VLAN Trunking Protocol

VLAN Communication

- Devices on different VLANS must have a router to communicate with each other
- If devices are on the same VLAN, then they can communicate through a switch.

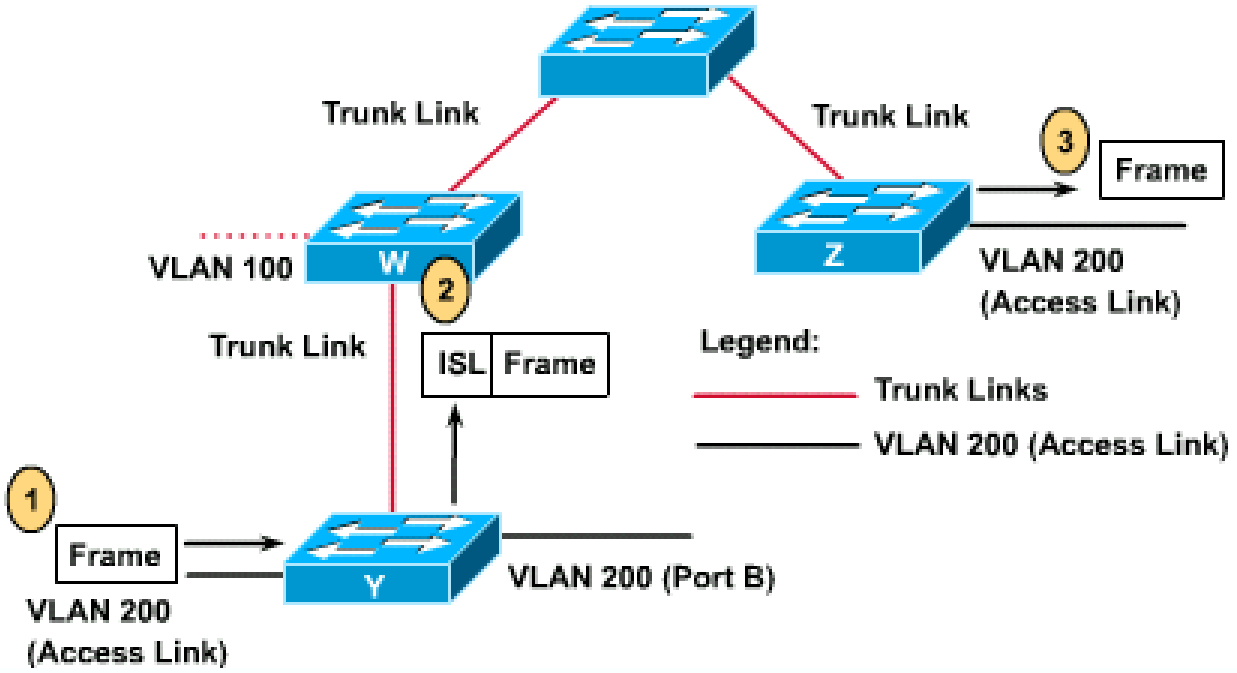
Access Links

- An access link is a link on the switch that is a member of only one VLAN.
- This VLAN is referred to as the *native VLAN* of the port.
  - Any device that is attached to the port is completely unaware that a VLAN exists.

Trunk Links

- A trunk link is capable of supporting multiple VLANs.
- Trunk links are typically used to connect switches to other switches or routers.
- Switches support trunk links on both Fast Ethernet and Gigabit Ethernet ports.
- Switches, routers, and some servers can be connected to a VLAN trunk (NIC must support trunking)

Access and Trunk Links



Trunk Links

- A trunk link does not belong to a specific VLAN.
  - acts as a conduit for VLANs between switches and routers.
- The trunk link can be configured to transport all VLANs or to transport a limited number of VLANs.
- A trunk link may, however, may have a native VLAN.
  - The native VLAN of the trunk is the VLAN that the trunk uses if the trunk link fails for any reason.

Trunk Links

- In Ethernet, the switch has two methods of identifying the VLAN that a frame belongs to:
  - ISL – InterSwitch Link (Cisco proprietary)
  - IEEE 802.1Q (standards-based)
    - Also known as *dot1q*

VLAN Identification

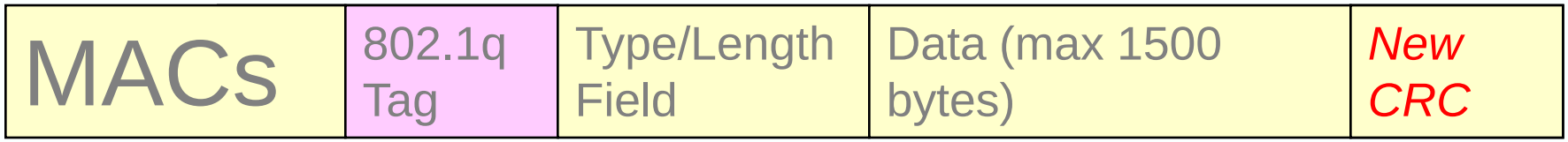
- ISL - **This protocol is a Cisco proprietary *encapsulation* protocol for interconnecting multiple switches; it is supported in switches as well as routers.**

VLAN Identification

- **IEEE 802.1Q - This protocol is an IEEE standard method for identifying VLANs by inserting a VLAN identifier into the frame header. This process is referred to as frame tagging.**

802.1q

NIC cards and networking devices can understand this "baby" giant frame (1522 bytes). However, a Cisco switch must remove this encapsulation before sending the frame out on an access link.



2-byte TPID

2-byte TCI

Tag Protocol Identifier

Tag Control Info (includes **VLAN ID**)

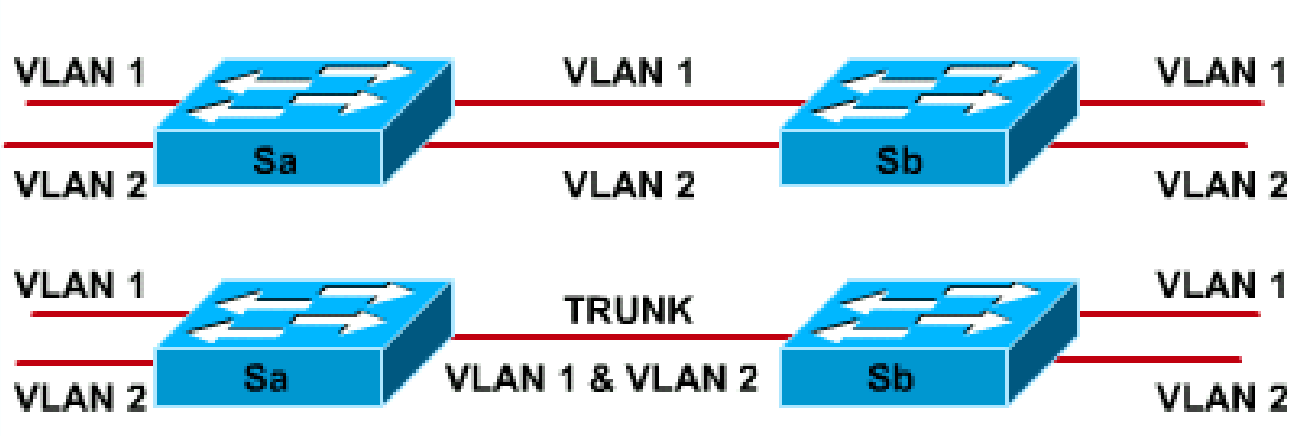
802.1q

- A 4-byte tag header containing a tag protocol identifier (TPID) and tag control information (TCI) with the following elements:
  - A 2-byte TPID with a fixed value of 0x8100. This value indicates that the frame carries the 802.1Q/802.1p tag information.
  - A TCI containing the following elements:
    - Three-bit user priority
    - One-bit canonical format (CFI indicator)
    - ***Twelve-bit VLAN identifier (VID)-Uniquely identifies the VLAN to which the frame belongs***
      - **This VLAN ID is added to each frame to allow delivery of frames across a switched trunk.**

Trunking

- A trunk is a point-to-point link that supports several VLANs
- A trunk is used to save ports when creating a link between two devices implementing VLANs

Trunking


VLAN 1
VLAN 2
Sa
VLAN 1
VLAN 2
Sb
VLAN 1
VLAN 2
VLAN 1
VLAN 2
Sa
TRUNK
VLAN 1 & VLAN 2
Sb
VLAN 1
VLAN 2

Configuring Trunking

- **Fast Ethernet and Gigabit Ethernet trunking modes:**
  - **On**
  - **Off**
  - **Desirable**
  - **Auto**
  - **Non negotiate**

Configuring Trunking

- On - This mode puts the port into permanent trunking mode. The port becomes a trunk port even if the neighboring port does not agree to the change.
- The on state does not allow for the negotiation of an encapsulation type.
  - You must, therefore, specify the encapsulation in the configuration

Configuring Trunking

- Off - **This mode puts the port into permanent nontrunking mode and negotiates to convert the link into a nontrunk link.**
- **The port becomes a nontrunk port even if the neighboring port does not agree to the change.**

Configuring Trunking

- **Desirable - This mode makes the port actively attempt to convert the link to a trunk link. The port becomes a trunk port if the neighboring port is set to on, desirable, or auto mode.**

Configuring Trunking

- Auto - This mode makes the port willing to convert the link to a trunk link.
- The port becomes a trunk port if the neighboring port is set to on or desirable mode.
- This is the default mode for all Ethernet ports.
  - if the default setting is left on both sides of the trunk link, the link will not become a trunk

Configuring Trunking

- **Non negotiate - This mode puts the port into permanent trunking mode but prevents the port from generating Dynamic Trunking Protocol (DTP) frames.**
  - **You must configure the neighboring port manually as a trunk port to establish a trunk link.**

Configuring Trunking

- For trunking to be auto negotiated on Fast Ethernet or Gigabit Ethernet ports, the ports must be in the same VTP domain.
- However, you can use on or non negotiate mode to force a port to become a trunk, even if it is in a different domain.

Configuring Trunking

IOS-Based Switch

```
Switch(config)# interface fastethernet 0
Switch(config-if)# switchport mode [access | multi | trunk]
Switch(config-if)# switchport trunk encapsulation {isl|dot1q}
Switch(config-if)# switchport trunk allowed vlan remove vlan-list
Switch(config-if)# switchport trunk allowed vlan add vlan-list
```

VLAN Trunking Protocol

- 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.

VTP Benefits

- VLAN configuration consistency across the network
- A mapping scheme for going across mixed-media backbones to map Ethernet VLANs to a high-speed backbone VLAN such as ATM LANE or FDDI, thus allowing a VLAN to be trunked over mixed media
- Accurate tracking and monitoring of VLANs
- Dynamic reporting of added VLANs across the network
- "Plug-and-play" configuration when adding new VLANs

VTP

- All switches in the same management domain share their VLAN information with each other, and a switch can participate in only one VTP management domain.
- Switches in different domains do not share VTP information.
- Using VTP, switches advertise:
  - Management domain
  - Configuration revision number
  - Known VLANs and their specific parameters

VTP

- Switches can be configured not to accept VTP information.
- These switches will forward VTP information on trunk ports in order to ensure that other switches receive the update, but the switches will not modify their database, nor will the switches send out an update indicating a change in VLAN status.

VTP

- By default, management domains are set to a non secure mode, meaning that the switches interact without using a password.
- Adding a password automatically sets the management domain to secure mode.
  - A password must be configured on every switch in the management domain to use secure mode.

VTP

- The VTP database contains a revision number.
- Each time a change is made, the switch increments the revision number

VTP

- A higher configuration revision number indicates that the VLAN information that is being sent is more current then the stored copy.
- Any time a switch receives an update that has a higher configuration revision number, the switch will overwrite the stored information with the new information being sent in the VTP update.
- That is why when adding a new switch, you should make sure it has a lower revision number than the others in the domain.

VTP Modes

- Switches can operate in any one of the following three VTP modes:
  - Server
  - Client
  - Transparent

VTP Modes

- ***Server*** **- If you configure the switch for server mode, you can create, modify, and delete VLANs, and specify other configuration parameters (such as VTP version and VTP pruning) for the entire VTP domain.**
- **VTP servers:**
  - **Advertise their VLAN configuration to other switches in the same VTP domain**
  - **Synchronize the VLAN configuration with other switches based on advertisements received over trunk links.**
- **This is the default mode on the switch.**

VTP Modes

- ***Client*** **- VTP clients behave the same way as VTP servers.**
- **However, you cannot add, change, or delete VLANs on a VTP client.**
- **You can only adopt VLAN management changes**

VTP Modes

- ***Transparent*** **- VTP transparent switches do not participate in VTP.**
- ***A VTP transparent switch does not advertise its VLAN configuration*****, and does not synchronize its VLAN configuration based on received advertisements.**
  - **However, in VTP Version 2, transparent switches do forward VTP advertisements that the switches receive out their trunk ports.**

Configuring VTP

- Determine the version number
- Choose the domain
- Choose the VTP mode
- Password protect the domain

Different version numbers are not compatible

Configuring VTP

IOS-Based Switch

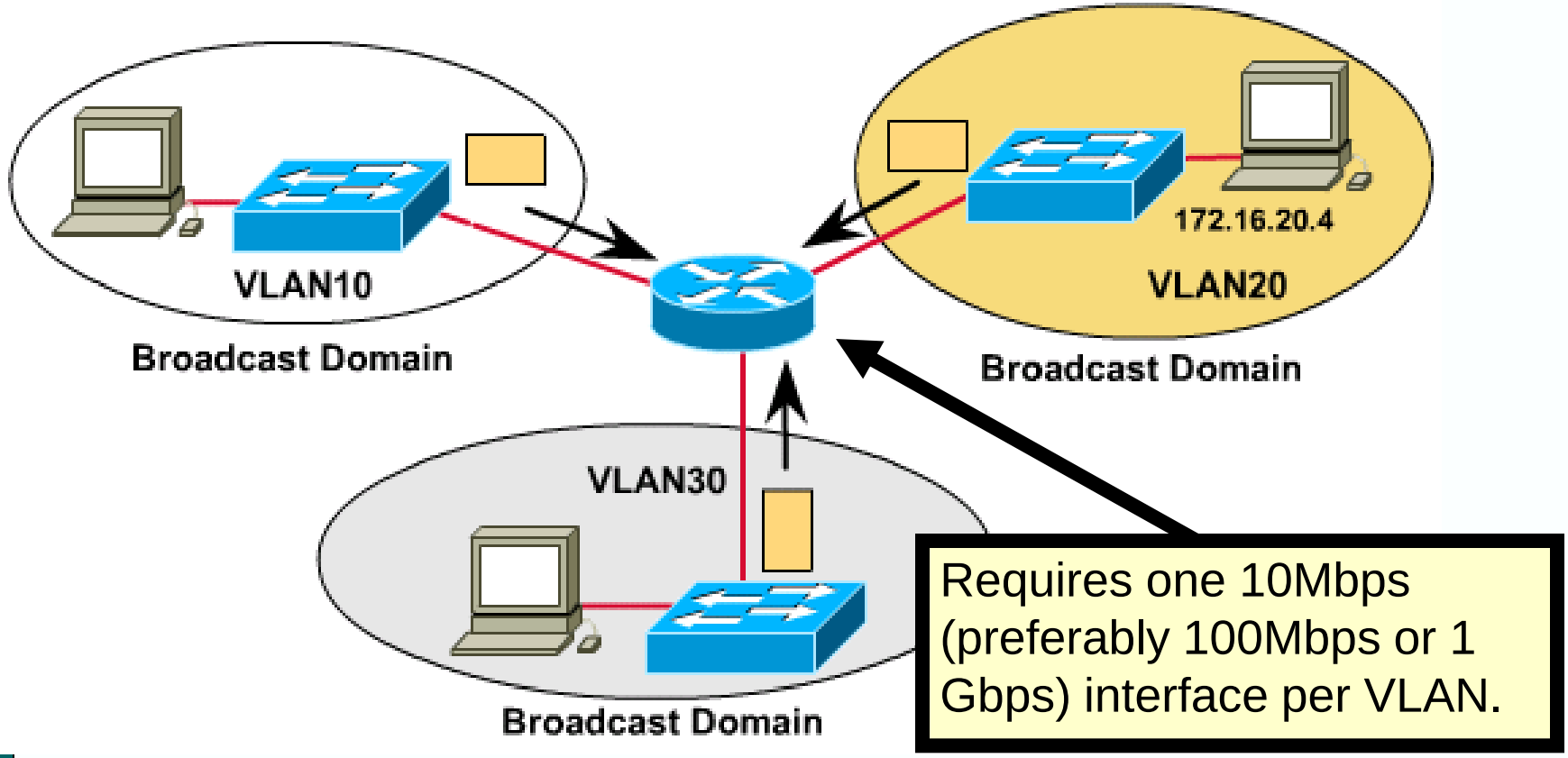
```
Switch(vlan)# vtp domain domain-name
Switch(vlan)# vtp {server | client |
  transparent}
Switch(vlan)# vtp password password
Switch(vlan)# vtp v2-mode  (version2)
```

Adding a Switch to an Existing Domain

Be sure to reset the configuration revision number of the new switch to be lower than the other switches or VLAN info will be erased on the VTP Server and VTP Clients

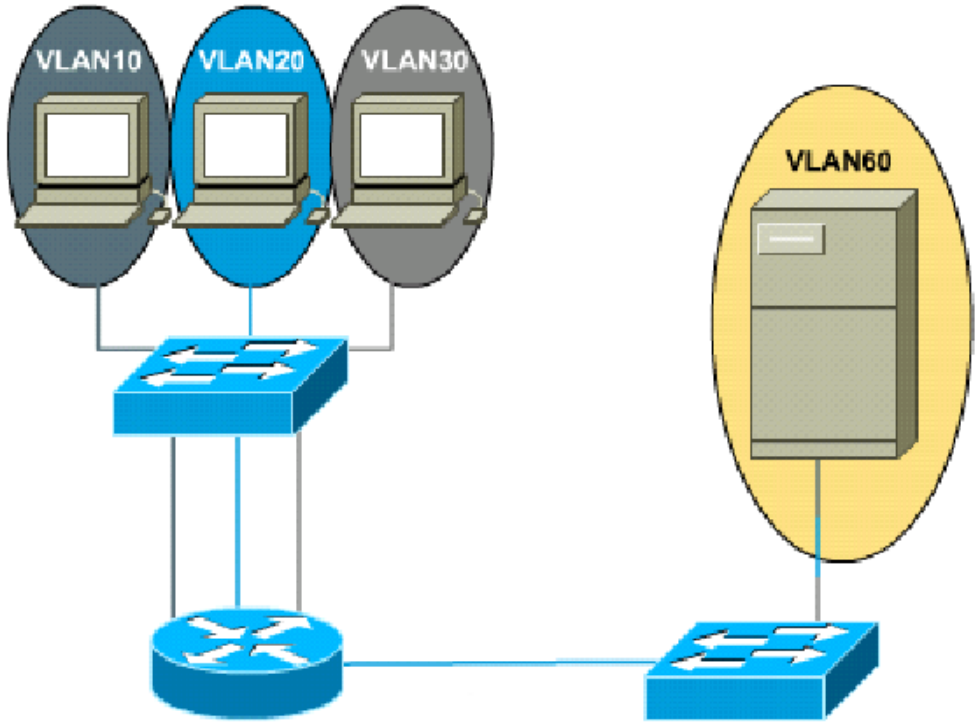
- Clear the configuration
- Clear the VTP file
- Power cycle the switch
- Configure VTP mode and domain
- Password protect the domain

Inter-VLAN legacy routing

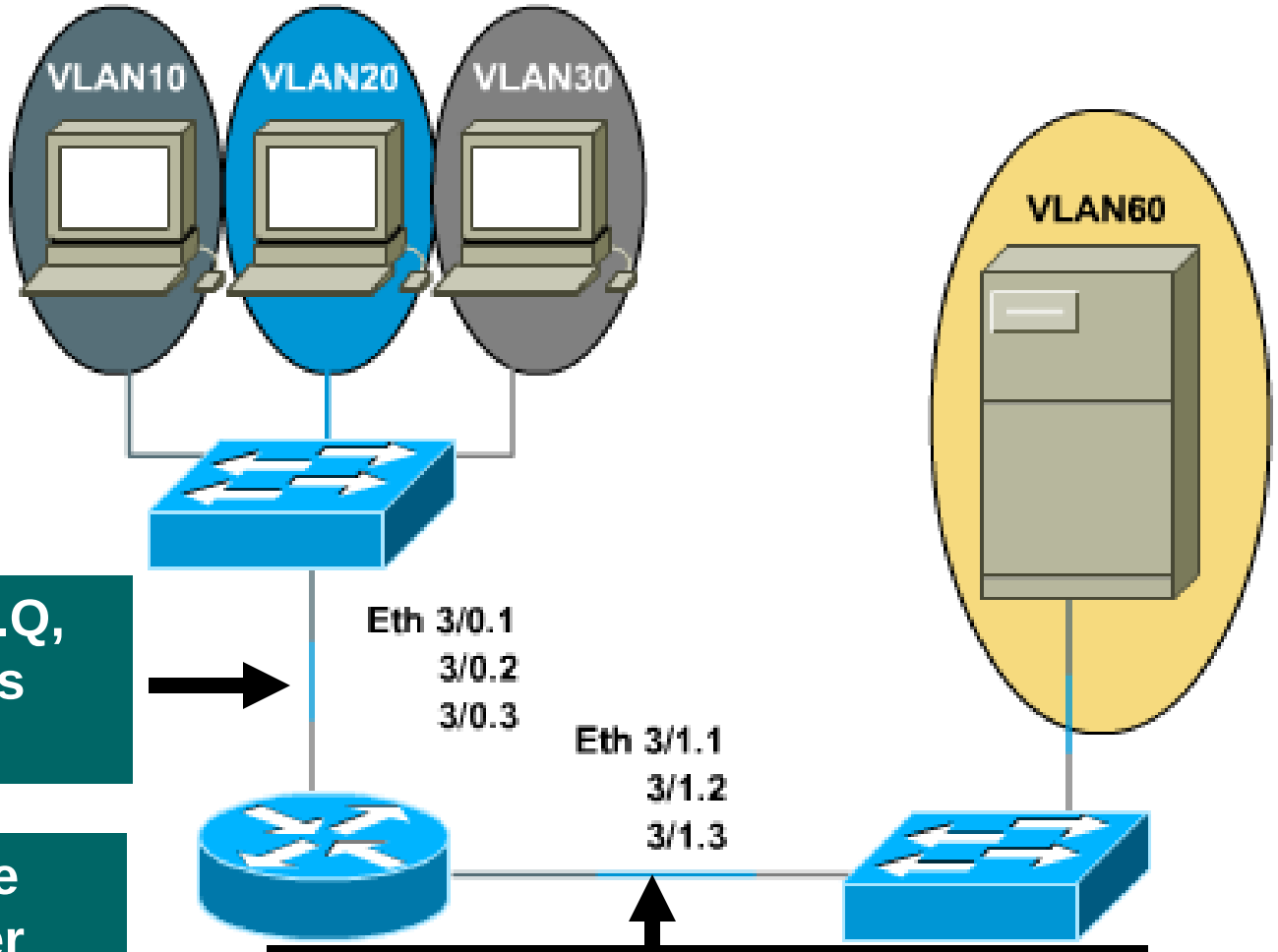


Multiple links aren't scalable

Requires four ports for four VLANs; this router is getting expen$ive!



Trunking Provides Scalability

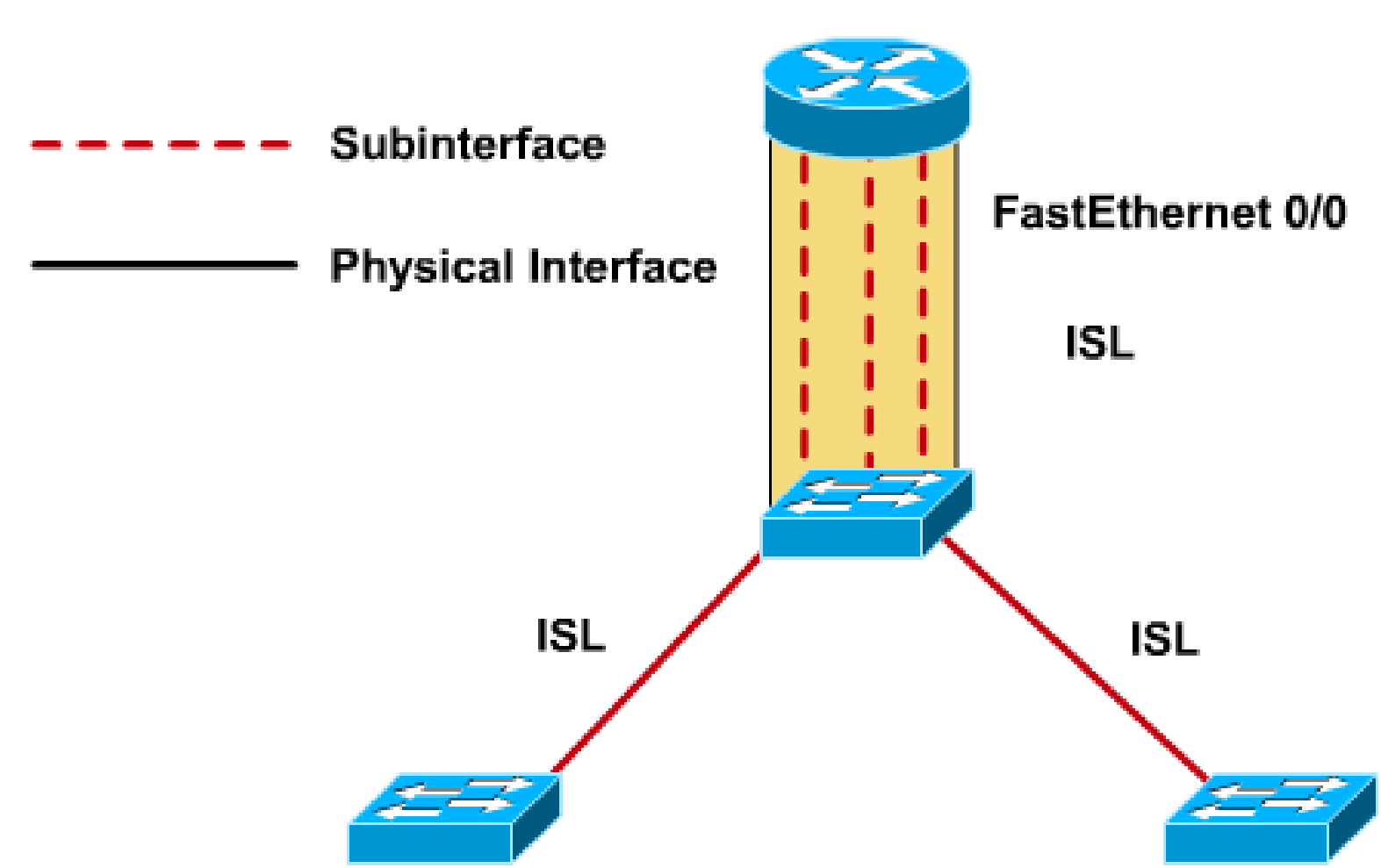


Using ISL or 801.Q, router only needs one port.

Subinterfaces are only on the router for the VLANs

Note: this must be FastEthernet!

External router config example "Router on a Stick"



External router config example

```
RTA(config)#interface f0/0
RTA(config-if)#no ip address
RTA(config-if)#interface f0/0.1
RTA(config-subif)#encapsulation dot1q 1
RTA(config-subif)#ip address 10.1.1.1
RTA(config-subif)#int f0/0.2
RTA(config-subif)#encapsulation dot1q 20
RTA(config-subif)#ip address 10.1.2.1
RTA(config-subif)#int f0/0.3
RTA(config-subif)#encapsulation dot1q 30
RTA(config-subif)#ip address 10.1.3.1
```

Switch Configuration

```
Switch(config)#interface FastEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk encapsulation
  dot1q
```

Can't skip this step – could be isl if using older equipment

```
Switch(config)#interface FastEthernet0/2
Switch(config-if)#switchport access vlan 1

Switch(config)#interface FastEthernet0/3
Switch(config-if)#switchport access vlan 10
```