Designing the Campus Infrastructure Module

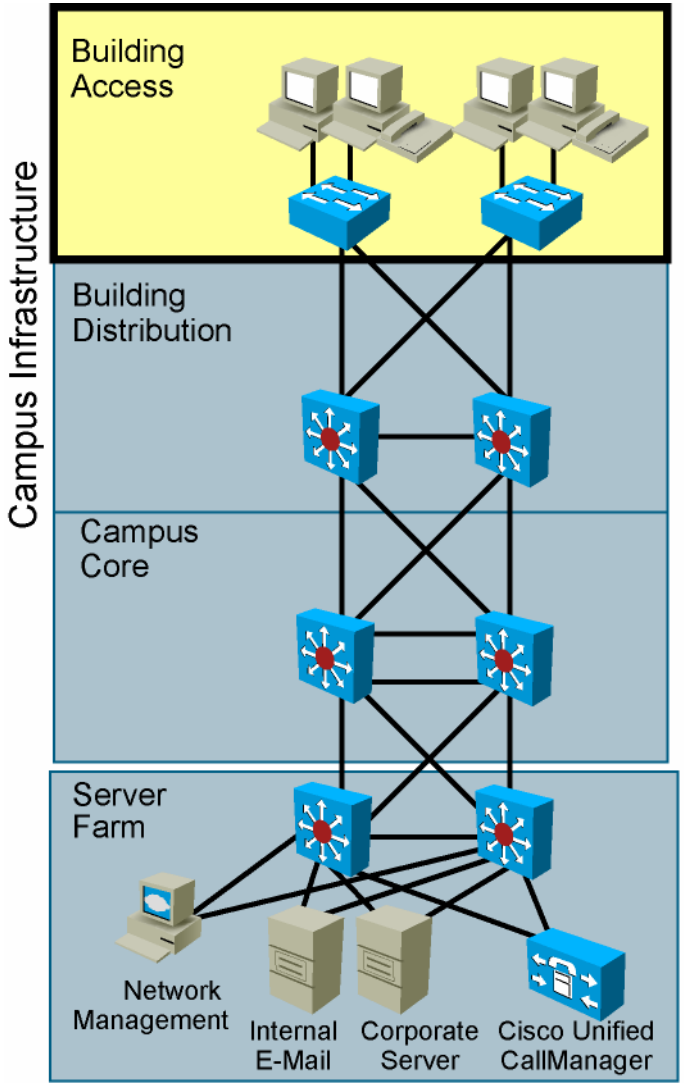
Designing Basic Enterprise Campus Networks

Relative Considerations for the Campus Design

Campus Infrastructure				
	Building Access	Building Distribution	Campus Core	Server Farm
Technology	Data Link Layer/ Multilayer Switched	Multilayer Switched	Multilayer Switched	Multilayer Switched
Scalability	High	Medium	Low	Medium
High availability	Medium	Medium	High	High
Performance	Medium	Medium	High	High
Cost per Port	Low	Medium	High	High

Building Access Layer Design Considerations

- Number of users or ports
- Cabling
- Performance
- Redundancy
- Connectivity speed for hosts and uplinks
- VLAN deployment
- Additional features such as QoS and IP multicast

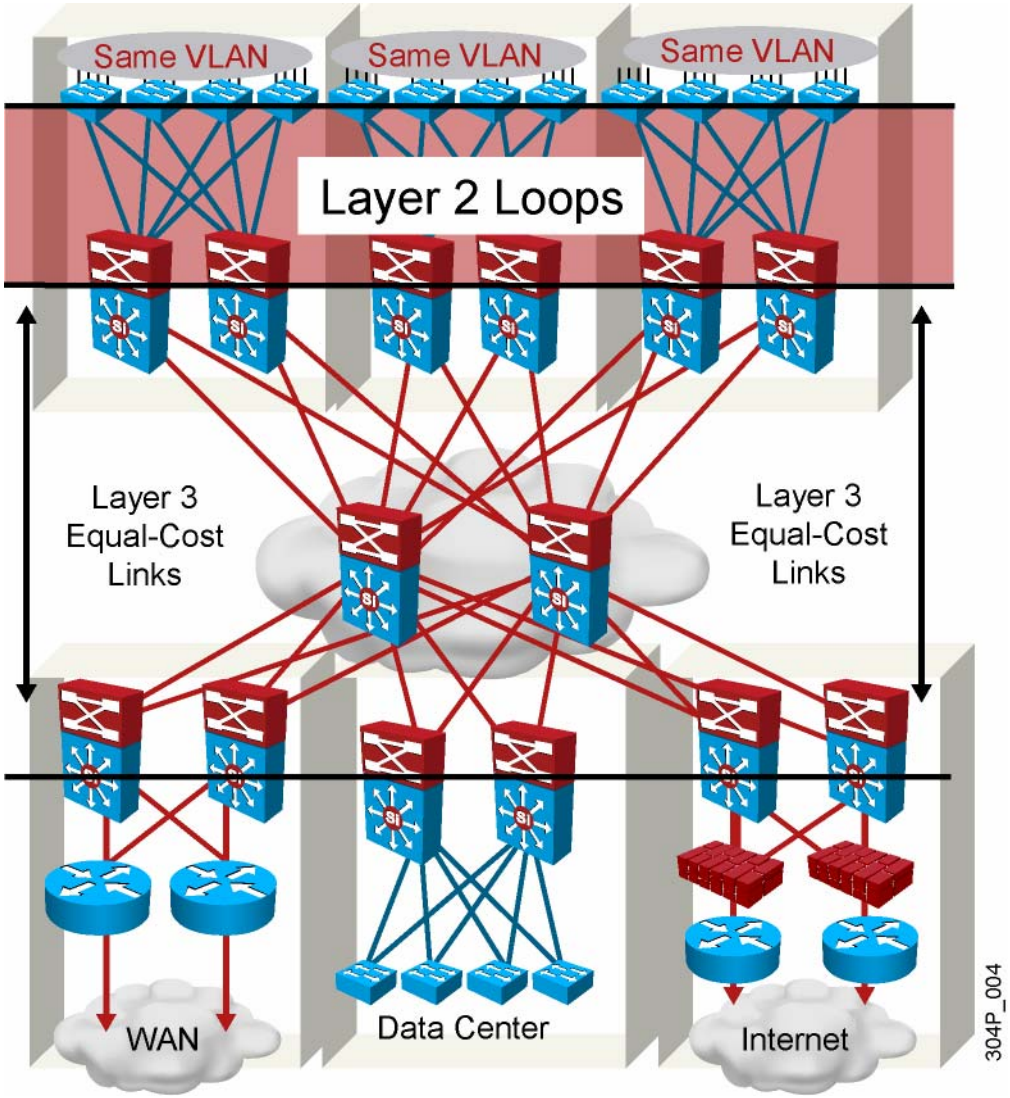


Overview of Recommended Practices for the Building Access Layer

- Manage VLANs and STP:
  - Limit VLANs to a single closet whenever possible.
  - If STP is required, use RPVST+.
  - Set trunks to desirable and desirable with negotiate.
  - Manually prune unused VLANs.
  - Use VTP transparent mode.
- Manage trunks between switches.
- Manage default PAgP settings between the catalyst operating system and Cisco IOS Software.
- Consider implementing routing in the access layer.

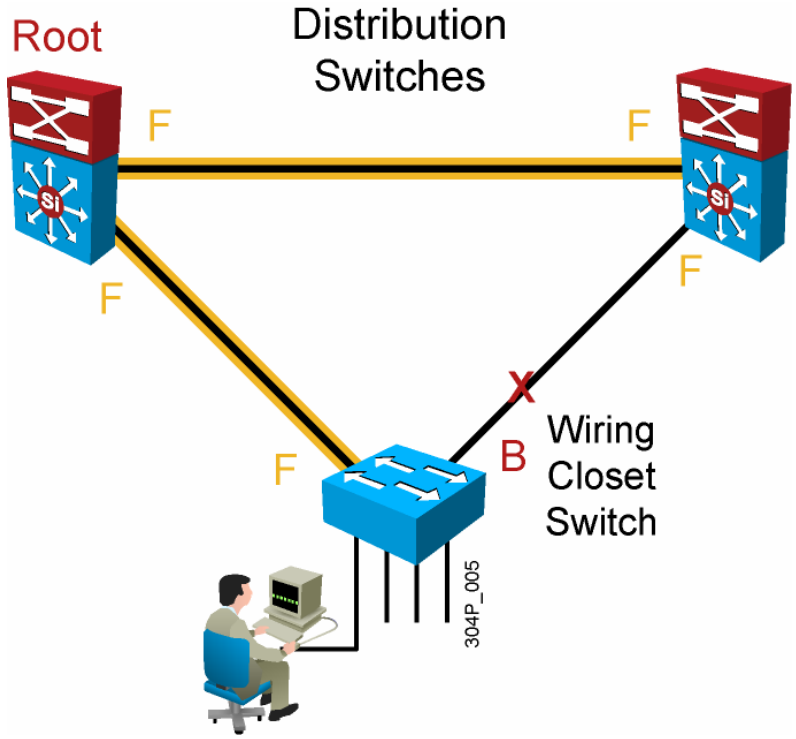
STP Considerations

- Use *only* when you have to!
  - Required when a VLAN spans access layer switches
  - Required to protect against "user side" loops
  - More common in the data center
- Use RPVST+ for best convergence.
- Take advantage of the Spanning Tree Toolkit.



Cisco STP Toolkit

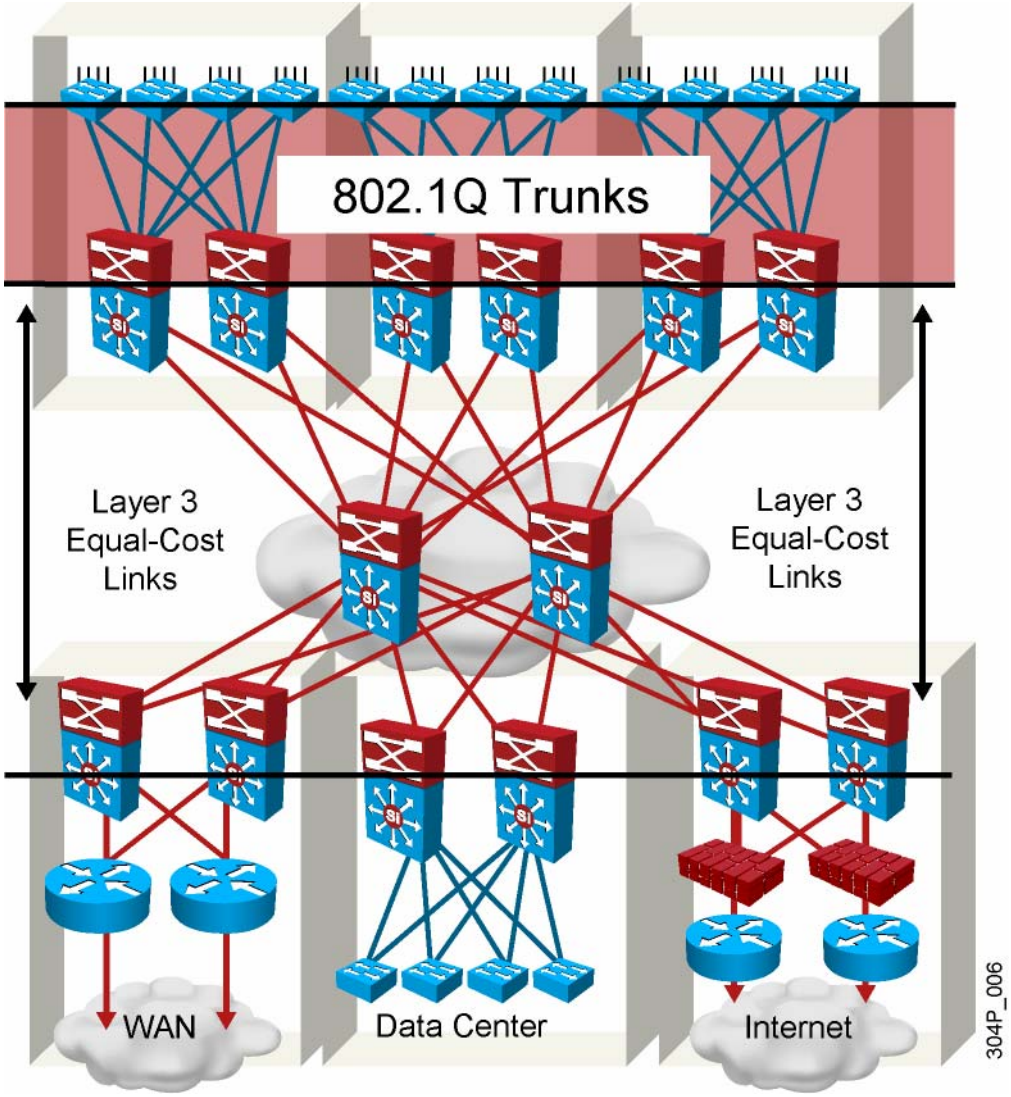
- PortFast: Bypass listening-learning phase for access port*
- UplinkFast: Three to five seconds convergence after link failure
- BackboneFast: Cuts convergence time by max_age for indirect failure
- LoopGuard: Prevents alternate or root port from becoming designated in absence of BPDUs*
- RootGuard: Prevents external switches from becoming root*
- BPDUGuard: Disable PortFast-enabled port if a BPDU is received*



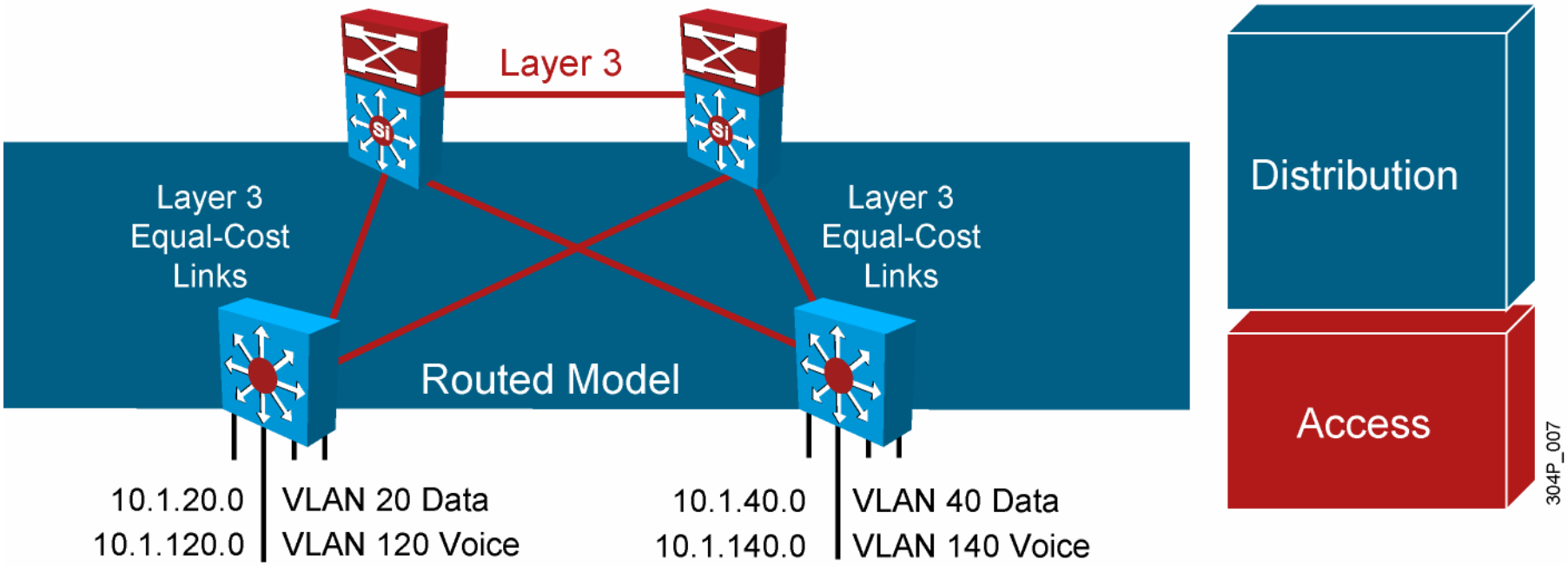
* Also supported with RPVST+

Trunk Considerations

- Set trunk mode to desirable and desirable and encapsulation negotiate on
- Manually prune all VLANS except those needed
- Use VTP transparent mode to decrease potential for operational error
- Disable trunks on host ports:
  - Catalyst Operating System: `set port host`
  - Cisco IOS Software: `switchport host`



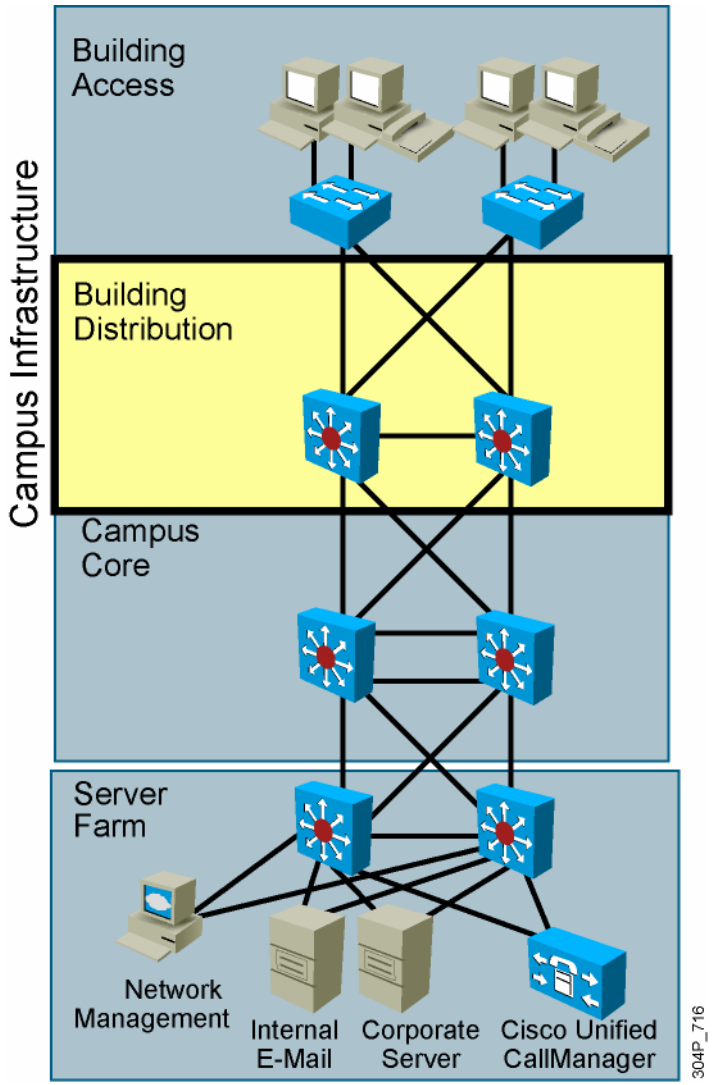
Layer 3 Access-to-Distribution Interconnection



- Best option for *fast* convergence
- Equal-cost Layer 3 load balancing on all links
- No spanning tree required for convergence
- No HSRP or GLBP configuration required
- No VLAN spanning possible

Building Distribution Layer Design Considerations

- Performance
- Redundancy
- Support for network infrastructure services

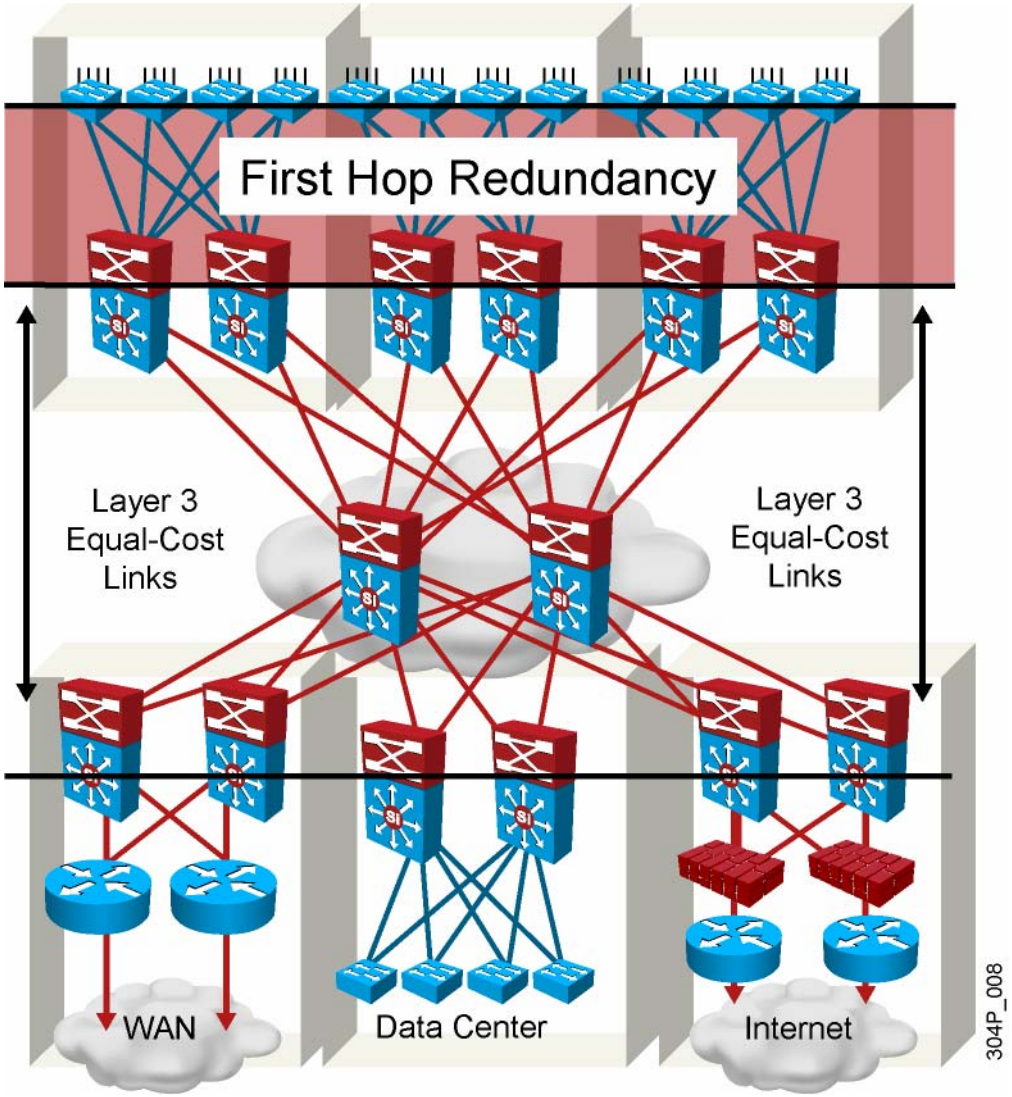


Overview of Recommended Practices for the Building Distribution Layer

- Use first-hop redundancy protocols (HSRP and GLBP).
- Deploy Layer 3 routing protocols from distribution switches to core switches.
- If required, connect distribution switches to support Layer 2 VLAN spanning multiple access switches.

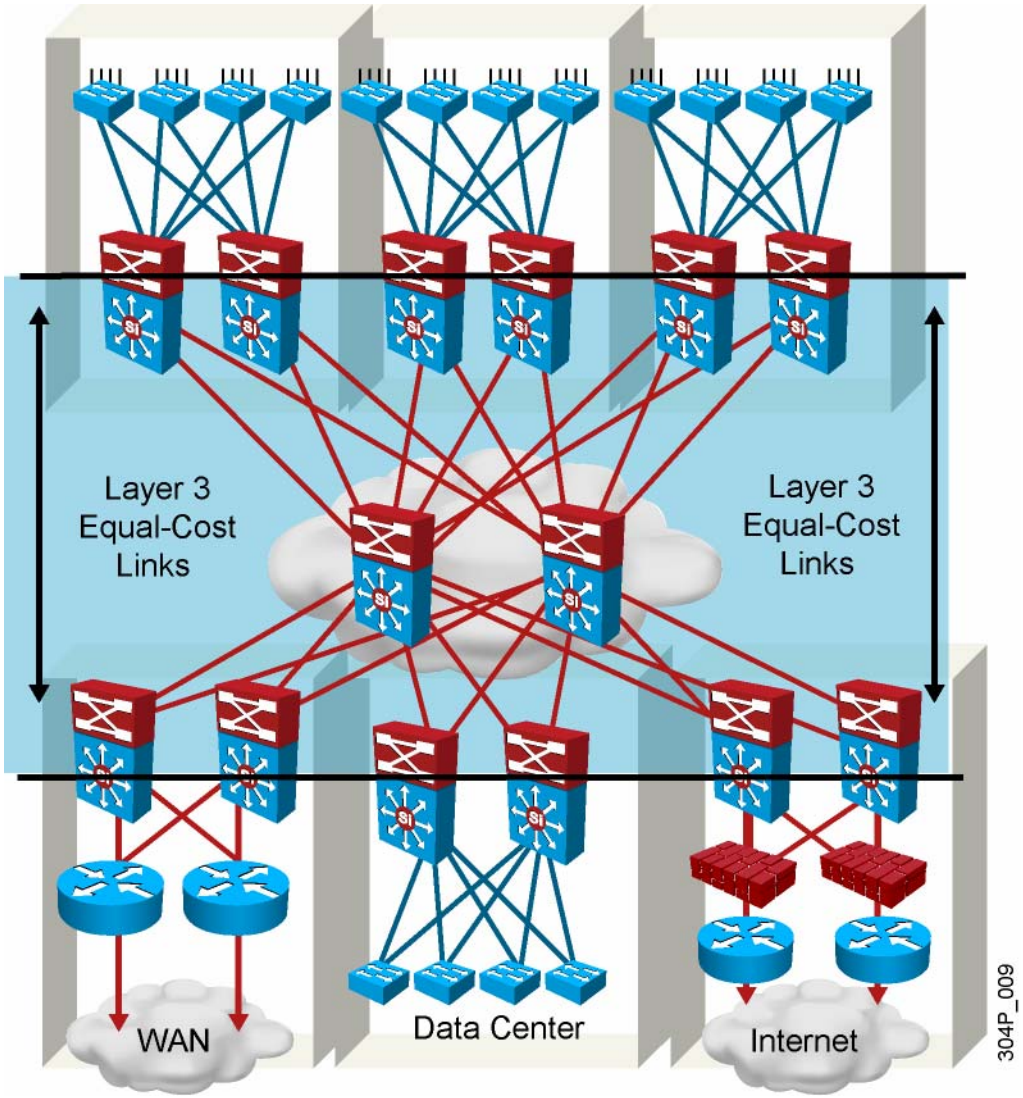
Recommended Practices—First-Hop Redundancy

- Provides a resilient default gateway or first-hop address to end stations with HSRP, VRRP, or GLBP
- HSRP, VRRP, and GLBP provide millisecond timers and excellent convergence performance
- HSRP common in Cisco environments
- VRRP if you need multi-vendor interoperability
- GLBP facilitates uplink load balancing



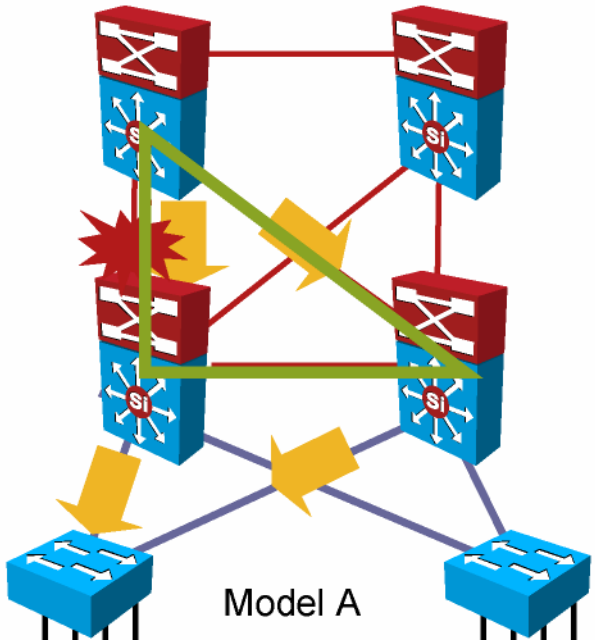
Recommended Practices—Use Layer 3 Routing Protocols

- Build triangles, not squares, for deterministic convergence.
- Only peer on links that you intend to use as transit.
- Summarize routes from distribution to core.

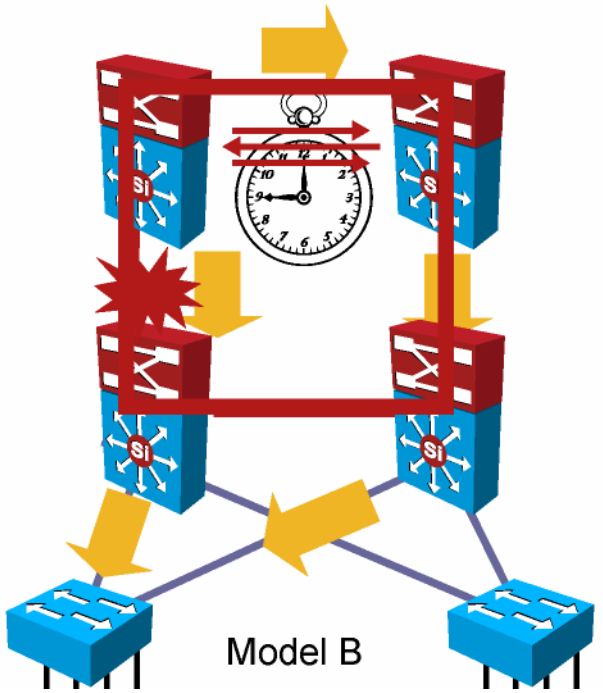


Example: Build Redundant Triangles

Triangles: Link or Box Failure Does *Not* Require Routing Protocol Convergence

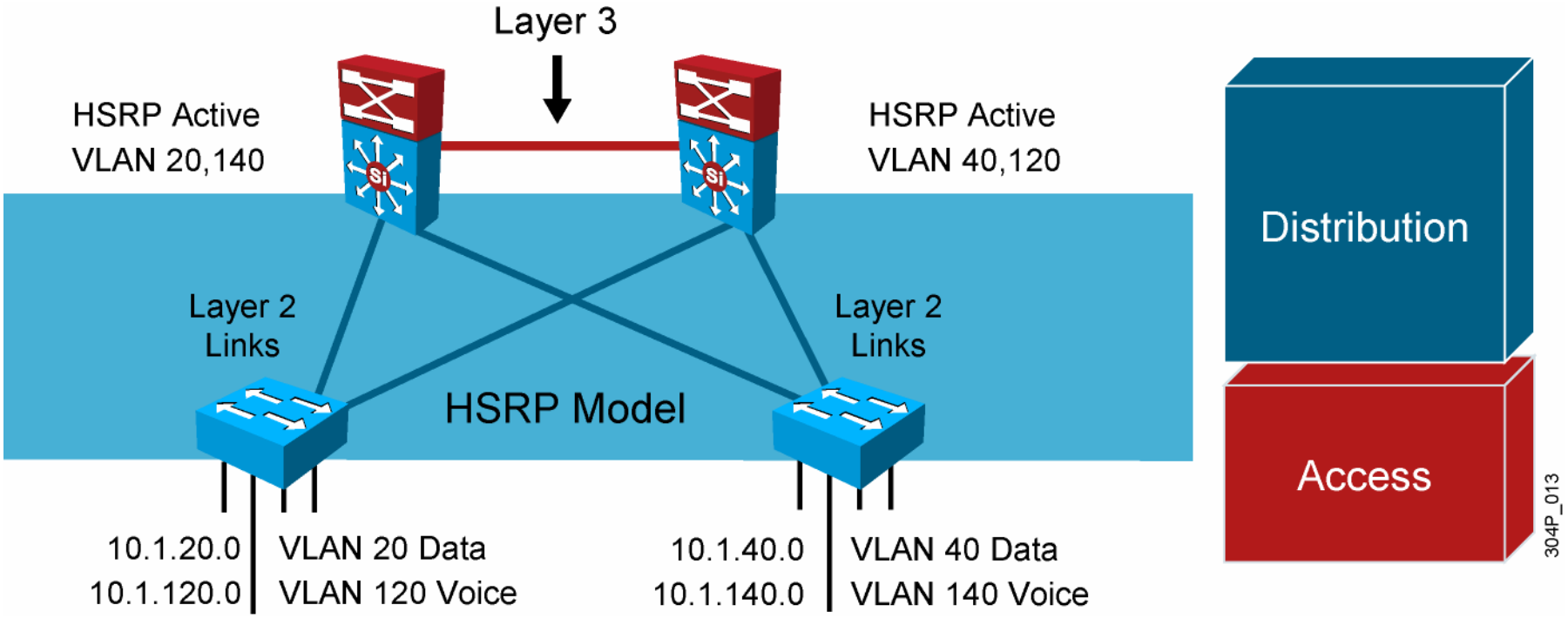


Squares: Link or Box Failure Requires Routing Protocol Convergence



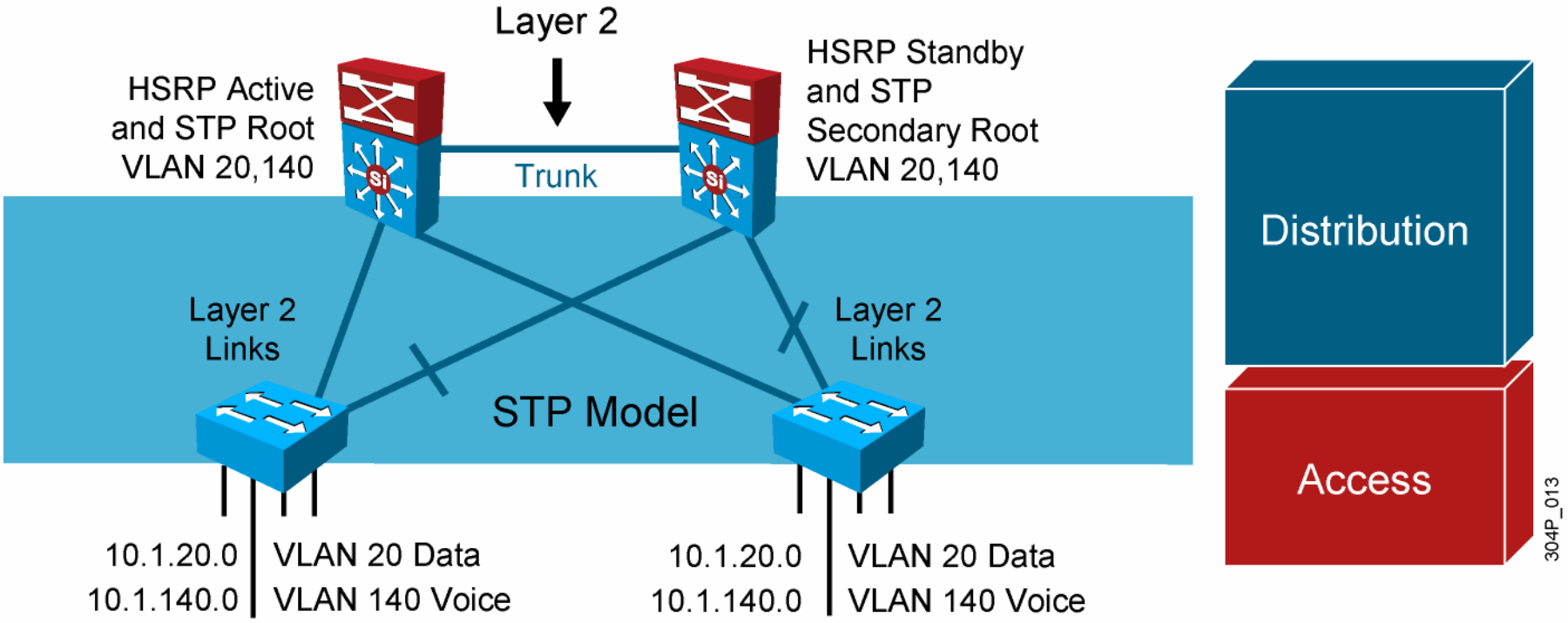
- Layer 3 redundant equal cost links support fast convergence.
- Hardware based—recovery to remaining path is fast.
- Convergence is extremely fast (dual equal-cost paths: no need for OSPF or EIGRP to recalculate a new path).

Layer 3 Distribution Interconnection



- Recommended practice—tried and true
- No STP convergence required for uplink failure and recovery
- Distribution-to-distribution link required for route summarization
- Map Layer 2 VLAN number to Layer 3 subnet for ease of use and management

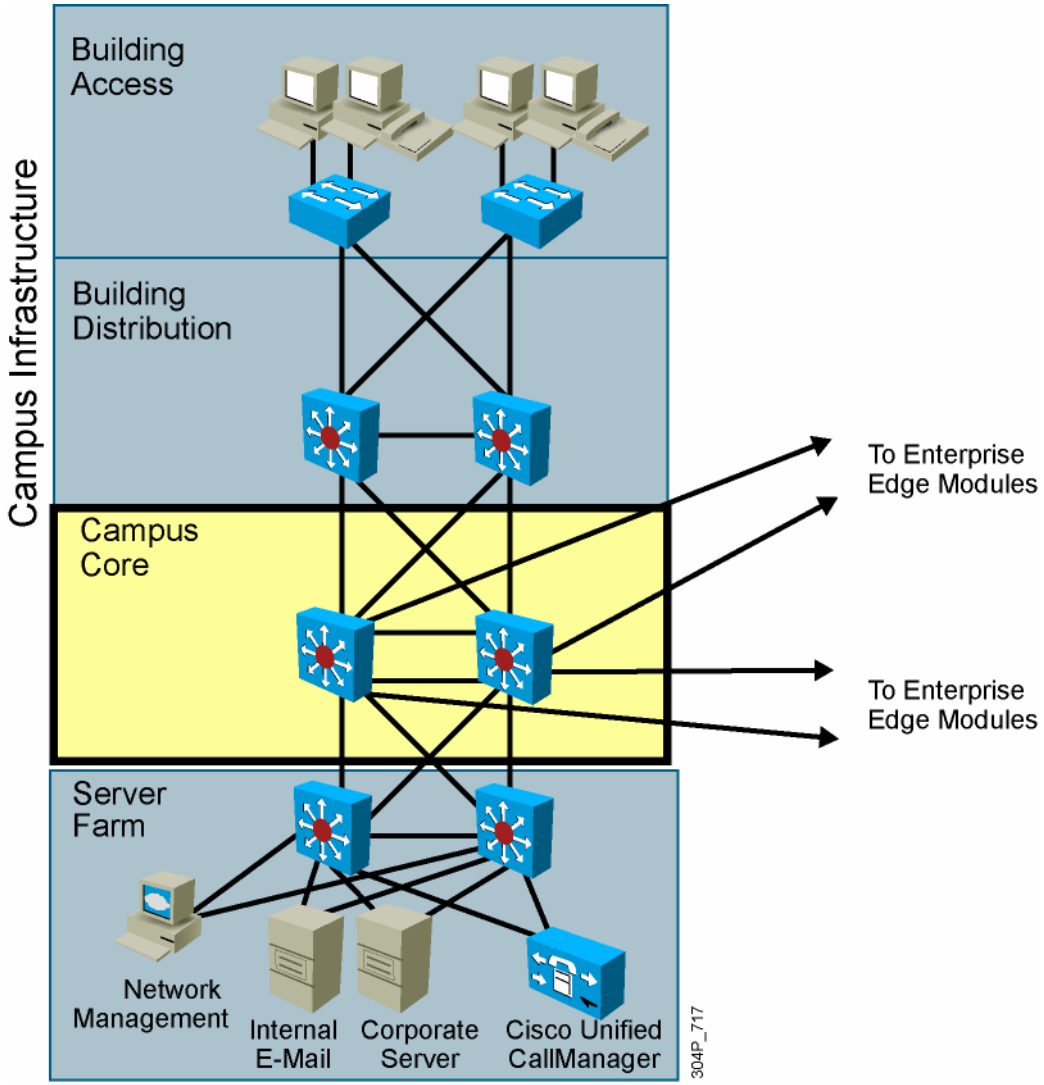
Alternate: Layer 2 Distribution Interconnection



- Use only if Layer 2 VLAN spanning flexibility required
- STP convergence required for uplink failure and recovery
- More complex because STP root and HSRP should match
- Distribution-to-distribution link required for route summarization

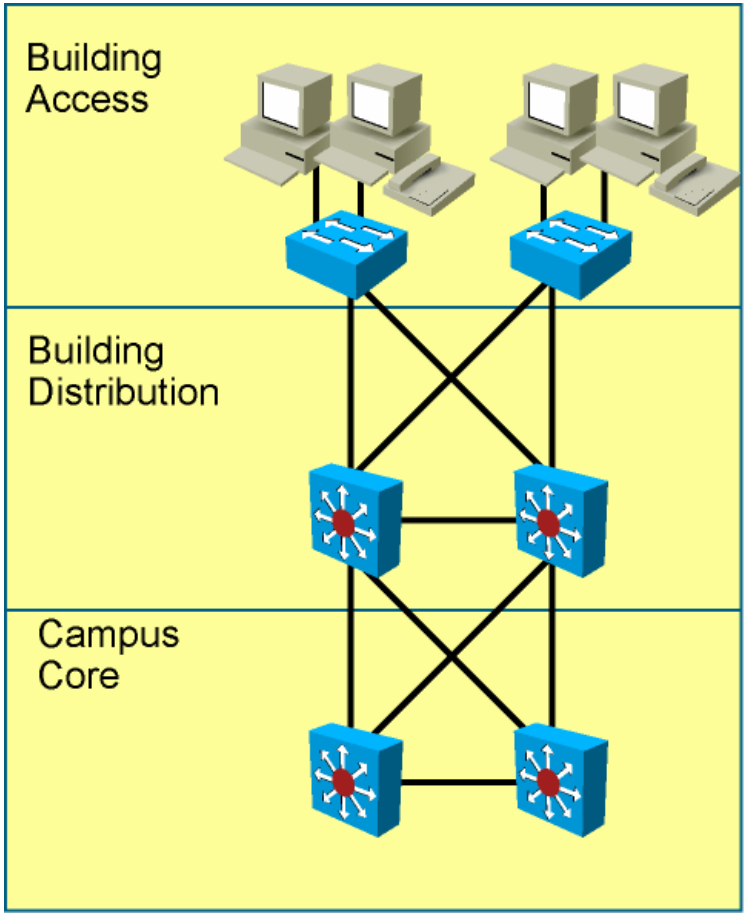
Campus Core Design Considerations

- Determine if core is needed.
- Determine performance and capacity needed.
- Determine redundancy.
- Determine if enterprise edge and WAN connectivity is to core or data center.

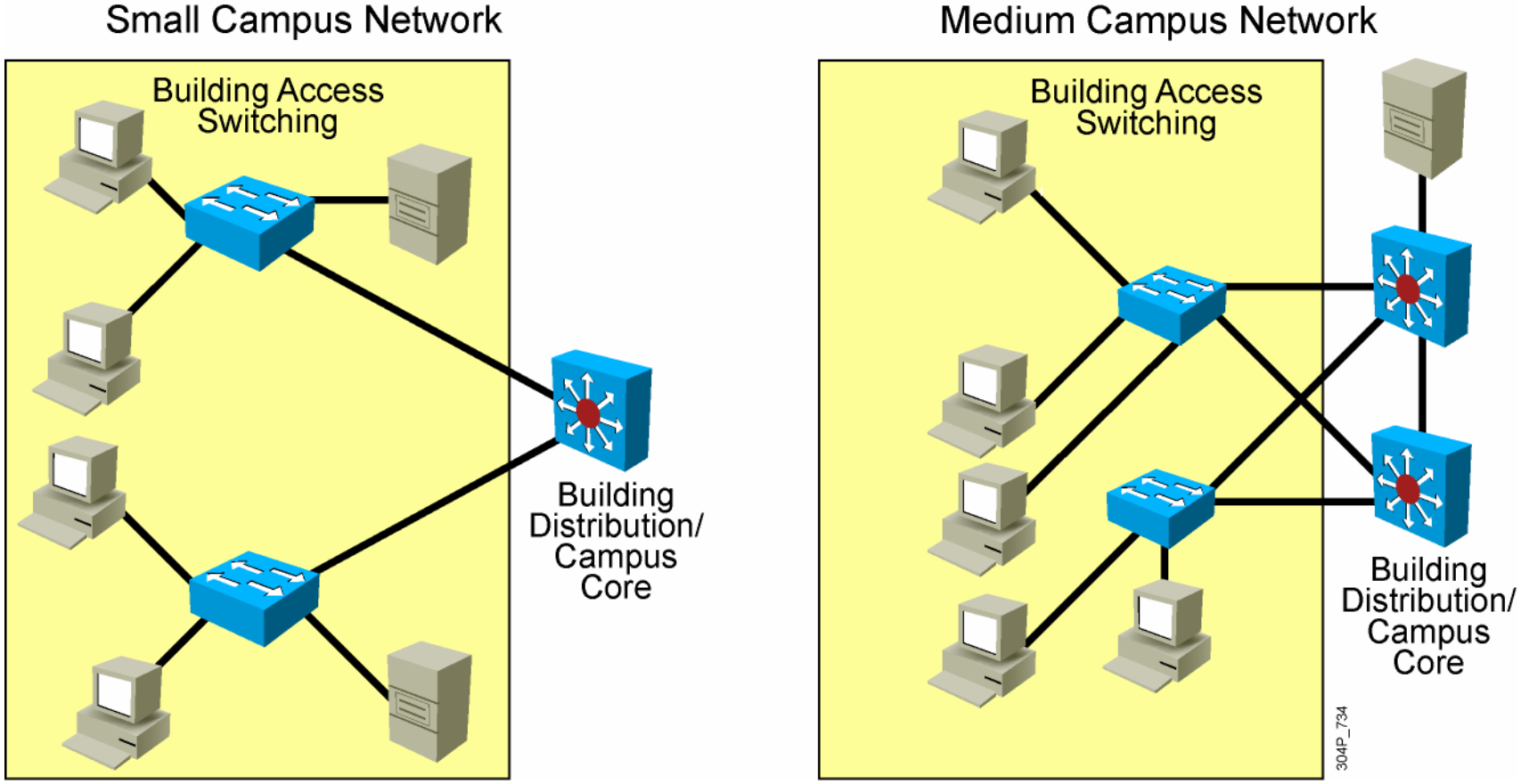


Example: Large Campus Multilayer Switched Backbone Design

- Reduced multilayer switch peering
- Topology with no spanning-tree loops
- Scalability to arbitrarily large size
- Improved network services support
- Two equal-cost paths to every destination network
- Fast recovery from link failure



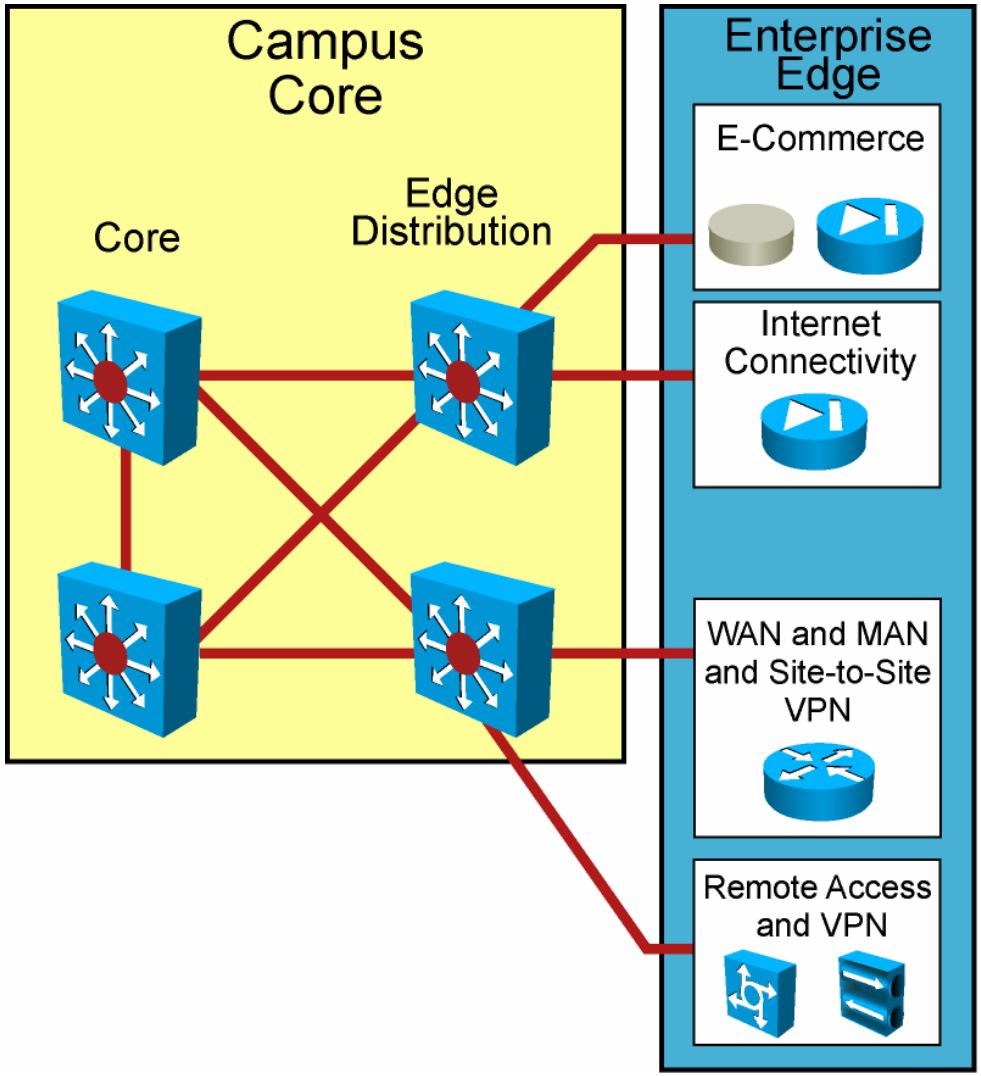
Small and Medium Campus Design Options



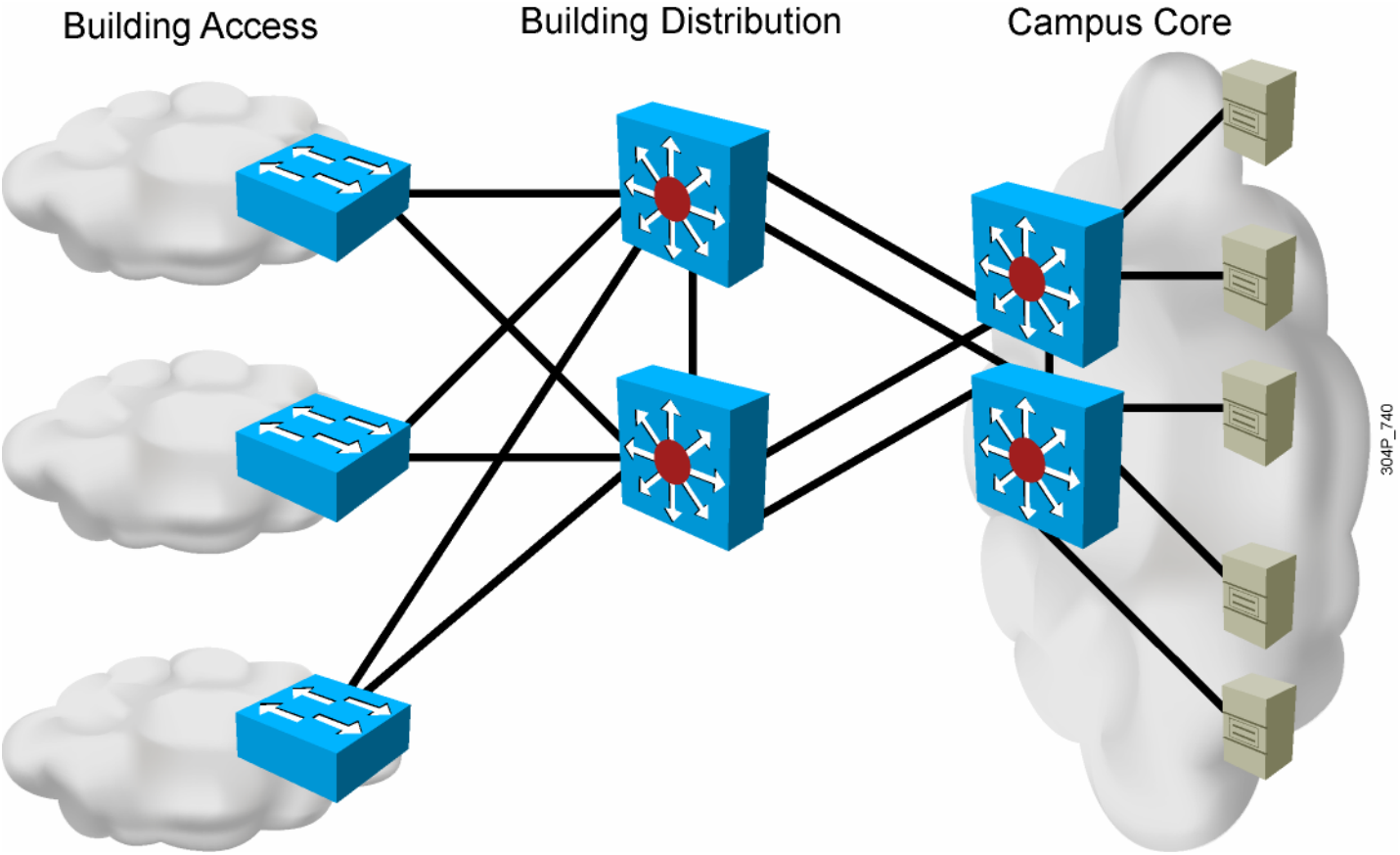
Edge Distribution Design

Edge distribution switches have to protect the campus core from:

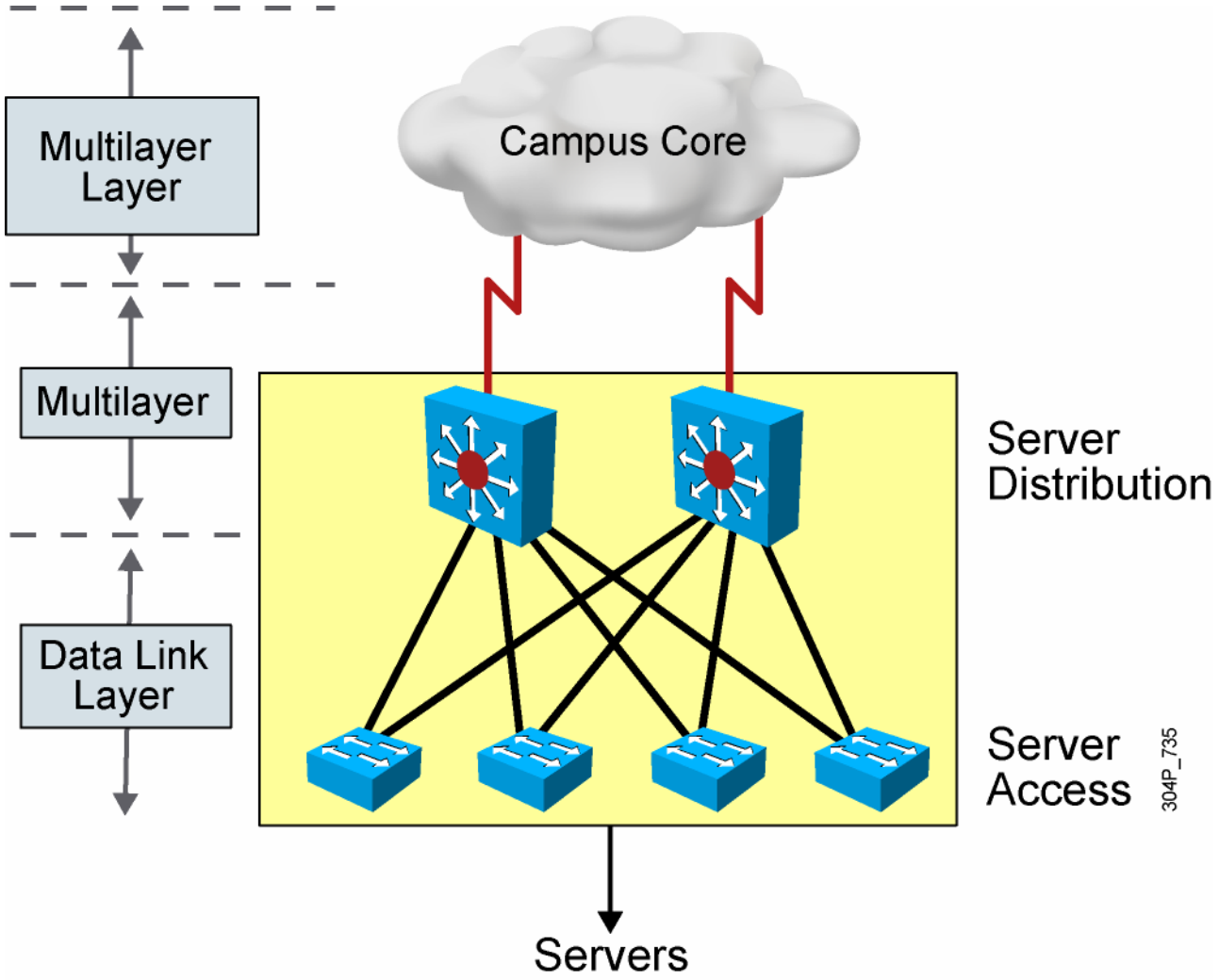
- Unauthorized access
- IP spoofing
- Network reconnaissance
- Packet sniffers



Server Placement in a Medium-Sized Network



Server Placement in a Large Network



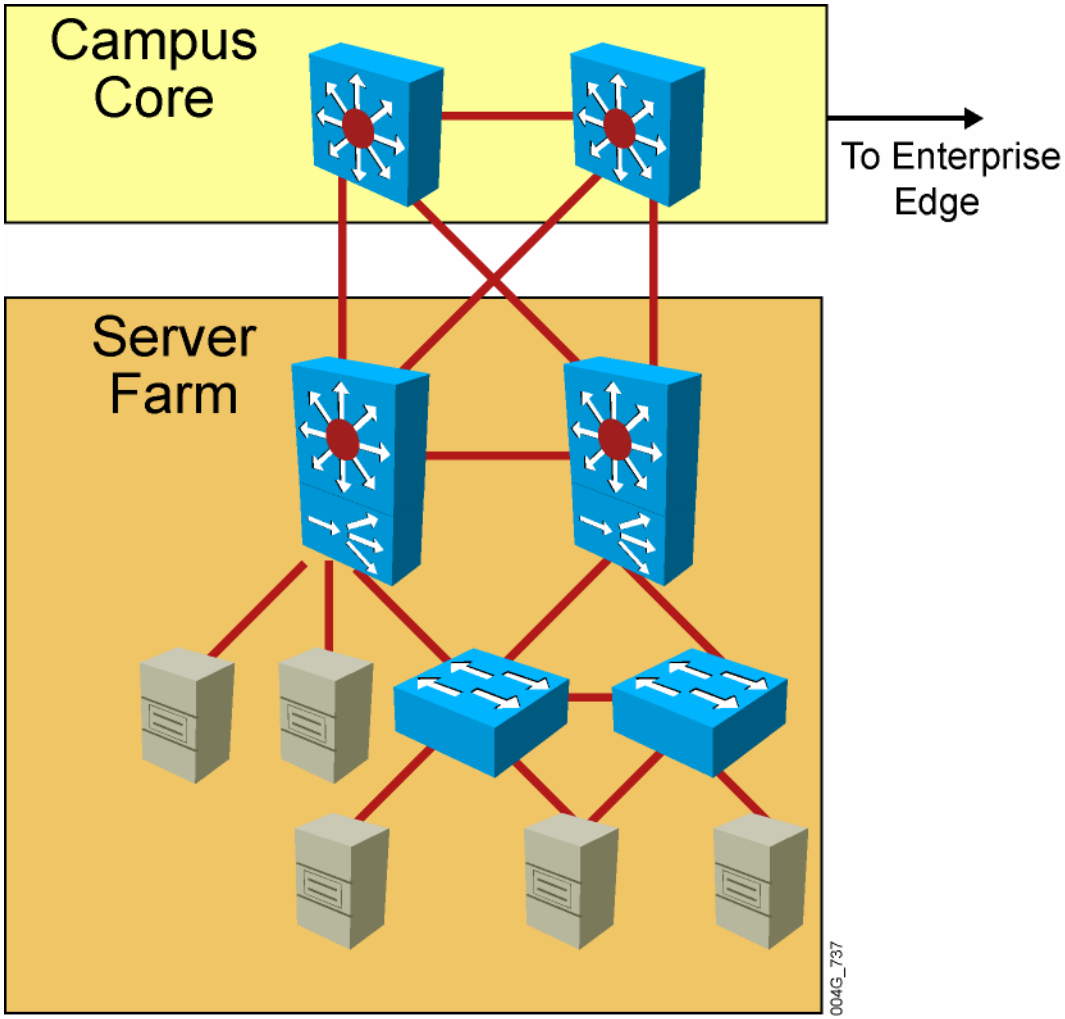
Server Farm Design Guidelines

Key design considerations:

- Access control
- Traffic demands
- Oversubscription

Server connectivity options:

- Single NIC
- Dual-NIC redundancy
- Content switching (server load balancing)



Summary

Design an enterprise campus network using recommended practices:

- Use low price per port and high port density on data link layer switches for the building access layer.
- Use redundant multilayer switching in the building distribution layer for high availability and performance.
- Use high-performance wire-rate multilayer switching in the campus core design.
- Group centralized servers into a server farm module for moderate enterprise server requirements.