

# Chapter 7

# Extending Switched Networks with Virtual LANs

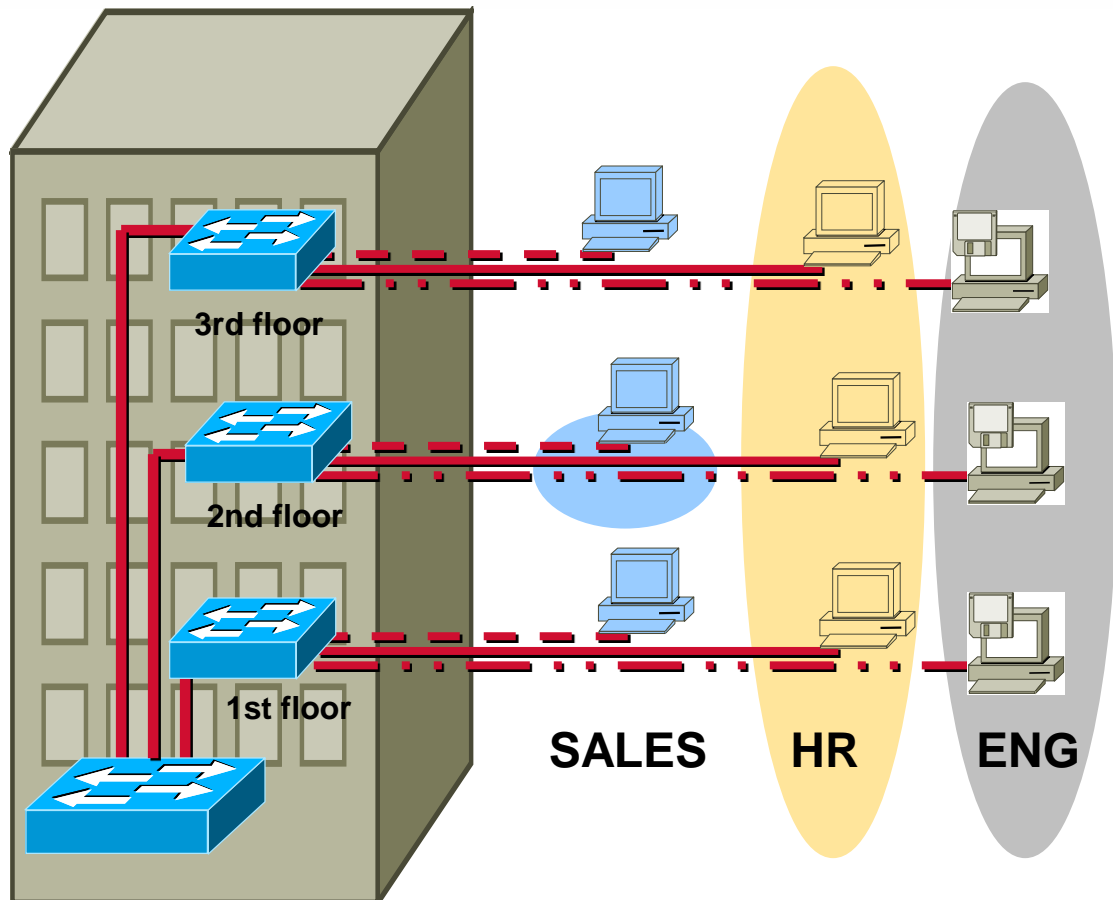


# Objectives

**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**

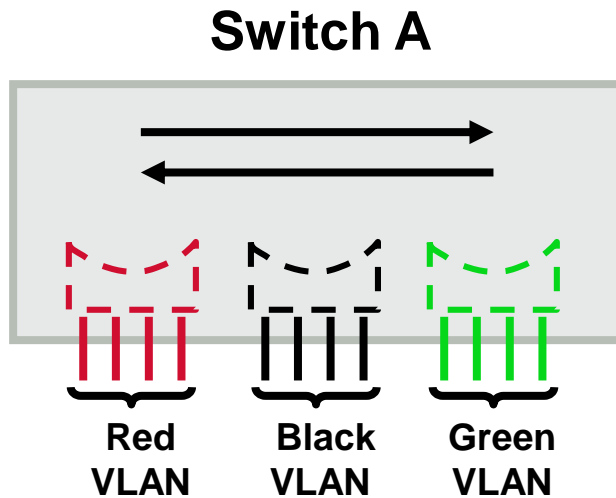
# VLAN Overview



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

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

# VLAN Operations



- Each logical VLAN is like a separate physical bridge

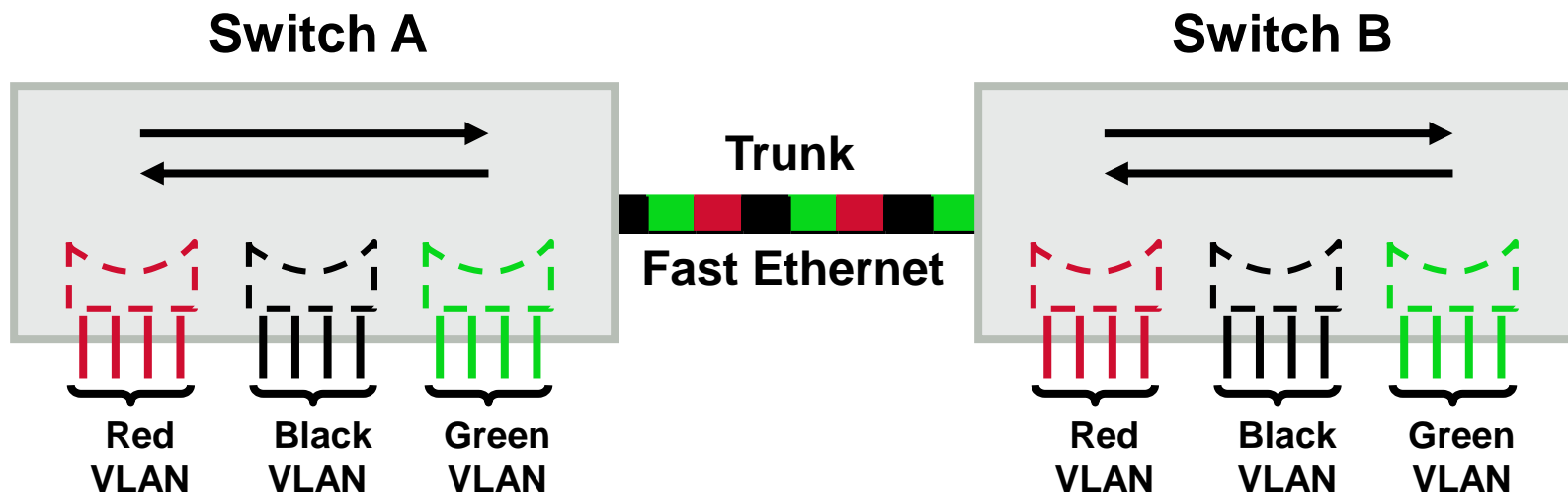


# VLAN Operations



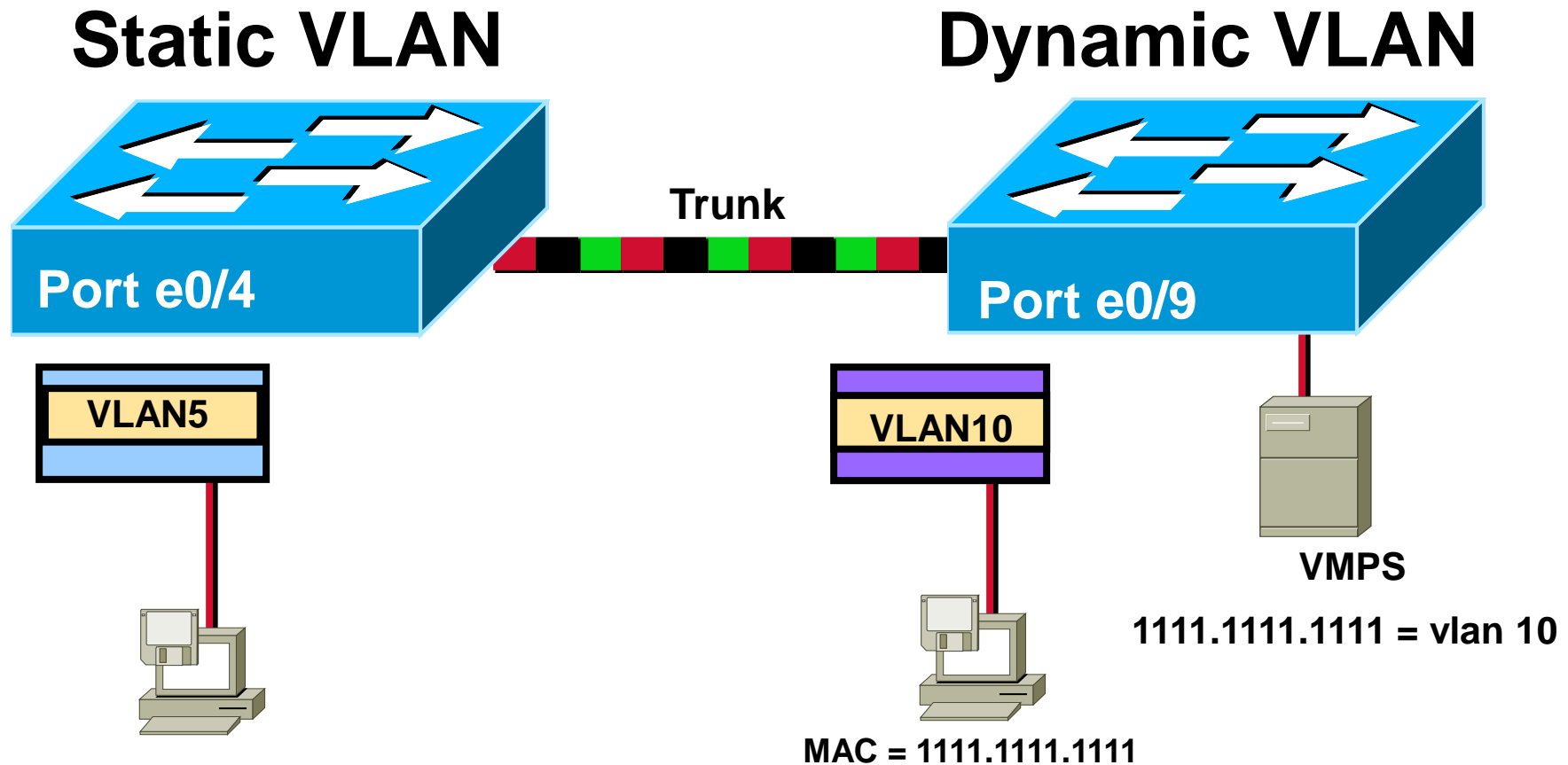
- Each logical VLAN is like a separate physical bridge
- VLANs can span across multiple switches

# VLAN Operations



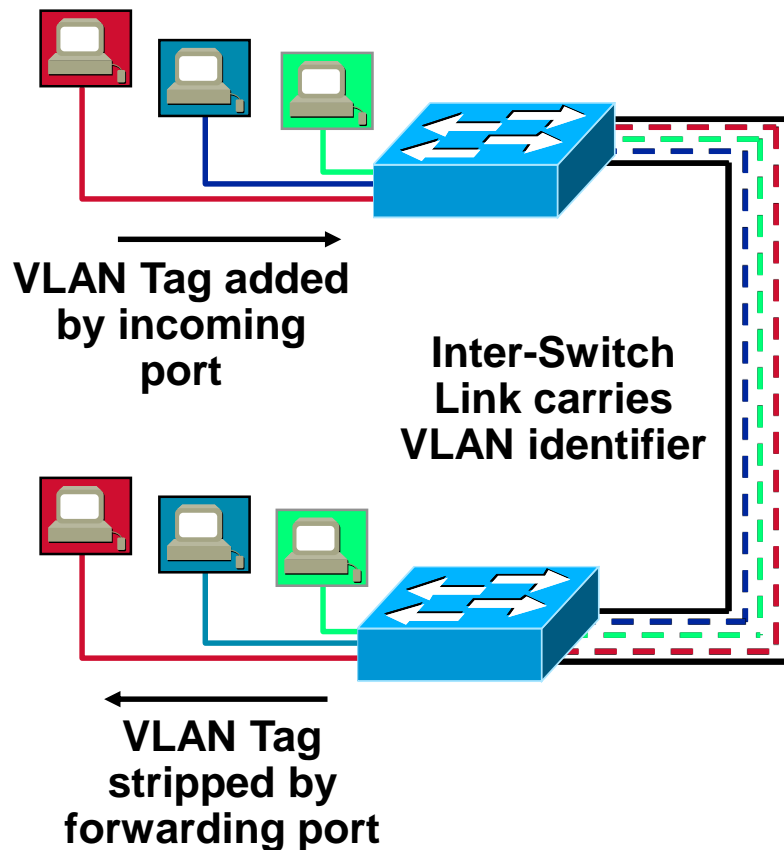
- Each logical VLAN is like a separate physical bridge
- VLANs can span across multiple switches
- Trunks carries traffic for multiple VLANs
- Trunks use special encapsulation to distinguish between different VLANs

# VLAN Membership Modes

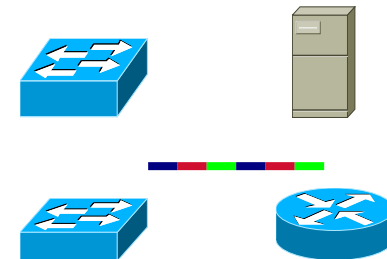


# ISL Tagging

## ISL trunks enable VLANs across a backbone

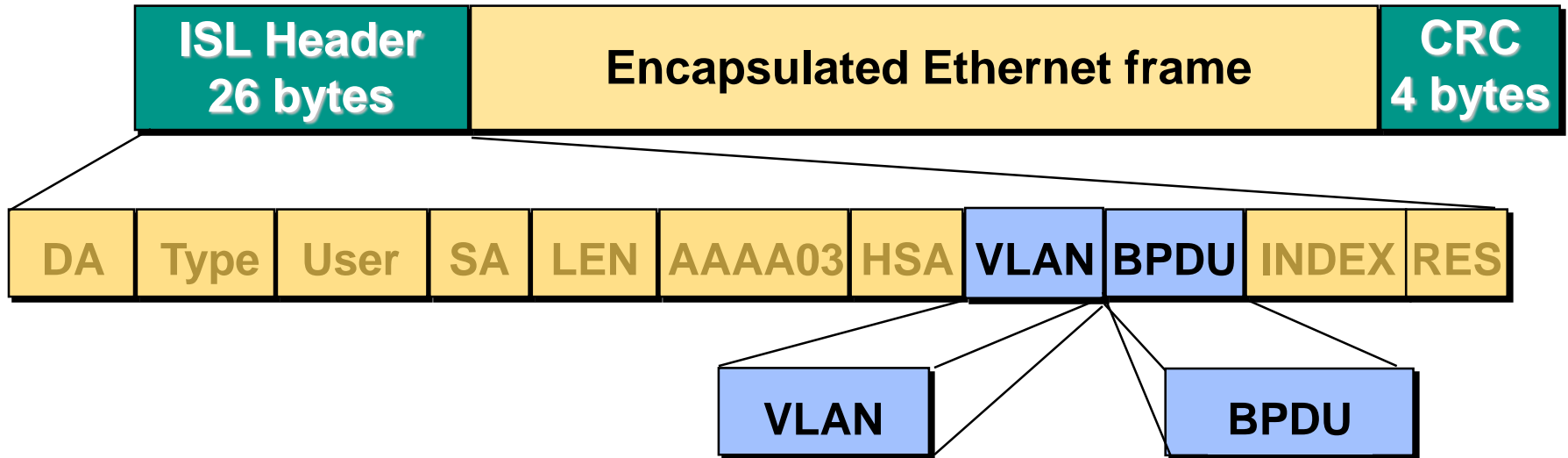


- Performed with ASIC
- Not intrusive to client stations, client does not see the ISL header
- Effective between switches, routers and switches, switches and servers with ISL network interface cards





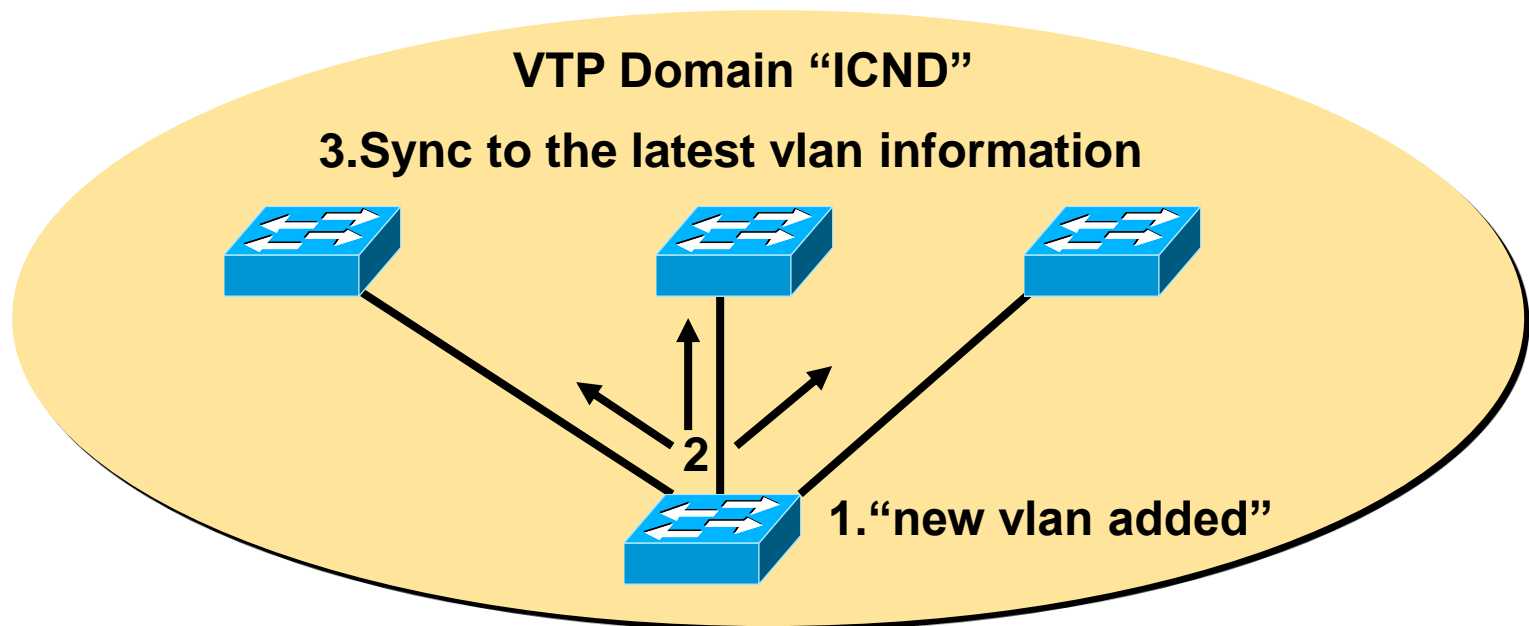
# ISL Encapsulation



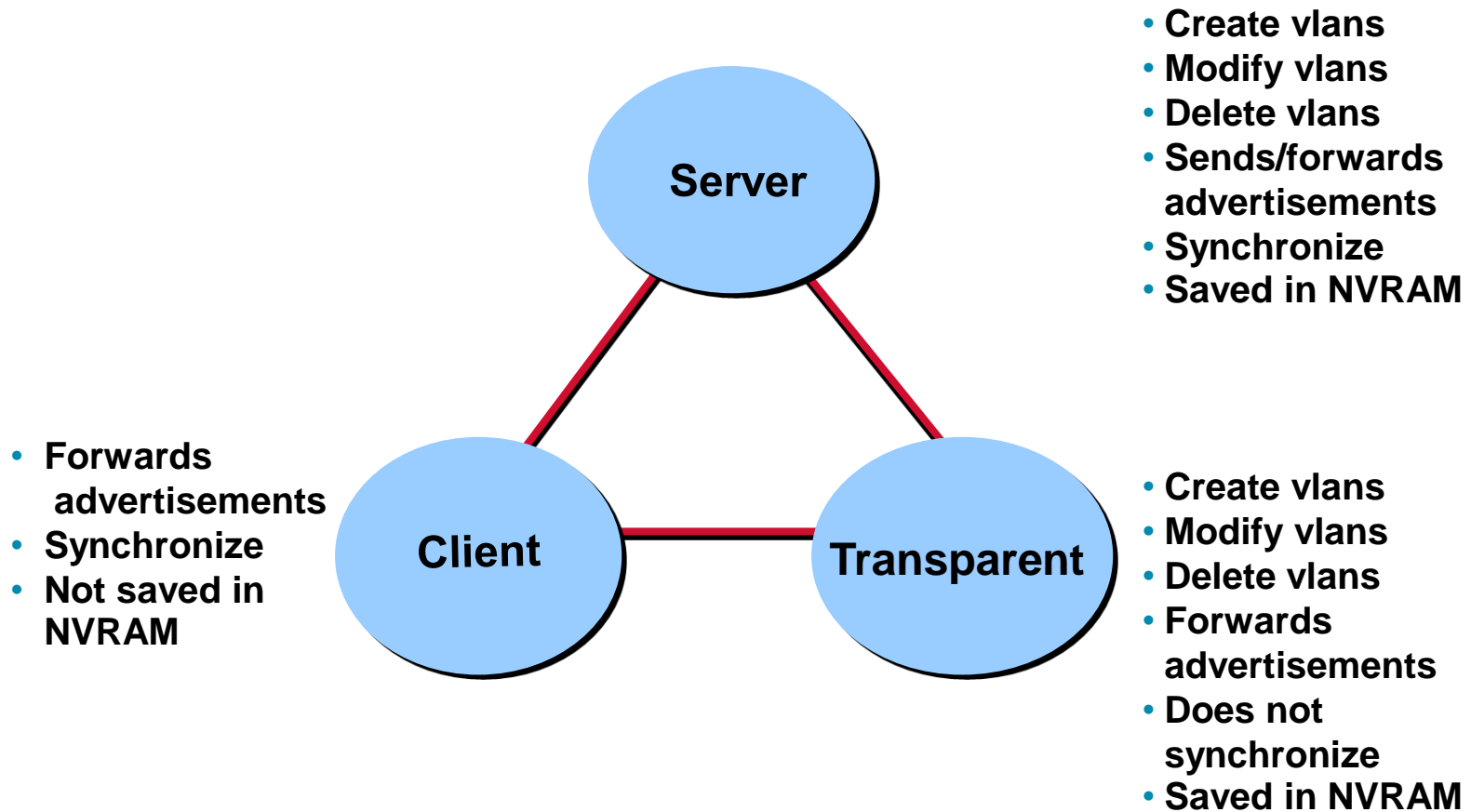
- Frames encapsulated with ISL header and CRC
- Support for many VLANs (1024)
- VLAN field
- BPDU bit

# 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 Modes



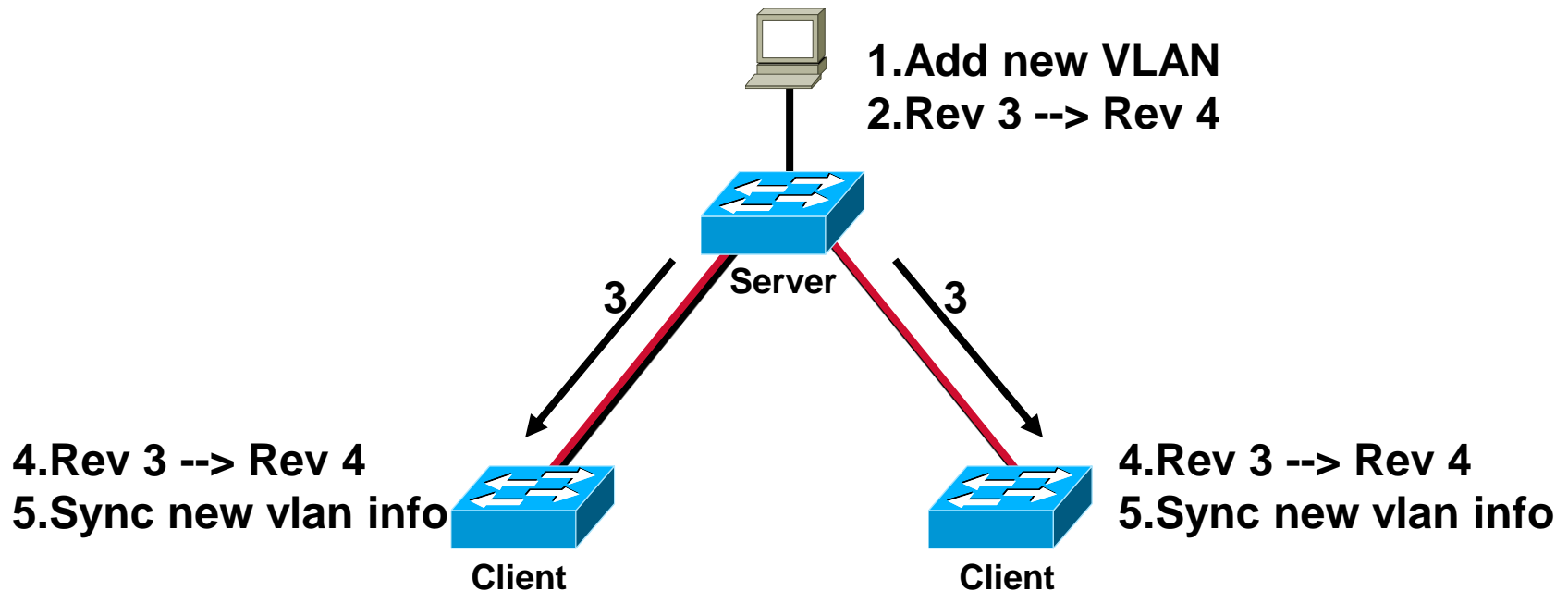
# How VTP Works

- **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**



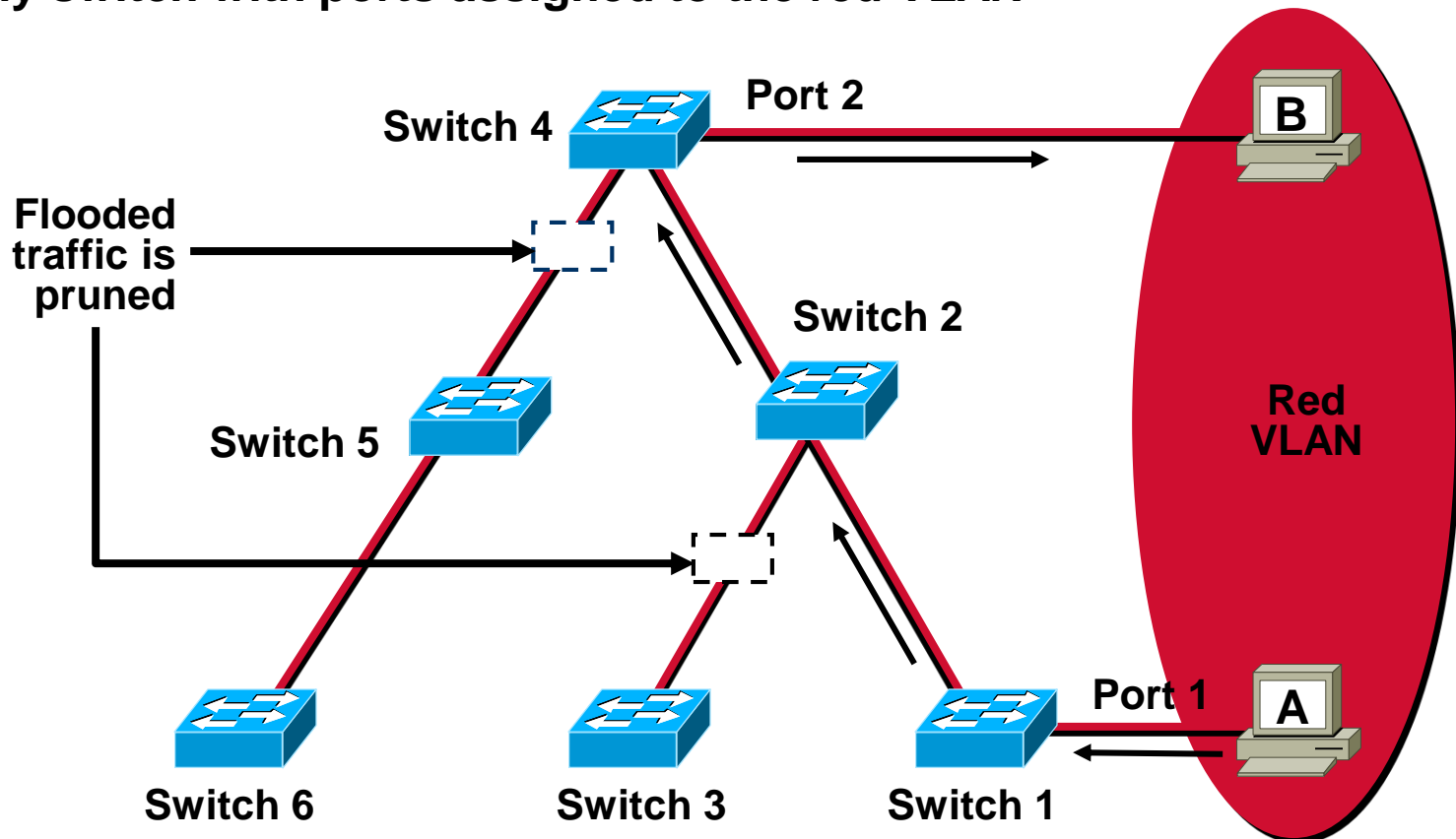
# How VTP Works

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# 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#show 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]
```

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**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

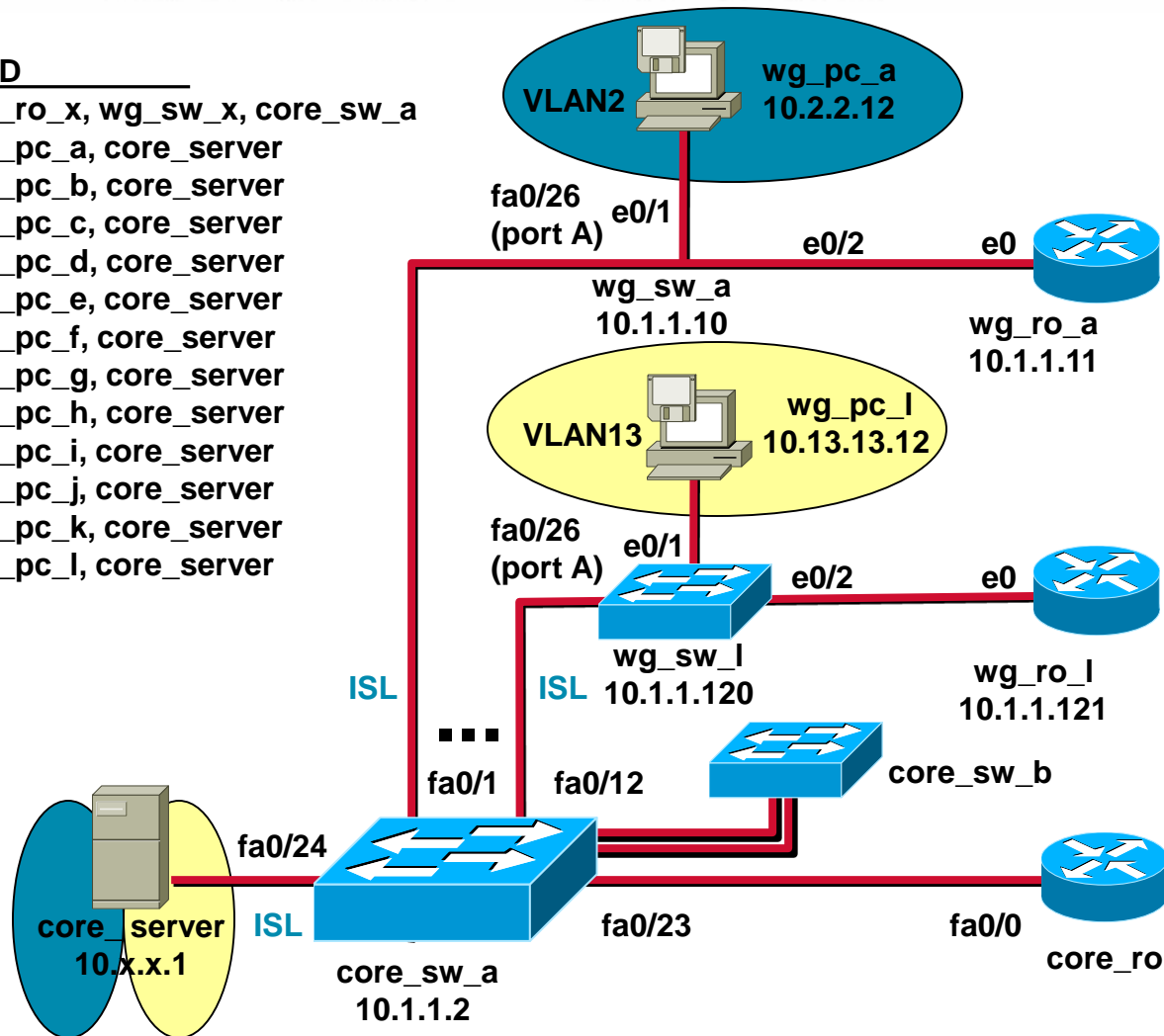
```
wg_sw_a#show spantree {vlan number}
```

```
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 occurred 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
```

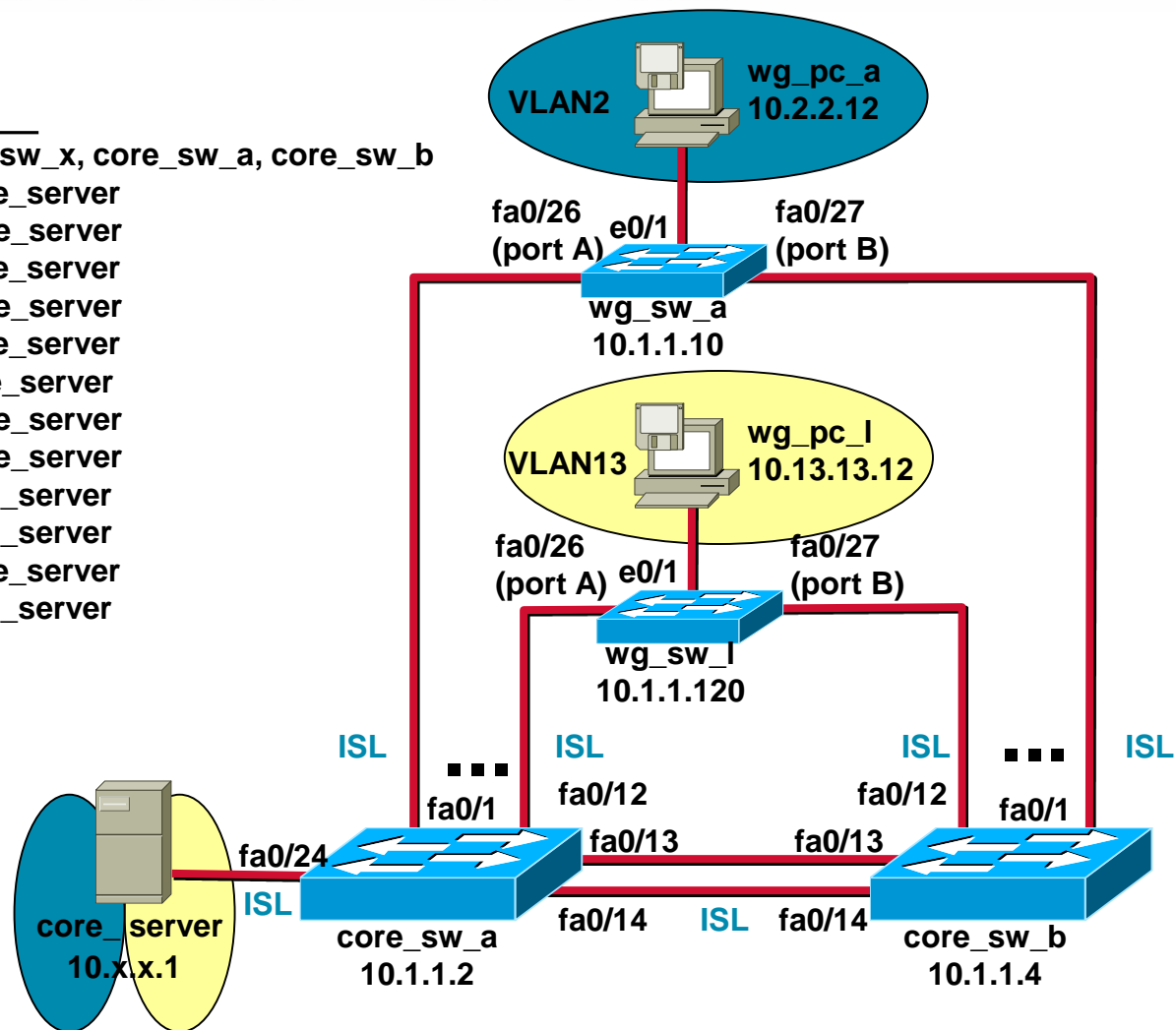
# Visual Objective

SUBNET	VLAN	POD
10.1.1.0	1	wg_ro_x, wg_sw_x, core_sw_a
10.2.2.0	2	wg_pc_a, core_server
10.3.3.0	3	wg_pc_b, core_server
10.4.4.0	4	wg_pc_c, core_server
10.5.5.0	5	wg_pc_d, core_server
10.6.6.0	6	wg_pc_e, core_server
10.7.7.0	7	wg_pc_f, core_server
10.8.8.0	8	wg_pc_g, core_server
10.9.9.0	9	wg_pc_h, core_server
10.10.10.0	10	wg_pc_i, core_server
10.11.11.0	11	wg_pc_j, core_server
10.12.12.0	12	wg_pc_k, core_server
10.13.13.0	13	wg_pc_l, core_server



# Visual Objective

SUBNET	VLAN	POD
10.1.1.0	1	wg_ro_x, wg_sw_x, core_sw_a, core_sw_b
10.2.2.0	2	wg_pc_a, core_server
10.3.3.0	3	wg_pc_b, core_server
10.4.4.0	4	wg_pc_c, core_server
10.5.5.0	5	wg_pc_d, core_server
10.6.6.0	6	wg_pc_e, core_server
10.7.7.0	7	wg_pc_f, core_server
10.8.8.0	8	wg_pc_g, core_server
10.9.9.0	9	wg_pc_h, core_server
10.10.10.0	10	wg_pc_i, core_server
10.11.11.0	11	wg_pc_j, core_server
10.12.12.0	12	wg_pc_k, core_server
10.13.13.0	13	wg_pc_l, core_server





# Summary

**After completing this chapter, you should be able to perform the following tasks:**

- **Configuring VLAN**
- **Configuring VTP**
- **Configuring a trunk**
- **Verifying Spanning Tree Operations**



# Review Questions

- 1. What are the three VTP modes?**
- 2. Over what type of port can VTP advertisements be sent?**
- 3. VLAN ID is carried in the \_\_\_\_\_ header.**
- 4. How do we assign a VLAN to a port?**