Internet Technology and Protocols

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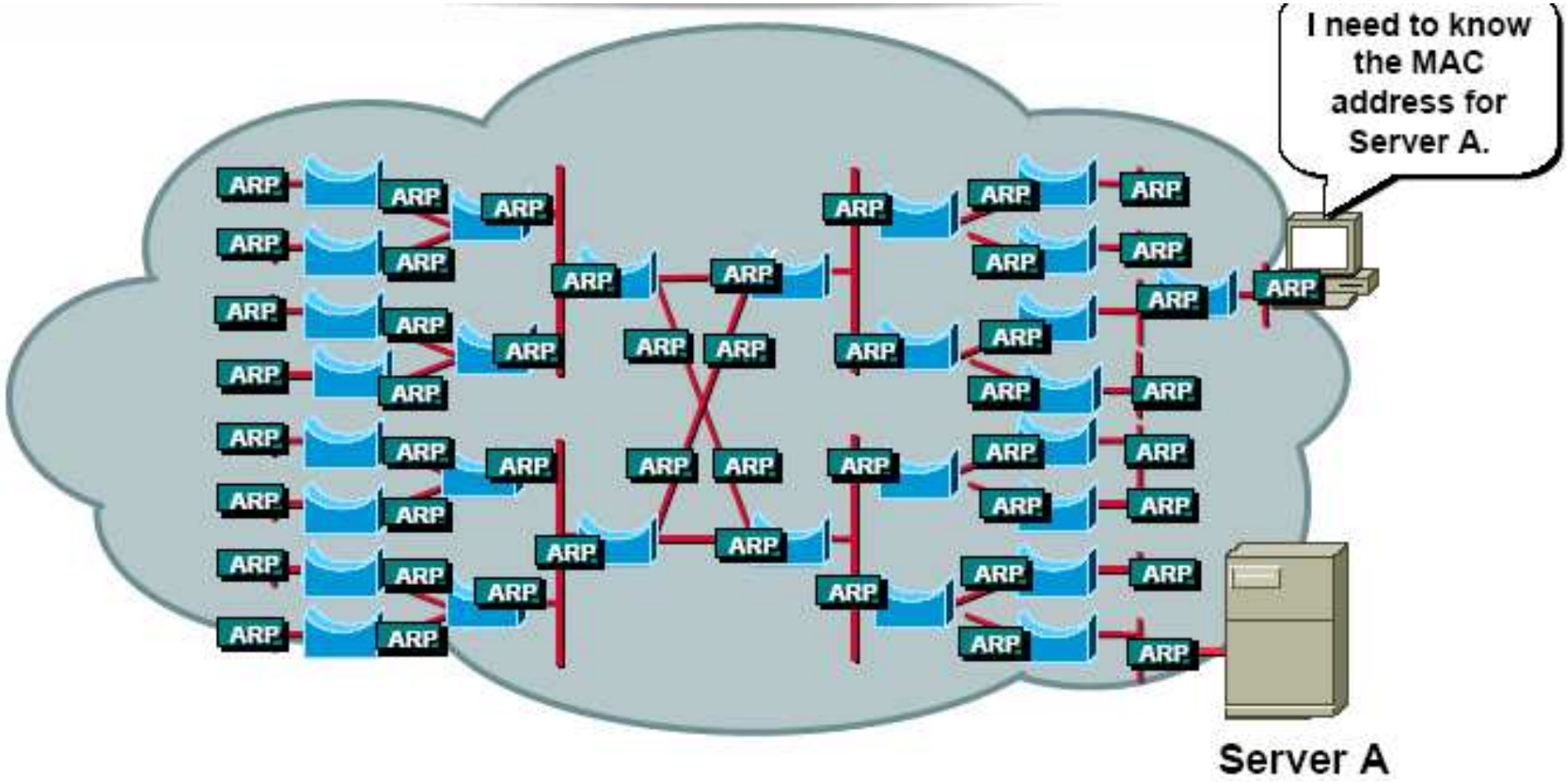
Virtual LANs

Broadcast issues



Switches: - did partition collision domains

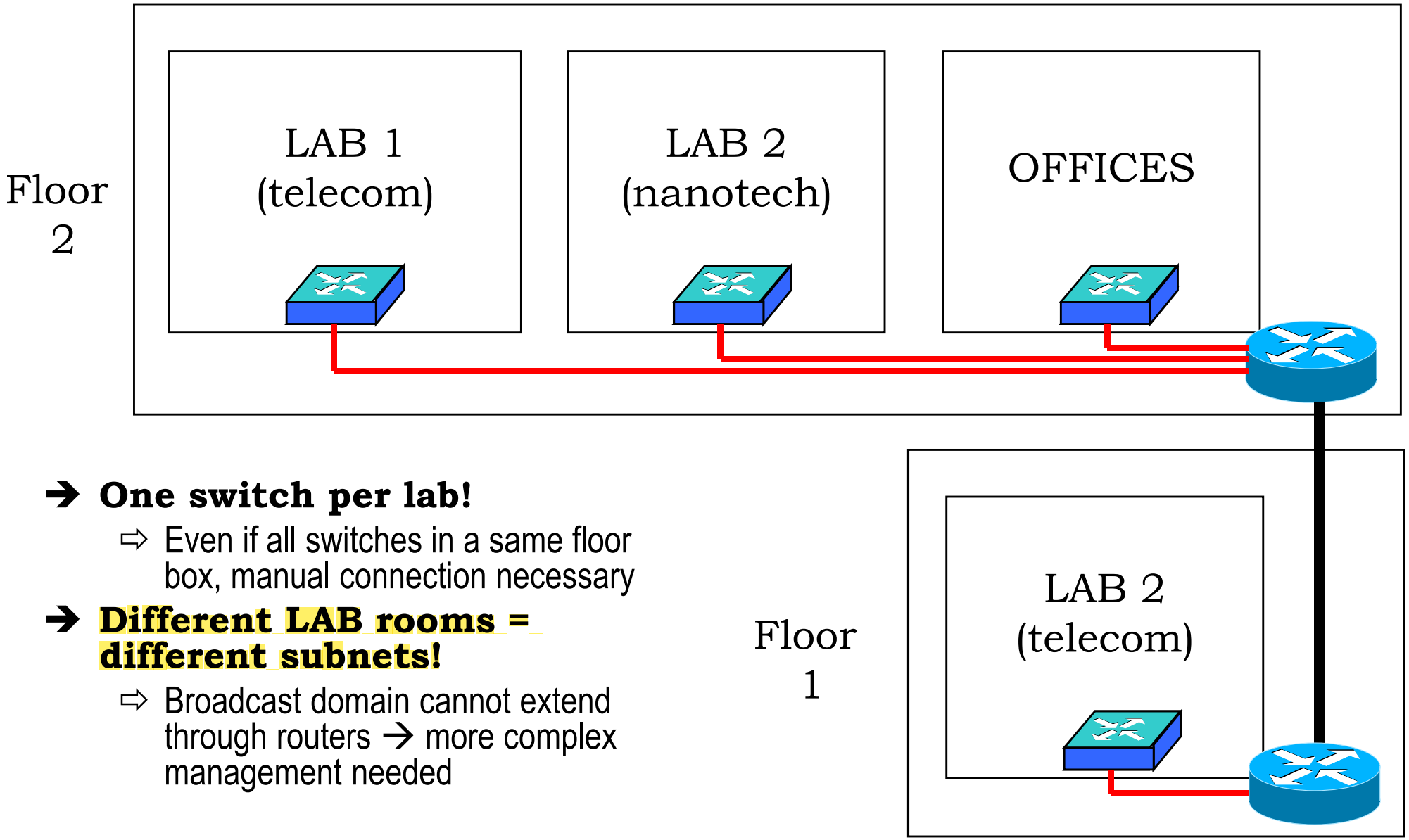
- bud DID not partition broadcast domain

The “obvious” solution: IP subnets

- **Partition network into several subnets**
  - Critical approach (especially in the past):
    - routers were slow
    - Need to replace switches with routers
  - No more a problem of efficiency, today
    - layer 3 switches = hardware-based routers, very fast!
  - However… Non adatto a tutte le situazioni

Insieme di Laboratori, i router non estendono il dominio broadcast, i due LAB non possono mandare msg broadcast tra i due laboratori (No arp o Ping di Lab1 a Lab2).

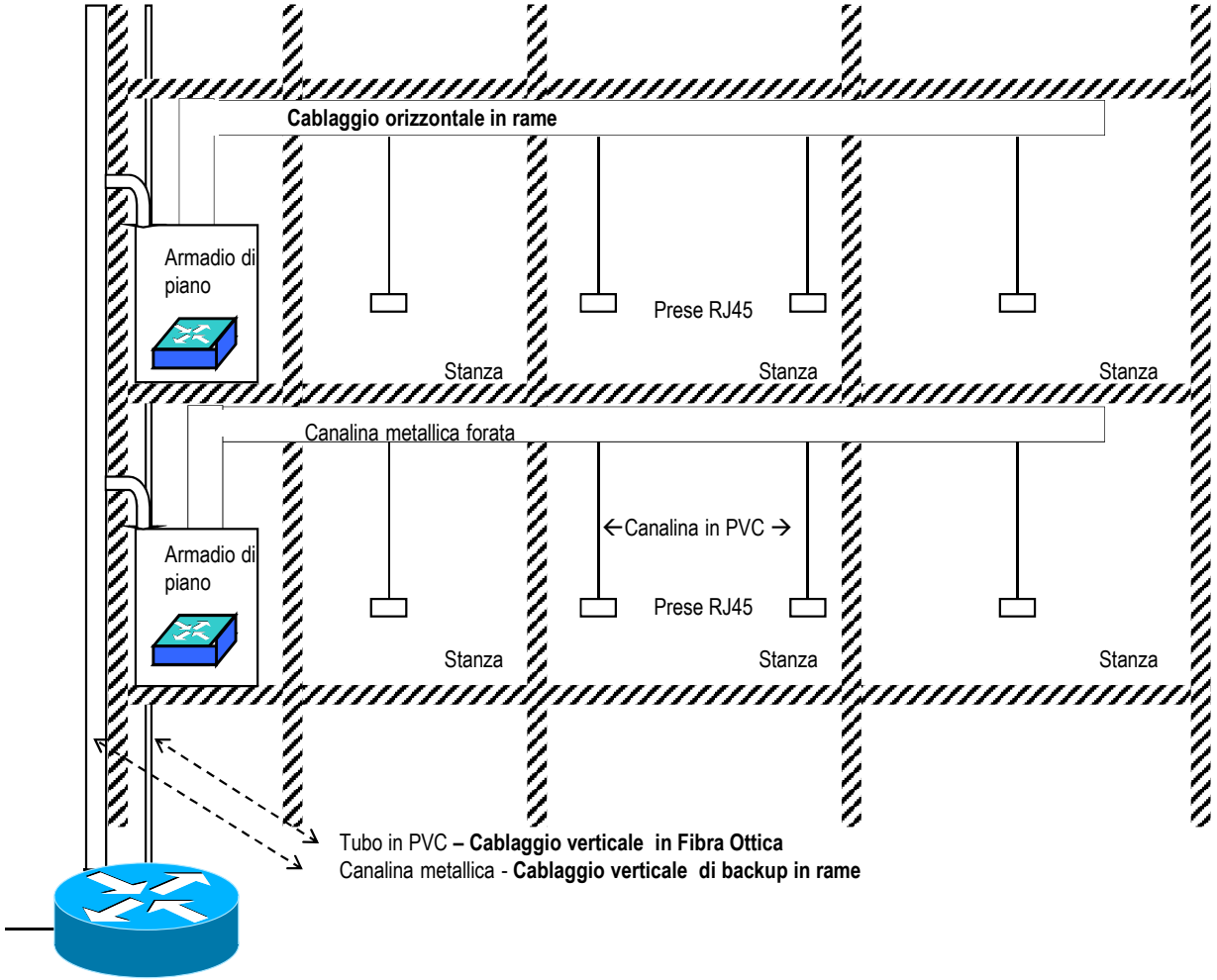
Cons of physical IP subnets



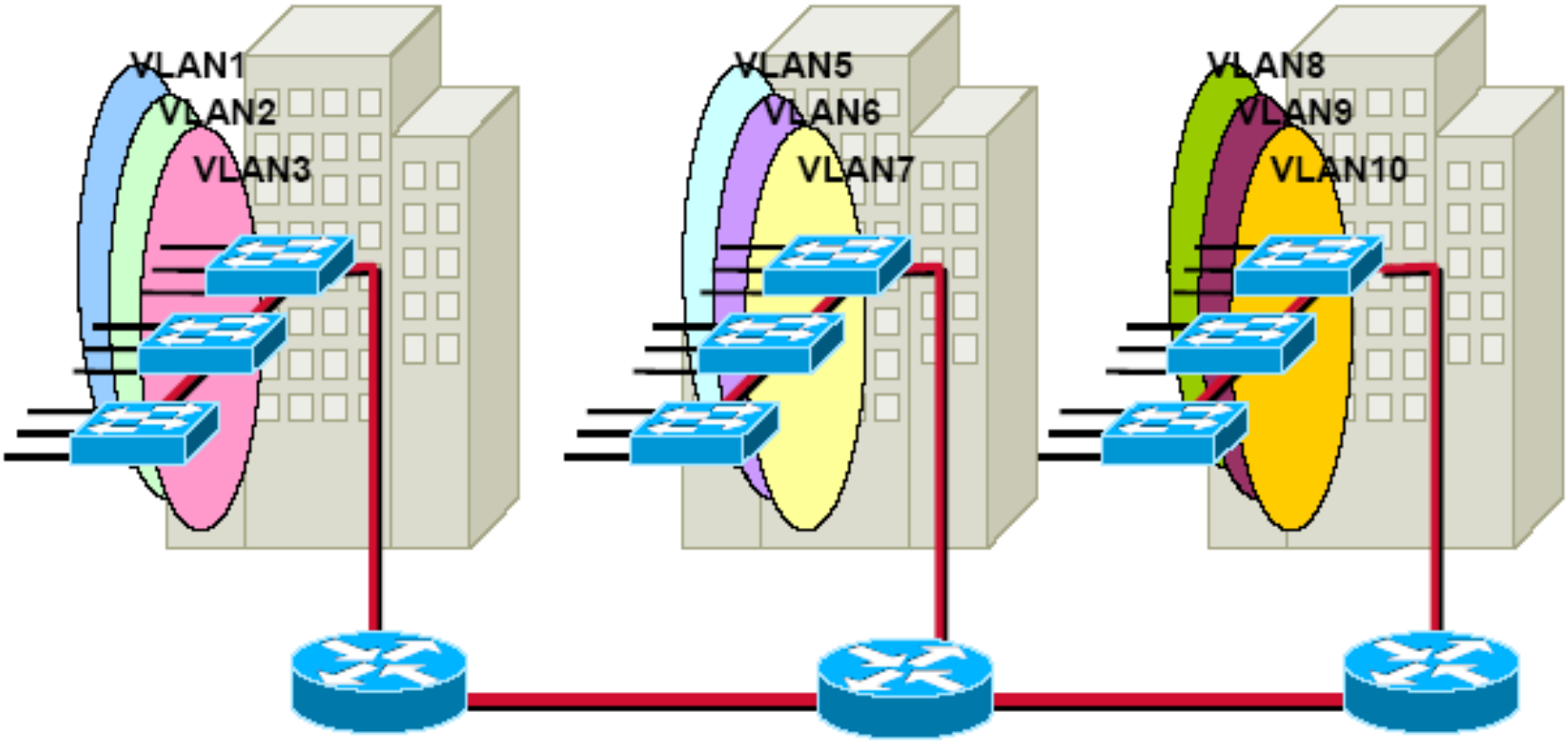
- ➔ **One switch per lab!**
  - ⇨ Even if all switches in a same floor box, manual connection necessary
- ➔ **Different LAB rooms = different subnets!**
  - ⇨ Broadcast domain cannot extend through routers → more complex management needed

Physical Network Design vs Logical Network Design

➔ **Standard design for physical network**



Solution: Virtual LAN (VLAN)



➔ VLAN = area which limits the broadcast domain partizione logica.

⇨ **Benefits**

→ **Broadcast confinement – solves scalability issues of large flat networks**

→ **Isolation of failures and network impairments**

→ **Security (more later)**

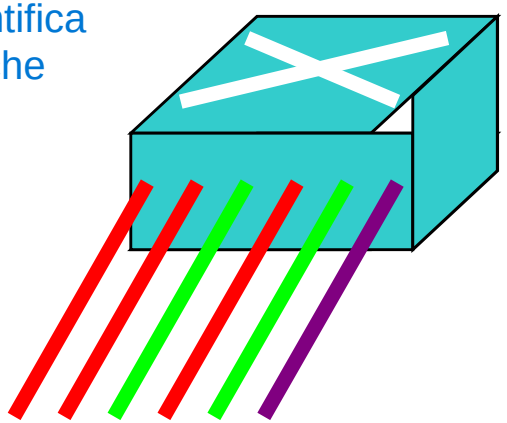
➔ Multiple VLANs may coexist over a same Switched LAN

VLAN Membership

- **Per Port**
  - THE typical VLAN approach
  - The IEEE 802.1Q approach
- **Per User**
  - Via MAC address
  - Via VLAN tag
  - Results: anarchic VLAN
    - but too easy to break into ☹
- **Per Protocol**
  - New feature in IEEE 802.1v
- **Combination (cross-layer)**
  - Supported as proprietary extensions
    - Via IP subnet address
    - ….
  - Classification hierarchy may be defined
    - E.g. per IP subnet;
    - if not IP → per protocol;
    - if not in the set of classified protocols → per MAC;
    - if not in MAC list per port.

Come posso essere membro o colui che da la VLAN? Tipicamente per porta fisica dello switch, ognuna associata a una certa VLAN. (es: fili rossi = VLAN 1)

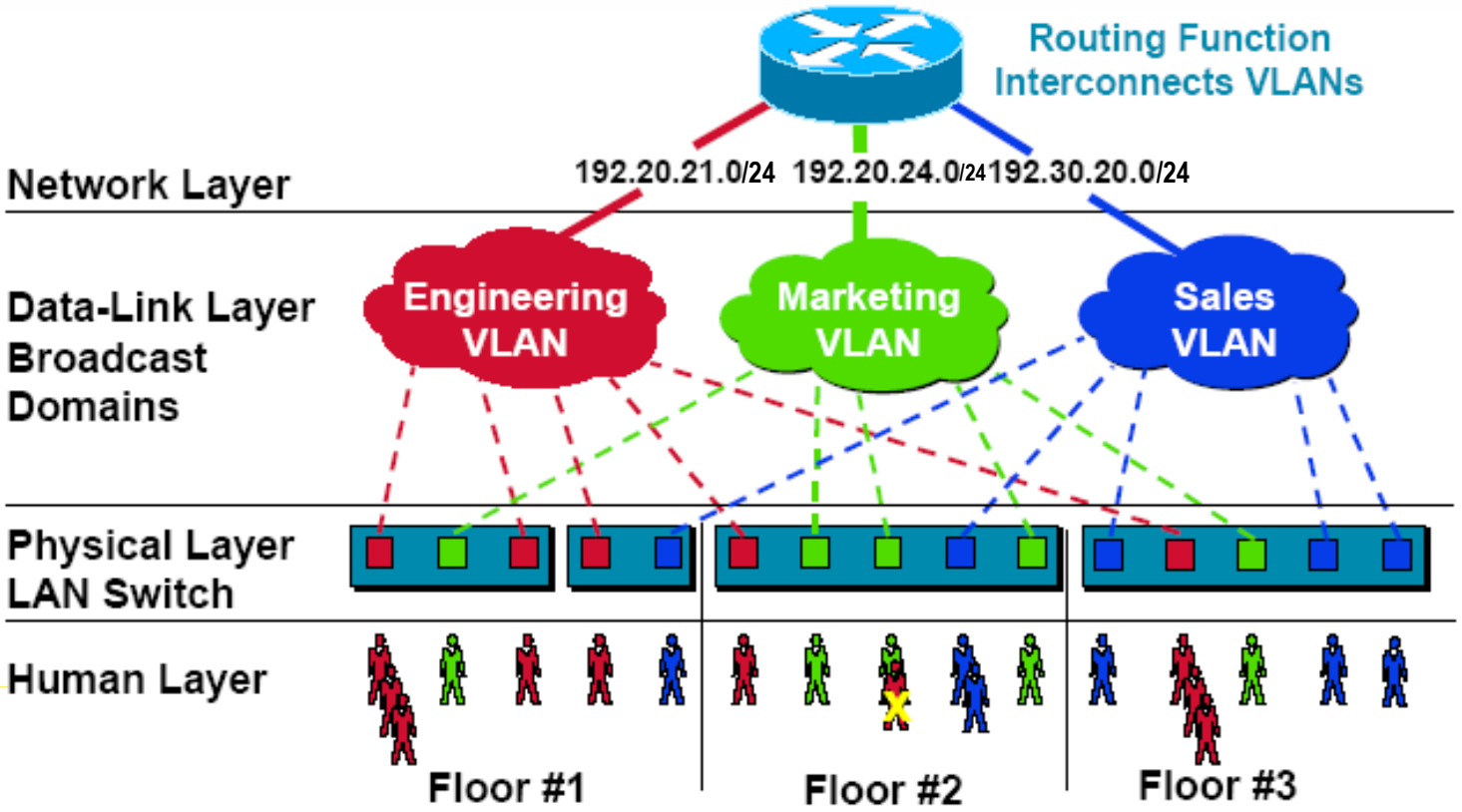
C'è header di pochi byte che identifica a VLAN, come un tag. Posso anche associarne una per ogni user!



Oggi è molto diffusa la loro combinazione, quindi alcuni membri sono attaccati per Porta, altri ce l'hanno associata ad una Subnet etc..

Physical vs logical view (i.e. why VLANS instead of IP network)

- **Layer 3 subnets ought to be physically separated**
- **BUT many VLANs may overlap**
- **on the same, unique physical network structure!**
  - ⇨ Robust, failure-proof, single managed

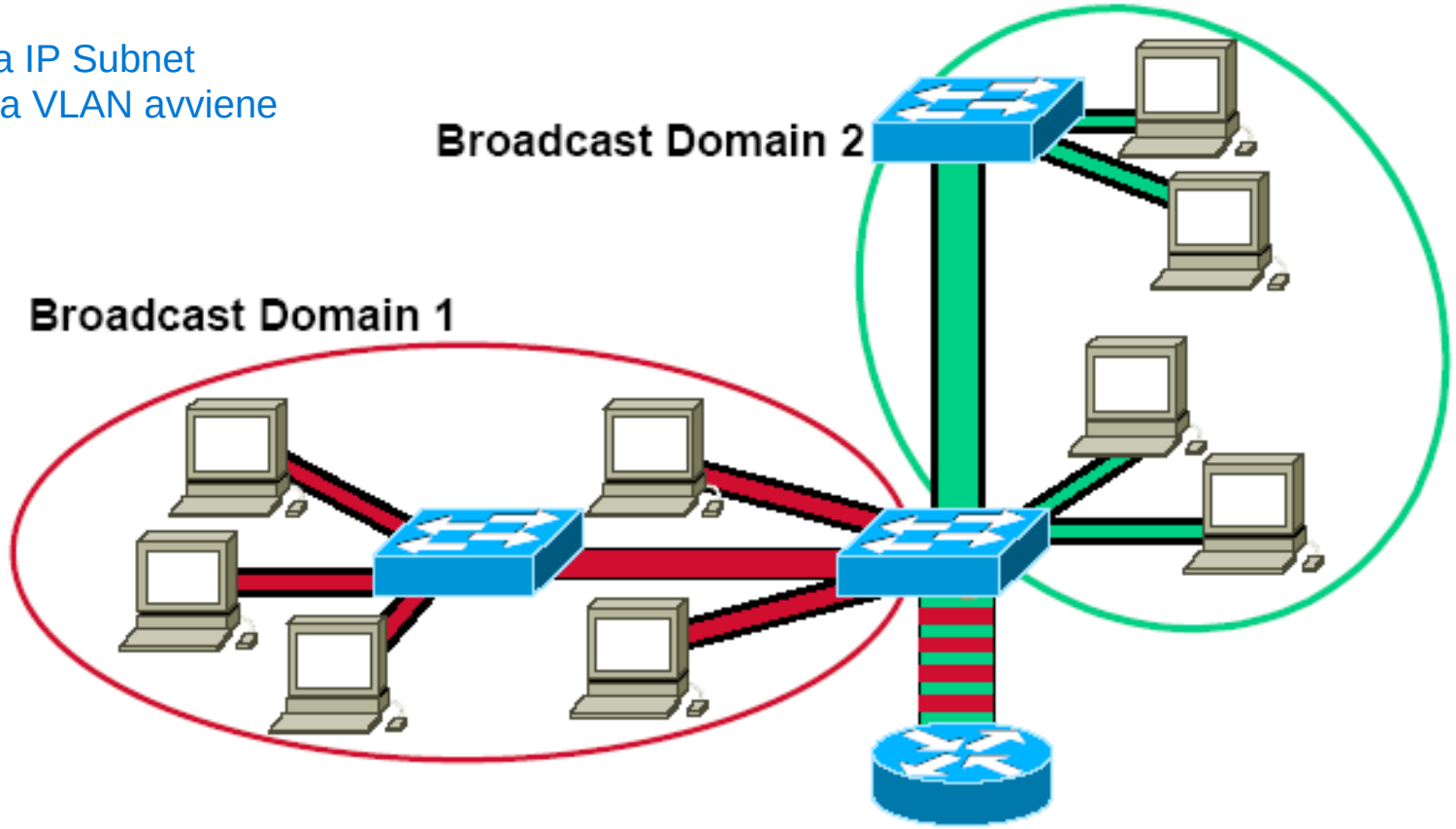


All users attached to same switch port must be in the same VLAN.

dal basso verso l'alto: physical layer switch a cui gli utenti si connettono. Possiamo avere membri diversi. Saliamo e virtualizziamo la rete, siamo sicuri che il broadcast di Engineering non va in Marketing VLAN, anche se fisicamente il collegamento è unico.

VLANs and IP subnets /1

Una VLAN = Una IP Subnet
La connettività tra VLAN avviene tramite Router.

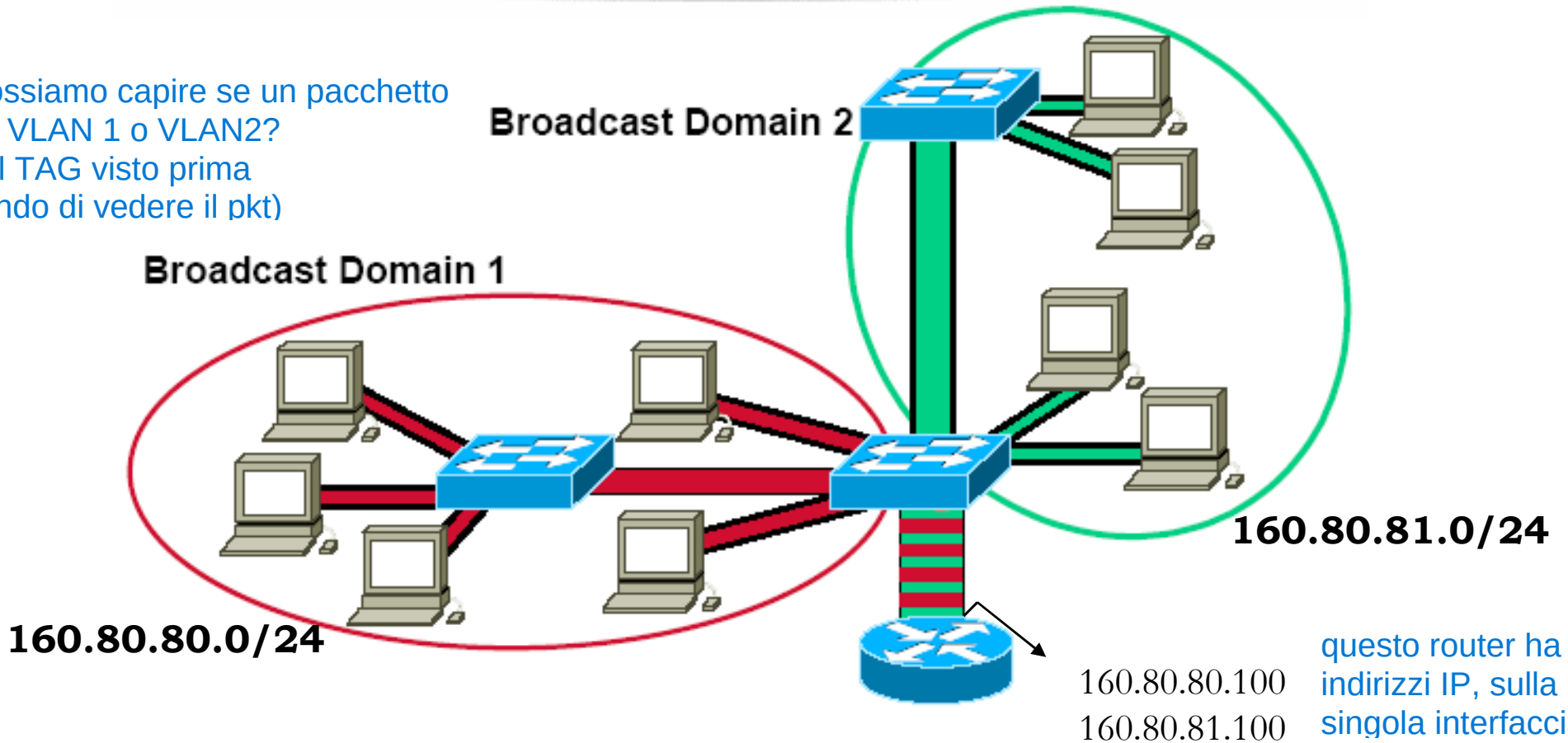


➔ **1 VLAN = 1 IP subnet**
- ⇨ Routers are needed to move frames from different VLANs
- ⇨ Even if STAs are in the same physical network

➔ **Inter-VLAN connectivity through router: improves security**
- ⇨ May apply packet filtering mechanisms such as ACL, etc

VLANs and IP subnets /2

Come possiamo capire se un pacchetto arriva da VLAN 1 o VLAN2?
Usiamo il TAG visto prima (escludendo di vedere il pkt)



questo router ha più indirizzi IP, sulla singola interfaccia

- **Routers for VLAN interconnection may have as little as just one physical interface**
  - ⇨ Also called, in jargon, "one-armed routers"
- **Multiple IP addresses on the single interface**

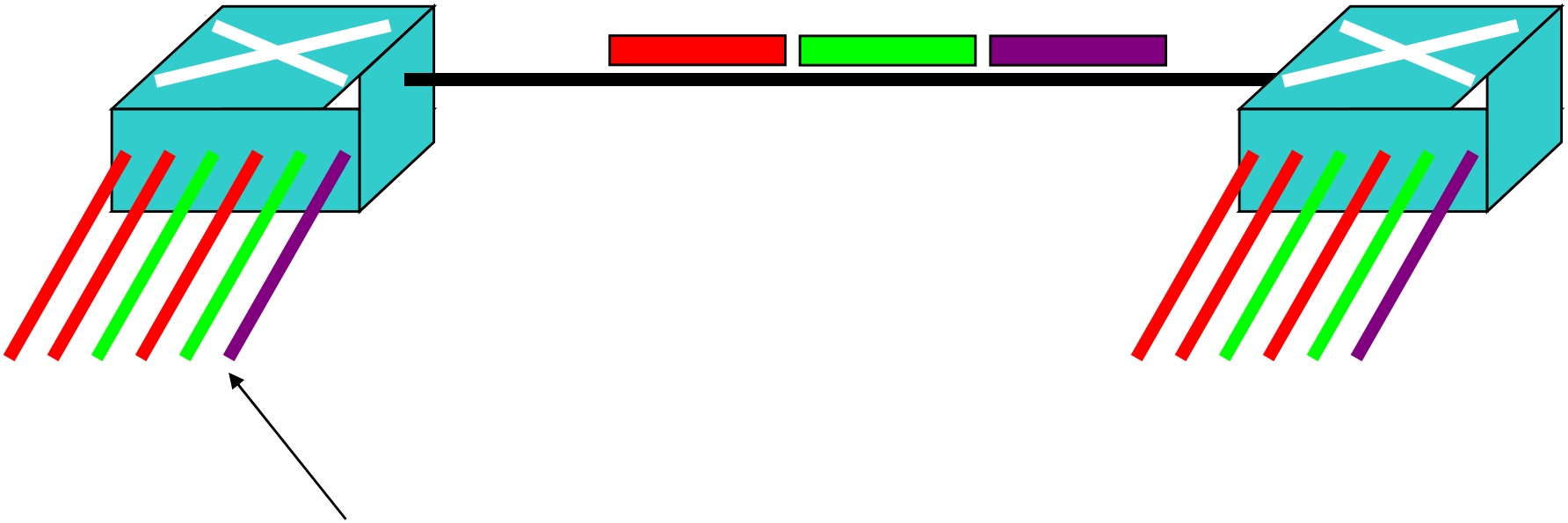
VLAN tagging

TRUNK port è una porta dove pacchetti tra VLAN diverse passano.

Port types

(in realtà potrò avere tagged frame e untagged frame, perchè vlan private)

TRUNK port: transmits and receives tagged frames
i.e. with explicit VLAN membership indication



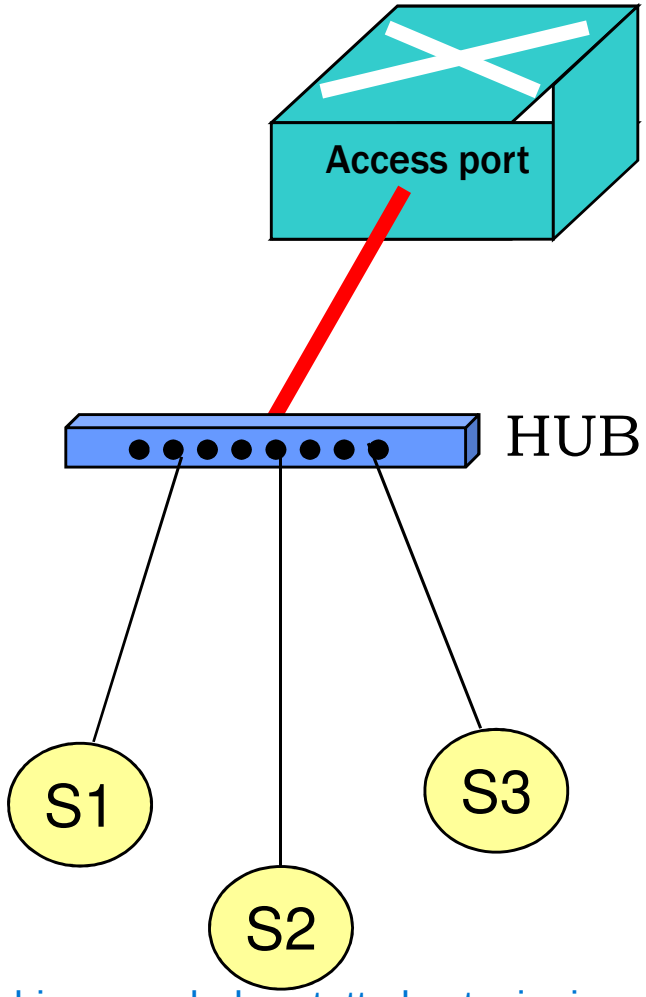
ACCESS port: transmits and receives untagged frames
i.e. with no VLAN membership indication

Solo UNA VLAN, quindi NO TAG.

HYBRID ports: may handle both tagged and untagged frames

Access links

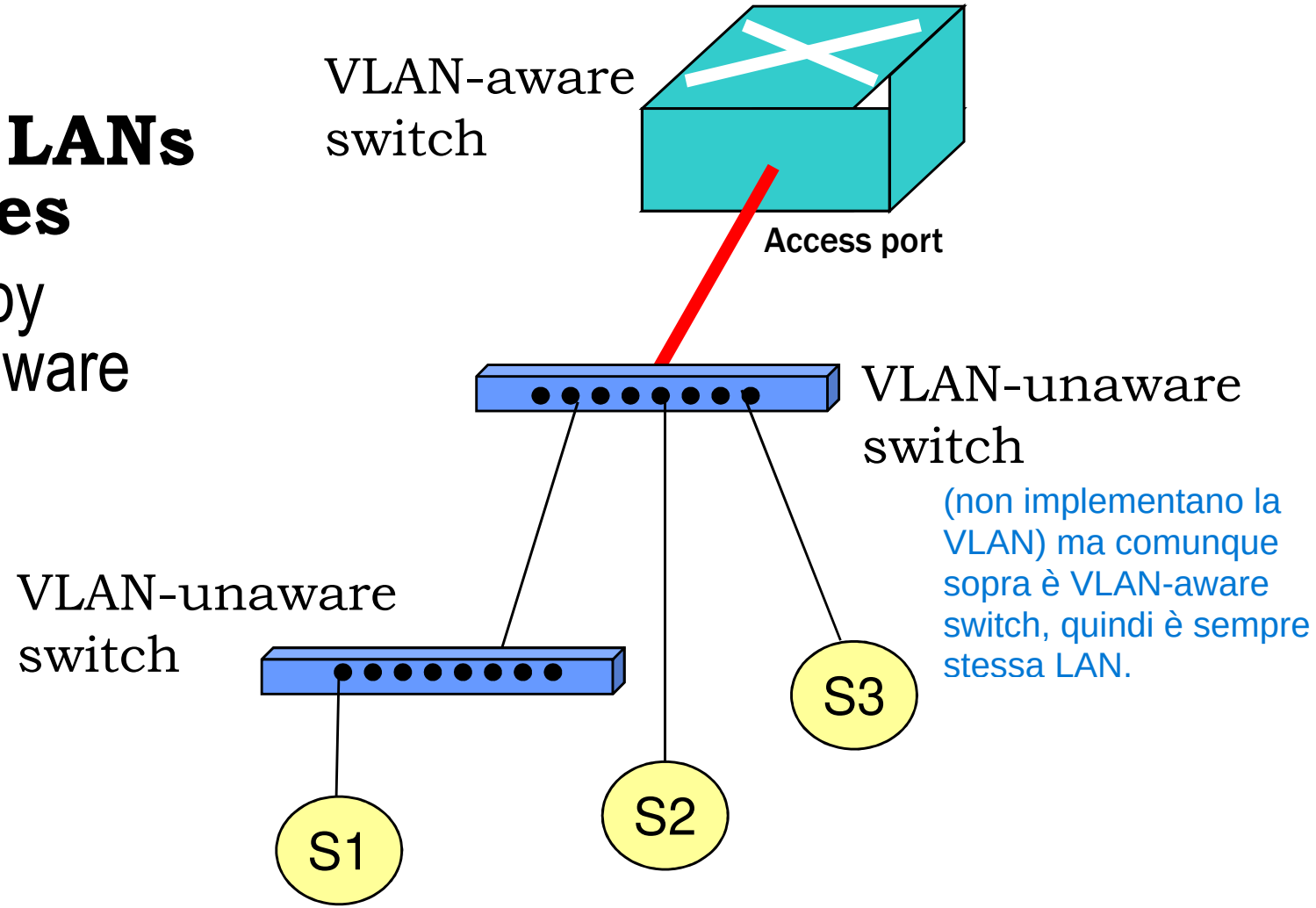
- **A link connected to an access port**
  - Typically the PC-to-switch link
  - or small-hub-to-switch link
- **Connected STAs belong to only 1 VLAN**
- **Connected STAs DO NOT NEED TO KNOW they are on a VLAN**
  - They just assume to be on a dedicated IP subnet
- **TX/RX frames:**
  - standard Ethernet (no QTAG prefix)



Qui abbiamo un hub, e tutte le stazioni connesse all'hub, che a sua volta è collegato da un trunk, appartengono alla stessa VLAN.

Access links (legacy regions)

- **May be switched LANs themselves**
  - Made up by VLAN-unaware switches

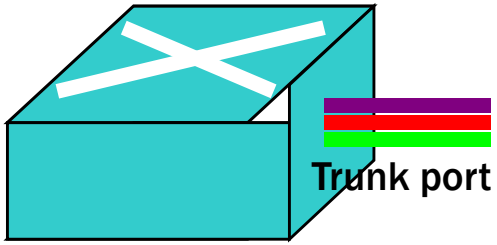


(non implementano la VLAN) ma comunque sopra è VLAN-aware switch, quindi è sempre stessa LAN.

Trunk links

➔ **A link connected to a trunk port**
- ⇨ Typically switch-to-switch or switch-to-router links
- ⇨ frequently server-to-switch link

- ⇨ If PC-to-switch link:
  - → Anarchic VLANs considered



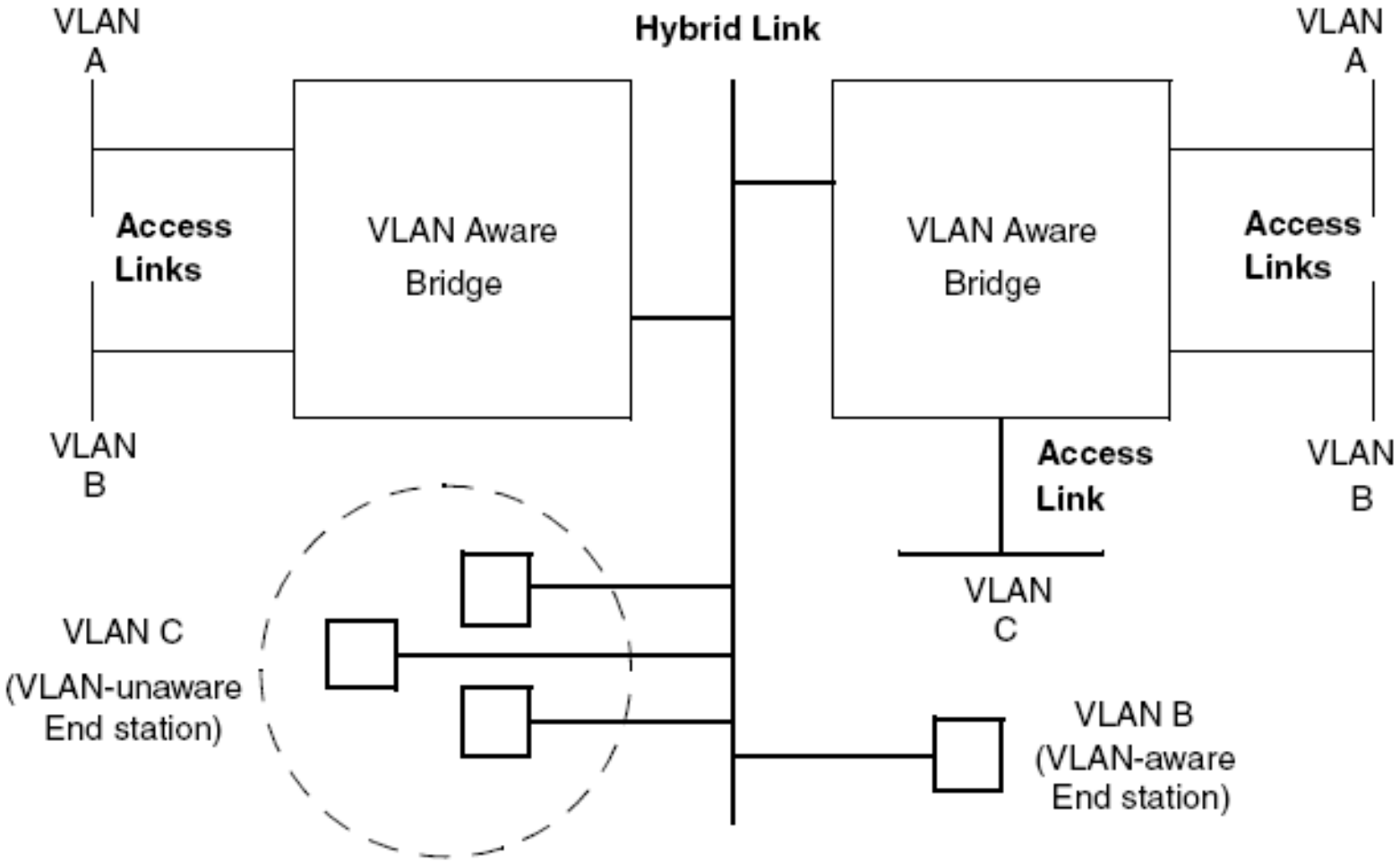
➔ **Support tagged Ethernet frames**
- ⇨ Explicit tagging mechanism to differentiate them

➔ **Does not belong to a VLAN but transport VLAN frames**
- ⇨ Either from all VLANs
- ⇨ Or just from selected VLANs

➔ **However, may belong to a VLAN**
- ⇨ Case of hybrid link
- ⇨ Untagged frames assumed to belong to a VLAN

(alla fine non è così raro) generalmente è la VLAN di default di un trunk, per questo non ha un tag.

Hybrid links

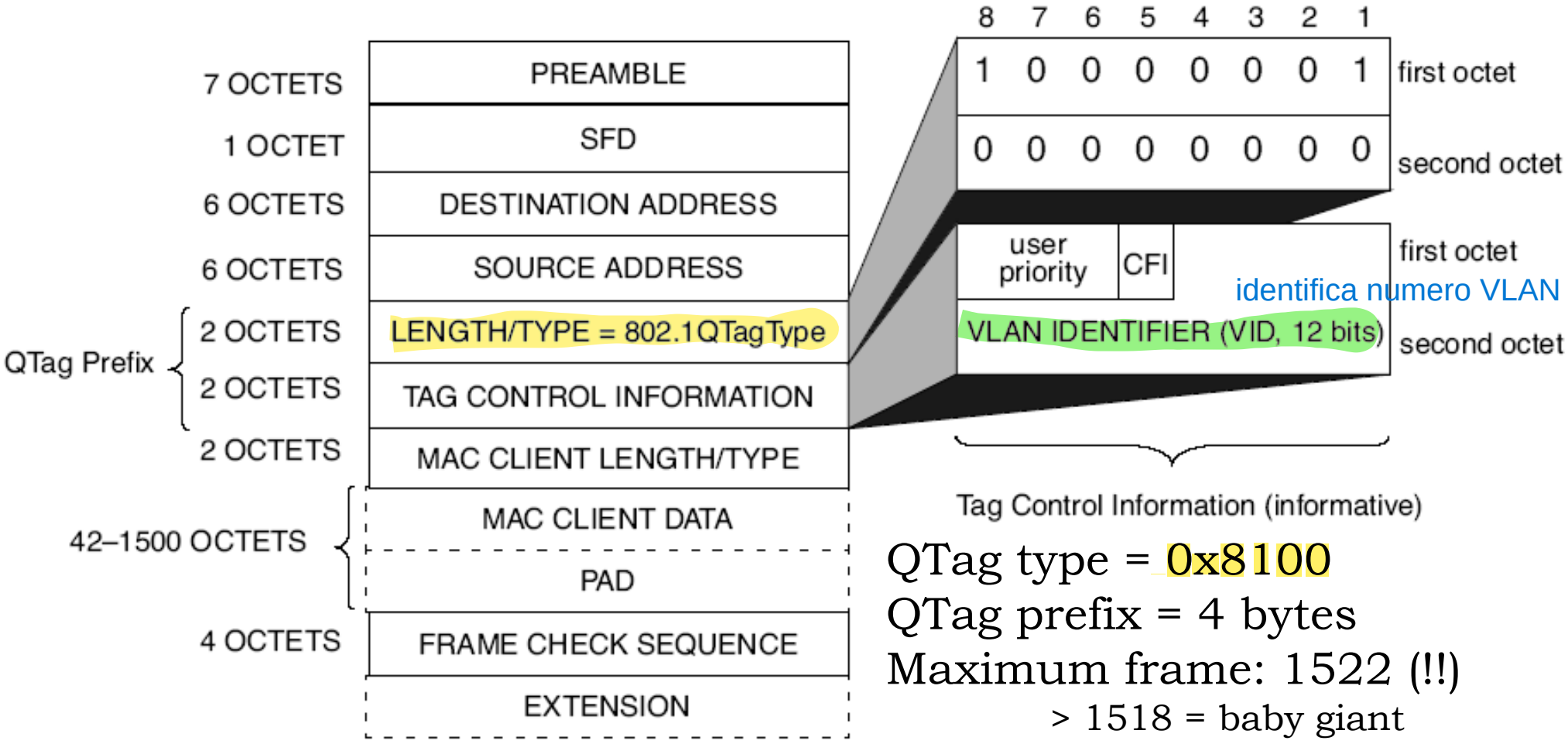


➔ **Support both tagged and untagged Ethernet frames**

⇨ Untagged frames belong to the same VLAN (in the example, VLAN C)

⇨ Modern understanding and implementations: all links are of hybrid type…

Ethernet Frame format for VLAN (802.3ac, 1998)



QTag type = 0x8100

QTag prefix = 4 bytes

Maximum frame: 1522 (!!)

> 1518 = baby giant

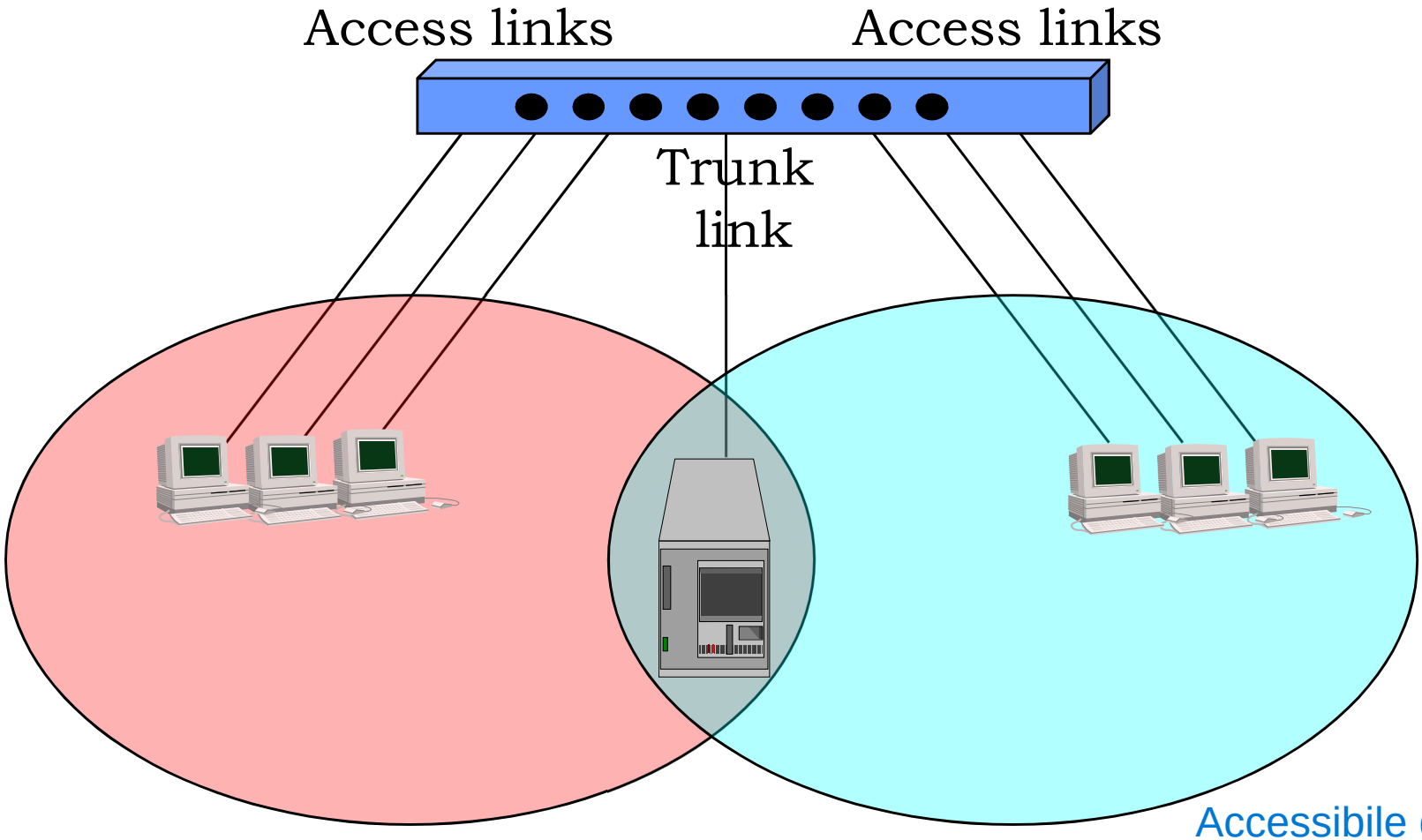
User Priority (802.1p)

SKIP

0	BE	Best Effort (default)
1	BK	Background
2	---	Unspecified
3	EE	Excellent Effort
4	CL	Controlled Load
5	VI	Video < 100ms latency/jitter
6	VO	Voice < 10 ms latecny/jitter
7	NC	Network Control

Managed via separated output queues
- typically with priority queueing
- but more complex scheduling mechanisms can be used

May a station belong to more than 1 VLAN?



Yes! (typical case: servers)

Accessibile da entrambe, quindi deve stare nel trunk link