

# BUSINESS DATA COMMUNICATIONS & NETWORKING

## Chapter 8 Backbone Networks

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# Outline

- Components
- Architectures
  - Switched Backbone Networks
  - Routed Backbone Networks
  - Virtual LANs (VLANs)
- Best Practices
- Implications for Management

# Backbone Networks

- High-speed network that connects other networks together (LANs, WANs)
- Distribution layer BNs connect access LANs
- Core layer BNs connect different buildings

# Backbone Network Components

- Network cables (often fiber for higher data rates)
- Switches



– **Layer-2 switches** are “transparent” devices that do not change messages, only read and forward them (see Ch. 7)

- **Managed switches** have configuration options and management features



– e.g., spanning tree protocol (STP) or SNMP

– **VLAN switches** or **layer-3 switches** are a devices combine the features of Layer-2 switches and routers, primarily for virtual LANs

# Backbone Network Components



- Routers
  - Network layer devices that connect different networks
  - TCP/IP gateways
  - Not “transparent” devices
    - Messages are passed up to the network layer including stripping off data link layer frames
    - Routers respond to ARP (and other messages)
  - Read IP addresses and determine best route
  - Routing requires more processing than switches

# Backbone Network Layers

- Separate from the layers of the Internet or OSI models, sections of backbone networks are referred to as three different hierarchical layers
  1. **Access layer** - How users access network (LAN, WLAN)
  2. **Distribution layer** - BN that connects access layer to core layer (within building)
  3. **Core layer** - Connects BNs between buildings and to WAN/Internet

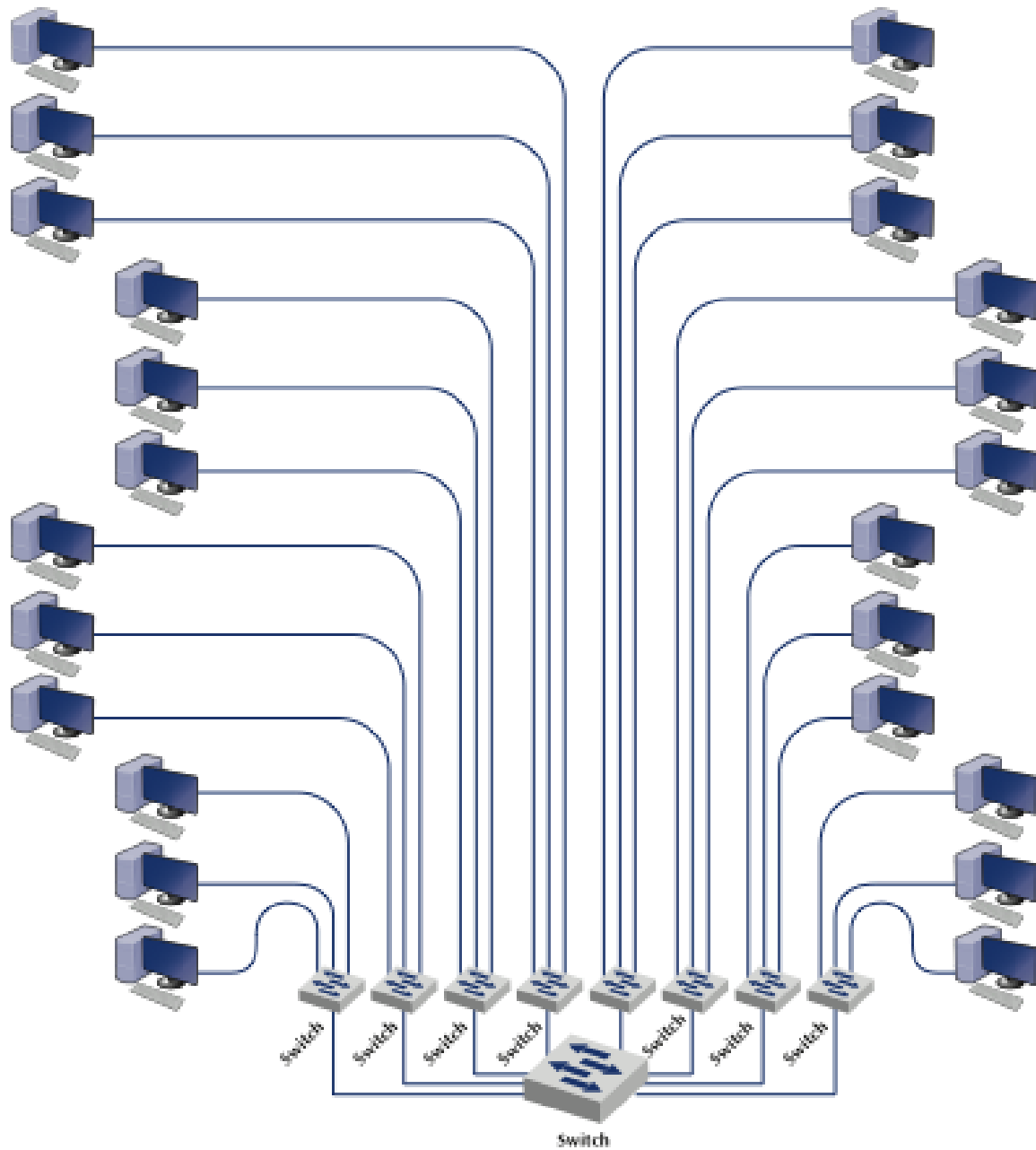
# Backbone Network Architectures

- Three major types of BNs are based on the devices used
  - 1. Switched backbones**
  - 2. Routed backbones**
  - 3. Virtual LANs**
- In practice, it is most common to use a combination of these architectures

# Switched Backbone Networks

- Most common type of BN used in the distribution layer
- Uses layer-2 switches
- Switches come in different form factors
  - Desktop
  - Rack-mounted
  - Chassis
- Star topology
- Physical location of devices
  - More common to locate centrally in **main distribution facility (MDF)** or other wiring closets



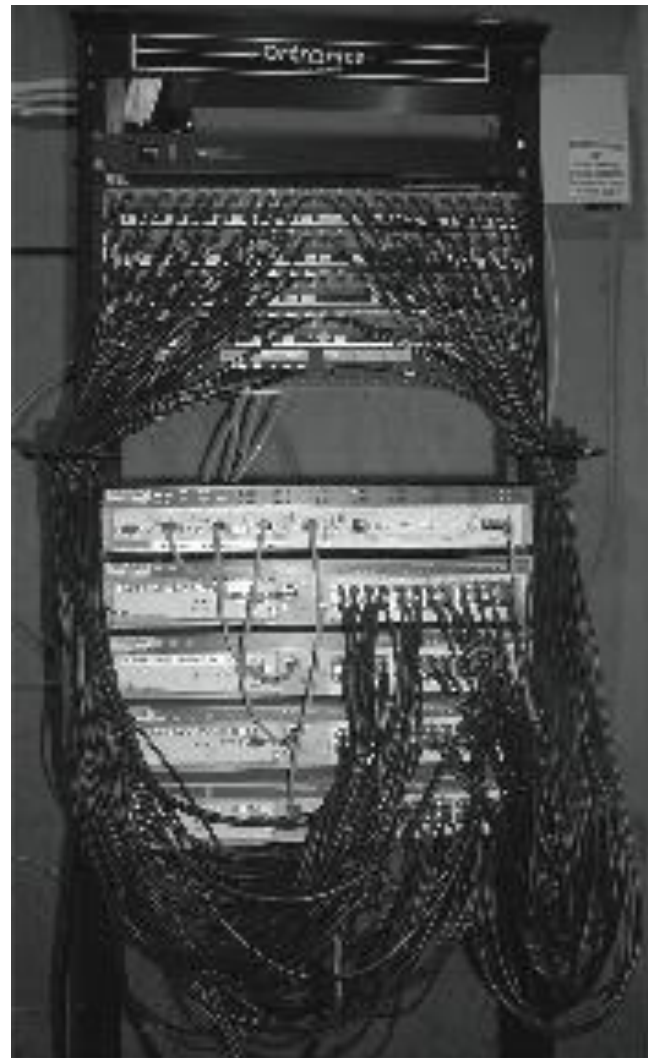


**FIGURE 8-1** Rack-mounted switched backbone network architecture

# Switched Backbone Networks

*Source:*

Photo courtesy of the author,  
Alan Dennis



Patch Panels

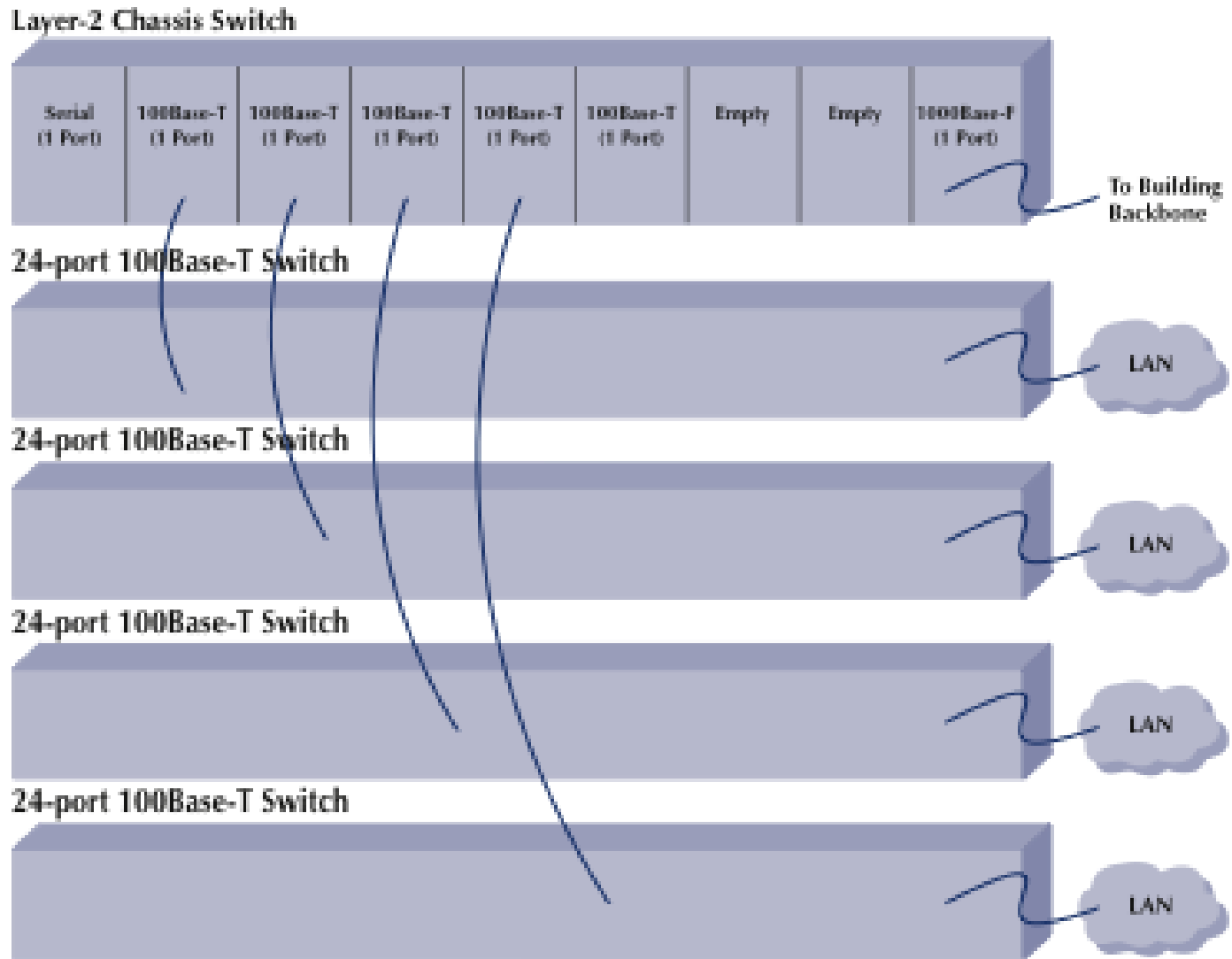
Patch Cables

Chassis Switch  
(4 - 100Base-T ports)

Switches  
(24 port, 100Base-T)

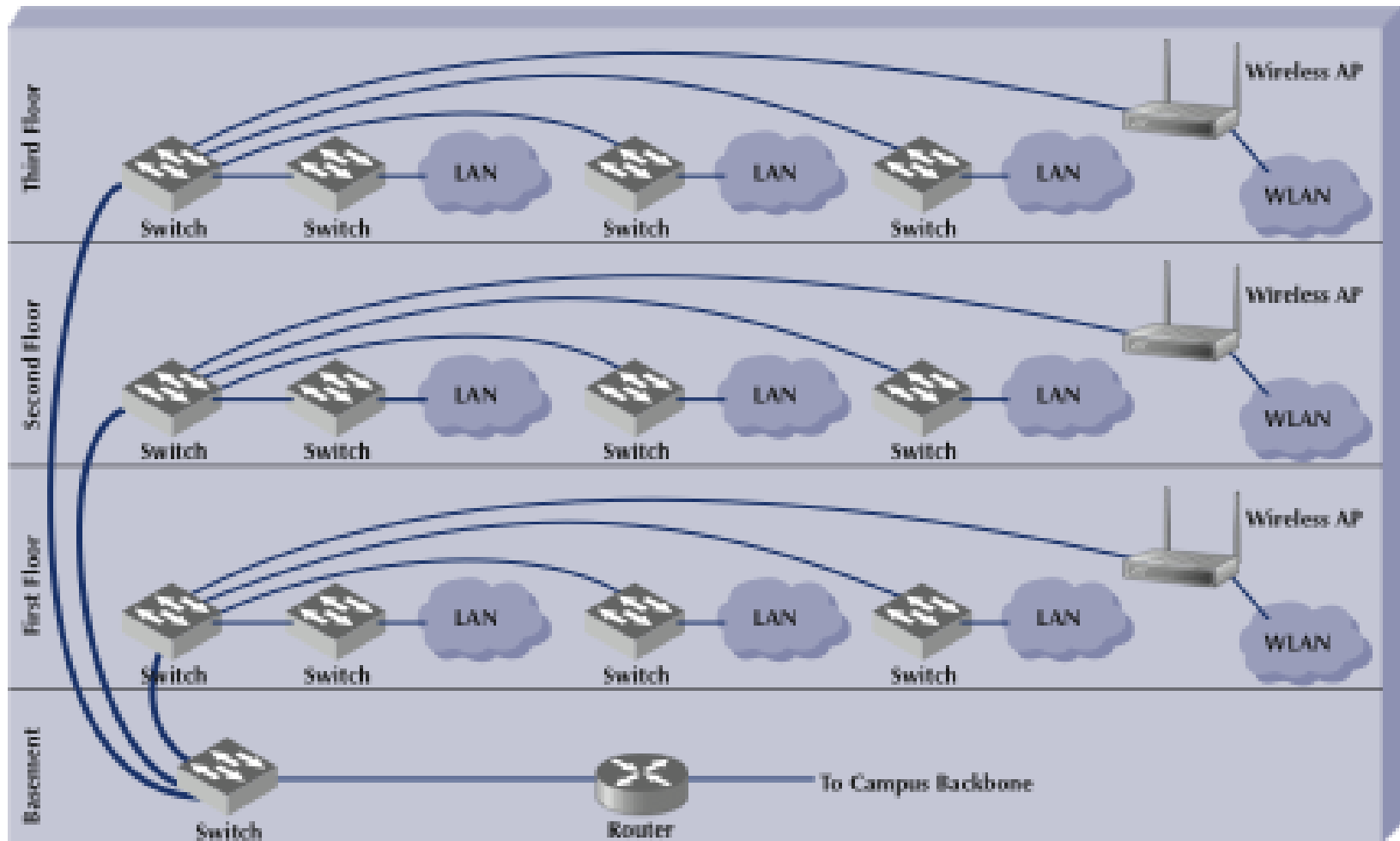
Backbone  
Connection  
(1000 Base-F)

# Switched Backbone Networks



**FIGURE 8-3** MDF network diagram

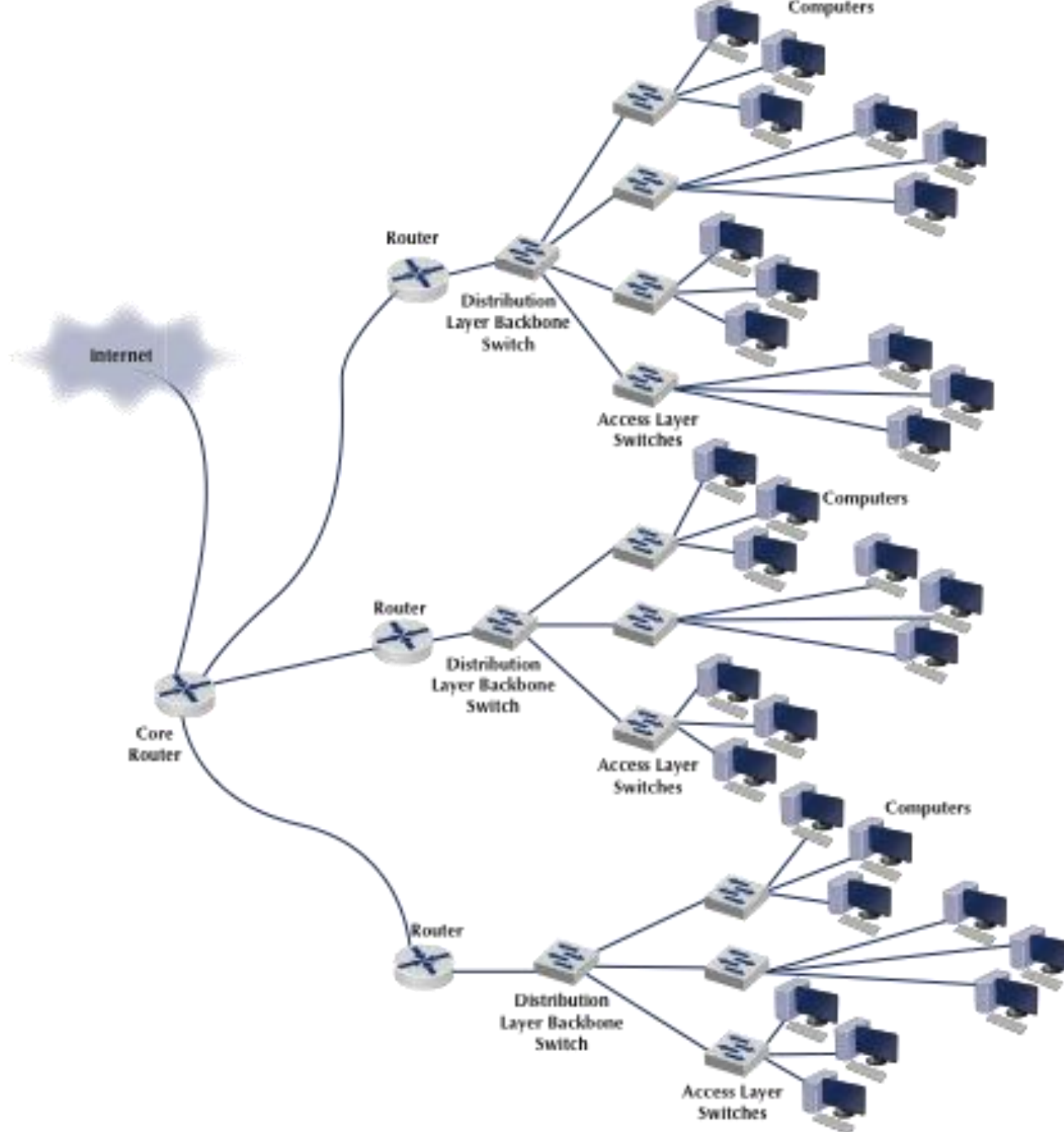
# Switched Backbone Networks



**FIGURE 8-4** Switched backbones at Indiana University

# Routed Backbone Networks

- Sometimes called subnetted backbones or hierarchical backbones
- Typically used at core layer, but sometimes at distribution layer
- Advantages
  - LAN segmentation
- Disadvantages
  - Tend to be slower
  - More expensive
  - Harder to manage



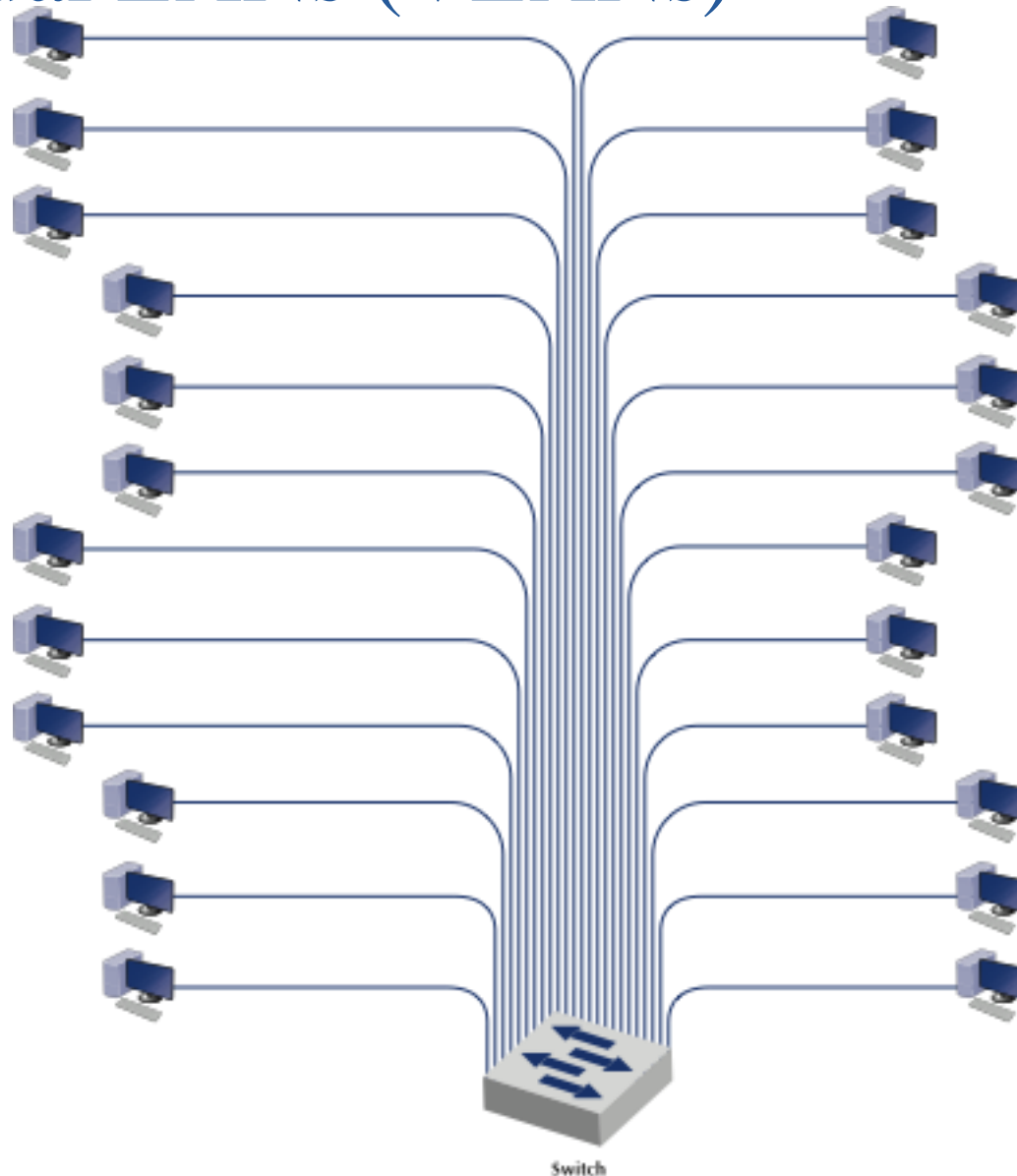
**FIGURE 8-5** Routed backbone architecture

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# Virtual LANs (VLANs)

- Routers segment networks based on physical location (i.e., the cables connected to it)
- Devices in different physical locations may need to access to the same LAN resources
- VLANs perform flexible LAN segmentation so that it can be based on logical instead of physical design
- VLANs are enabled by high-speed layer-3 switches
- Much more complex to manage and typically only used in large networks

# Virtual LANs (VLANs)



**FIGURE 8-6** VLAN-based backbone network architecture

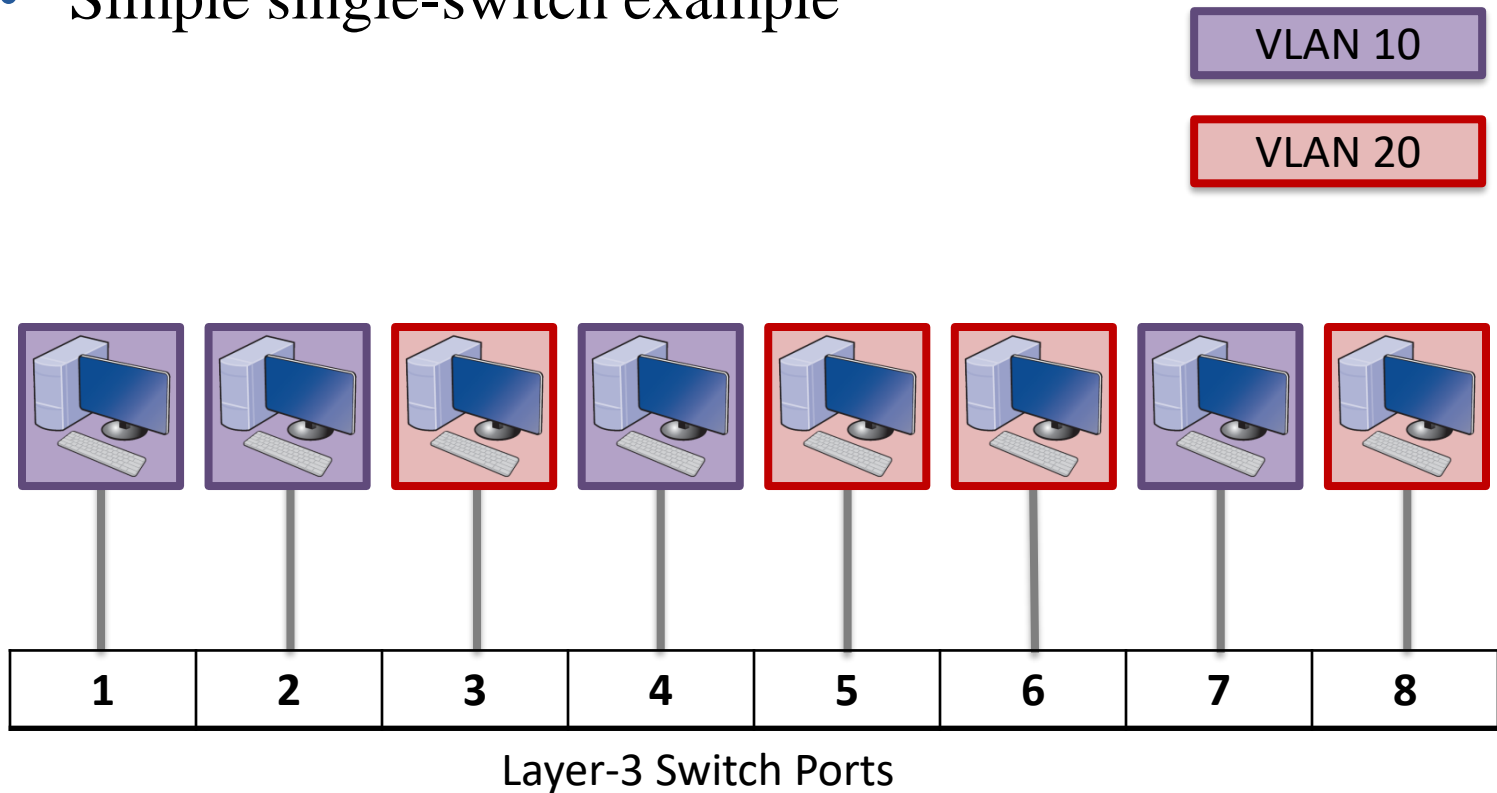


# Virtual LANs (VLANs)

- Each VLAN identified by **VLAN ID** which is mapped to traditional IP subnet
- Each device assigned into a VLAN based on the physical port
- VLANs are transparent
- Require router or Layer-3 switch

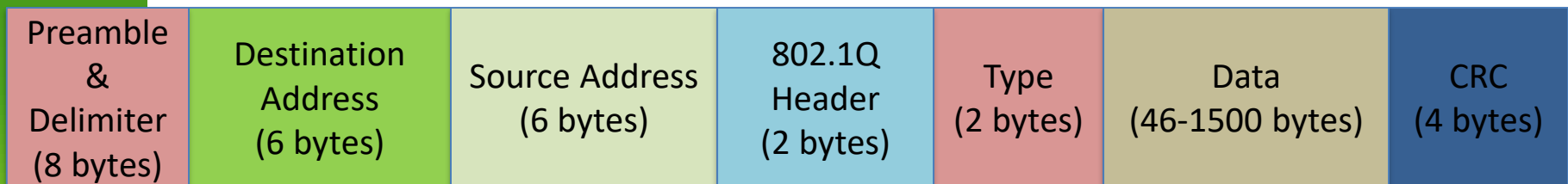
# Virtual LANs (VLANs)

- Simple single-switch example

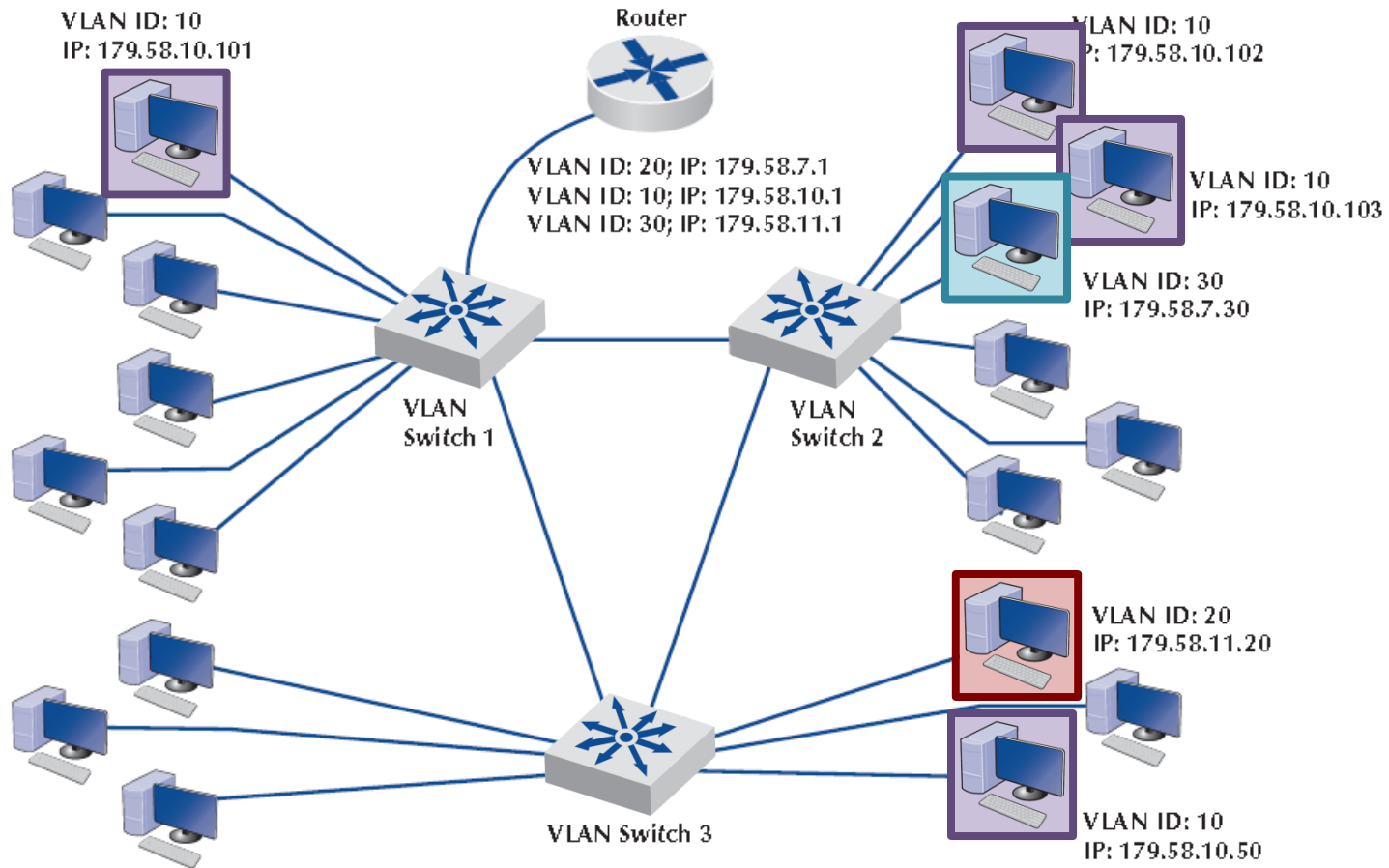


# Virtual LANs (VLANs)

- Multiswitch VLANs
  - L3-switches communicate using inter-switch protocols that support VLANs
  - **VLAN trunks** are circuits that connect two VLAN switches
  - **VLAN tag** inserted into Ethernet frame (e.g., 802.1Q) or encapsulates frame (e.g. ISL)



# Virtual LANs (VLANs)



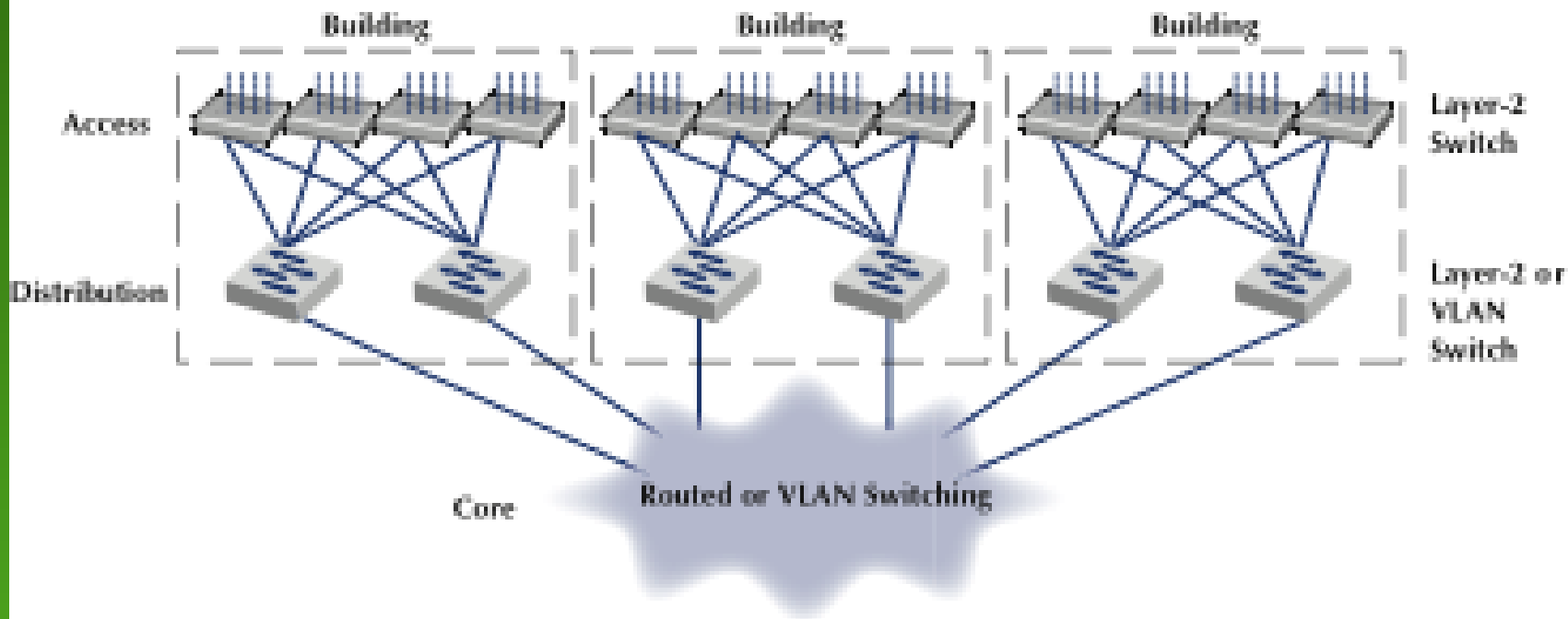
# Virtual LANs (VLANs)

- Advantages
  - More flexible subnetting
  - Better managed traffic flow which may lead to faster performance
  - Traffic prioritization
    - Can include quality of service information in tag
- Disadvantages
  - Complex
  - May increase management when VLAN memberships change
  - Layer 3 switches are more costly than L2

# Best Practices

- Architecture
  - Switched has best cost to performance ratio at the distribution layer
  - Most organizations use routed at the core layer
  - VLANs are becoming more widely used, especially for organizations needing the flexibility
- Technologies
  - Gigabit Ethernet for distribution layer
  - Gigabit Ethernet or faster for core layer
  - Redundant devices and connections

# Best Practices



**FIGURE 8-8** The best practice network design

# Improving Backbone Performance

- Devices
- Circuits
- Demand



# Implications for Management

- Cost and necessity of upgrading BNs will grow as demand increases
- VLAN backbones provide flexibility and are becoming increasingly popular
- As with LANs, Ethernet is now the predominant protocol in BNs