Corso di Laurea in Ingegneria Informatica

Corso di Reti di Calcolatori

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Virtual LAN: VLAN

I lucidi presentati al corso sono uno strumento didattico che NON sostituisce i testi indicati nel programma del corso
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Nota di Copyright

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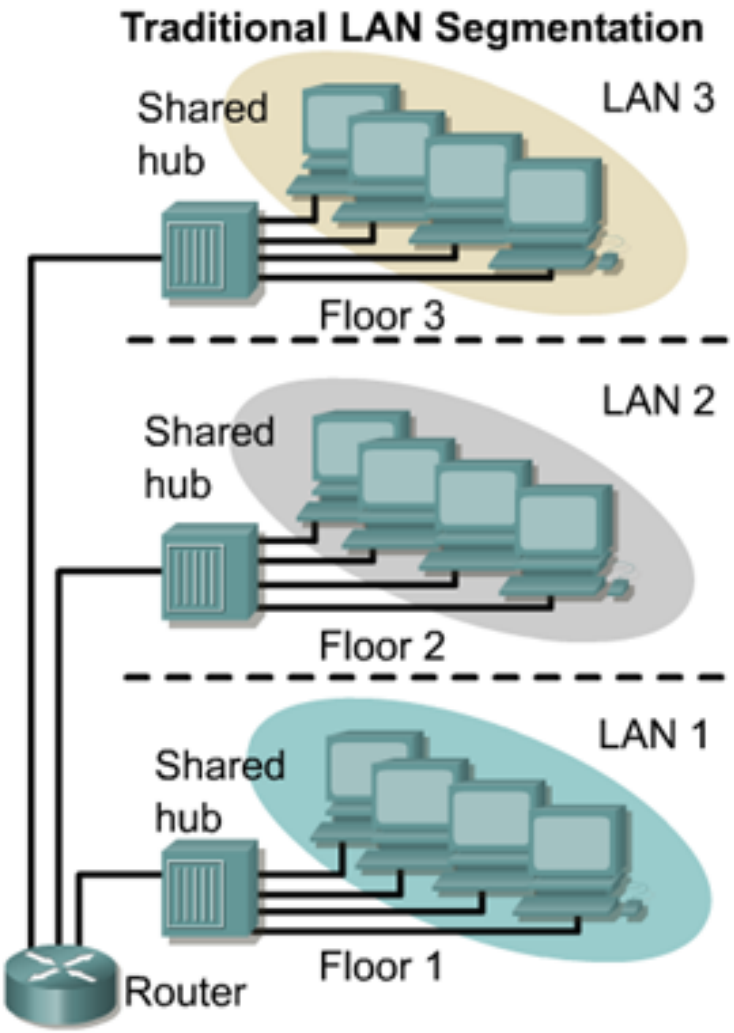
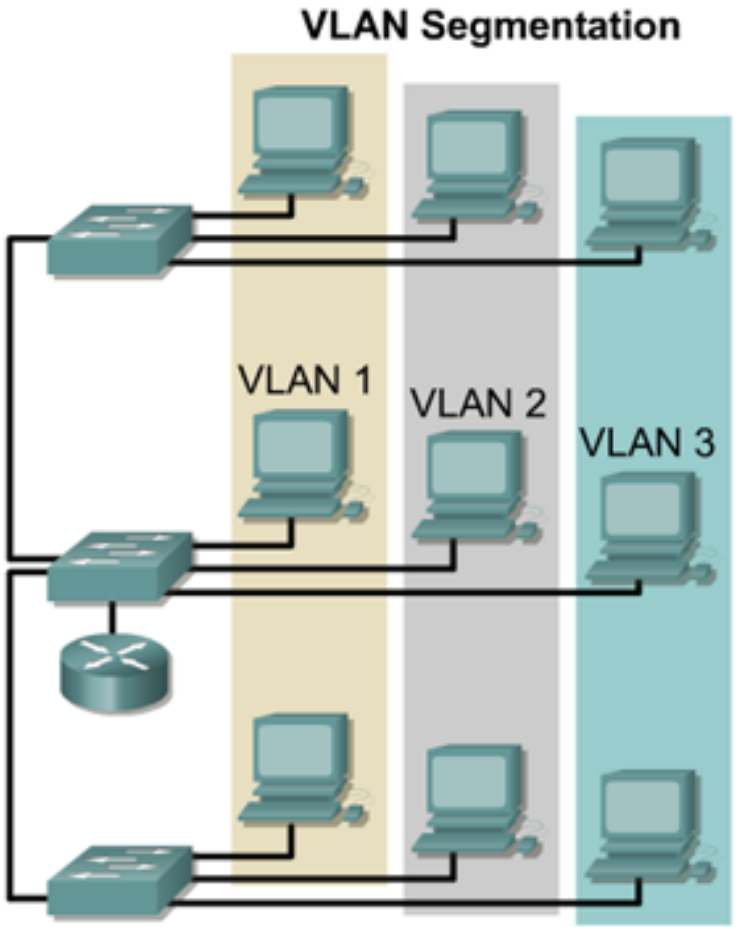
Partizionamento di una rete mediante router

- La rete della figura a dx è ottenuta collegando tre LAN distinte mediante un router
- Il traffico broadcast rimane confinato in ciascun piano
- Le comunicazioni tra piano avvengono mediante router



VLAN: necessità di partizionamento

- Spesso è necessario partizionare una rete in modalità che non seguono la collocazione fisica degli host
- Quando la rete è costituita da switch Ethernet che supportano le VLAN, questo è possibile proprio attraverso l'uso delle VLAN
- Una VLAN è un gruppo di porte di uno switch tra le quali è possibile una comunicazione diretta e l'inoltro di traffico broadcast (es ARP)
- La comunicazione tra VLAN diverse è possibile solo attraverso una funzione L3 (routing)

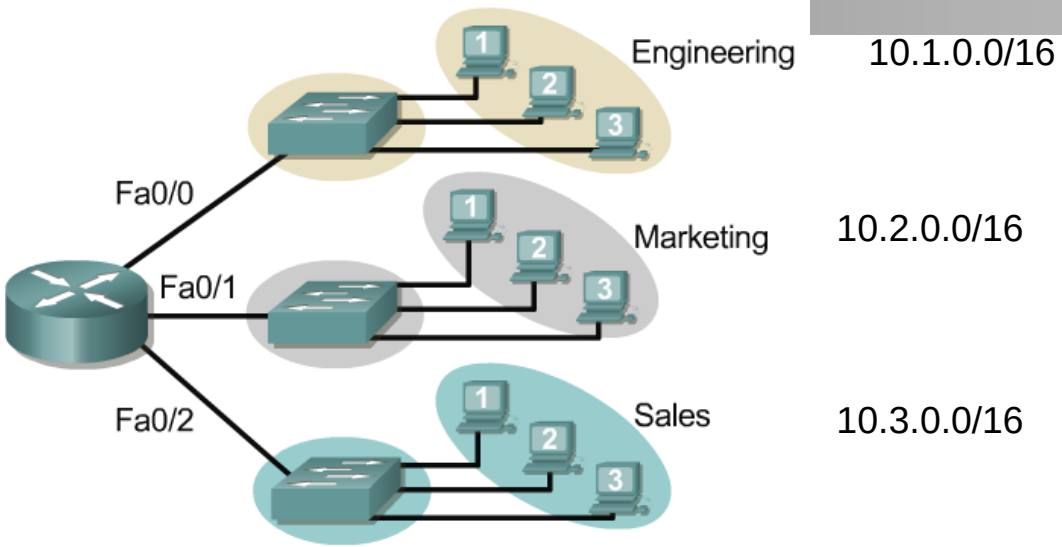


VLAN: come funzionano

- Attraverso l'uso di VLAN è possibile partizionare un'unica infrastruttura LAN creata attraverso l'interconnessione di switch Ethernet in reti "LAN virtuali" distinte ciascuna delle quali forma un dominio di trasmissione broadcast
- Non sono possibili comunicazioni dirette tra host di VLAN differenti: solo attraverso una funzione di livello L3 (routing)
- Tipicamente, una VLAN coincide con una sottorete IP

Broadcast domains with VLANs and routers

1) Without VLANs

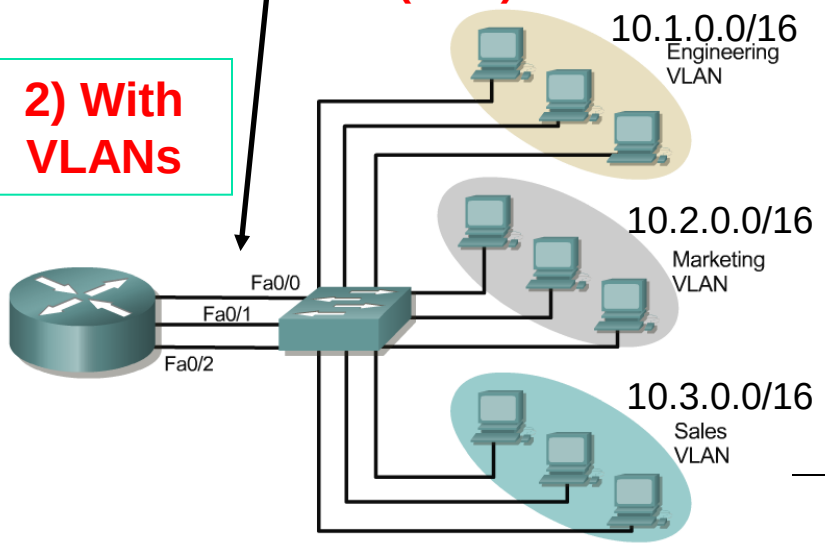


1) **Without VLANs**, each group is on a different IP network and on a different switch.
2) **Using VLANs:** Switch is configured with the ports on the appropriate VLAN. Still, each group on a different IP network; however, They are all on the same switch.

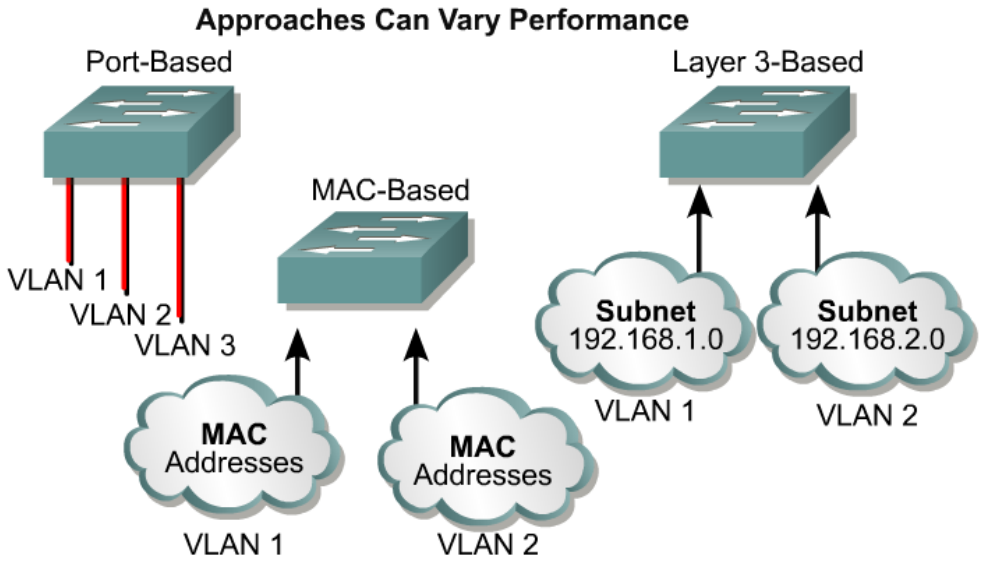
- What are the broadcast domains in each?

One link per VLAN or a single VLAN Trunk (later)

2) With VLANs

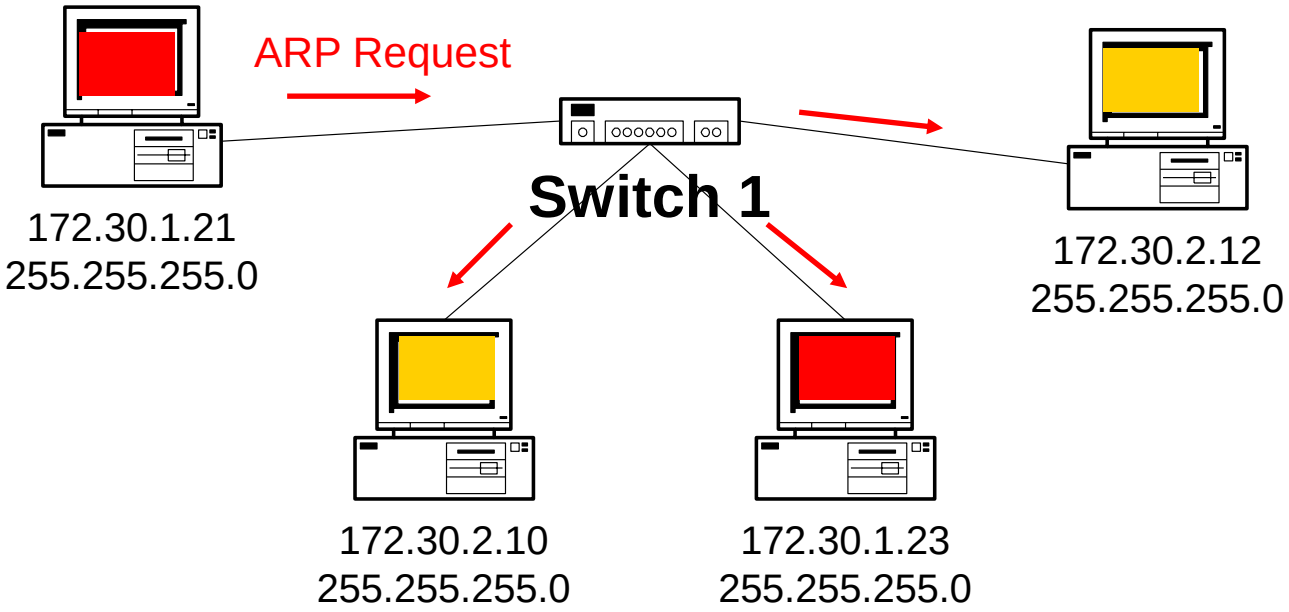


VLAN Types



VLAN Types	Description
Port-based	• Most common configuration method. • Ports assigned individually, in groups, in rows, or across 2 or more switches. • Simple to use. • Often implemented where Dynamic Host Control Protocol (DHCP) is used to assign IP addresses to network hosts.
MAC address	• Rarely implemented today. • Each address must be entered into the switch and configured individually. • Users find it useful. • Difficult to administer, troubleshoot and manage.
Protocol Based	• Configured like MAC addresses, but instead uses a logical or IP address. • No longer common because of DHCP.

Without VLANs – No Broadcast Control

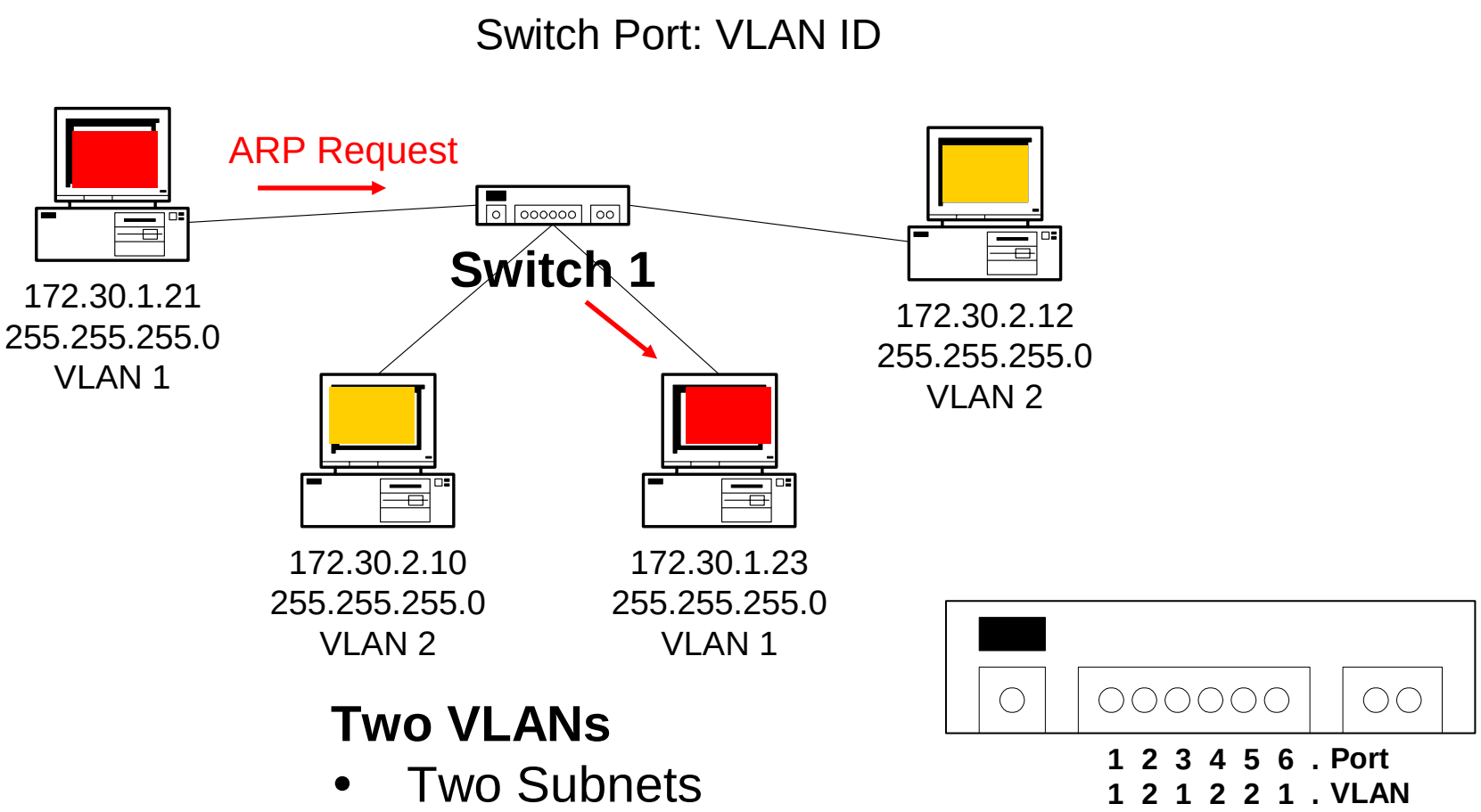


No VLANs

- Same as a single VLAN
- Two Subnets

- Without VLANs, the ARP Request would be seen by all hosts
- Consuming unnecessary network bandwidth and host processing cycles

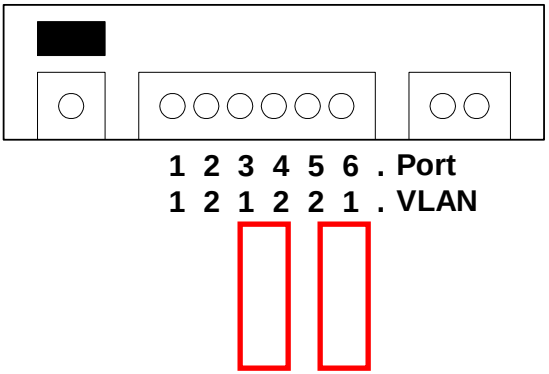
With VLANs – Broadcast Control

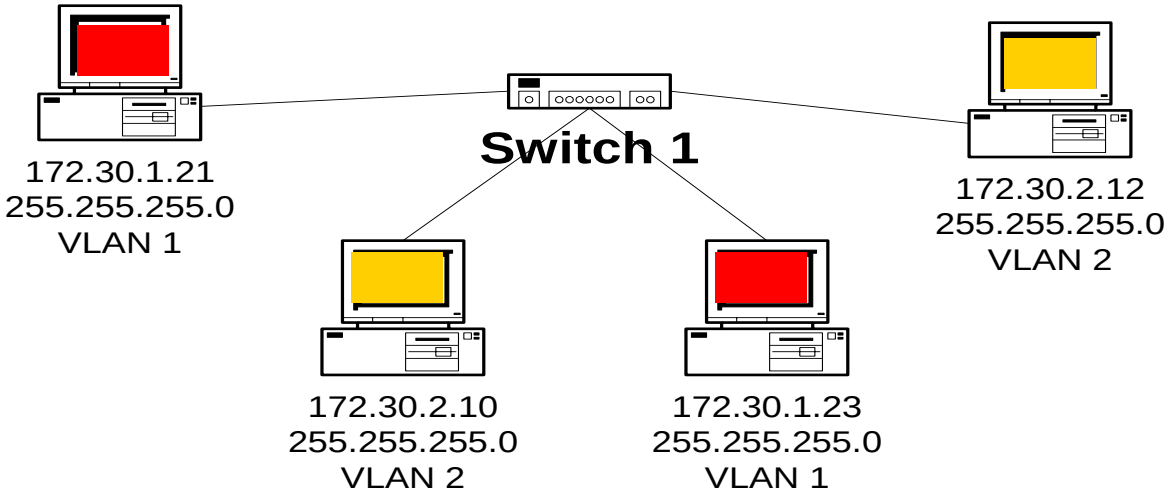


Two VLANs

- Two Subnets

VLAN operation





Two VLANs
- Two Subnets

Important notes on VLANs:

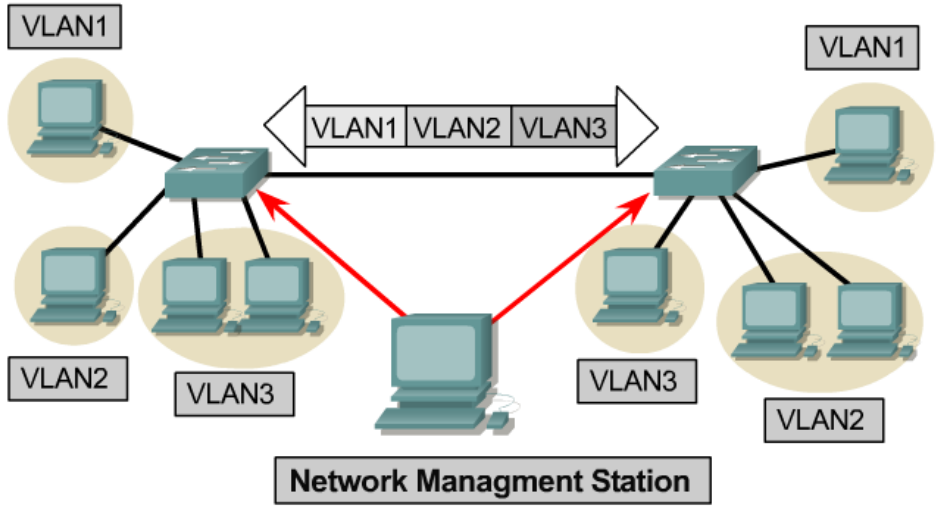
- VLANs are assigned on the switch port
  There is no “VLAN” assignment done on the host (usually)
- In order for a host to be a part of that VLAN, it must be assigned an IP address that belongs to the proper subnet. Remember: VLAN = Subnet
- Assigning a host to the correct VLAN is a 2-step process:
  1. Connect the host to the correct port on the switch
  2. Assign to the host the correct IP address depending on the VLAN membership

VLAN operation

Configuring VLANs	Description
Statically	Network administrators configure port-by-port. Each Port is associated with a specific VLAN. The network administrator is responsible for keying in the mappings between the ports and VLANs.
Dynamically	The ports are able to dynamically work out their VLAN configuration. Uses a software database of MAC address to VLAN mappings (which the network administrator must set up first).

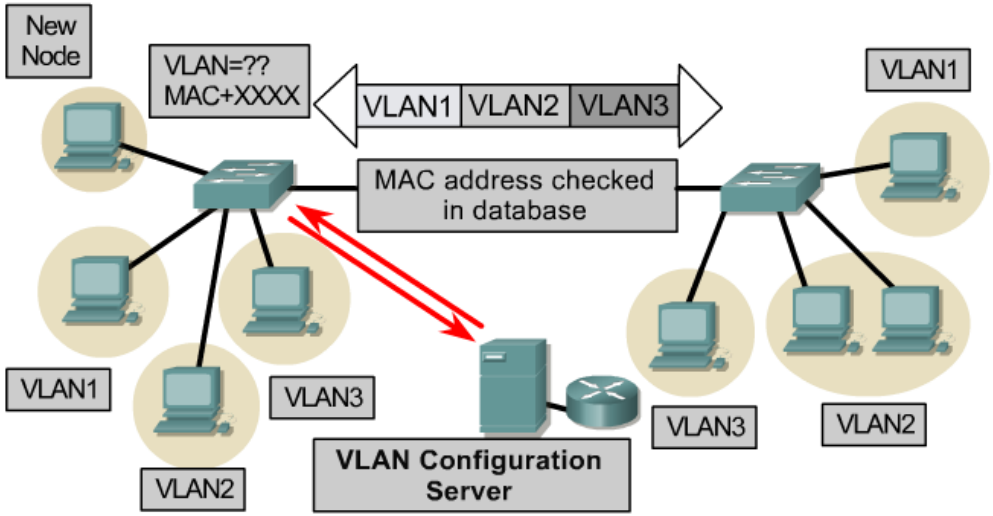
- Each switch port can be assigned to a different VLAN
- Ports assigned to the same VLAN share broadcasts
- Ports that do not belong to that VLAN do not share these broadcasts

VLAN operation



- **Static membership VLANs are called port-based VLANs**
- As a device enters the network, it automatically assumes the VLAN membership of the port to which it is attached
- The **default VLAN** for every port in the switch is the management VLAN (VLAN1) and **<u>may not be deleted</u>**
- All other ports on the switch may be reassigned to alternate VLANs

VLAN operation

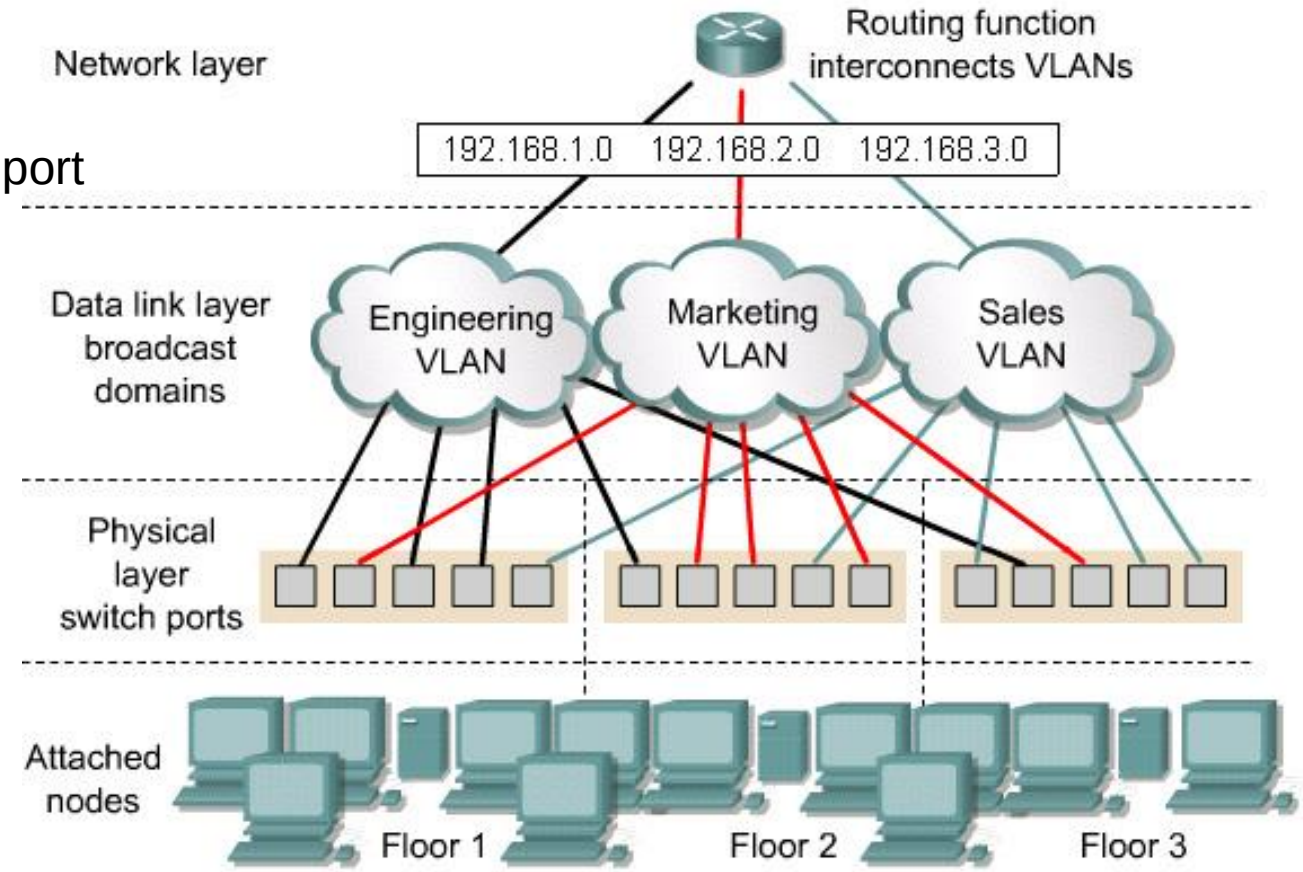


- Dynamic membership VLANs are created through network management software
  - Not as common as static VLANs
- Dynamic VLANs allow for membership based on the MAC address of the device connected to the switch port
- As a device enters the network, it queries a database within the switch for a VLAN membership

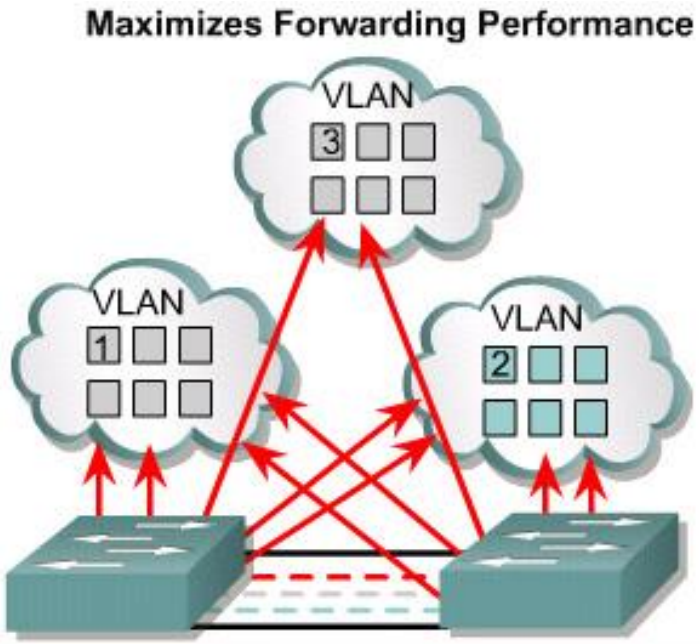
VLAN operation

- In port-based or port-centric VLAN membership, the port is assigned to a specific VLAN membership independent of the user or system attached to the port.

- All users of the same port must be in the same VLAN

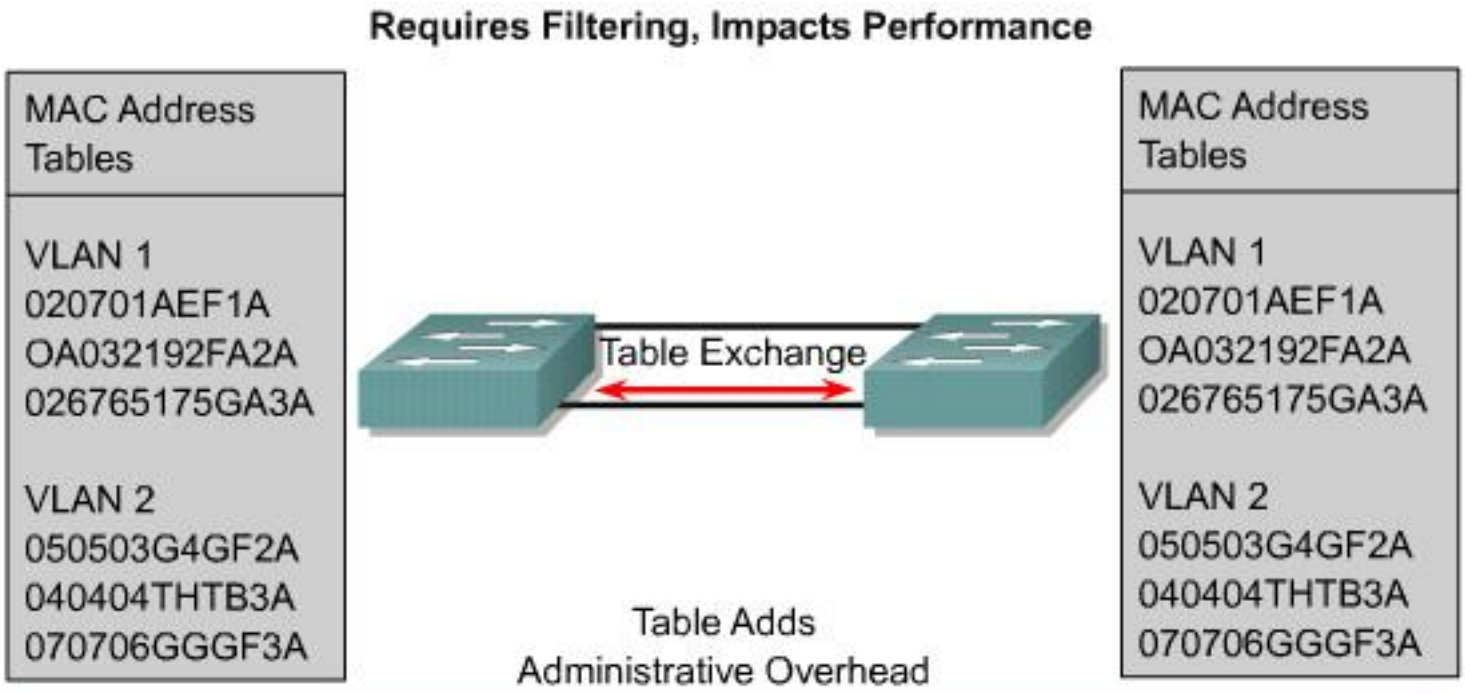


Membership by Port



- User assigned by port association
- Requires no lookup if done in ASICs
- Easily administered via GUIs
- Maximizes security between VLANs
- Packets do not "leak" into other domains
- Easily controlled across network

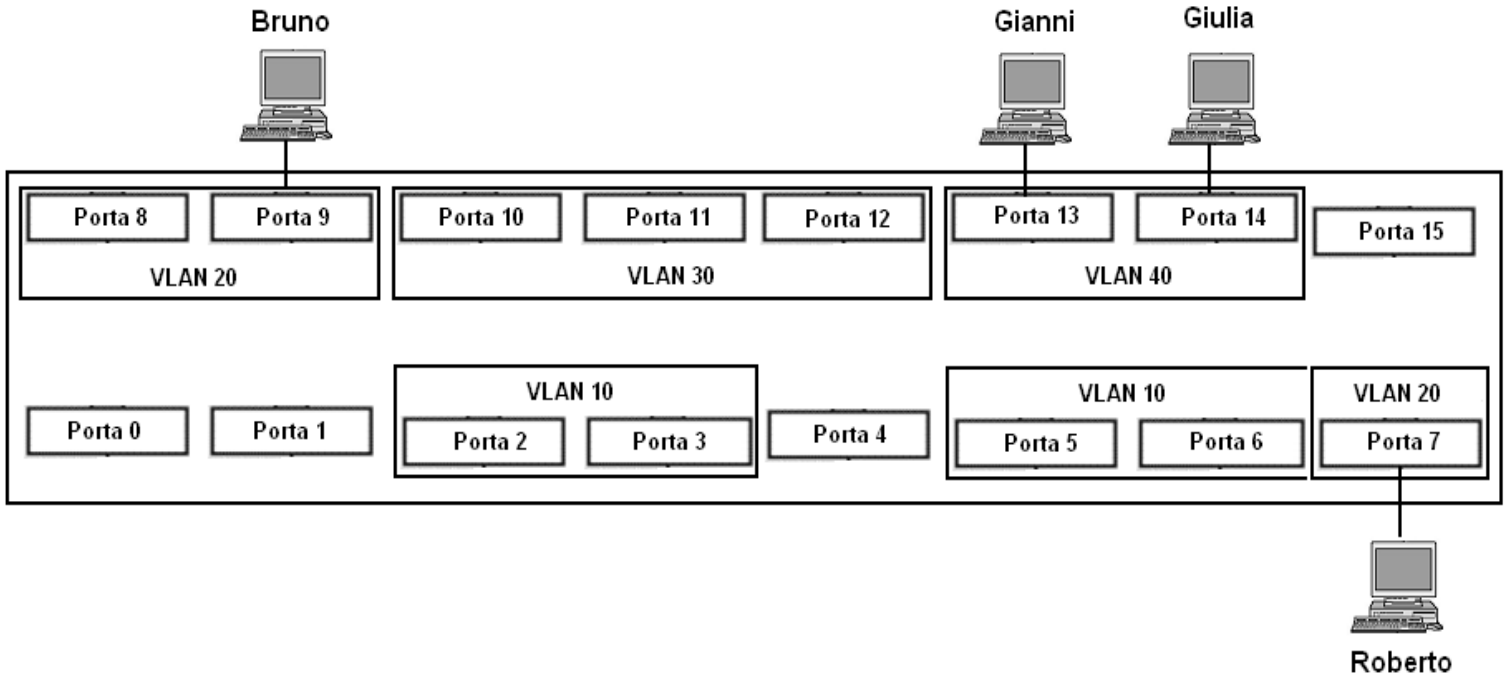
Membership by MAC-Addresses



- User assigned based on MAC addresses
- Offers flexibility, yet adds overhead
- Impacts performance, scalability, and administration
- Offers similar process for higher layers

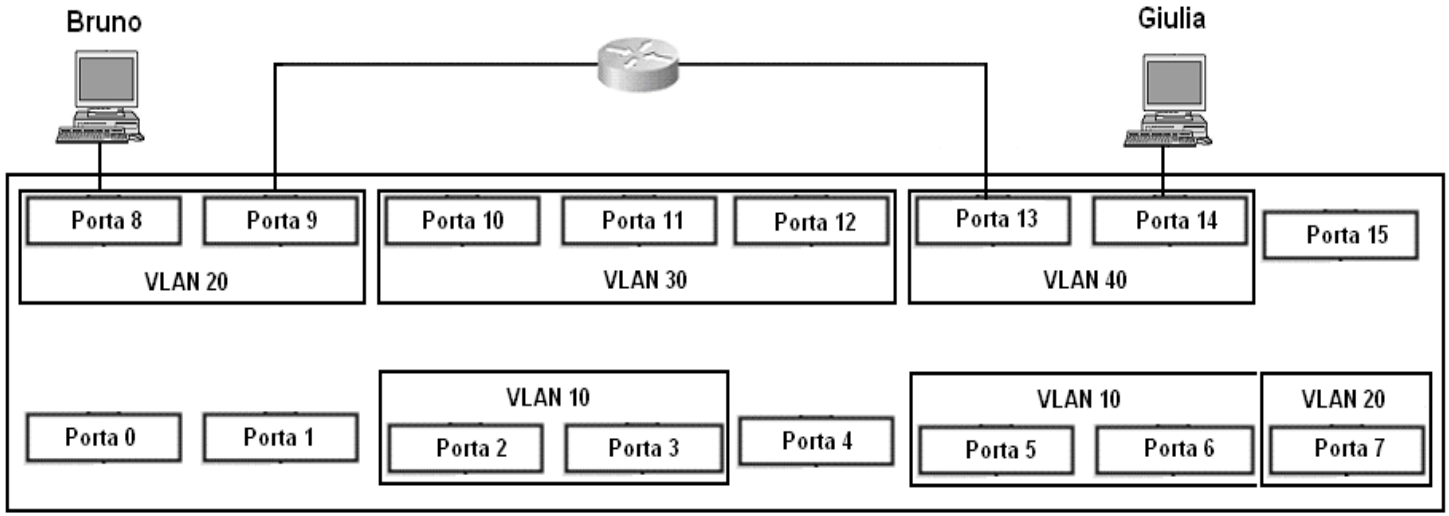
Comunicazione con VLAN

- Nella configurazione di VLAN rappresentata in figura, Gianni può inviare frame soltanto a Giulia



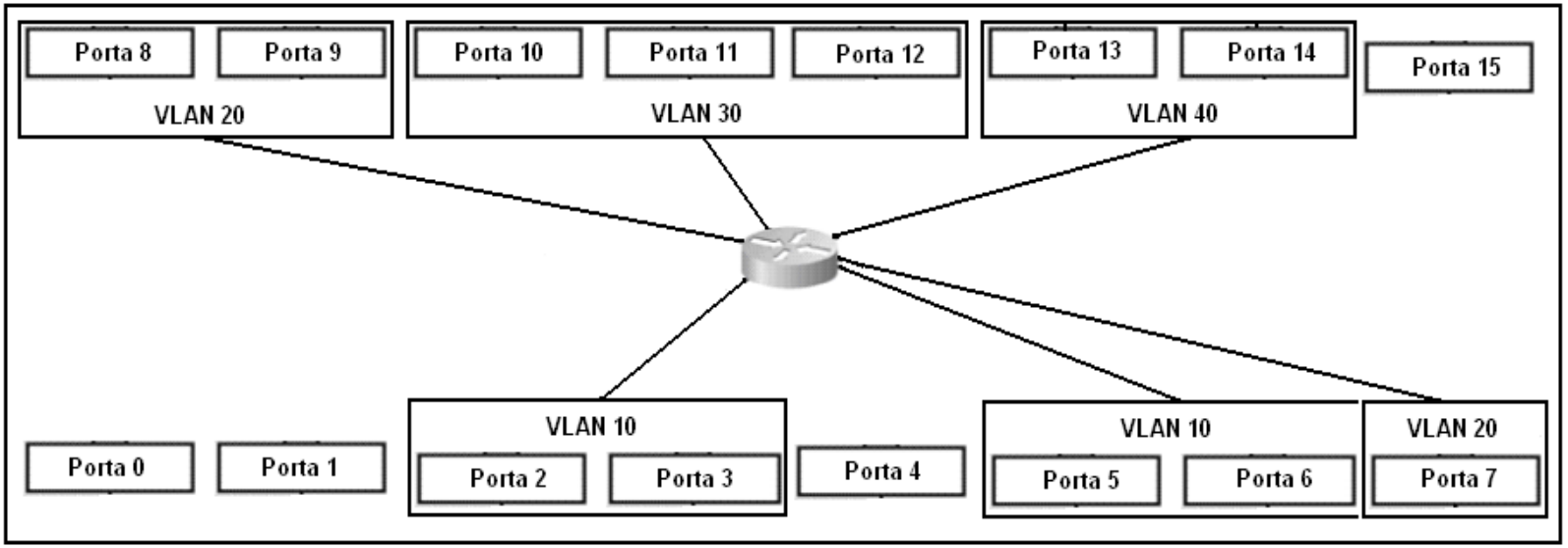
Comunicazione tra VLAN diverse

- Per fare comunicare VLAN diverse occorre creare un ponte attraverso un dispositivo apposito
  - bridge se opera a livello Ethernet (L2)
  - router se opera a livello rete (L3)



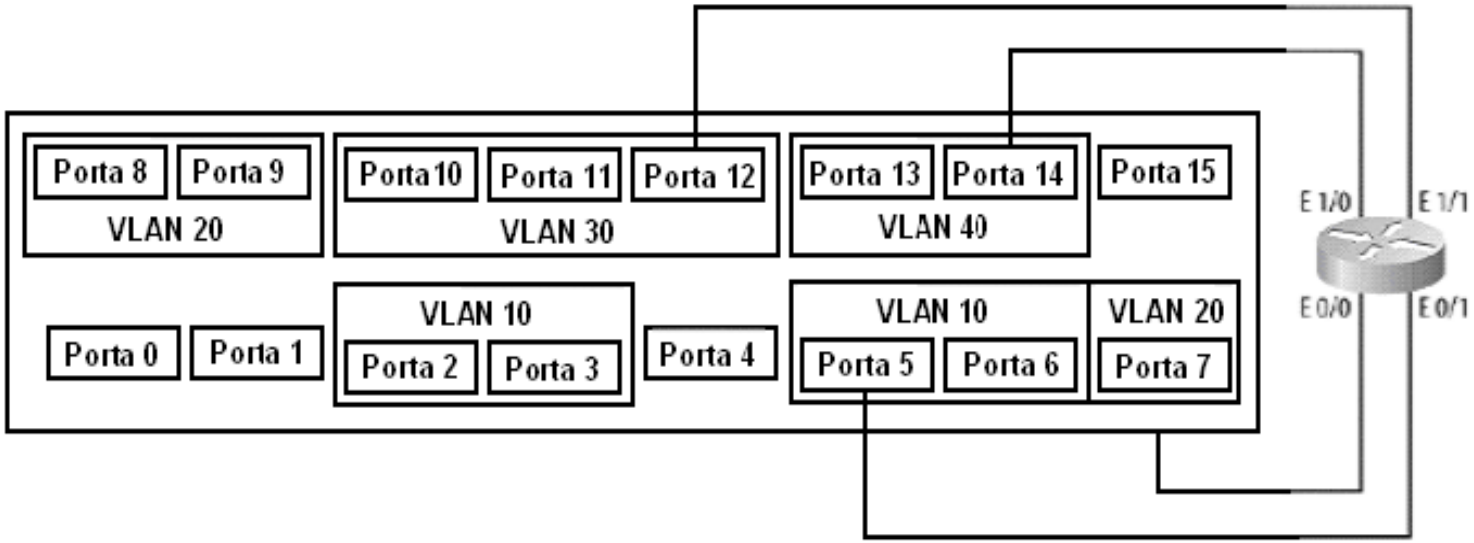
Switch/router

- Molti produttori offrono dispositivi in grado di svolgere contemporaneamente le funzioni di switch a livello Ethernet e di router a livello 3
- Questi dispositivi creano la connessione tra VLAN a livello 3



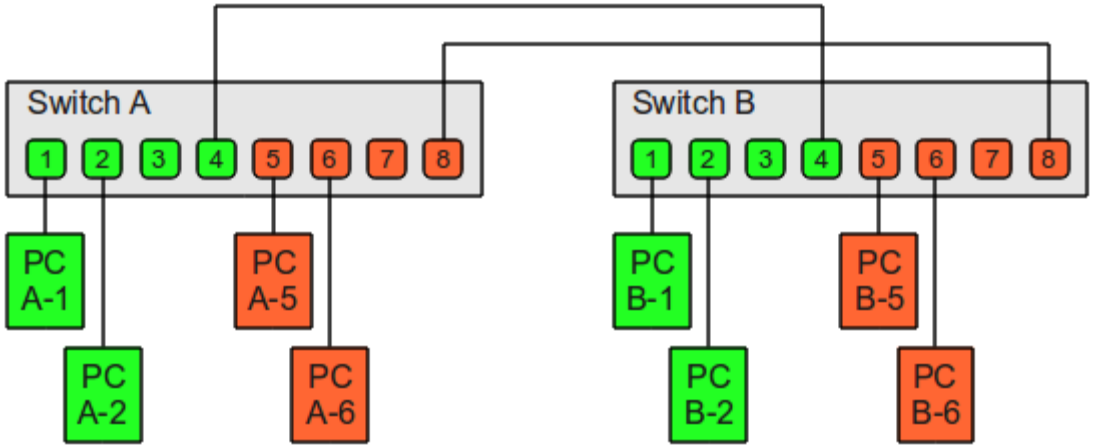
Connessione a livelli superiori (1)

• In linea di principio, si potrebbe ottenere lo stesso risultato collegando le interfacce di un router a tutte le coppie di VLAN



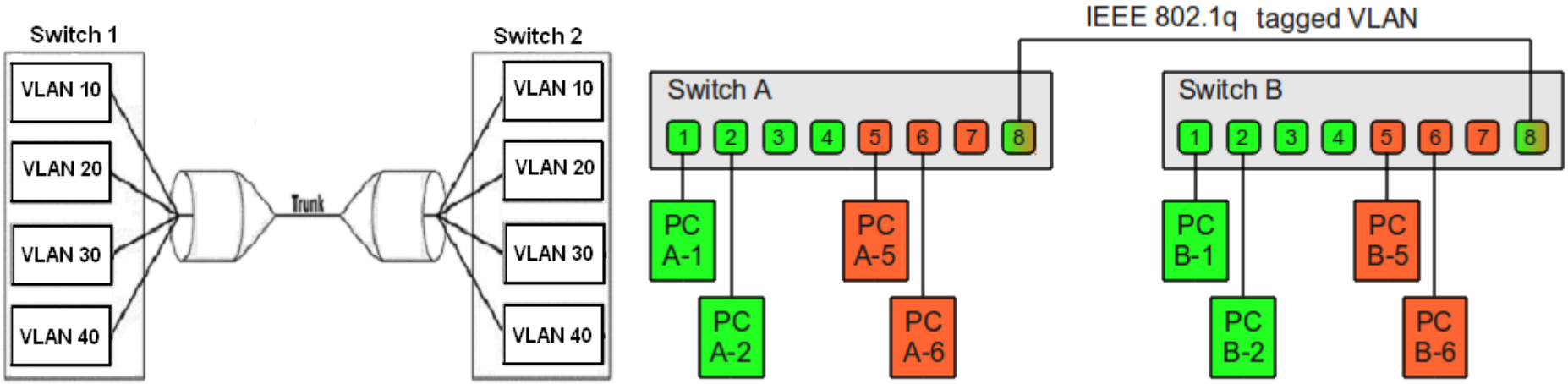
VLAN Trunking (1)

- La presenza delle VLAN crea un problema nella connessione tra due o più switch
  - Se collego la porta di uno switch a una porta di un altro switch, la connessione riguarderà solo le VLAN che comprendono le due porte utilizzate
  - Occorrerebbero quindi tanti collegamenti quante sono le VLAN da collegare



VLAN trunking (2)

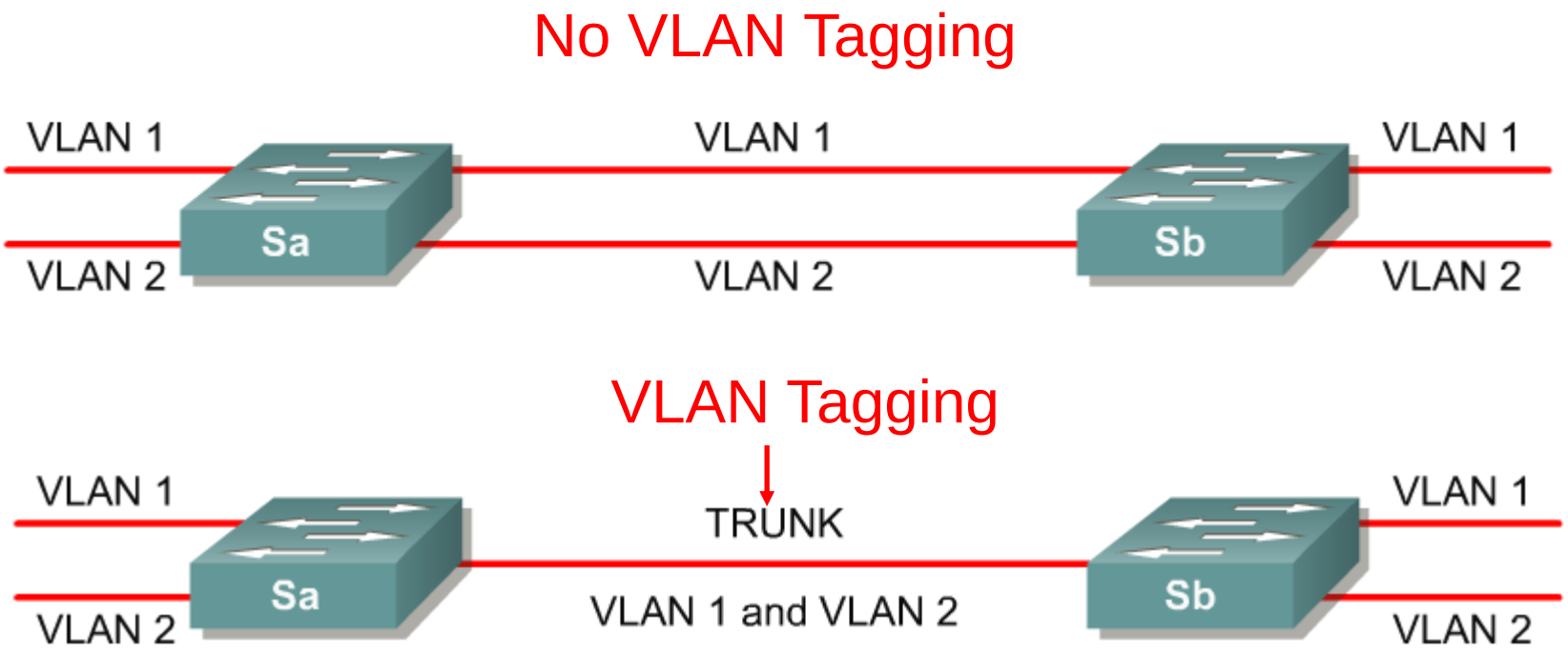
- Il trunking abilita la connessione tra le VLAN di switch diversi
  - Perché lo switch di destinazione sappia a quale VLAN inoltrare i frame in arrivo su una porta di trunking, occorre *taggare* (contrassegnare) i frame con l'identificativo della VLAN di destinazione
  - Questo non è previsto dal protocollo Ethernet originale



VLAN Tagging

- **VLAN Tagging is used when a link needs to carry traffic for more than one VLAN**
  - **Trunk link:** As packets are received by the switch from any attached end-station device, a unique packet identifier is added within each header.
- **This header information designates the VLAN membership of each packet**
- The packet is then forwarded to the appropriate switches or routers based on the VLAN identifier and MAC address
- Upon reaching the destination node (Switch) the VLAN ID is removed from the packet by the adjacent switch and forwarded to the attached device
- Packet tagging provides a mechanism for controlling the flow of broadcasts and applications while not interfering with the network and applications
- This is known as a trunk link or VLAN trunking

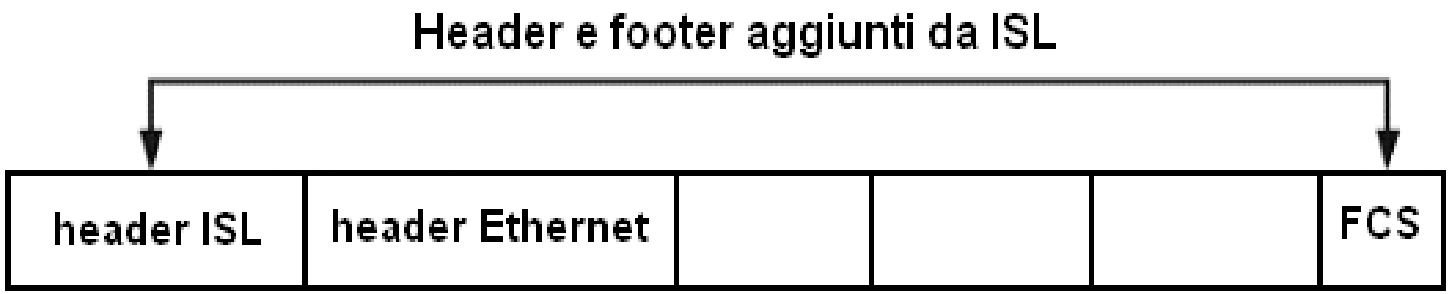
VLAN Tagging



- VLAN Tagging is used when a single link needs to carry traffic for more than one VLAN

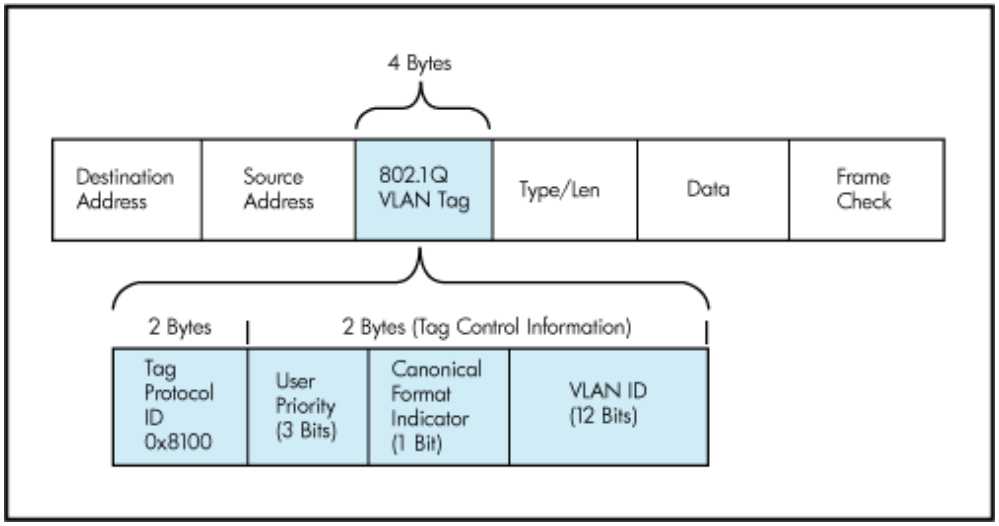
Protocolli di trunking (1)

- **Protocolli a incapsulamento**
  - Viene aggiunto uno header al frame Ethernet per indicare la VLAN di destinazione
  - Es. Cisco Inter-Switch Link (ISL)



Protocolli di trunking (2)

- Protocolli a piggyback (IEEE 802.1Q)
  - L'identificativo della VLAN (12 bit) è parte di un campo da 4 byte inserito nel frame Ethernet tra i campi indirizzo sorgente e tipo
  - Occorre ricalcolare il CRC all'ingresso e all'uscita dal trunk



Router on a stick

Collegamento tra VLAN distinte mediante un router collegato ad uno switch mediante un collegamento in trunk mode

Soluzione più economica rispetto a quella basata su un collegamento per ciascuna VLAN