Extending Switched Networks with Virtual LANs
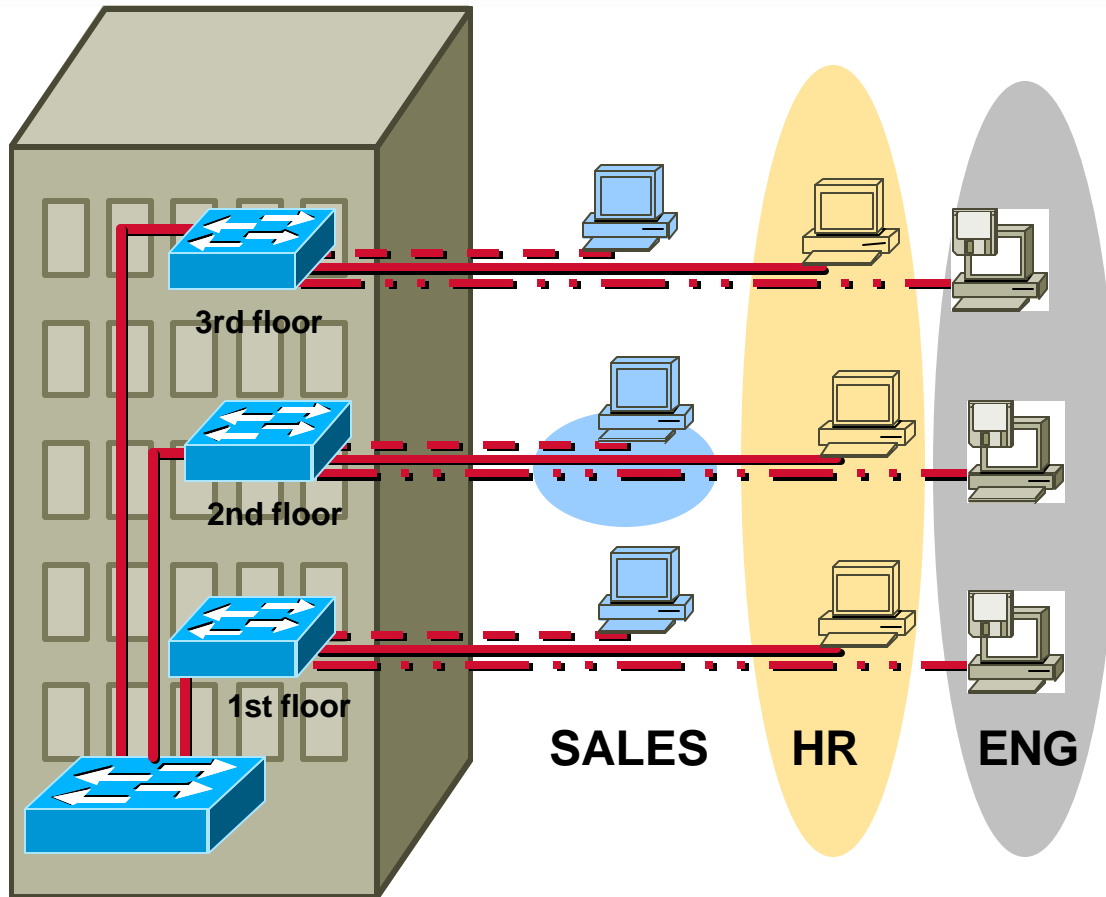
Objectives

Upon completion of this chapter, you will be able to perform the following tasks:

- **Configure a VLAN**

- **Configure VLAN Trunking Protocol (VTP)**

- **Configure a switch for trunking**

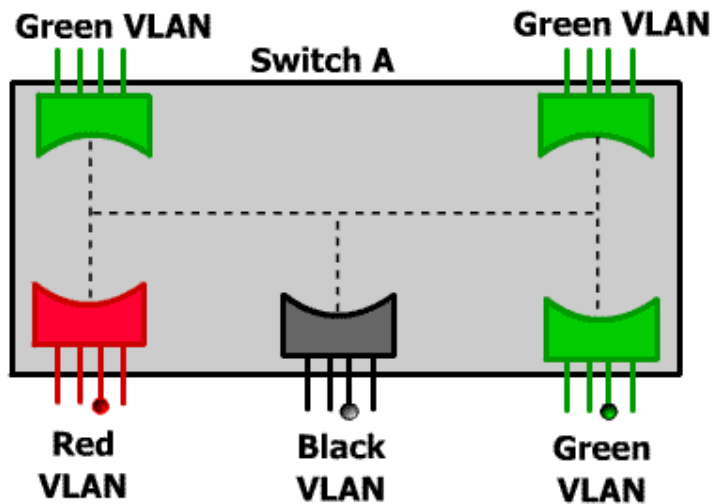- **Verify VLAN connectivity**

- **Verify spanning-tree operations**

VLAN Overview

- **Segmentation**
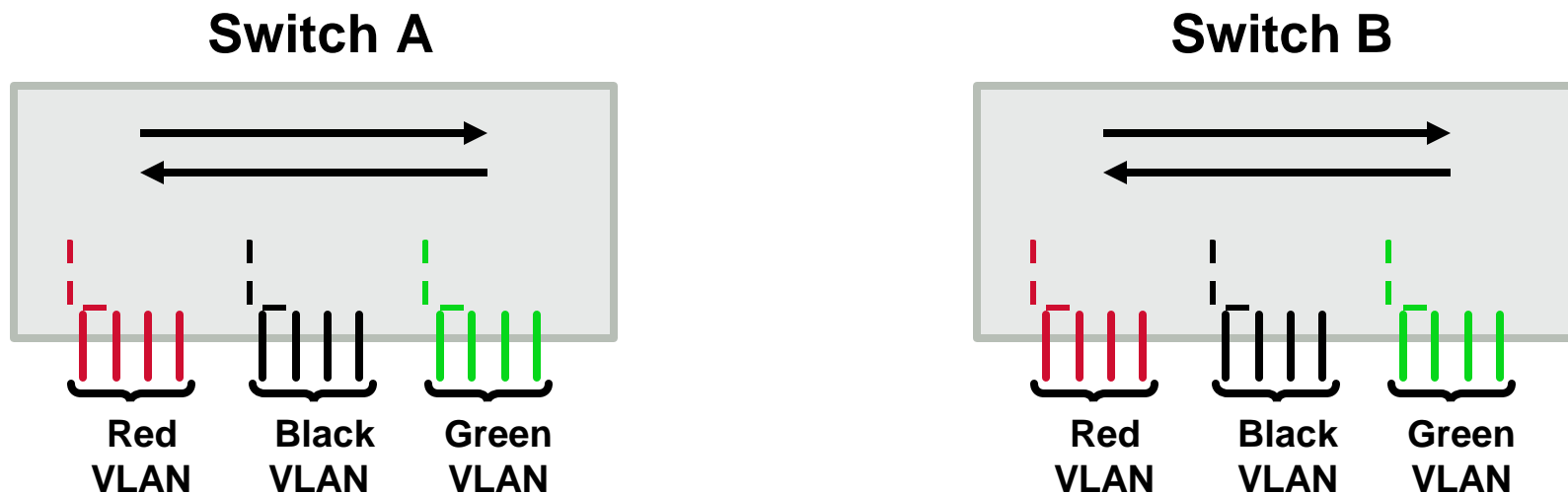- **Flexibility**
- **Security**

3rd floor

2nd floor

1st floor

SALES   HR   ENG

A VLAN = A broadcast domain = Logical network (subnet)

www.cisco.com

VLAN Operations

- **Each logical VLAN is like a separate physical bridge**

VLAN Operations

Switch A

Switch B

Red VLAN Black VLAN Green VLAN

Red VLAN Black VLAN Green VLAN

- **Each logical VLAN is like a separate physical bridge**
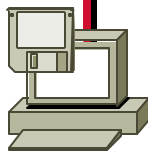- **VLANs can span across multiple switches**

VLAN Operations
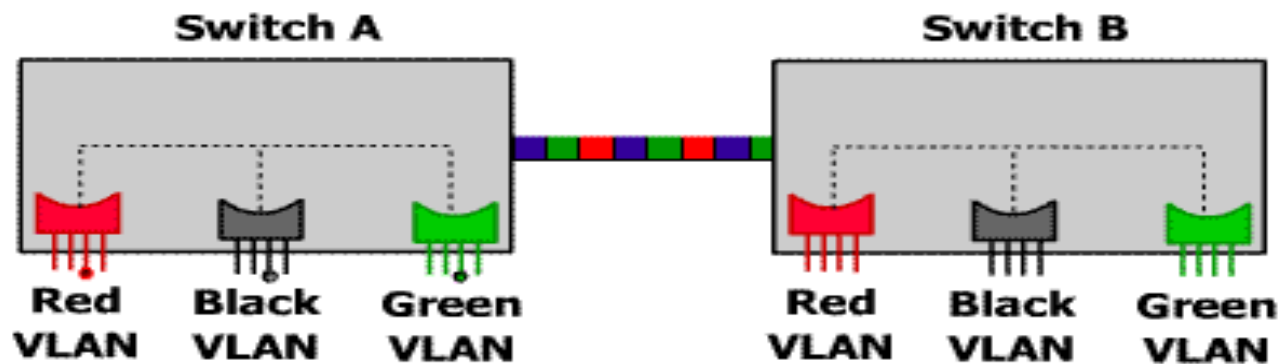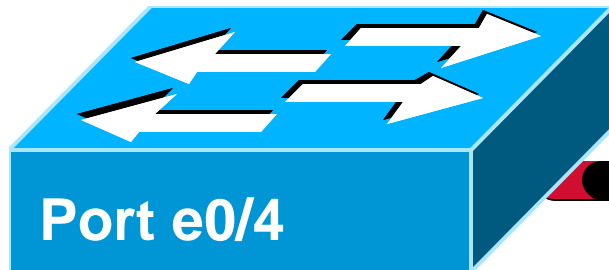

- **Each logical VLAN is like a separate physical bridge**
- **VLANs can span across multiple switches**
- **Trunks carries traffic for multiple VLANs**
- **Trunks use special encapsulation to distinguish between different VLANs**

VLAN Membership Modes

Static VLAN

Dynamic VLAN

Port e0/4

Trunk

Port e0/9

VLAN5
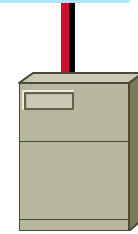
VLAN10

VMPS

1111.1111.1111 = vlan 10

MAC = 1111.1111.1111

ISL Tagging

ISL trunks enable VLANs across a backbone

VLAN Tag added by incoming port

Inter-Switch Link carries VLAN identifier

VLAN Tag stripped by forwarding port
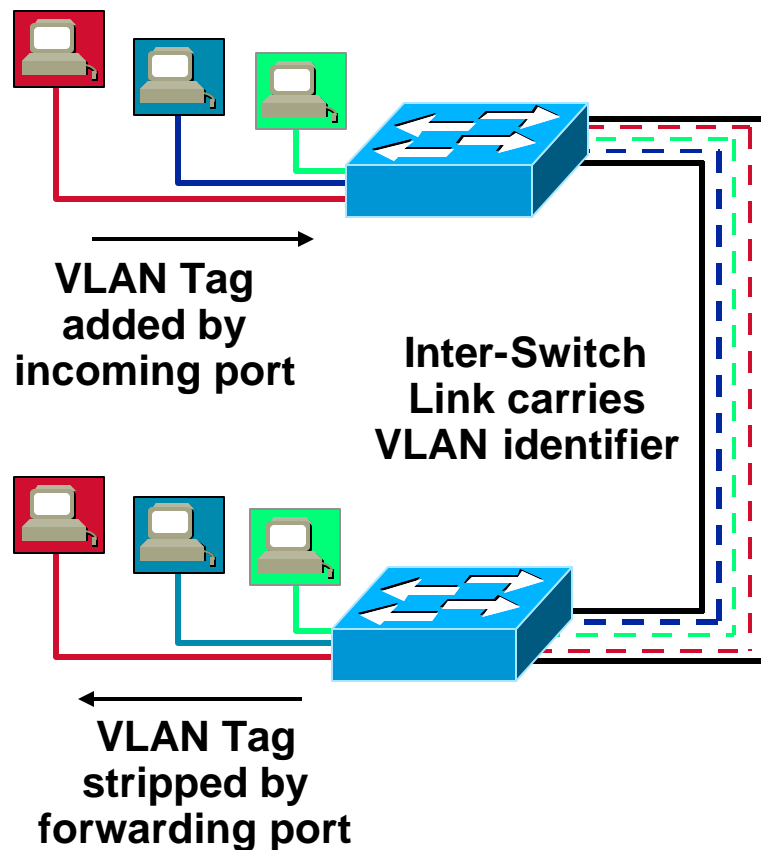
- **Performed with ASIC**

- **Not intrusive to client stations, client does not see the ISL header**

- **Effective between switches, routers and switches, switches and servers with ISL network interface cards**

ISL Encapsulation

ISL Header 26 bytes	Encapsulated Ethernet frame	CRC 4 bytes

DA	Type	User	SA	LEN	AAAA03	HSA	VLAN	BPDU	INDEX	RES

VLAN   BPDU
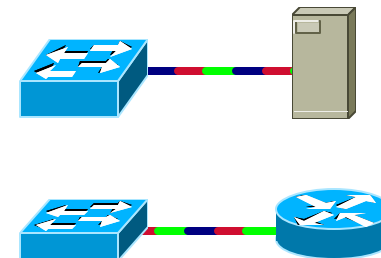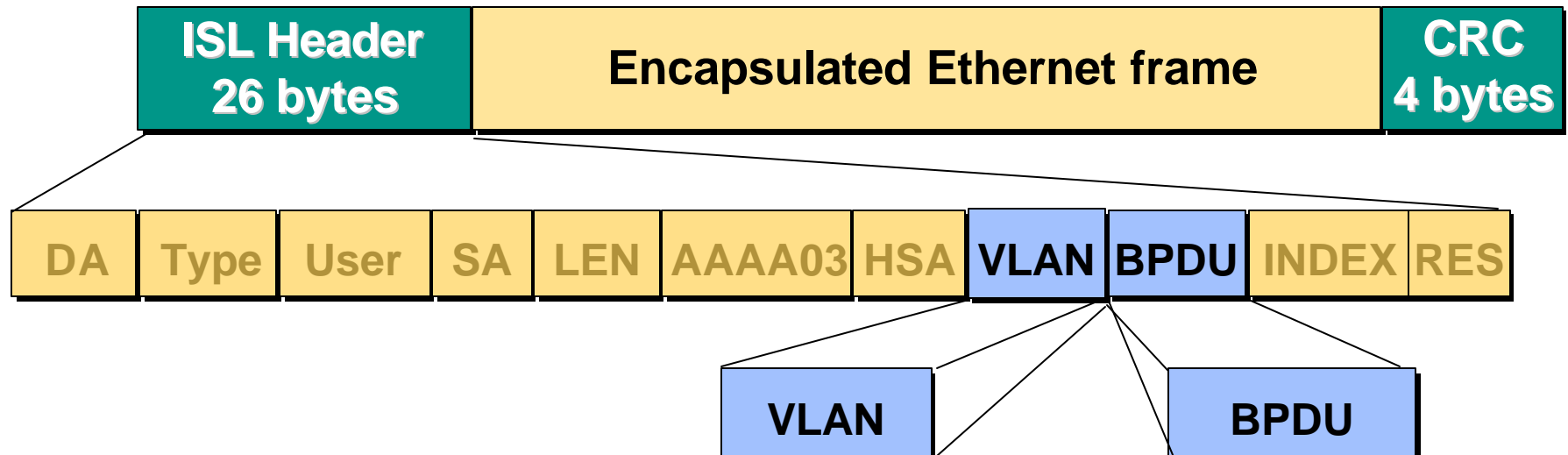
- **Frames encapsulated with ISL header and CRC**
- **Support for many VLANs (1024)**
- **VLAN field**
- **BPDU bit**

VLAN Trunking Protocol (VTP)

- **A messaging system that advertises VLAN configuration information**

- **Maintains VLAN configuration consistency throughout a common administrative domain**

- **VTP sends advertisements on trunk ports only**

- **Support mixed media trunks (Fast Ethernet, FDDI, ATM)**
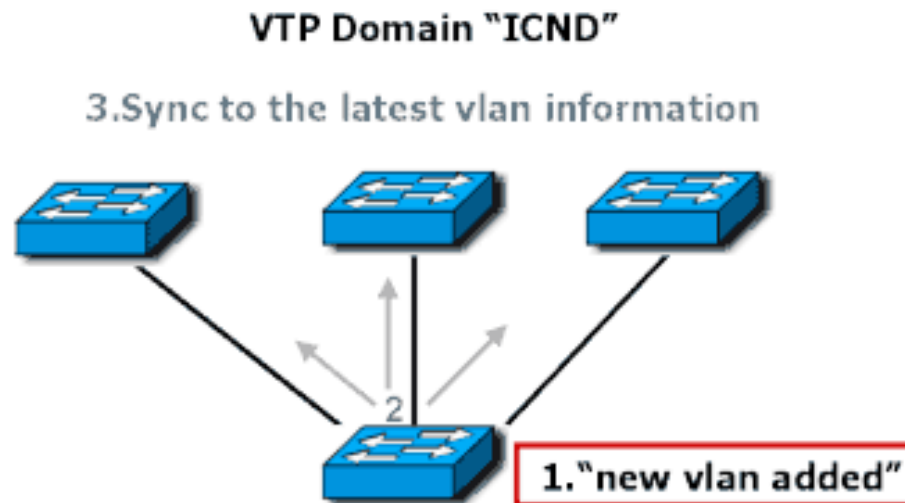
VTP Domain "ICND"
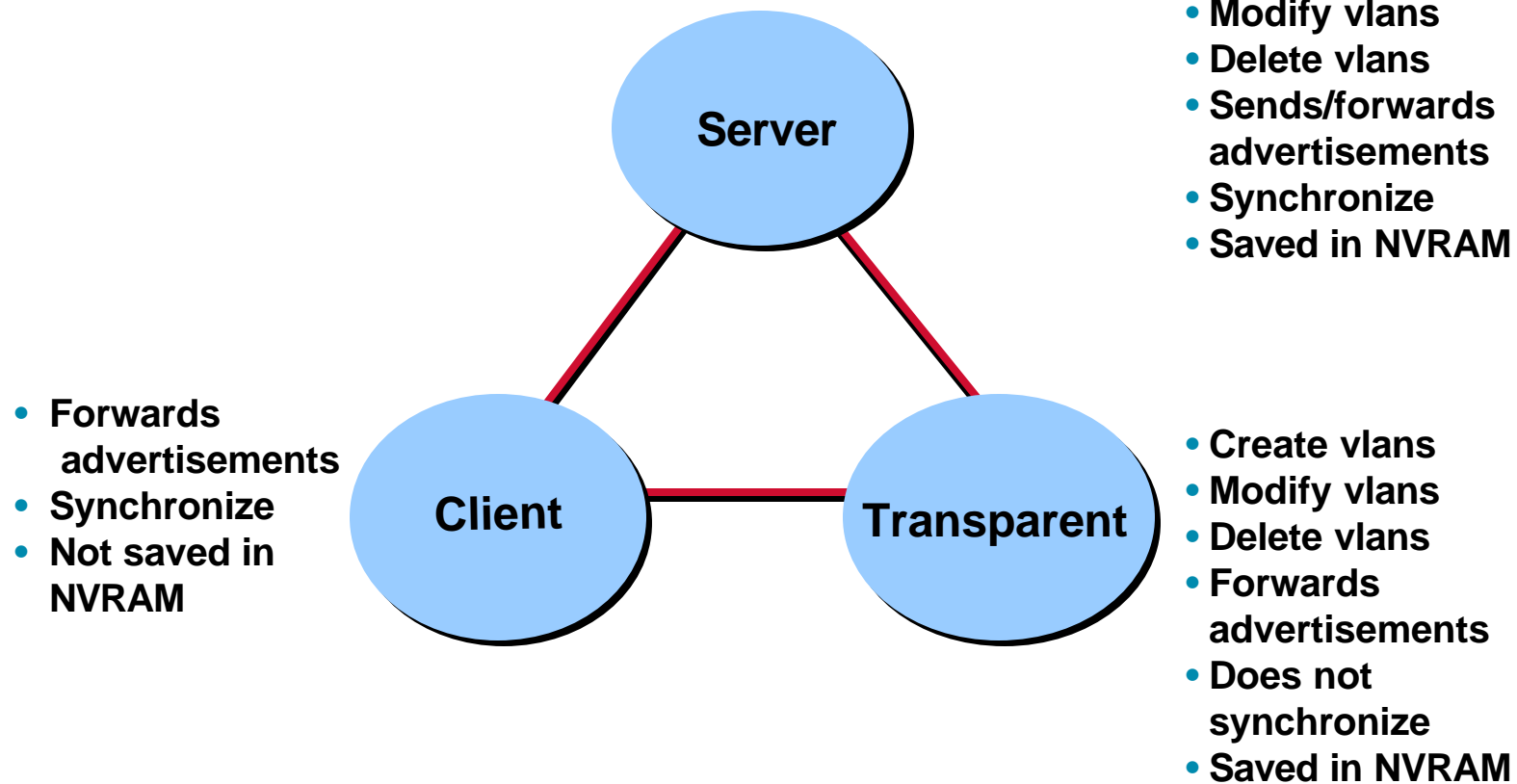
3.Sync to the latest vlan information

1."new vlan added"

VTP Modes

Server
- Create vlans
- Modify vlans
- Delete vlans
- Sends/forwards advertisements
- Synchronize
- Saved in NVRAM

Client
- Forwards advertisements
- Synchronize
- Not saved in NVRAM

Transparent
- Create vlans
- Modify vlans
- Delete vlans
- Forwards advertisements
- Does not synchronize
- Saved in NVRAM

How VTP Works

- **VTP advertisements are sent as multicast frames**
- **VTP servers and clients synchronized to latest revision number**
- **VTP advertisement are sent every five minutes or when there is a change**
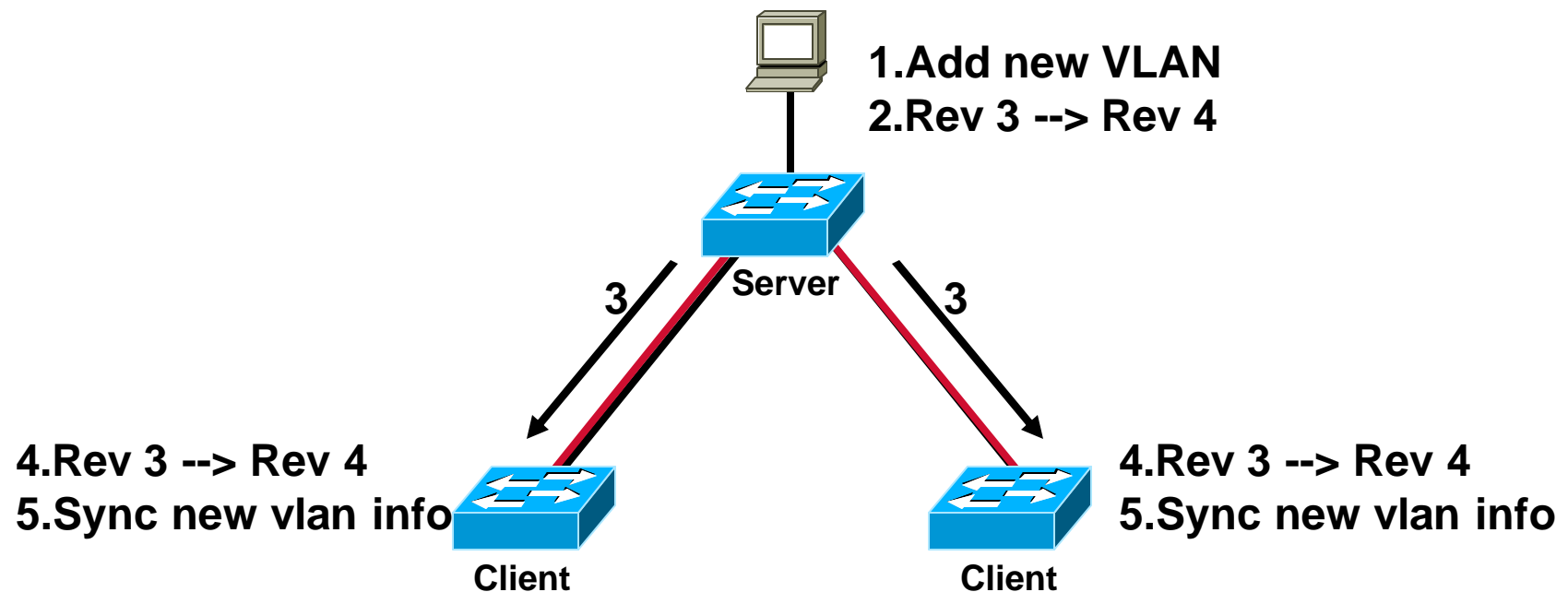
How VTP Works

- **VTP advertisements are sent as multicast frames**
- **VTP servers and clients synchronized to latest revision number**
- **VTP advertisement are sent every five minutes or when there is a change**

1.Add new VLAN
2.Rev 3 --> Rev 4

3 Server **3**

4.Rev 3 --> Rev 4
5.Sync new vlan info
Client

4.Rev 3 --> Rev 4
5.Sync new vlan info
Client

VTP Pruning

By default, a trunk connection carries traffic for all VLANs in the VTP management domain. This creates wasted bandwidth due to excess flooding.
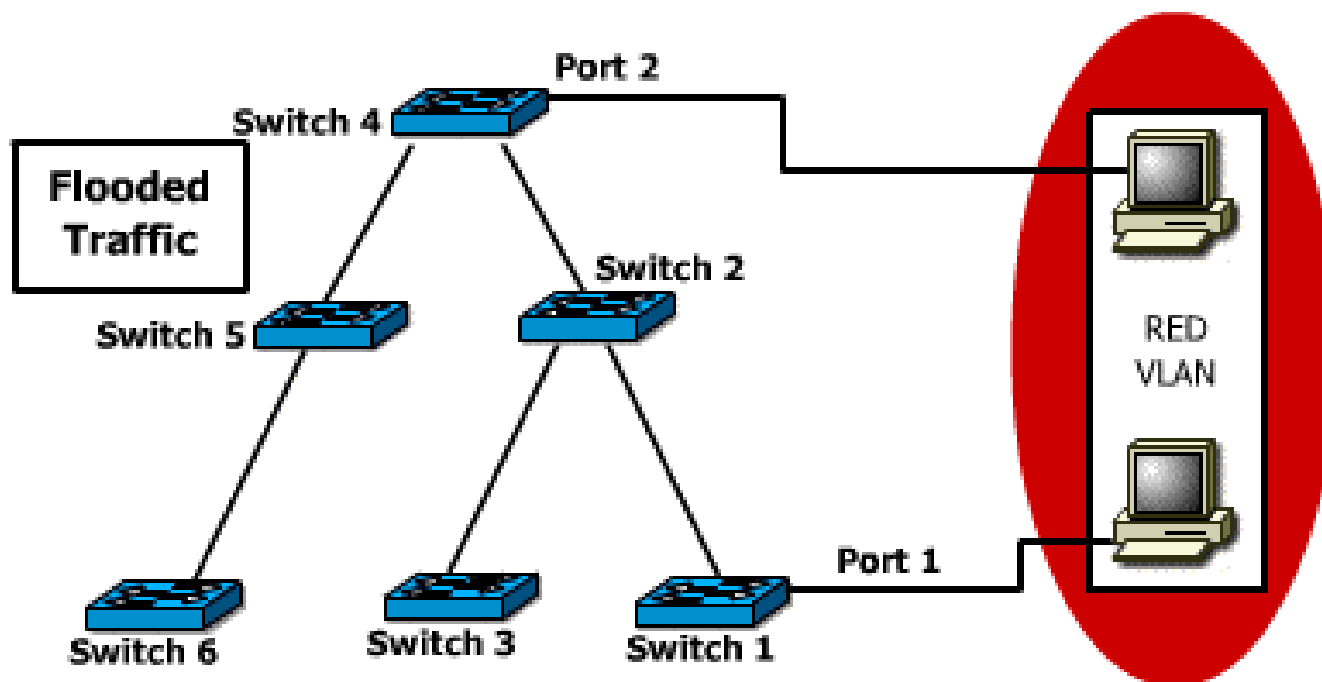
VTP Pruning

- **Increases available bandwidth by reducing unnecessary flooded traffic**
- **Example: Station A sends broadcast, broadcast is only flooded toward any switch with ports assigned to the red VLAN**
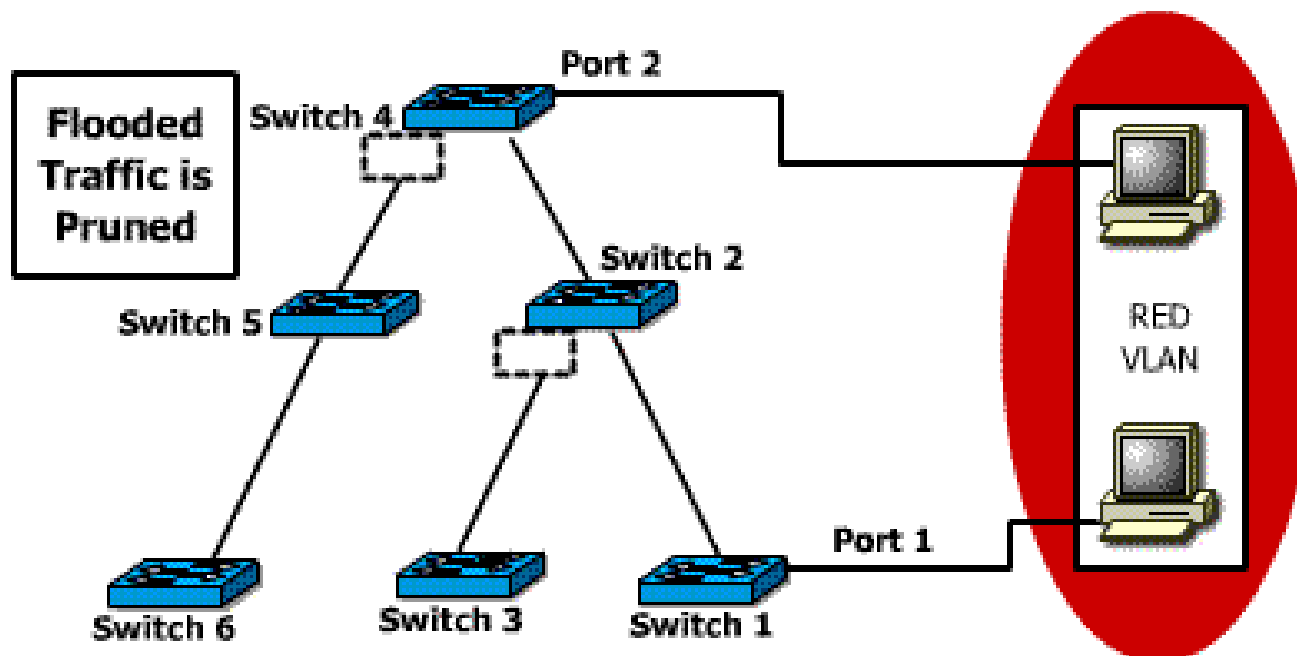
VLAN Configuration Guidelines

- Maximum number of VLANs is switch-dependent

- Catalyst 1900 supports 64 VLANs with a separate spanning tree per VLAN

- VLAN1 is One of the factory default VLANs

- CDP and VTP advertisements are sent on VLAN1

- Catalyst 1900 IP address is in the VLAN1 broadcast domain

- Must be in VTP server or transparent mode to create, add, or delete VLANs

VLAN Configuration Steps

- **Enable VTP (optional)**

- **Enable trunking**

- **Create VLANs**

- **Assign VLAN to ports**

VTP Configuration Guidelines

- VTP domain name
- VTP mode (server/client/transparent)—VTP server mode is the default
- VTP pruning
- VTP password
- VTP trap

Use caution when adding a new switch into an existing domain. A new switch should be added in client mode to prevent the new switch from propagating incorrect VLANs information

Use the delete vtp command to reset the VTP revision number

Creating a VTP Domain

wg_sw_a(config)#

vtp [server | transparent] [domain *domain-name*] [trap {enable | disable}]
[password *password*] [pruning {enable | disable}

Creating a VTP Domain

wg_sw_a(config)#

---

vtp [server | transparent | client] [domain *domain-name*]
[trap {enable | disable}] [password *password*] [pruning {enable | disable}]

---

wg_sw_a#conf terminal
Enter configuration commands, one per line. End with CNTL/Z
wg_sw_a(config)#vtp transparent
wg_sw_a(config)#vtp domain switchlab

Verifying VTP Configurations

```
wg_sw_a#sAhow vtp
```

Verifying VTP Configurations

```
wg_sw_a#show vtp
```

```
wg_sw_a#show vtp
    VTP version: 1
    Configuration revision: 4
    Maximum VLANs supported locally: 1005
    Number of existing VLANs: 6
    VTP domain name       : switchlab
    VTP password          :
    VTP operating mode    : Transparent
    VTP pruning mode      : Enabled
    VTP traps generation  : Enabled
    Configuration last modified by: 10.1.1.40 at 00-00-0000 00:00:00
```

Defining a Trunk

wg_sw_a(config-if)#

---

trunk [on | off | desirable | auto | nonegotiate]

- **On = Set trunk on and negotiate with other side**

- **Off = Set trunk off and negotiate with other side**

- **Desirable = Negotiate with other side.**
  Trunk on if other side is on, desirable, or auto

- **Auto = Will be a trunk only if the other side is on or desirable**

- **Non-negotiate = Set trunk on and will not negotiate**

Defining a Trunk

wg_sw_a(config-if)#

trunk [on | off | desirable | auto | nonegotiate]

- **On = Set trunk on and negotiate with other side**
- **Off = Set trunk off and negotiate with other side**
- **Desirable = Negotiate with other side.**
  Trunk on if other side is on, desirable, or auto
- **Auto = Will be a trunk only if the other side is on or desirable**
- **Non-negotiate = Set trunk on and will not negotiate**

```
wg_sw_a#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z
wg_sw_a(config)#interface f0/26
wg_sw_a(config-if)#trunk on
```

First trunk port(Port A)

Verifying a Trunk

```
wg_sw_a#show trunk [A | B]
```

Verifying a Trunk

```
wg_sw_a#show trunk [A | B]
```

wg_sw_a#show trunk a
DISL state: On, Trunking: On, Encapsulation type: ISL

Adding a VLAN

wg_sw_a(config)#

> vlan *vlan#* [name *vlan-name*]

Adding a VLAN

wg_sw_a(config)#

> vlan *vlan#* [name *vlan-name*]

wg_sw_a#conf terminal
Enter configuration commands, one per line. End with CNTL/Z
wg_sw_a(config)#vlan 9 name switchlab2

Verifying a VLAN

```
wg_sw_a#show vlan [vlan#]
```

Verifying a VLAN

```
wg_sw_a#show vlan [vlan#]
```

wg_sw_a#sh vlan 9

VLAN	Name	Status	Ports
9	switchlab2	Enabled	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	Trans1	Trans2
9	Ethernet	100009	1500	0	1	1	Unkn	0	0

Modifying a VLAN Name

wg_sw_a(config)#

---
vlan *vlan# name vlan-name*
---

wg_sw_a#conf terminal
Enter configuration commands, one per line. End with CNTL/Z
wg_sw_a(config)#vlan 9 name switchlab90

wg_sw_a#show vlan 9

VLAN Name   Status   Ports
----
9   switchlab90   Enabled

Assigning Switch Ports to a VLAN

wg_sw_a(config-if)#

vlan-membership {static {*vlan#*} | dynamic}

Assigning Switch Ports to a VLAN

wg_sw_a(config-if)#

vlan-membership {static {*vlan#*} | dynamic}

wg_sw_a#conf terminal
Enter configuration commands, one per line. End with CNTL/Z
wg_sw_a(config)#interface ethernet 0/8
wg_sw_a(config-if)#vlan-membership static 9

Verifying VLAN Membership

wg_sw_a#show vlan-membership

Verifying VLAN Membership

wg_sw_a#show vlan-membership

wg_sw_a#show vlan-membership

Port	VLAN	Membership Type
1	5	Static
2	1	Static
3	1	Static
4	1	Static
5	1	Static
6	1	Static
7	1	Static
8	9	Static

Port	VLAN	Membership Type
13	1	Static
14	1	Static
15	1	Static
16	1	Static
17	1	Static
18	1	Static
19	1	Static
20	1	Static

Note: port 1=e0/1, port 2=e0/2 .....

Verifying Spanning Tree

```
wg_sw_a#show spantree {vlan number}
```

Verifying Spanning Tree

wg_sw_a#show spantree {*vlan number*}

wg_sw_a#show spantree 1

VLAN1 is executing the IEEE compatible Spanning Tree Protocol
  Bridge Identifier has priority 32768, address 0050.F037.DA00
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 0, address 00D0.588F.B600
  Root port is FastEthernet 0/26, cost of root path is 10
  Topology change flag not set, detected flag not set
  Topology changes 53, last topology change occured 0d00h17m14s ago
  Times: hold 1, topology change 8960
      hello 2, max age 20, forward delay 15
  Timers: hello 2, topology change 35, notification 2
Port Ethernet 0/1 of VLAN1 is Forwarding
  Port path cost 100, Port priority 128
  Designated root has priority 0, address 00D0.588F.B600
  Designated bridge has priority 32768, address 0050.F037.DA00
  Designated port is Ethernet 0/1, path cost 10
  Timers: message age 20, forward delay 15, hold 1