

MODULE 12: Network Components and Access Technologies

Lecture 12.3

Switches, Routers, Hubs

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Lecture 12.3 Objectives

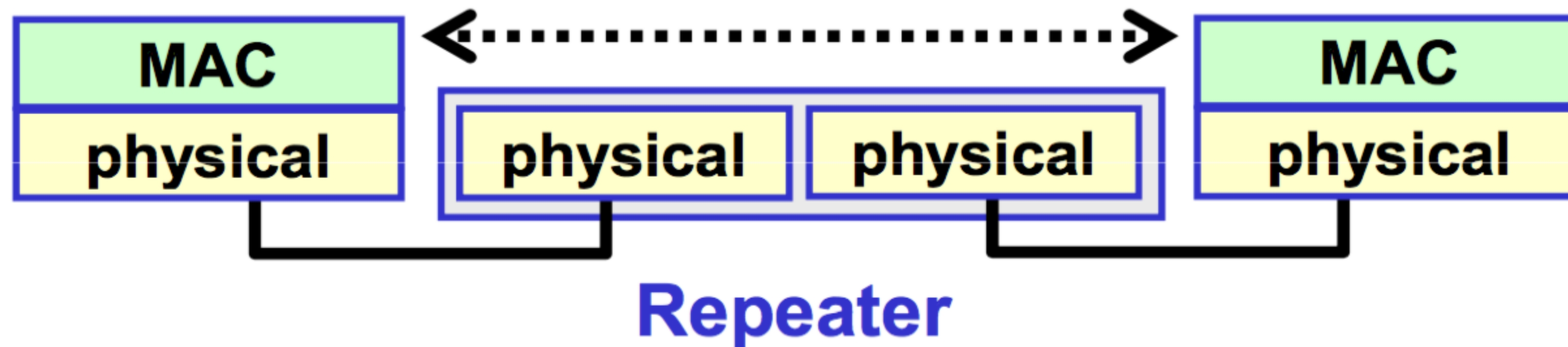
- After successful completion of this lecture, you should be able to:
 - Explain mechanisms to extend a local area network (LAN)
 - Describe different types of devices for an extended LAN (repeaters, hubs, bridges, switches)
 - Describe how routers connect LANs to form internets
 - Compare different LAN (layer2) devices and network layer (layer 3) routers

Extending Local Area Networks

- Devices to interconnect LANs – interworking or internetworking units (IWUs)
 - Repeaters
 - Hubs
 - Bridges
 - Switches
- Each provides different capabilities
- Other devices are needed to interconnect different networks (network layer devices)
 - Routers
 - Bridge/Routers (Brouters)

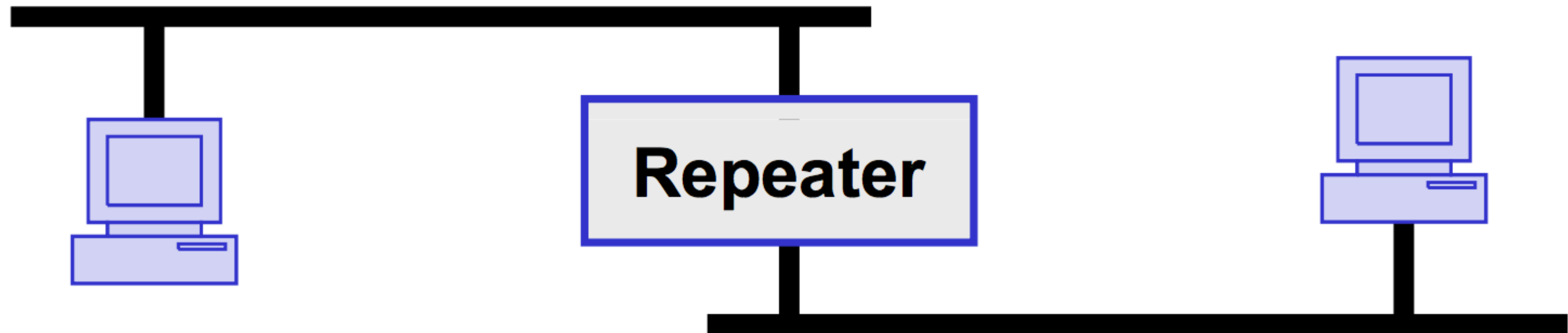
Repeaters

- A repeater is a “Layer 1” or physical (PHY) layer interworking unit
 - Regenerates PHY signals and timing
 - Does not alter or even process the data link layer frame
 - Does not participate in medium access control (MAC)



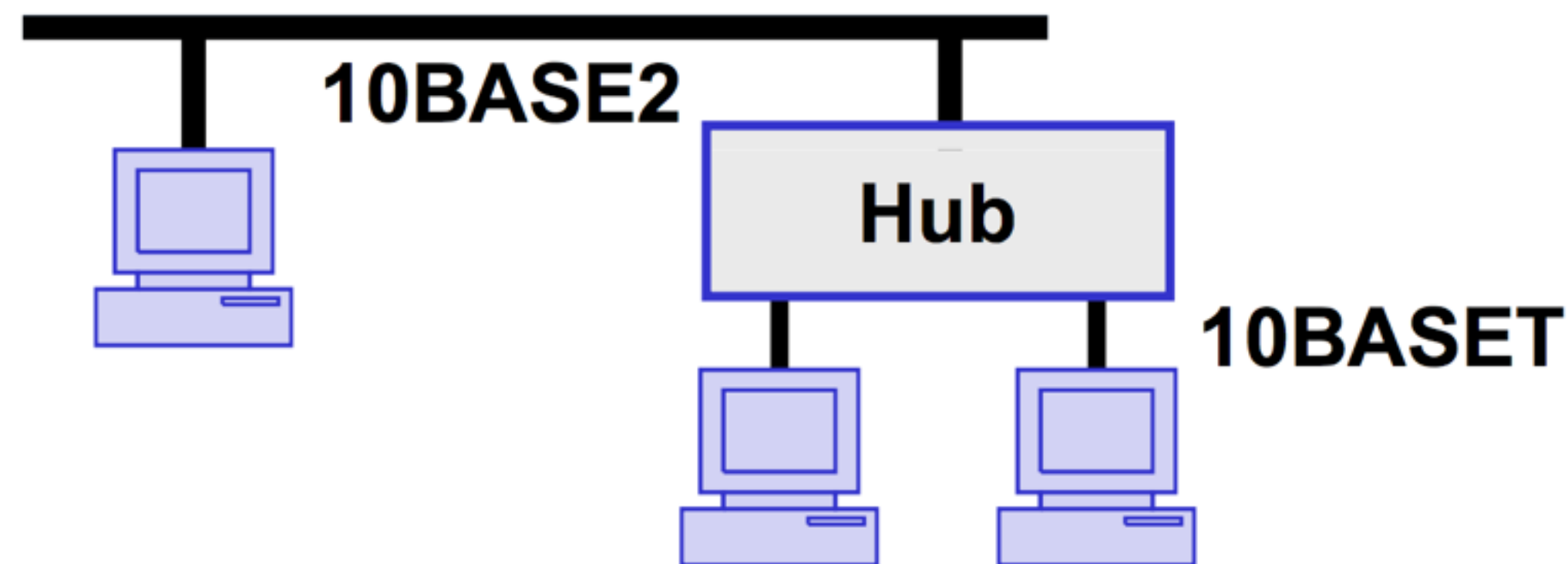
Repeaters (cont'd)

- A repeater may:
 - Translate between different types of PHY protocols (e.g., with different signal definitions)
 - Extend the range of a PHY protocol
 - Change the topology of a PHY protocol



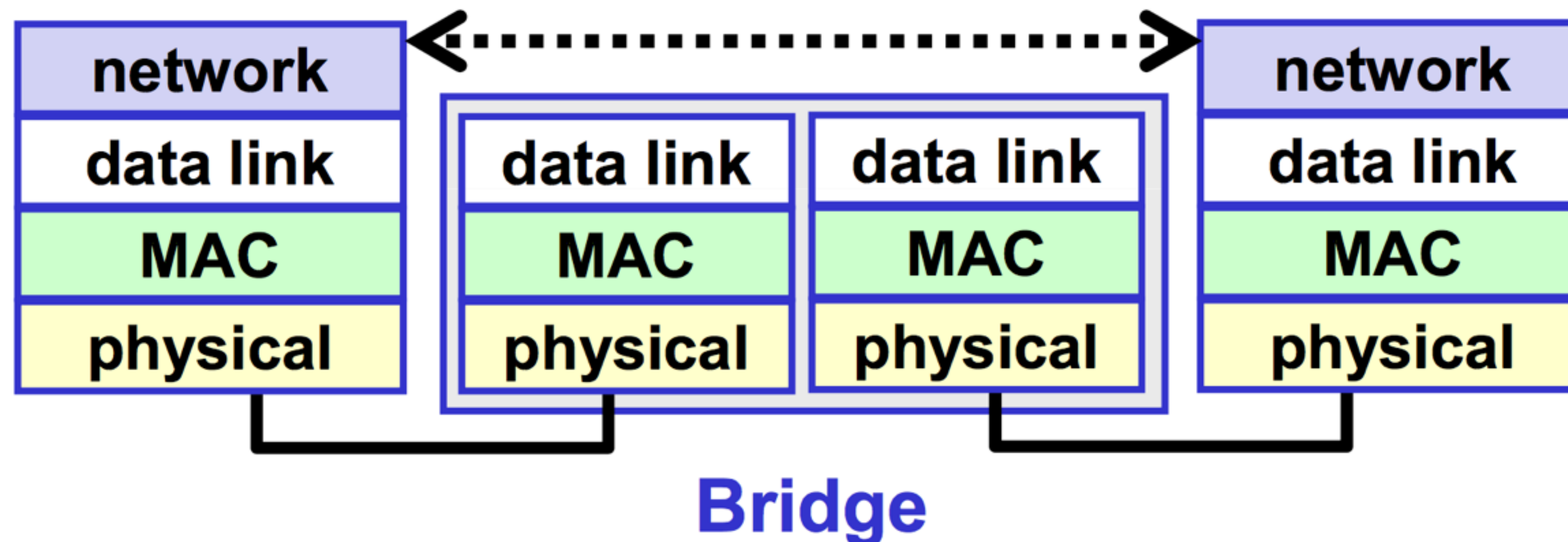
Hub

- A hub is a “Layer 2” or data link layer interworking unit
 - Participates in MAC operation to retransmit
 - Available capacity is shared, so all interfaces are in the same “collision domain”
- Useful for creating more complex topologies and for interoperability of different PHY types



Bridges

- Bridges interconnect LAN segments
 - Actively operate at the MAC sublayer of “Layer 2”
 - Form extended LANs
 - Perform primitive routing in that they selectively copy packets across segments – do simple routing at Layer 2



CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Explain mechanisms to extend a local area network (LAN)
- Describe different types of devices for an extended LAN (repeaters, hubs, bridges)

If you have any difficulties, please review the lecture video before continuing.

Broadcasts and Multicasts

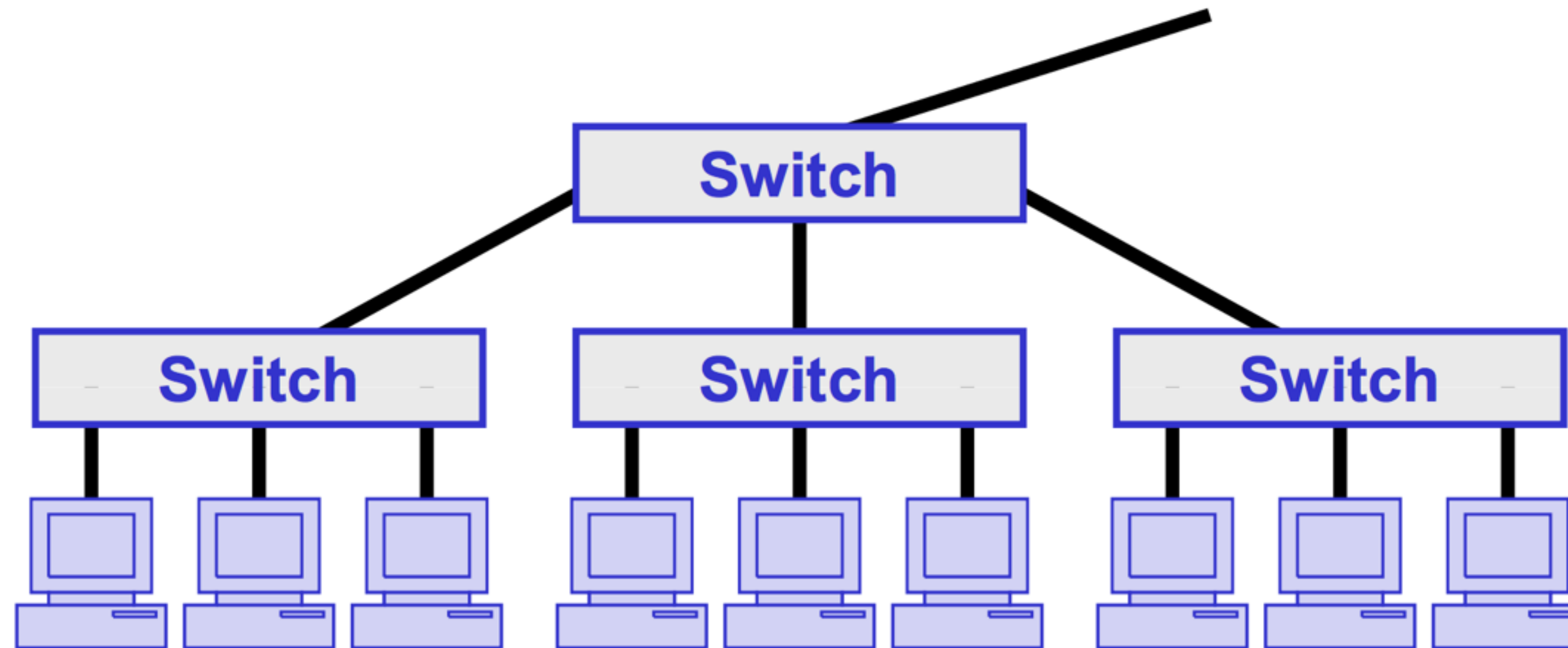
- LANs typically support broadcast and multicast, not just unicast
 - This must also be maintained in bridges
 - Multicast and broadcast addresses are special
- Bridges simply forward broadcast packets to all ports
- Multicast packets are, also, usually forwarded to all ports
 - Improvement possible if multiple frames are multicast

Switching

- Switches are, in effect, high-performance bridges
 - Process and selectively forward at the data link layer
- Switches often operate in full-duplex mode, where transmission and reception can occur simultaneously on the same interface
- Switches can have “cut-through” capabilities where the entire packet does not have to be received before being forwarded
 - Eliminates the store-and-forward delay
 - Switch examines destination address and begins outbound transmission

Switching Features

- Simultaneous use of capacity, not shared use as with a hub
- High performance since the “contention zone” is reduced
- Traffic filtering like a bridge
- Flexible topology

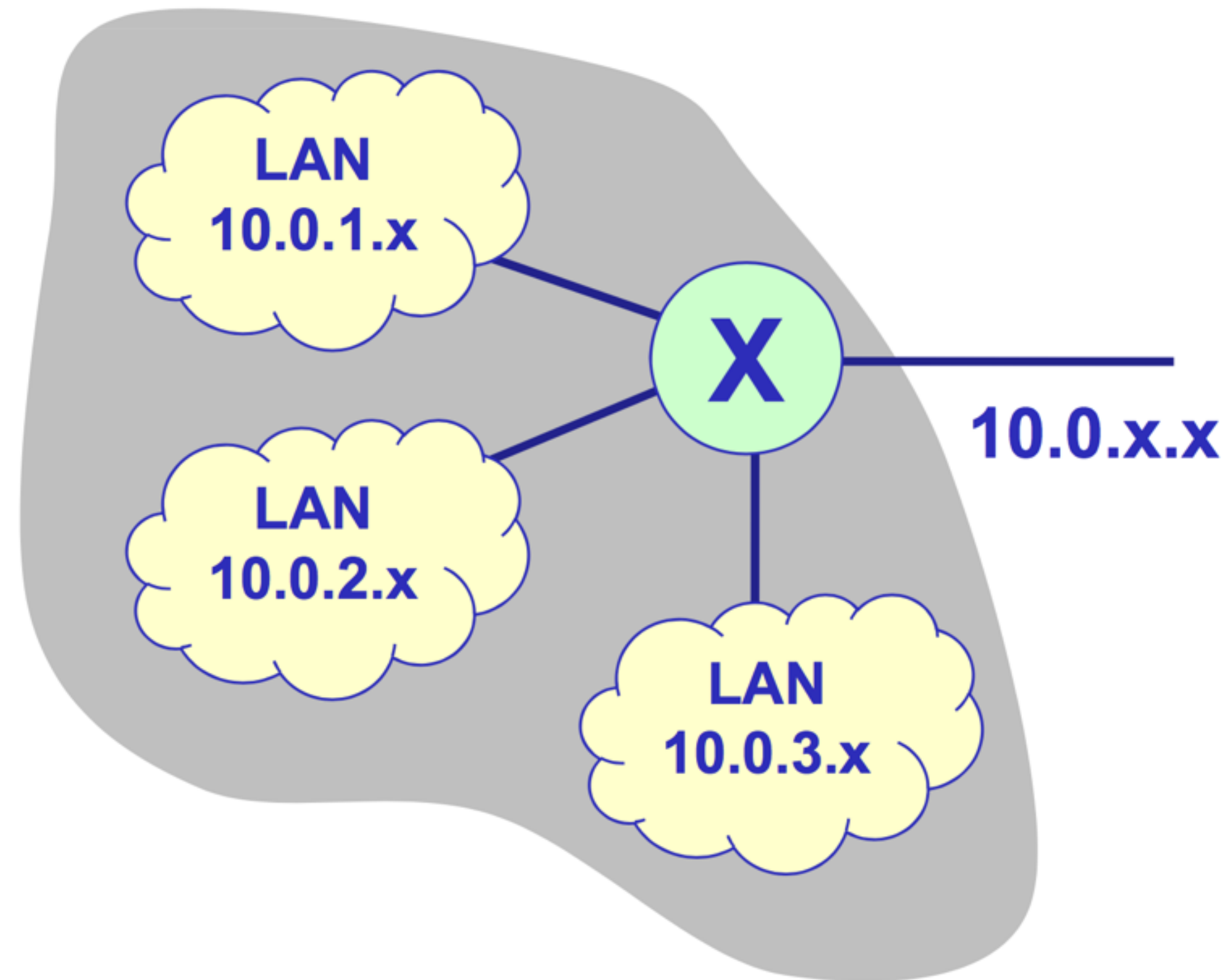


Need for Routing

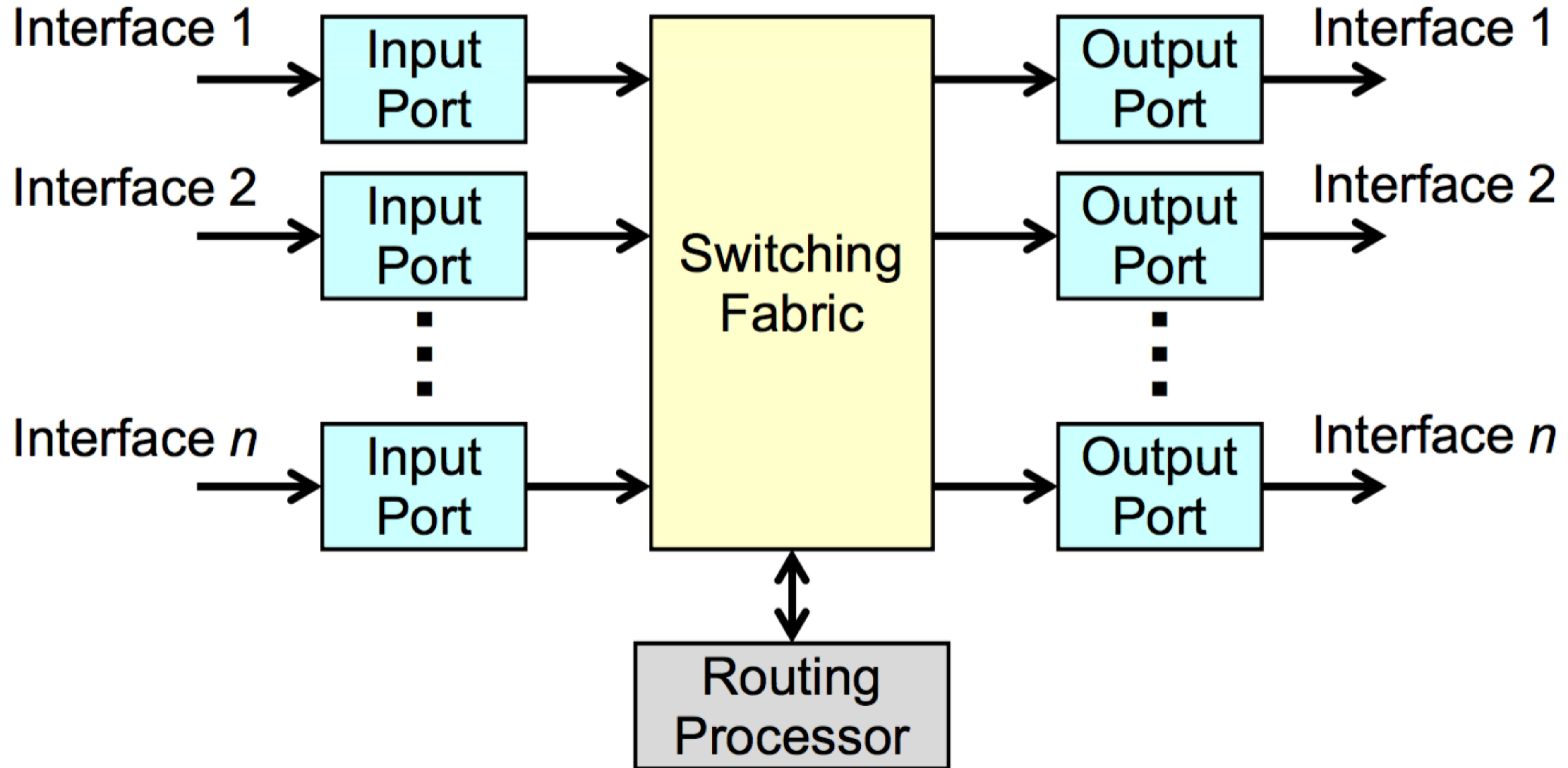
- Hubs, switches, and bridges can extend a LAN – but it is still, logically, a LAN
 - All hosts in the LAN are in the same Internet Protocol (IP) subnetwork
 - Broadcasts and multicasts propagate throughout the LAN, thus adding to traffic in the LAN
 - LANs require a single organization for management
- Routers allow networks to be divided into subnetworks
 - Filtering at the IP level and the LAN level
 - Requires a common network layer (IP) or a set of common network layer protocols

IP Subnets and Routers

- IP subnets allow partitioning of nodes and traffic (10.0.1.x, 10.0.2.x, etc.)
- External nodes see 10.0.x.x network



Router Components



Comparison

- The following table compares repeaters, hubs, bridges, switches, and (network layer) routers

	Ethernet				
	Repeaters	Hubs	Bridges	Switches	Routers
Traffic isolation	N	N	Y	Y	Y
“Plug and play”	Y	Y	Y	Y	N
Optimal routing	N	N	N	N	Y
Cut-through*	Y	Y	N	Y	N

*** “Cut-through” implies that store-and-forward is not needed**

CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Describe switches for an extended LAN
- Describe how routers connect LANs to form internets
- Compare different LAN (layer2) devices and network layer (layer 3) routers

If you have any difficulties, please review the lecture video before continuing.

Summary

- Repeaters operate at the physical layer
- Bridges, hubs, and switches operate at the data link layer
- Bridges and switches can filter and selectively forward frames to reduce traffic and provide some security
- Routers allow networks to be divided into IP subnetworks
- There are trade-offs between the different types of devices and between extended LANs and extending a network using Internet Protocol (IP) routing

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