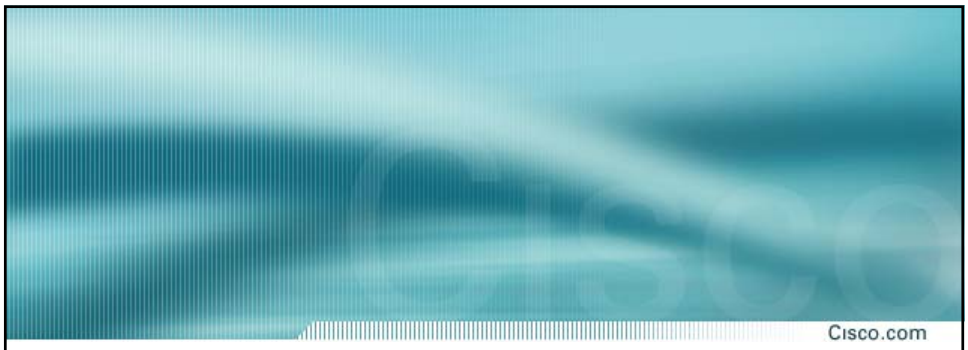

Multilayer Switching

Halmstad University

Olga Torstensson

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Module 1: New Requirements

Intelligent Information Network (IIN)

- **Intelligence across multiple products and infrastructure layers**
- **Active participation of the network in the delivery of services and applications**

Three phases in building IIN

- **Integrated transport**
- **Integrated services**
- **Integrated applications**

Service-Oriented Network Architecture (SONA)

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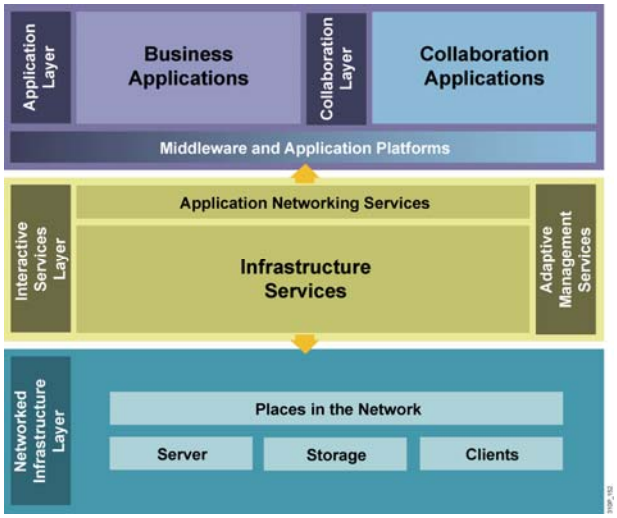

Network Models

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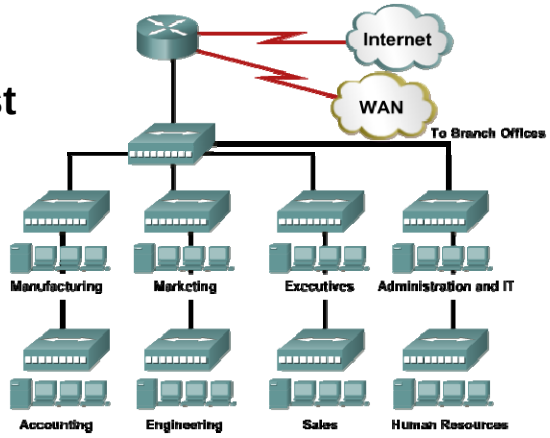
- Campus architecture
- Data center architecture
- Branch architecture
- Teleworker architecture
- WAN architecture

Nonhierarchical Network Devices

Cisco.com

- **Large collision domain**
- **Large broadcast domain**
- **High latency**
- **Difficult to troubleshoot**



Traffic that can affect network performance:

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Broadcast - traffic that polls the network about component status or availability and advertises network component status or availability

Multicast - traffic that is propagated to a specific group of users

Layer 2 Switching

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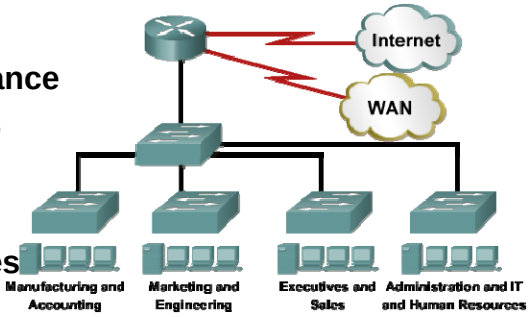
- Hardware-based bridging
- Wire-speed performance
- Collision domain per port
- Traffic containment based on MAC addres



Issues

- No traffic between VLANs
- Unbounded broadcast domain
- Servers not centrally located

Layer 3 Routing

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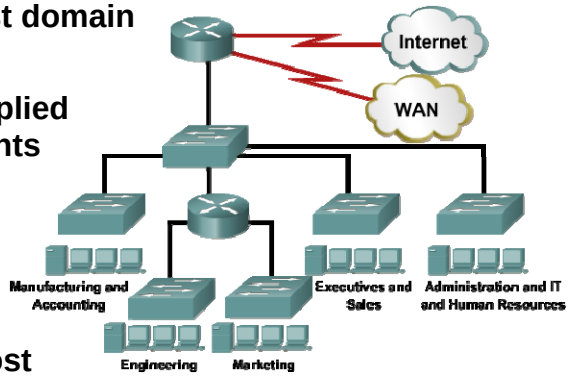
- Single broadcast domain per interface
- ACLs can be applied between segments



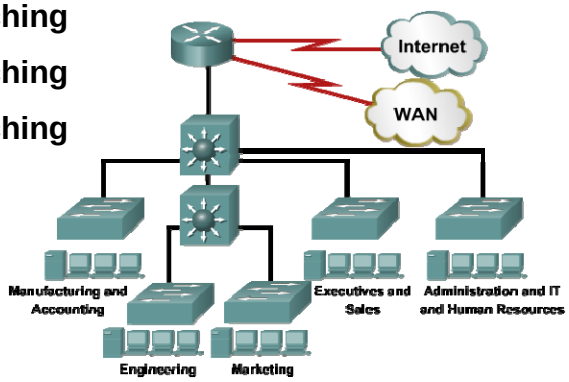
Issues

- High per-port cost
- Layer 3 processing required
- High latency over Layer 2 switching

Multilayer Switching

Cisco.com

- Combined functionality
  - Layer 2 switching
  - Layer 3 switching
  - Layer 4 switching
- Low latency
- High-speed scalability



Issues with Multilayer Switches in a Nonhierarchical Network

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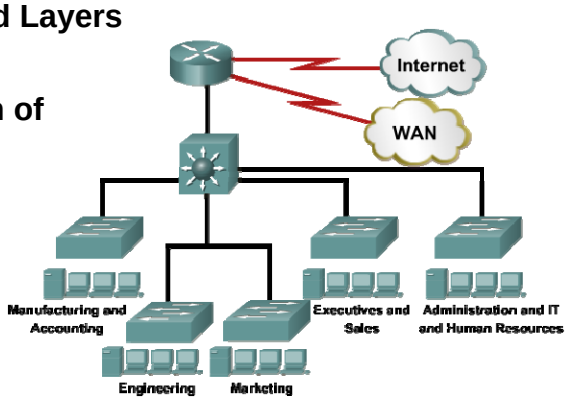
- Single point of failure for Layers 2 and Layers 3
- Underutilization of hardware
- Spanning tree complexity
- Servers not centrally located



Enterprise Composite Model Functional Areas

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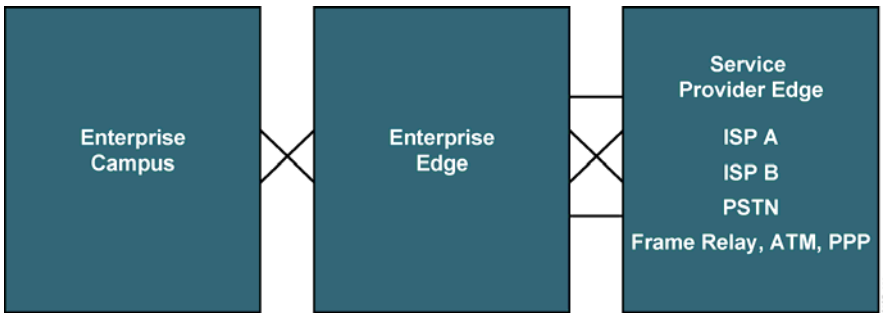
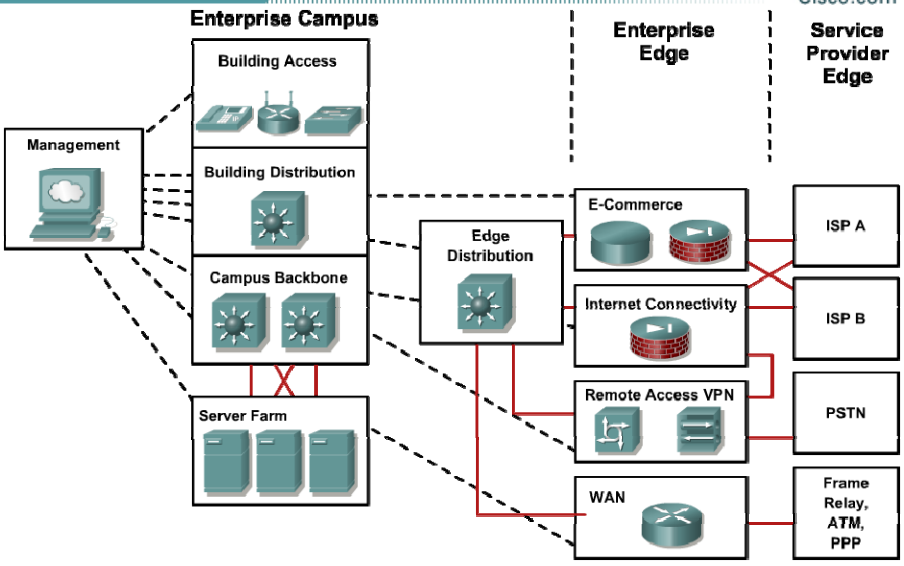


Enterprise Composite Network Model

Cisco.com



Hierarchical Campus Model

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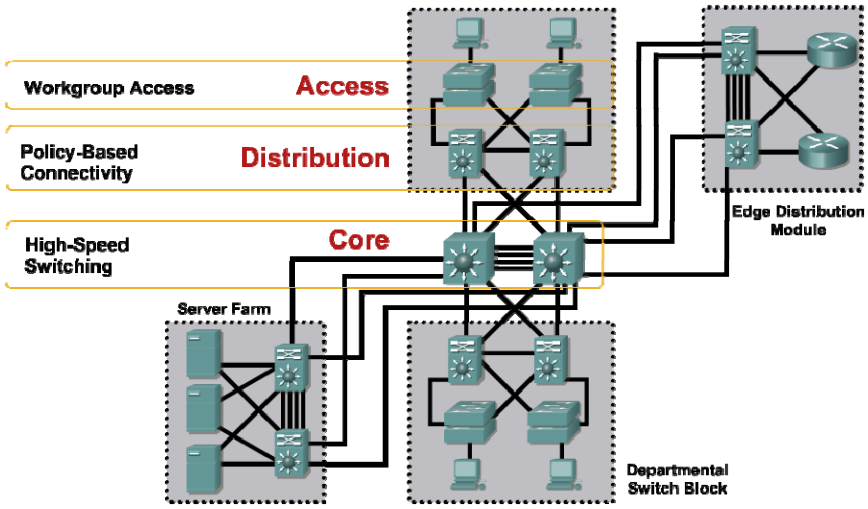


Module 2: Defining VLANs

Cisco.com

Issues in a Poorly Designed Network

FIGURE 1

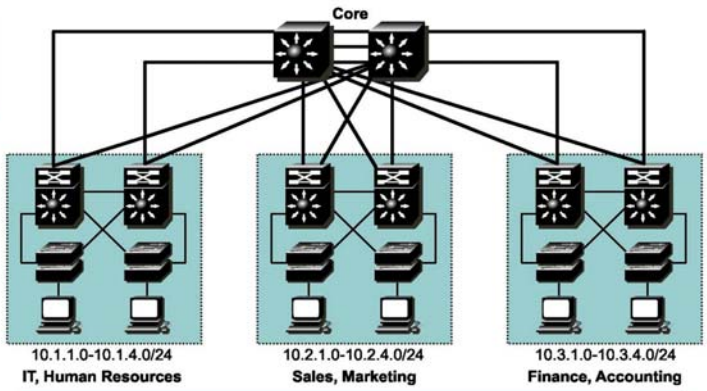
Issues in a Poorly Designed Network

- Unbounded failure domains
- Large broadcast domains
- Large amount of unknown MAC unicast traffic
- Unbounded multicast traffic
- Management and support challenges
- Possible security vulnerabilities

Scalable Network Addressing

FIGURES

1 2 3 4 5



- Allocate IP address spaces in contiguous blocks.
- Allocate one IP subnet per VLAN.

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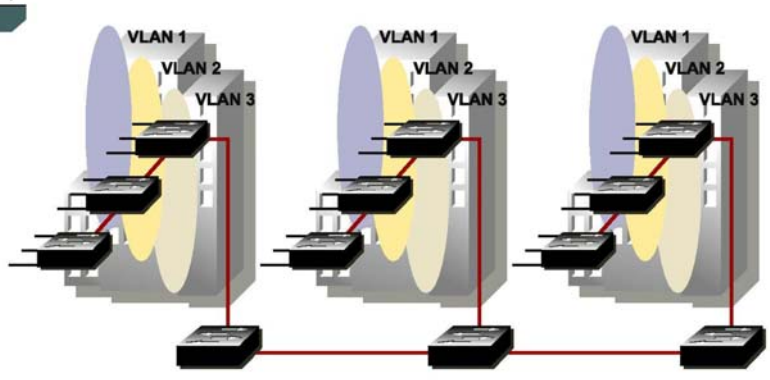
What Is an End-to-End VLAN?

FIGURE

1



- Users are grouped into VLANs independent of physical location.
- If users are moved within the campus, their VLAN membership remains the same.

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Defining VLANs
Local VLAN

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- Local VLANs should be created with physical boundaries in mind, rather than job functions of the users on the end devices.
- Traffic from a local VLAN is routed to reach destinations on other networks.
- A single VLAN does not extend beyond the Building Distribution submodule.
- VLANs on a given access switch should not be advertised to all other switches in the network.

Mapping VLANs in a Hierarchical Network

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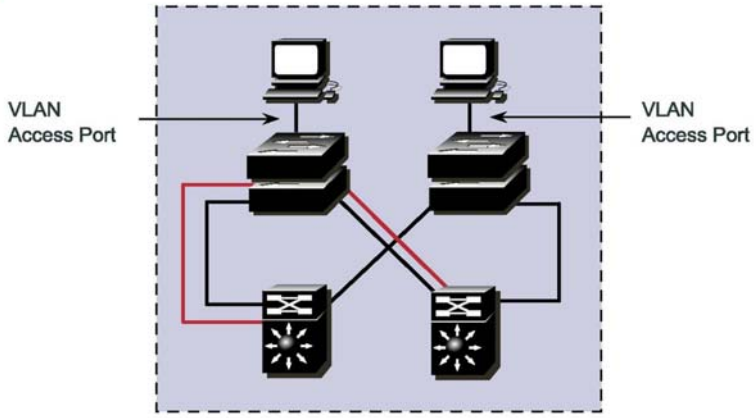
- Examine the subnetting scheme that has been applied to the network and associate a VLAN to each subnet.
- Configure routing between VLANs at the distribution layer using multilayer switches.
- Make end-user VLANs and subnets local to a specific switch block.
- Ideally, limit a VLAN to one access switch or switch stack. However, it may be necessary to extend a VLAN across multiple access switches within a switch block to support a capability such as wireless mobility.

VLAN Access Ports

FIGURE 1



The access switch port associated with a single data VLAN

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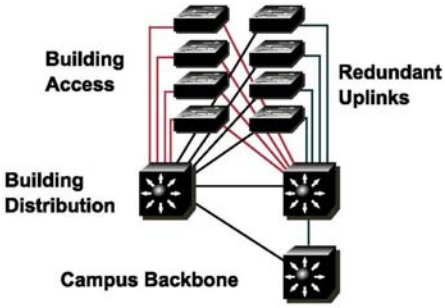
How to Implement a VLAN

FIGURES 1 2 3 4 5 6 7



- Create or configure a VLAN.
- Verify VLAN configuration.
- Associate switch ports with the VLAN.
- Verify switch port configuration.
- Test VLAN connectivity.
- Implement VLAN and switch security.

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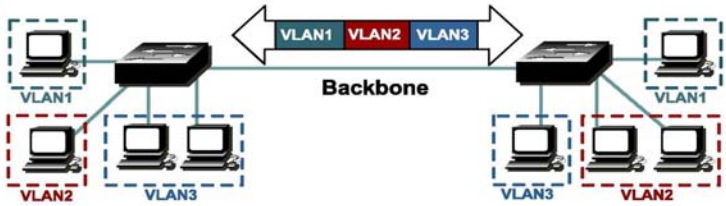
Defining VLANs
Trunk link

Maintaining Specific VLAN Identification

FIGURES 1 2 3



- Specifically developed for multi-VLAN interswitch communications
- Places a unique identifier in each frame
- Functions at Layer 2

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Defining VLANs
Trunk Links

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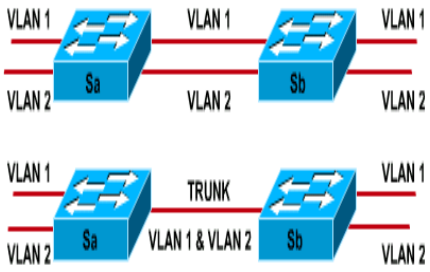
- **Two switches**
- **A switch and a router**
- **A Switch and a trunk capable NIC in a node such as a server**



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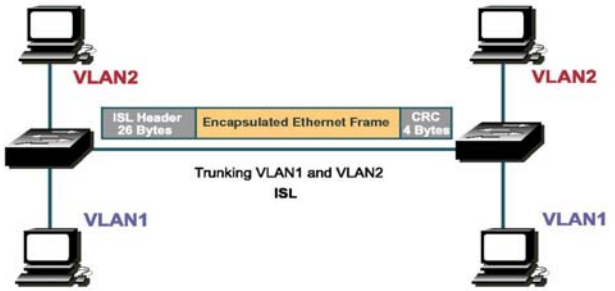
ISL

Trunking with ISL

FIGURES

1
2



- Is a Cisco proprietary protocol
- Supports PVST
- Uses an encapsulation process
- Does not modify the original frame

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802.1Q Trunking

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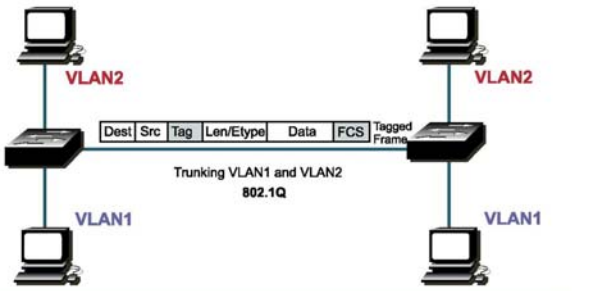
Trunking with 802.1Q

FIGURES

1
2



- An IEEE standard
- Adds a 4-byte tag to the original frame
- Additional tag includes a priority field
- Does not tag frames that belong to the native VLAN
- Supports Cisco IP Telephony

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802.1Q Native VLANs

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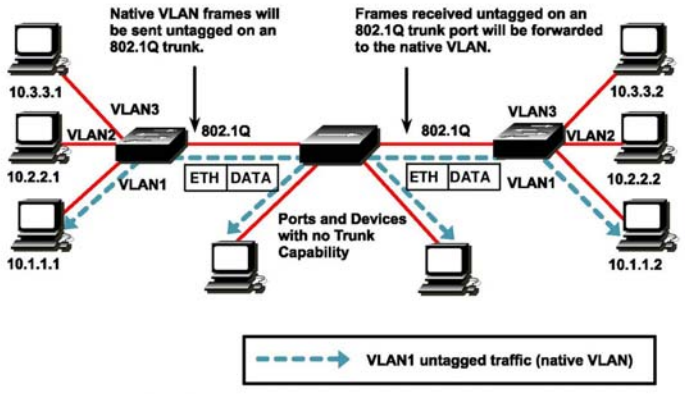
802.1Q Native VLAN

FIGURE 1



Native VLAN frames are carried over the trunk link untagged.

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Defining VLANs
VLAN Trunking Protocol

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- **VTP maintains VLAN configuration consistency across the entire network.**
- **VTP is a messaging protocol that uses Layer 2 trunk frames to manage the addition, deletion, and renaming of VLANs on a network-wide basis.**
- **Further, VTP allows you to make centralized changes that are communicated to all other switches in the network.**

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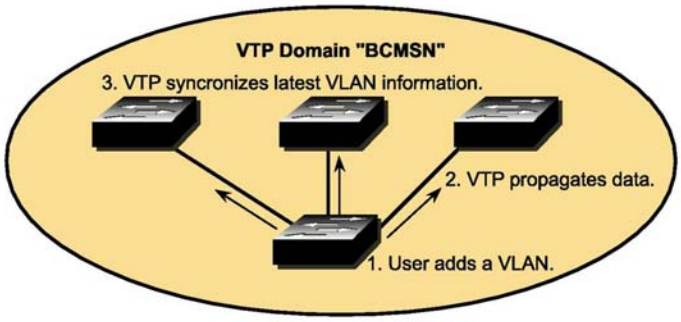
The VTP Protocol

FIGURE 1



- Advertises VLAN configuration information
- Maintains VLAN configuration consistency throughout a common administrative domain
- Sends advertisements on trunk ports only

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VTP Modes

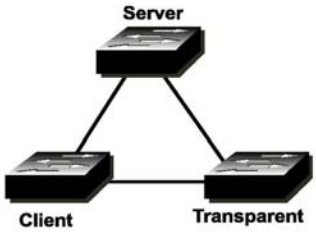
VTP Modes

FIGURES 1 2

Server (default mode)
- Creates, modifies, and deletes VLANs
- Sends and forwards advertisements
- Synchronizes VLAN configurations
- Saves configuration in NVRAM

Client
- Cannot create, change, or delete VLANs
- Forwards advertisements
- Synchronizes VLAN configurations
- Does not save in NVRAM

Transparent
- Creates, modifies, and deletes local VLANs
- Forwards advertisements
- Does not synchronize VLAN configurations
- Saves configuration in NVRAM



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VTP pruning

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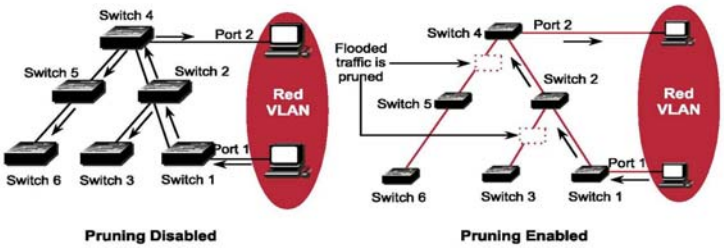
VTP Pruning

FIGURE 1

- Uses bandwidth more efficiently by reducing unnecessary flooded traffic
- Example: Station A sends broadcast; broadcast flooded only toward any switch with ports assigned to the red VLAN



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Implementing VTP in the Enterprise Composite Network Model

FIGURE 1

Implementing VTP

- Plan VTP domain boundaries
- Have only one or two VTP servers
- Configure a VTP password
- Manually configure the VTP domain name on all devices.
- When setting up a new domain
  - Configure VTP client switches first so that they participate passively
- When cleaning up an existing VTP domain
  - Configure passwords on servers first because clients may need to maintain current VLAN information until the server is verified as complete

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