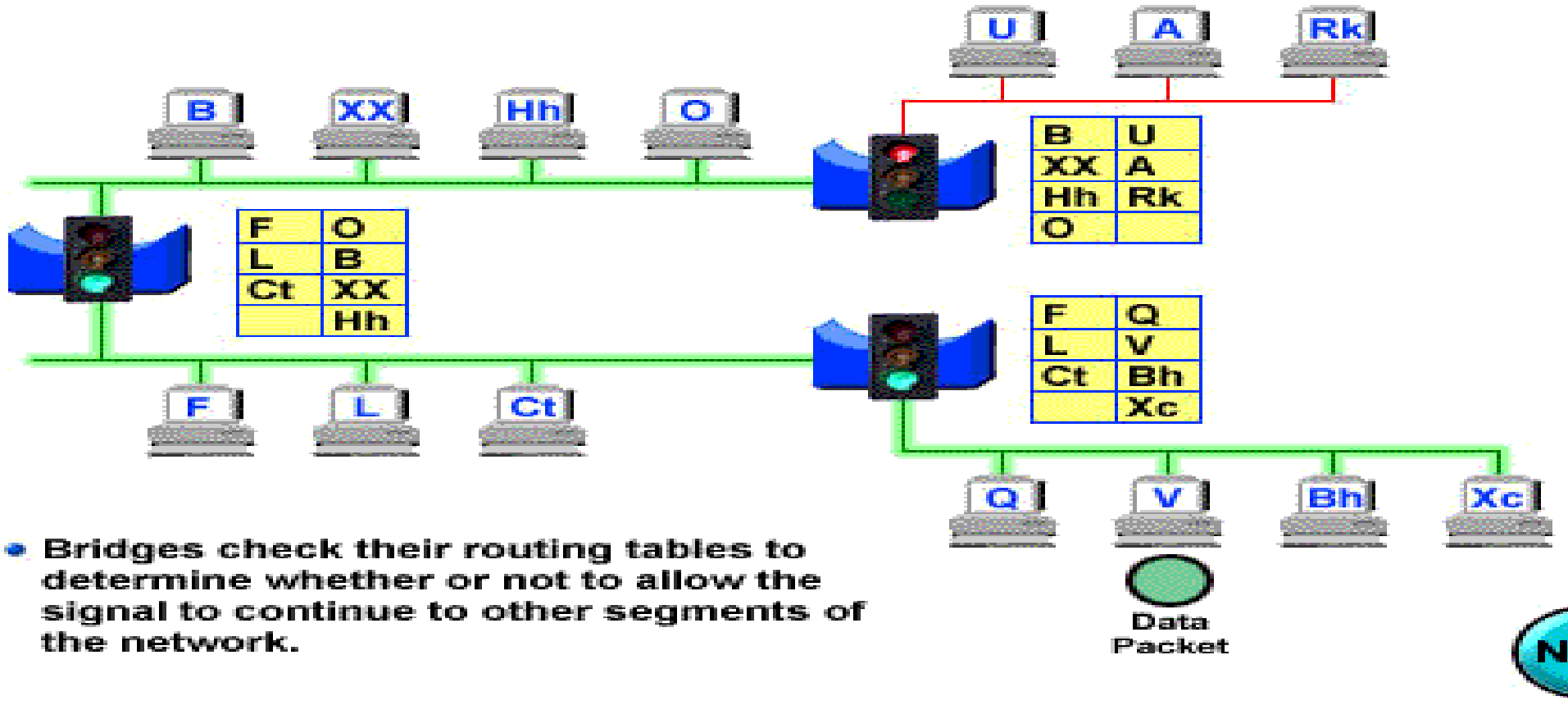


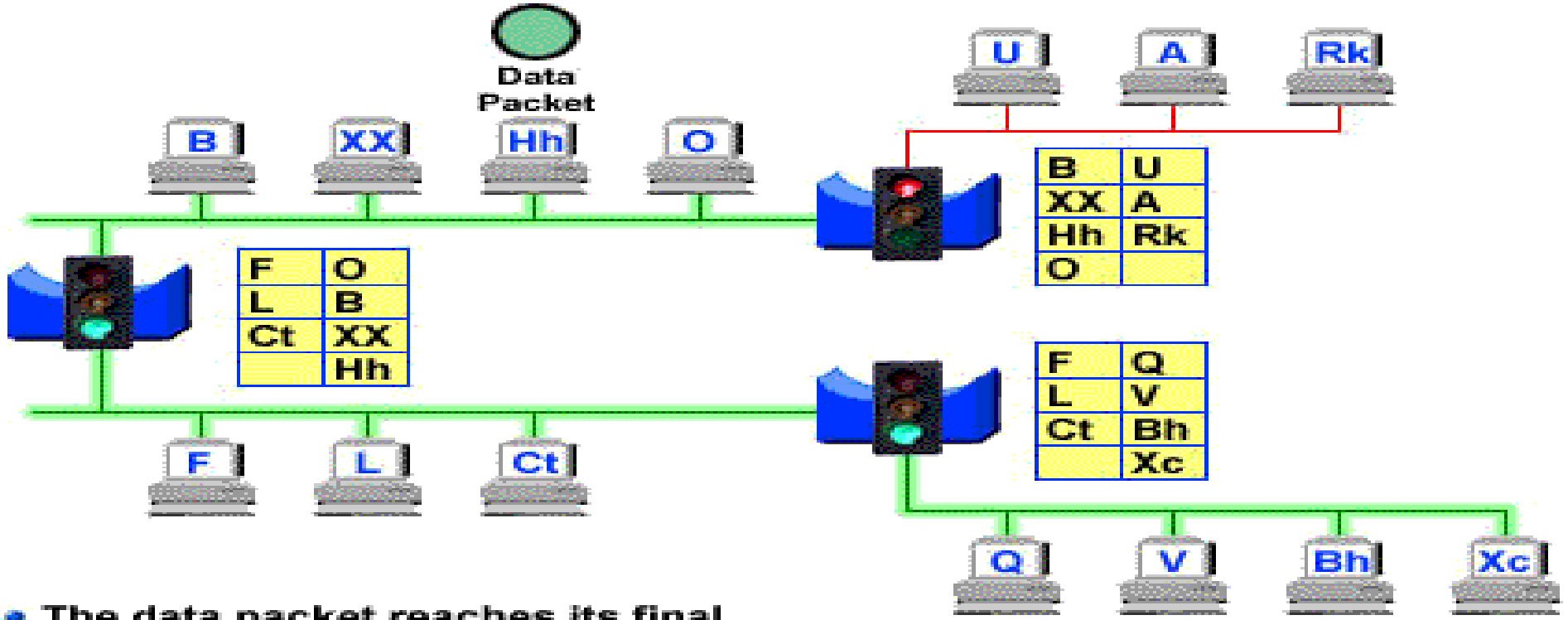
- The packet travels to all nodes on Source V's network segment.

In this example, a data packet originates from Computer V and its destination is Computer Hh.



- Bridges check their routing tables to determine whether or not to allow the signal to continue to other segments of the network.

In this example, a data packet originates from Computer V and its destination is Computer Hh.



- The data packet reaches its final destination.

How are bridge data-forwarding decisions limited?

- Although bridges use tables to determine whether to forward data to other segments of the network or not, the types of comparisons and decisions they make are relatively low level, simple ones

What types of network traffic problems is a bridge incapable of solving?

- Bridges work best where traffic from one segment of a network to other segments is not too great.
- However, when traffic between network segments becomes too heavy, the bridge can become a bottleneck and slow down communication.

How many addressing schemes are there in networking?

- You have already learned what one of these addressing schemes is. It is the MAC address.
- The second addressing scheme in networking makes use of what is called the IP address.

How do IP addresses differ from MAC addresses?

- Like MAC addresses, every IP address is unique. No two IP addresses are ever alike.
- However, while MAC addresses are physical addresses that are actually hard-coded into the NIC card and occur at the **data link layer**
- IP addresses are implemented in software and occur at the **network layer of the OSI model.**

How do routers differ from bridges?

- Routers differ from bridges in several respects. First, bridging occurs at the data link layer or layer 2,while routing occurs at the network layer or layer 3 of the OSI model.
- Second, bridges use physical or MAC addresses to make data forwarding decisions. Routers use a different addressing scheme that occurs at layer three

End of the Lecture – 3

Thank You