VLANs

Area de Ingeniería Telemática
http://www.tlm.unavarra.es

Redes
4º Ingeniería Informática

Temario

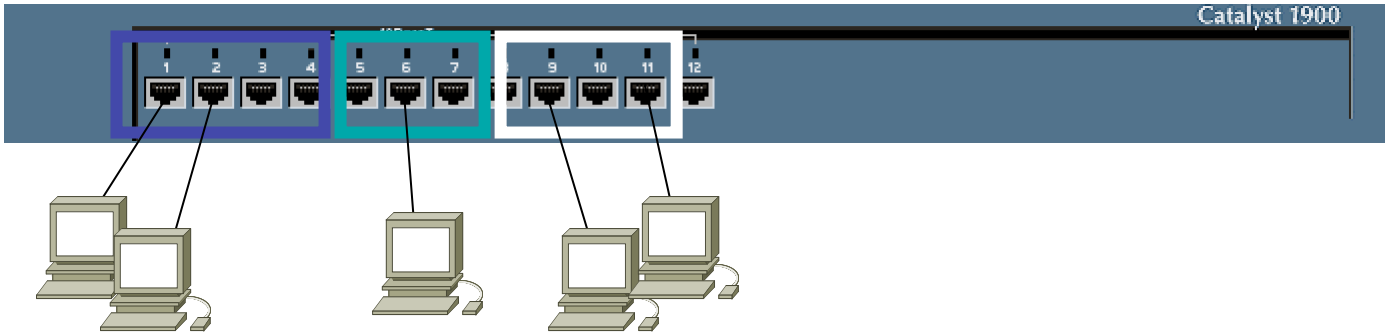
1. Introducción a las redes
2. Encaminamiento
3. Transporte extremo a extremo
4. Arquitectura de conmutadores de paquetes
5. **Tecnologías para redes de área local**
6. Tecnologías para redes de área extensa y última milla
7. Conmutación de circuitos

Objetivos

- Conocer el modo de funcionamiento de los conmutadores Ethernet con soporte de VLANs
- Saber predecir el camino que seguirán paquetes IP en una red Ethernet con VLANs interconectadas por routers

VLANs en un conmutador

- Conmutador que se comporte como varios
- Crea diferentes dominios de broadcast
- Cada uno es una *Virtual Local Area Network* (en realidad sería una *Virtual Bridged LAN*)



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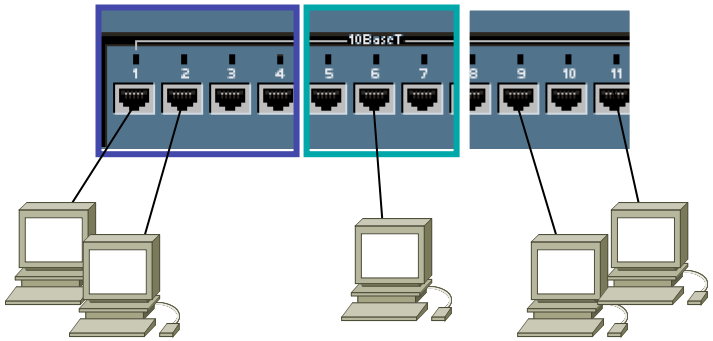

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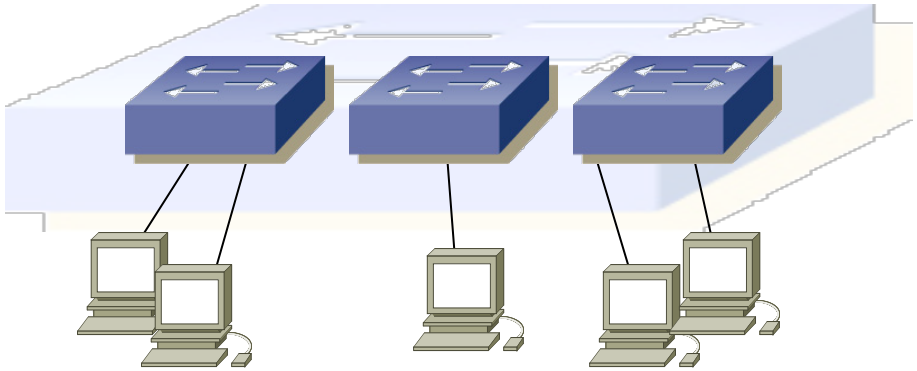
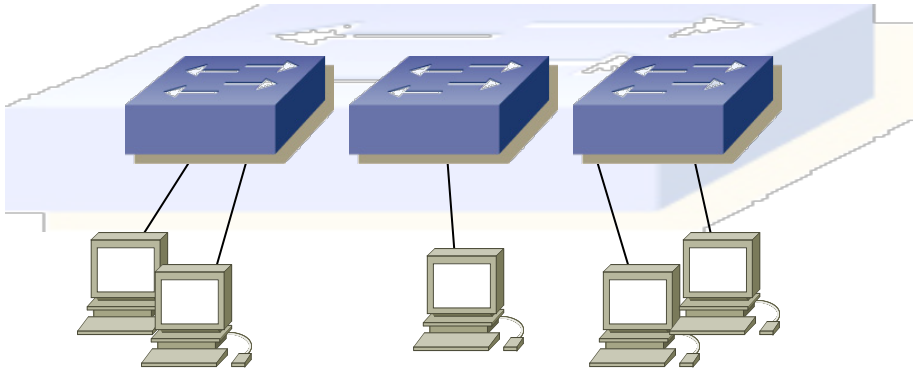


VLANs en un conmutador

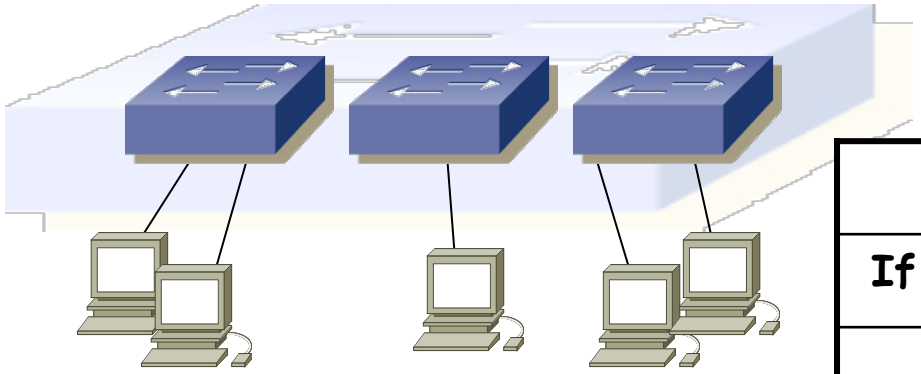
- Se implementa con una base de datos de filtrado que aprende información para cada VLAN (...)

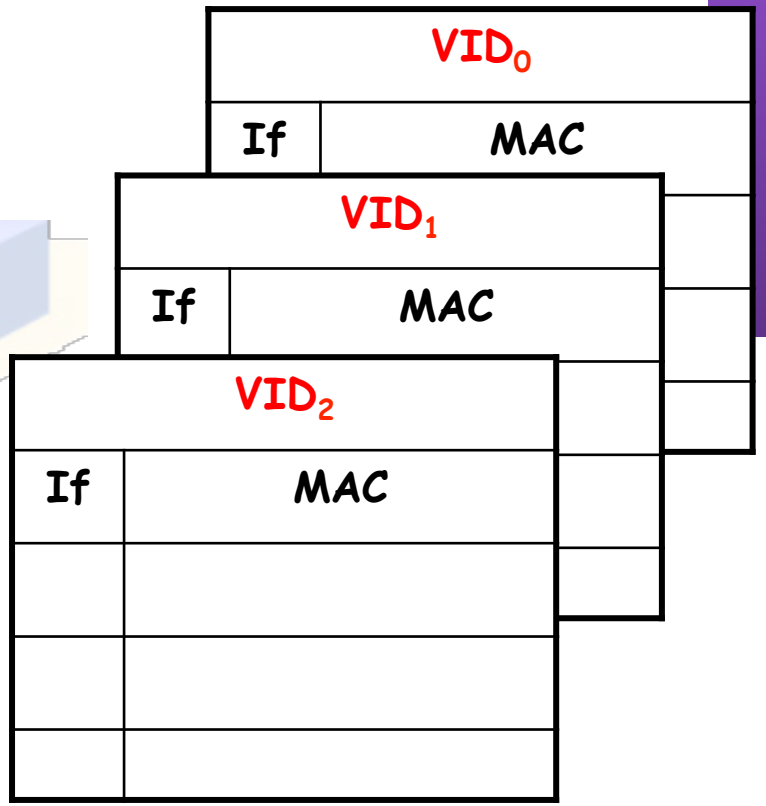


VID	If	MAC

VLANs en un conmutador

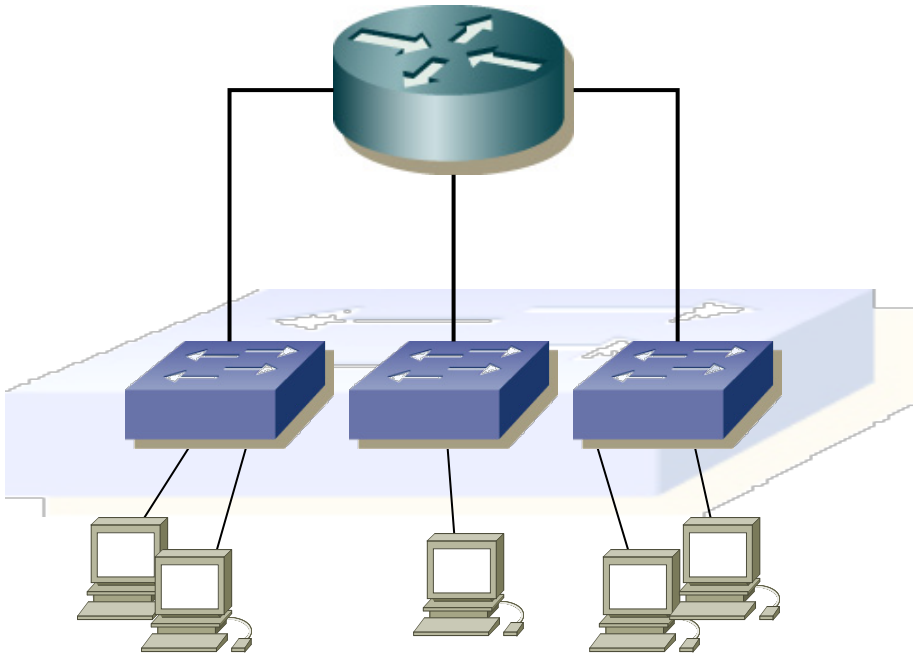
- Se implementa con una base de datos de filtrado que aprende información para cada VLAN (...)
- O se puede entender como una tabla por VLAN





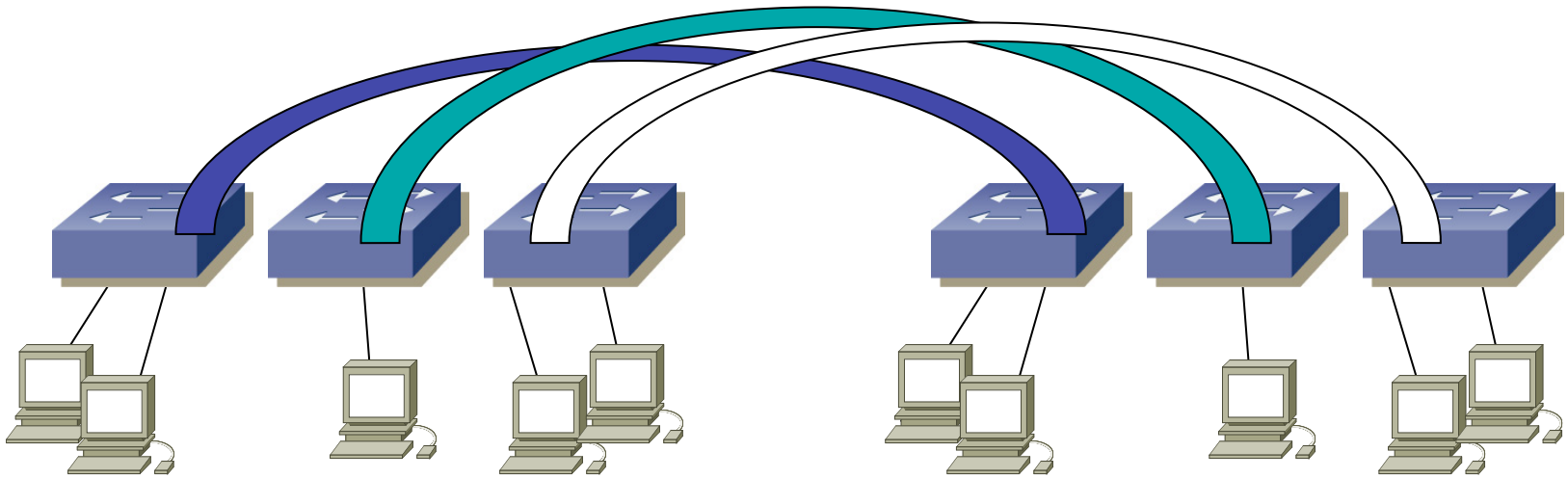
¿Comunicación entre VLANs?

- Con Routers



VLANs entre conmutadores

- ¿Podemos interconectar las VLANs de diferentes conmutadores? (…)



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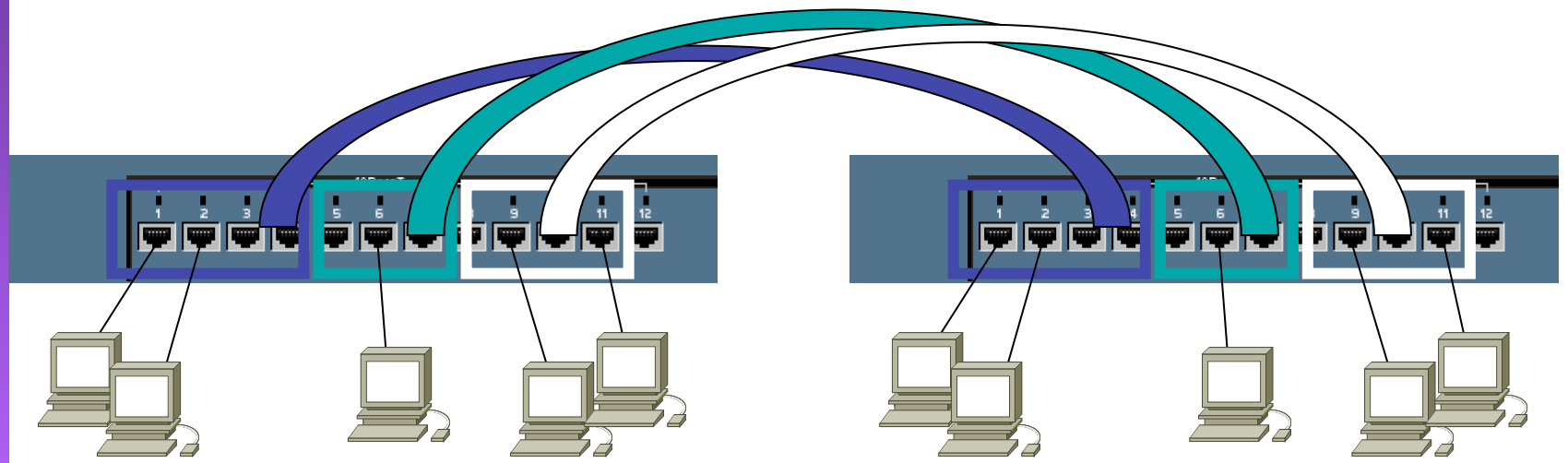
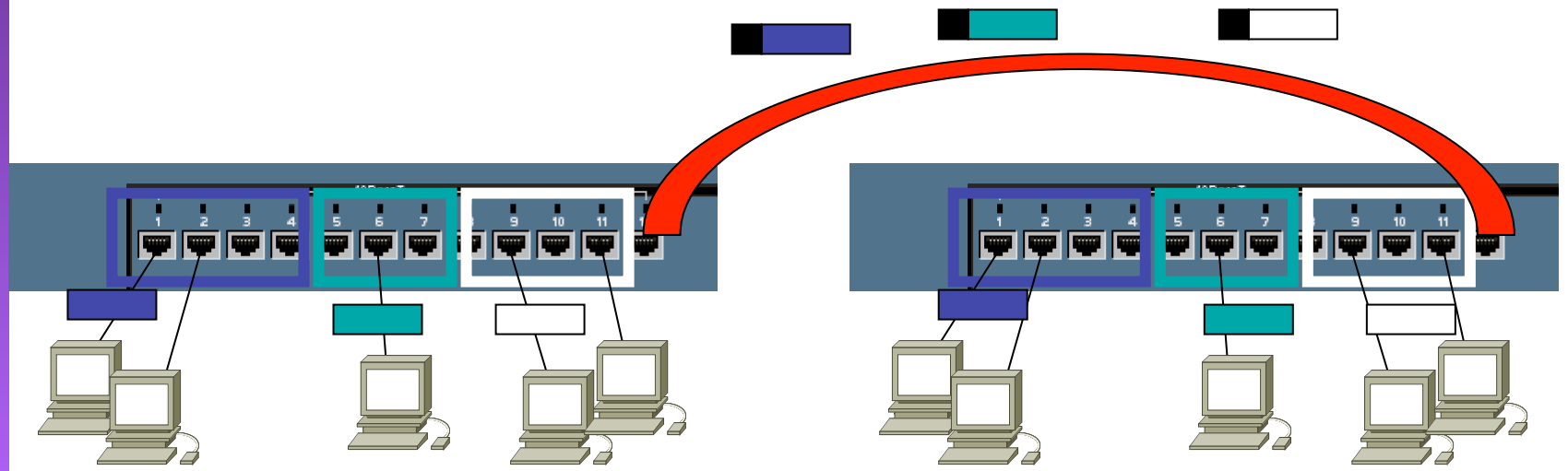


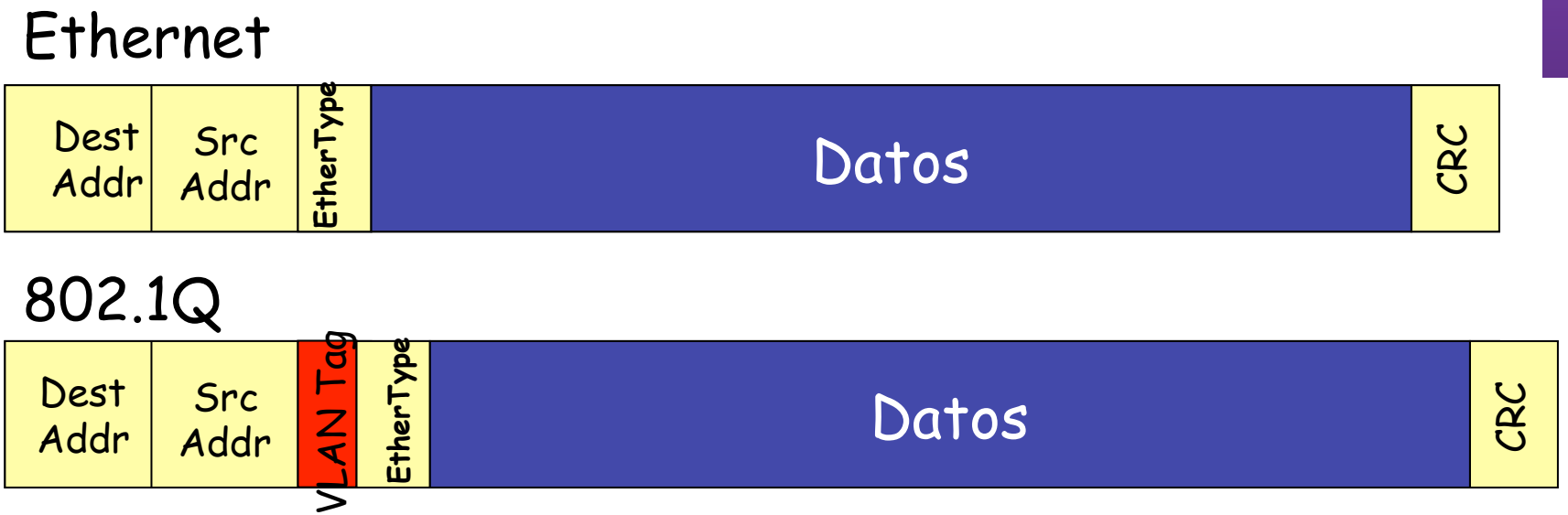
VLANs entre conmutador

- ¿Y con un solo enlace? (…)
- Encapsulado 802.1Q (… …)



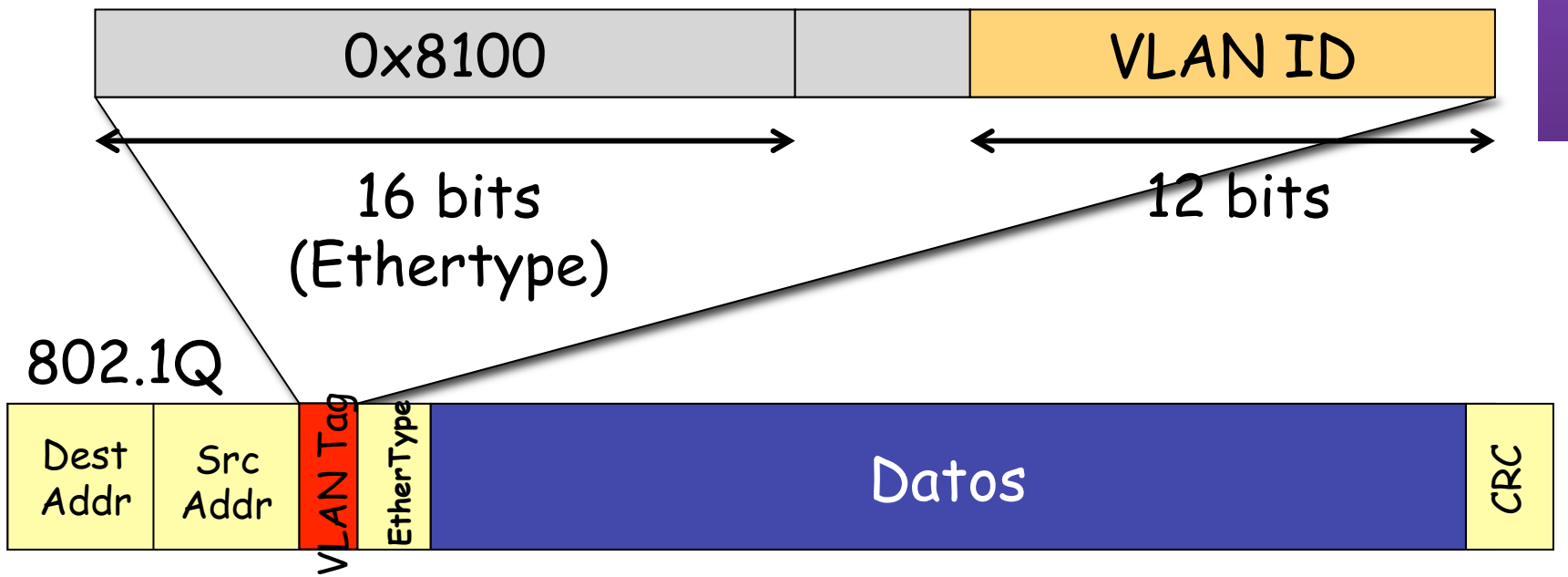
Trunking 802.1Q

- Un enlace 802.1Q emplea un etiquetado adicional
- *Tag* de 4 bytes
- Se recalcula el CRC



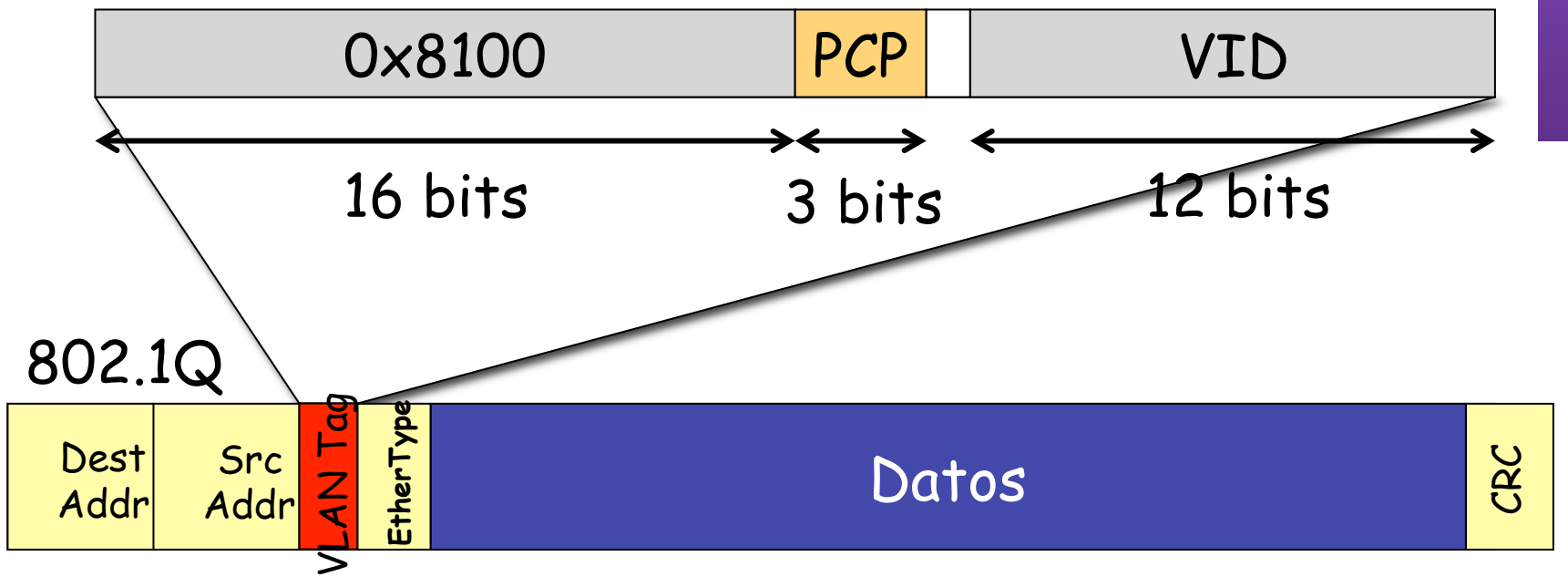
Trunking 802.1Q

- VLAN-ID (VID) de 12 bits (1-4094)
- Manteniendo la MTU aumenta el tamaño máximo de la trama 1518 → 1522 bytes
- El tamaño mínimo puede subir a 68 o quedarse en 64 bytes



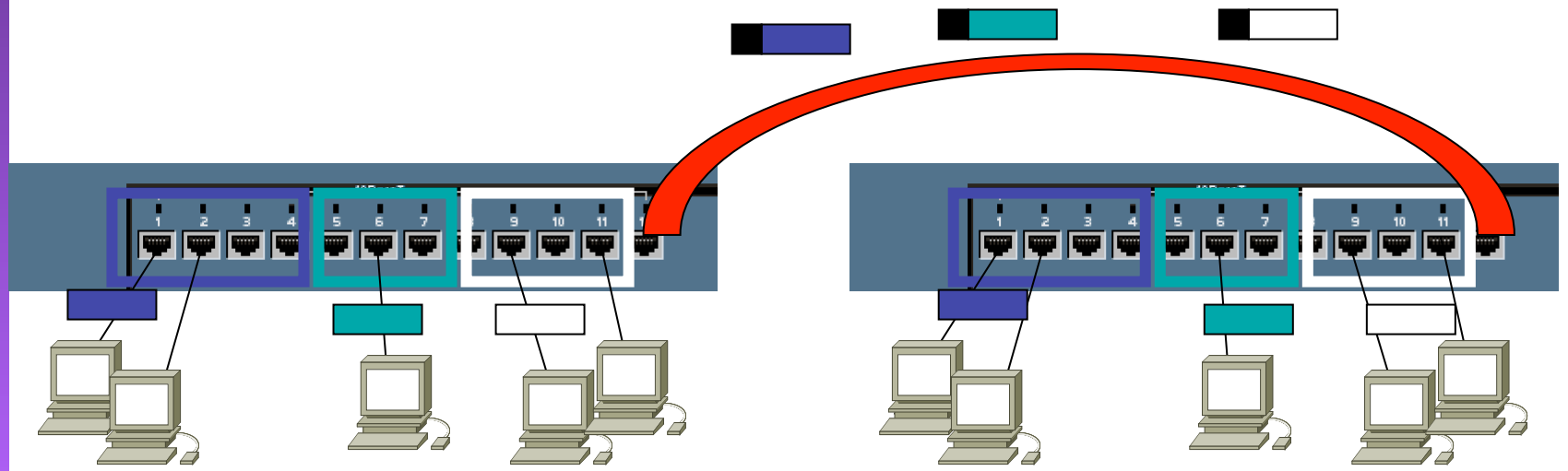
Frame Priority

- IEEE 802.1p (ahora parte de 802.1D)
- Classes of Service (CoS)
- PCP = Priority Code Point
- Permite aplicar técnicas de planificación
- Si VID=0 solo se indica la prioridad



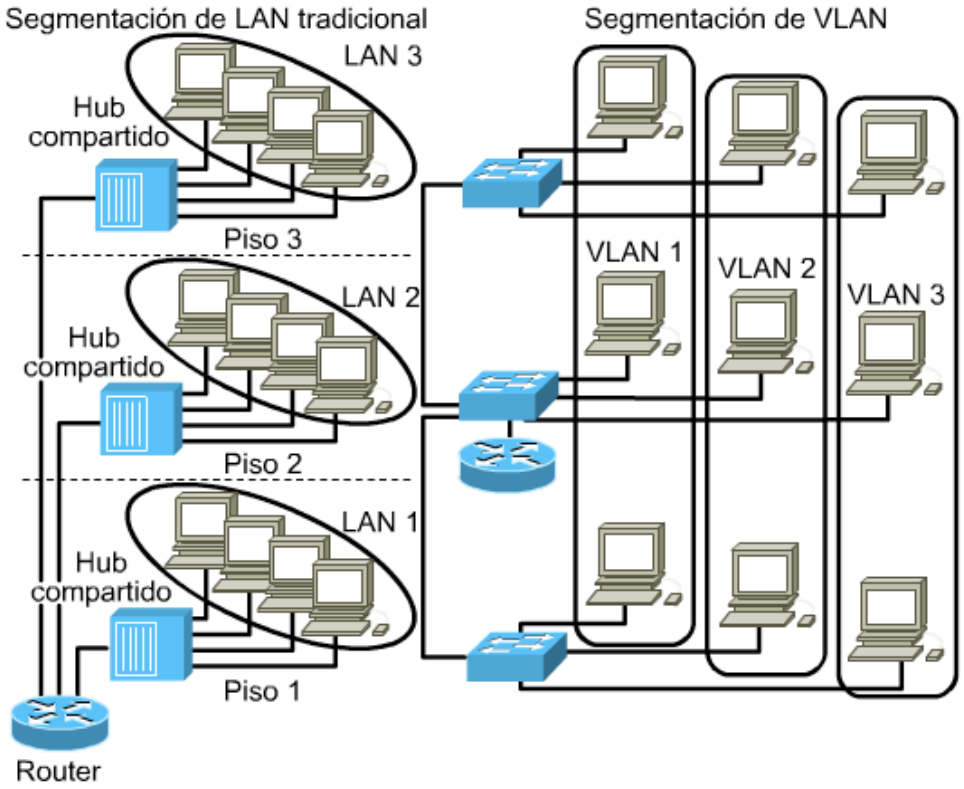
PVID

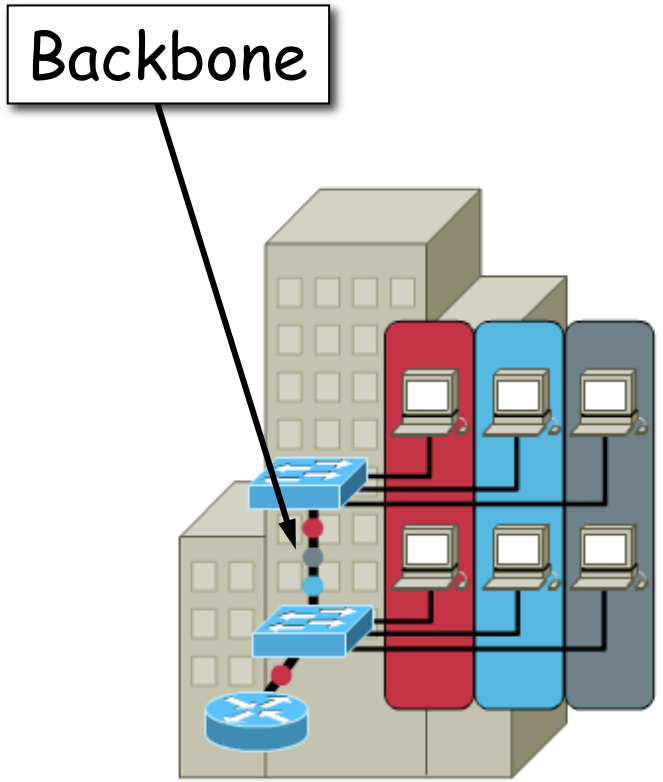
- Port VLAN ID
- Configurado uno para cada puerto
- Tramas sin etiquetado 802.1Q recibidas por el puerto pertenecen a la VLAN de ID el PVID del puerto
- En un enlace de trunk algunos fabricantes la llaman la VLAN *nativa*



Ventajas

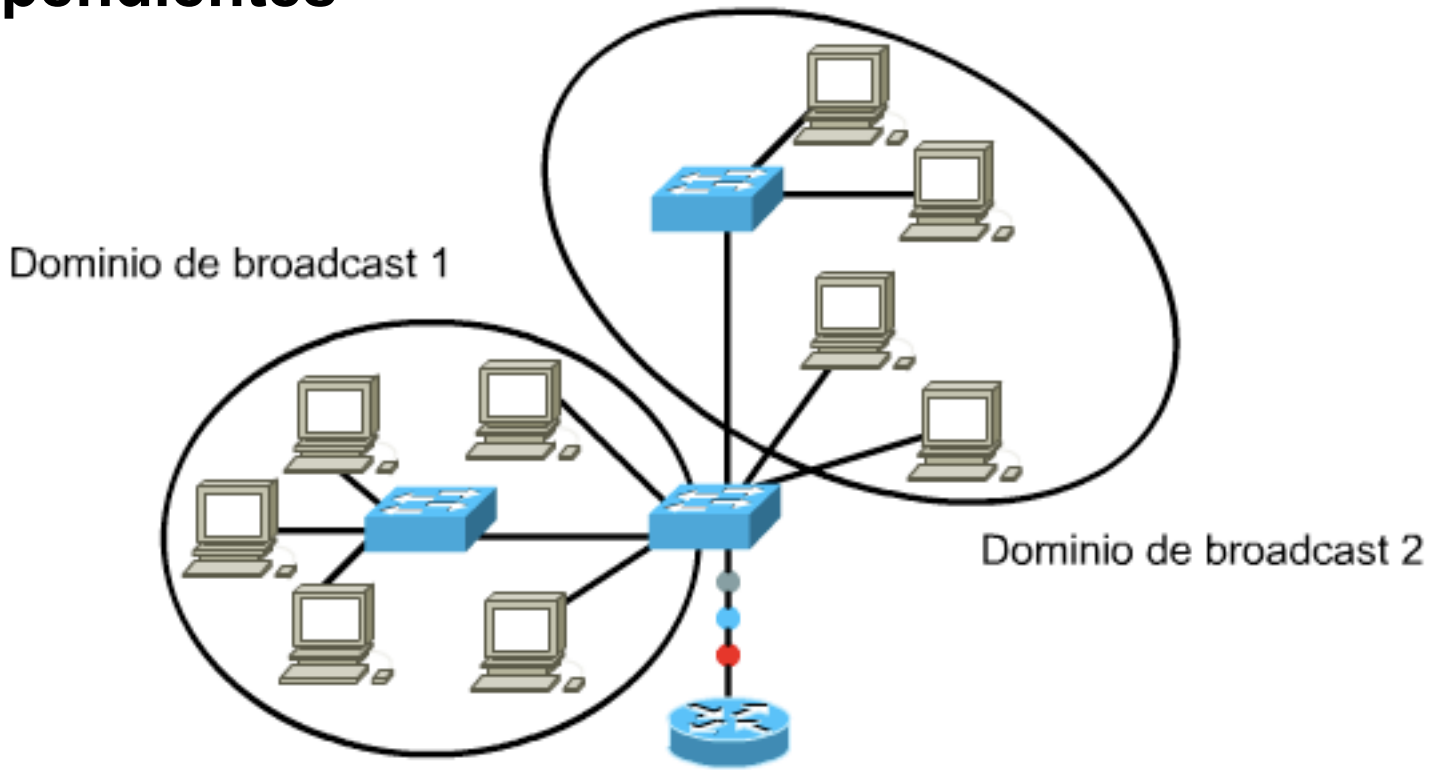
- Agrupar usuarios por departamento, equipo, aplicación… independiente de la ubicación
- Eliminar los límites físicos
- Movilidad
- Los routers suministran la comunicación entre las VLANs





Ventajas

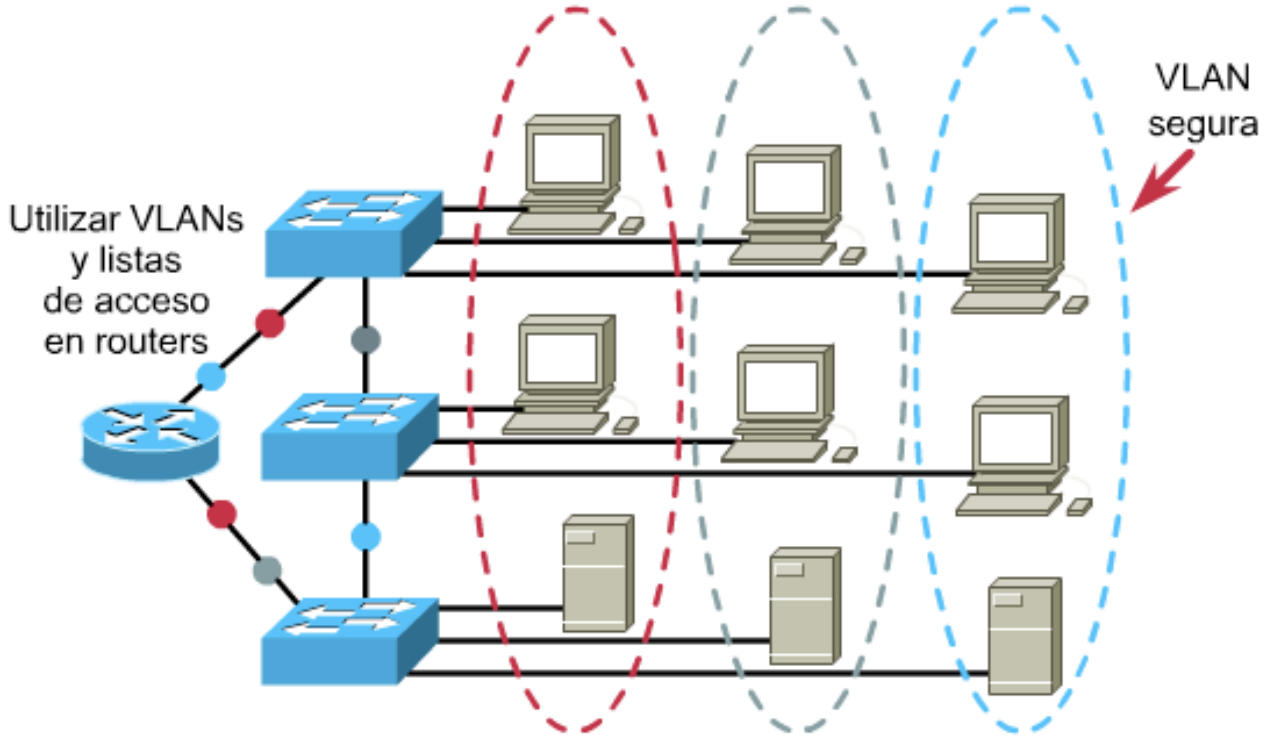
- En red plana: baja latencia y fácil de administrar
- Sin embargo el tráfico de broadcast crece con el número de hosts
- Las VLANs son **dominios de broadcast independientes**



Ventajas

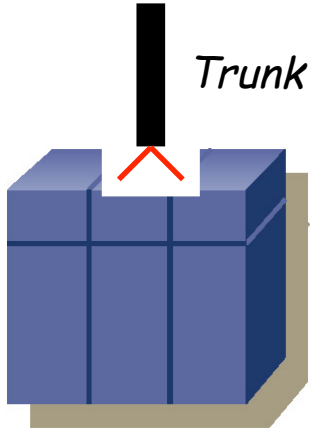
Seguridad

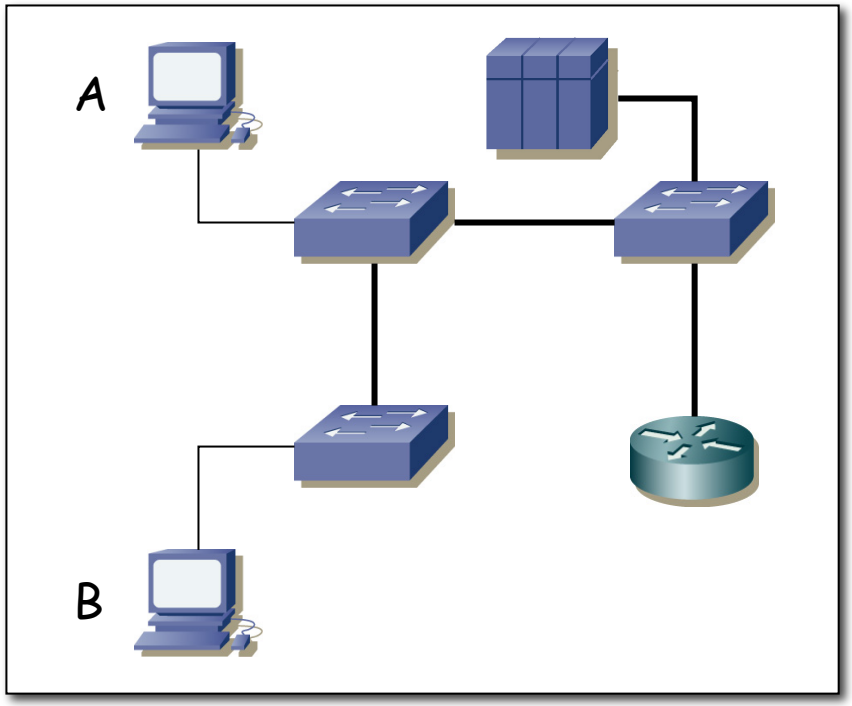
- Aplicaciones sensibles en una VLAN
- Controlar el acceso a la misma
- Puertos sin usar: en una VLAN separada
- El router puede controlar la comunicación entre VLANs

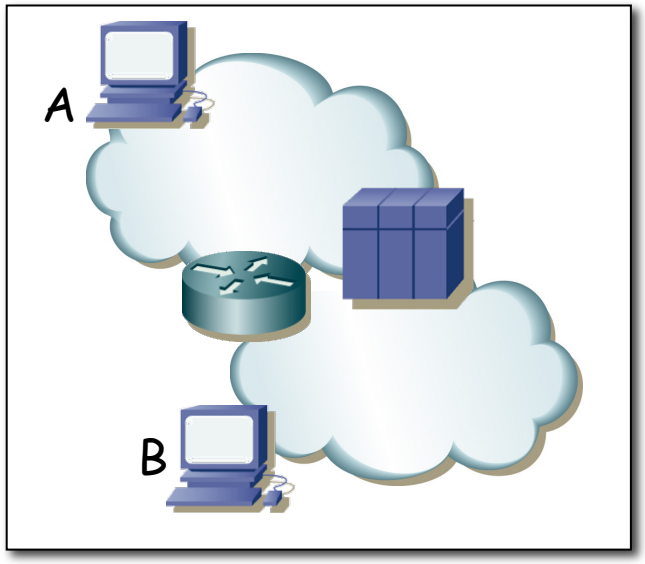


Ejemplo

- Trunk a un servidor
- 1 interfaz físico, 2 interfaces lógicos
- El servidor en ambas VLANs

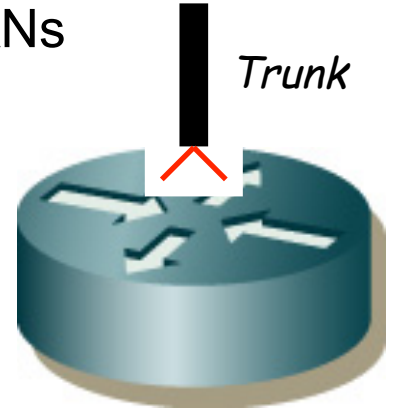


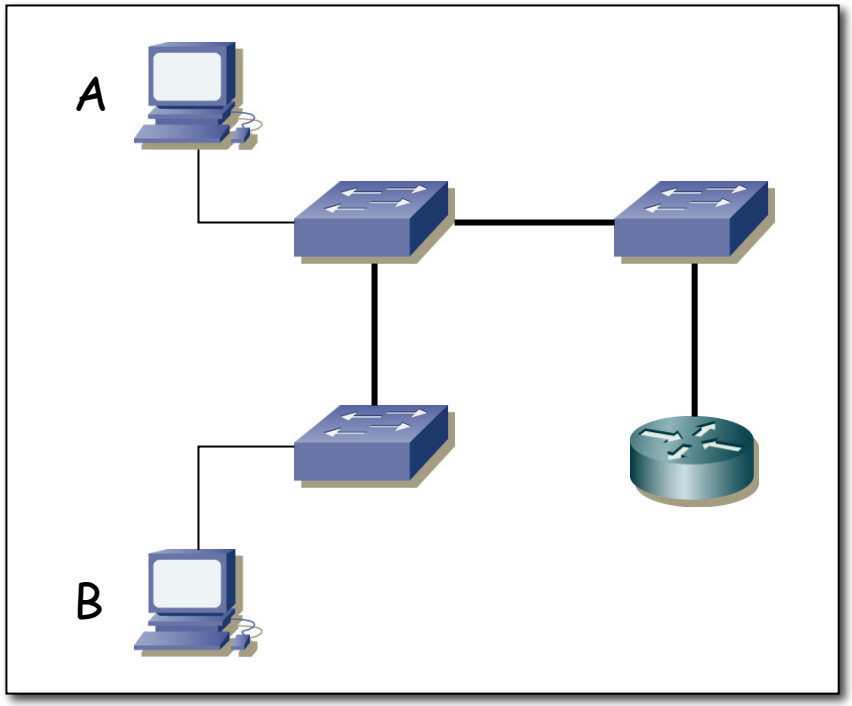


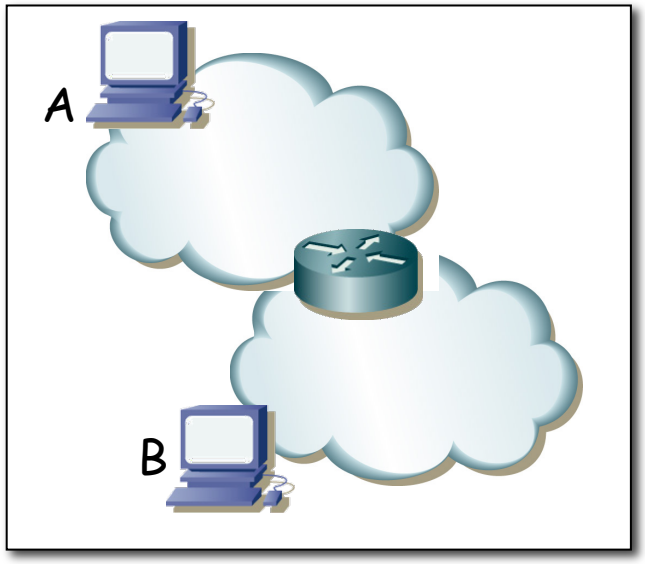


VLANs en interfaces: Ejemplo

- 2 VLANs
- Enlace de *trunking* al router con ambas VLANs
- Router: 1 interfaz físico, 2 lógicos
- VLAN 1: PC A y Router (if0)
- VLAN 2: PC B y Router (if1)

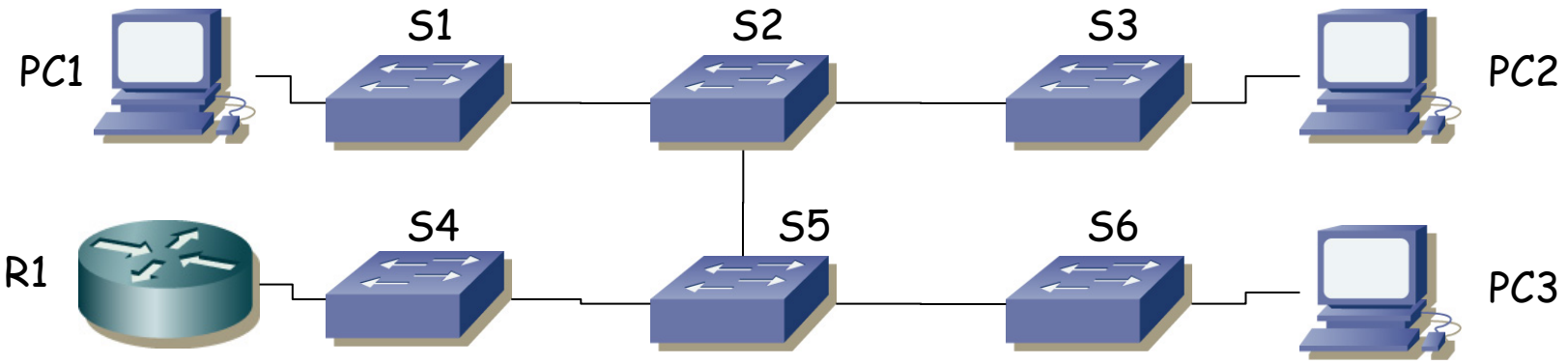






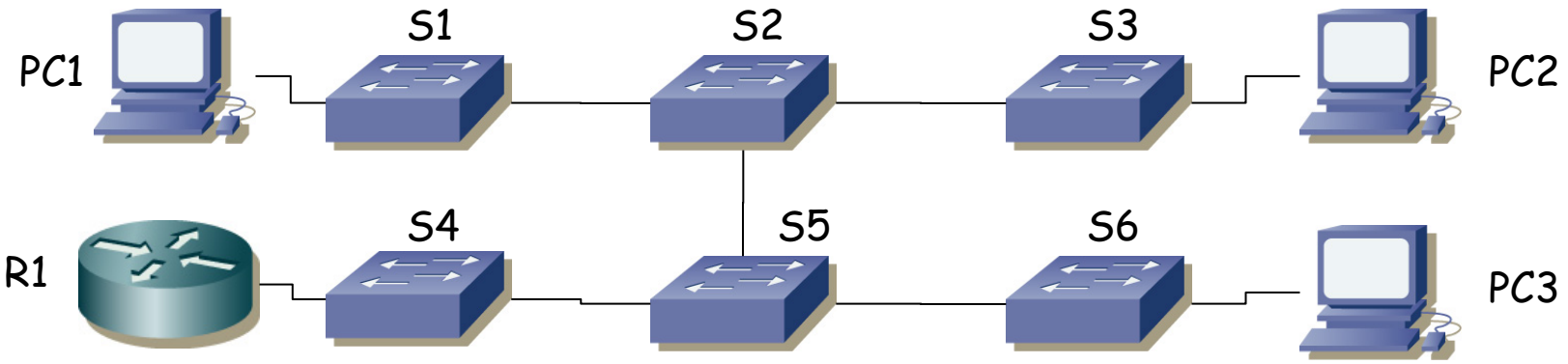
Ejercicio

- Máquinas con tablas vacías
- Vea qué sucede ante cada una de estas tramas:
  - PC1 envía trama broadcast
  - PC1 envía trama a PC2
  - PC1 envía otra trama a PC2
  - PC2 envía trama a PC3
  - PC1 envía trama a PC3
  - PC1 envía trama a PC2
  - PC2 envía trama broadcast
  - PC3 envía trama a PC2



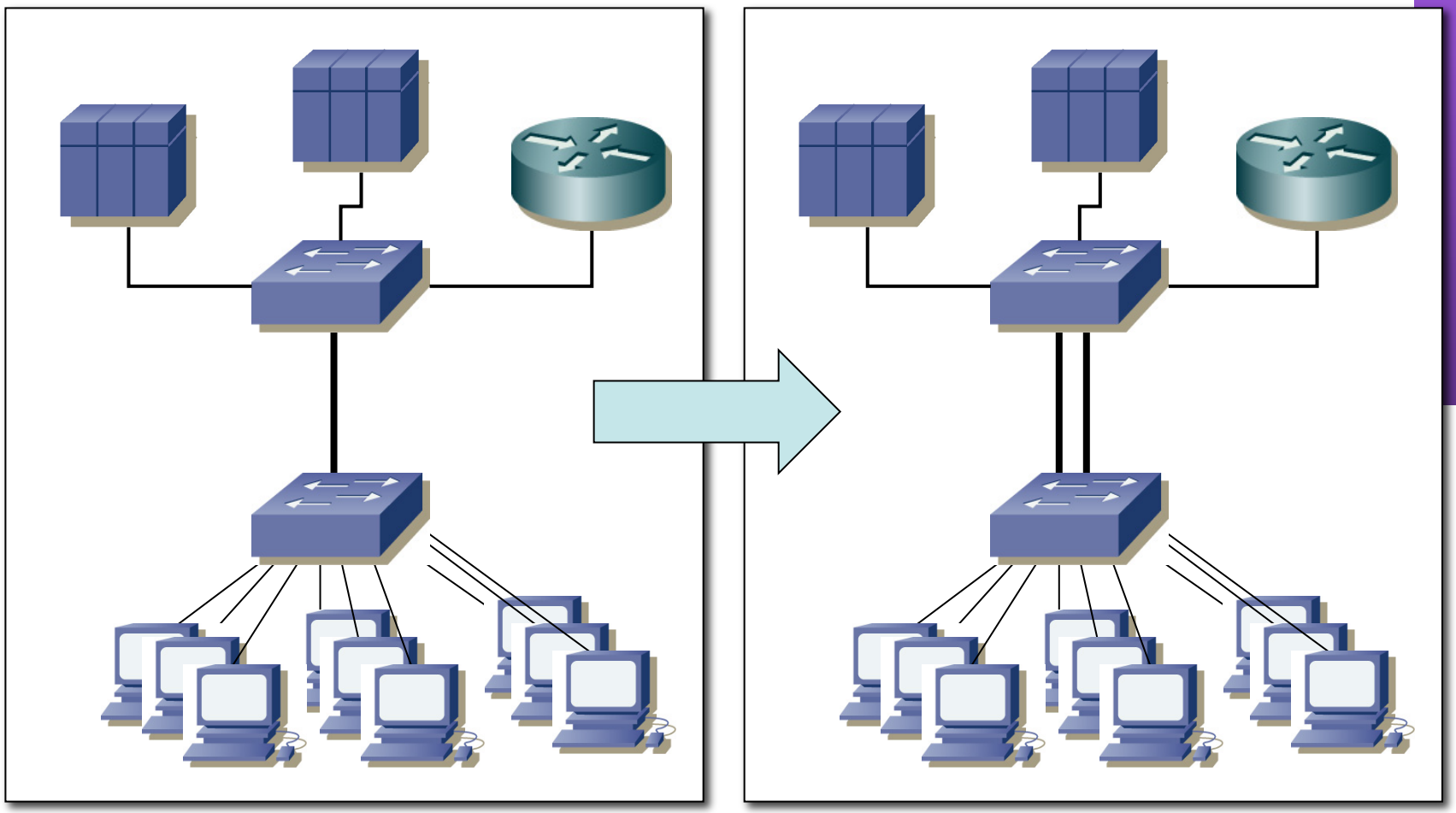
Ejercicio

- Máquinas con tablas vacías. 2 VLANs que aprenden **independientemente**
- PC1 y PC2 en VLAN1, PC3 en VLAN2, R1 interfaz con 802.1Q y un interfaz lógico en cada VLAN (if0,1 en VLAN1 e if0,2 en VLAN2)
- Enlaces entre switches 802.1Q permiten pasar ambas VLANs
- Qué sucede ante estas tramas:
  - PC1 envía trama broadcast
  - R1 envía trama a PC1
  - PC1 envía trama a if0,1
  - R1 if0,2 envía trama a broadcast
  - PC2 envía trama a if0,1
  - PC3 envía trama a if0,2
  - R1 if0,2 envía trama a PC3
  - PC1 envía trama a PC3



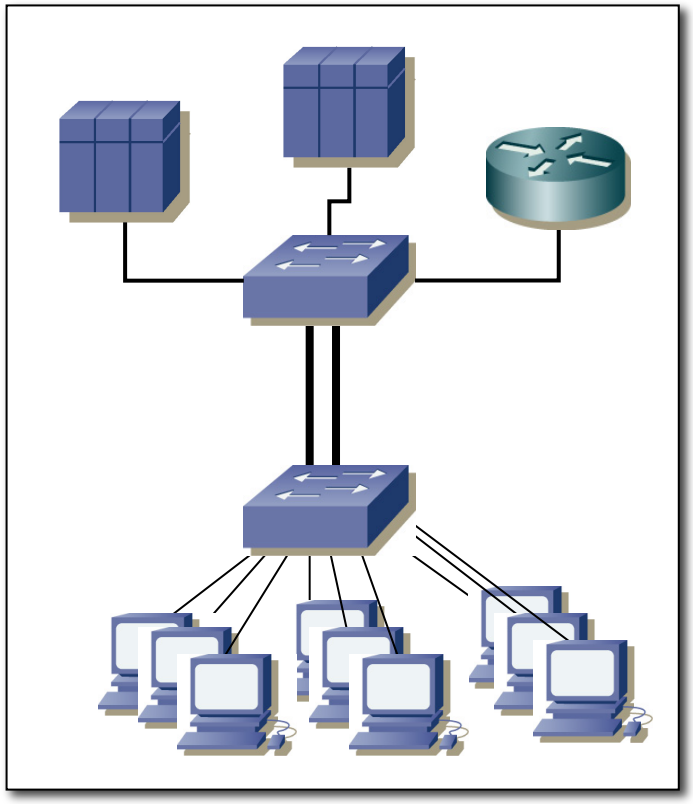
Link Aggregation

- IEEE 802.3ad
- Ahora 802.1AX



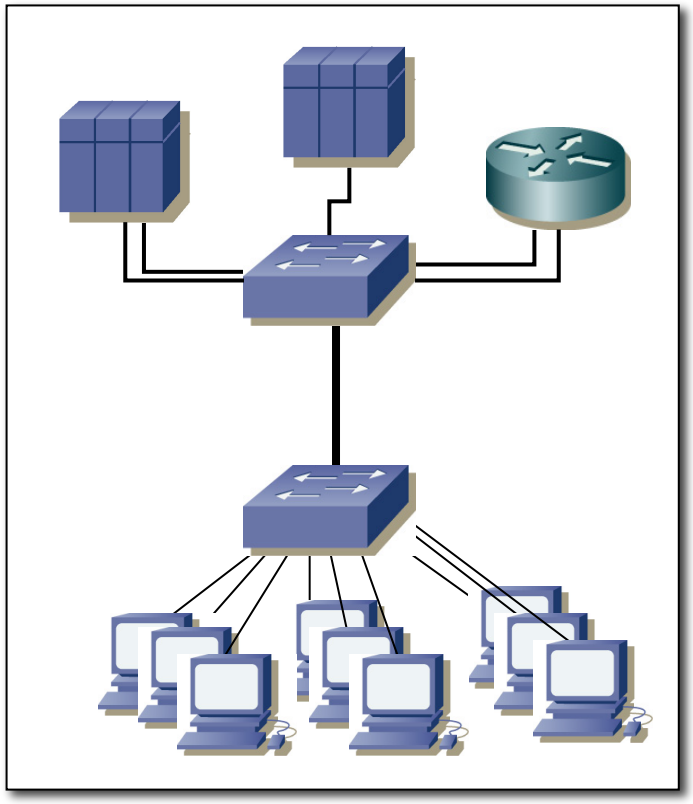
Link Aggregation

- Tipos de agregación:
  - *Switch-to-switch*



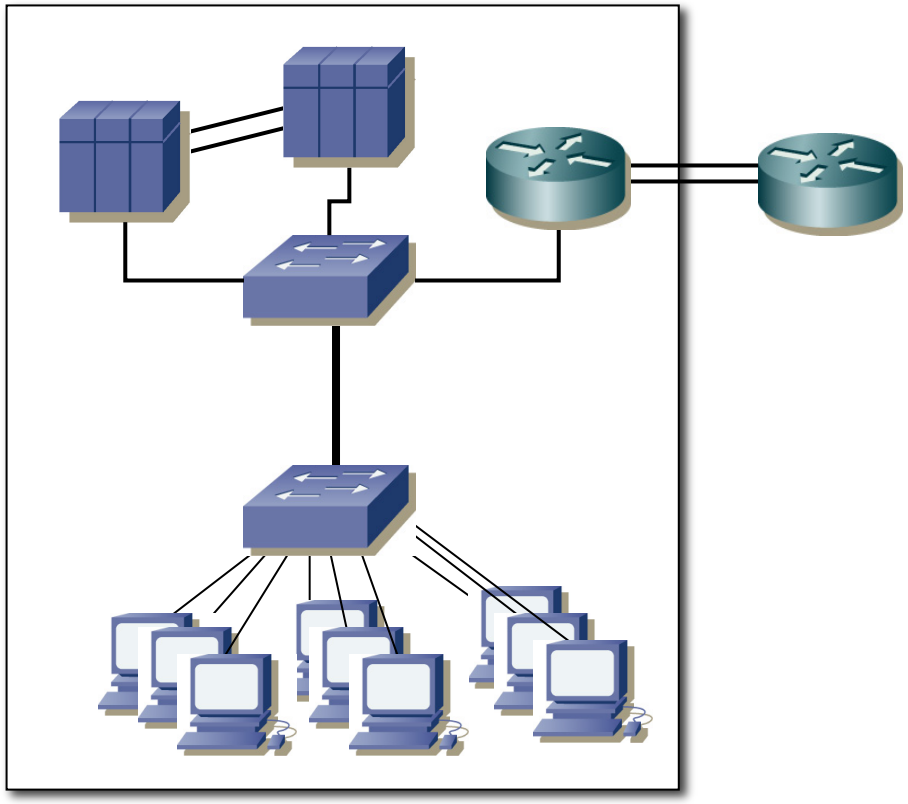
Link Aggregation

- Tipos de agregación:
  - *Switch-to-station*



Link Aggregation

- Tipos de agregación:
  - *Station-to-station*



Link Aggregation

- Implementado entre el subnivel MAC y el LLC
- Los enlaces se agregan en Grupos
- El agregado: como un solo interfaz
- Conversación: tramas de la misma MAC→MAC y prioridad
- Mantiene el orden de las tramas de la misma conversación
- ¿Cómo? (…)

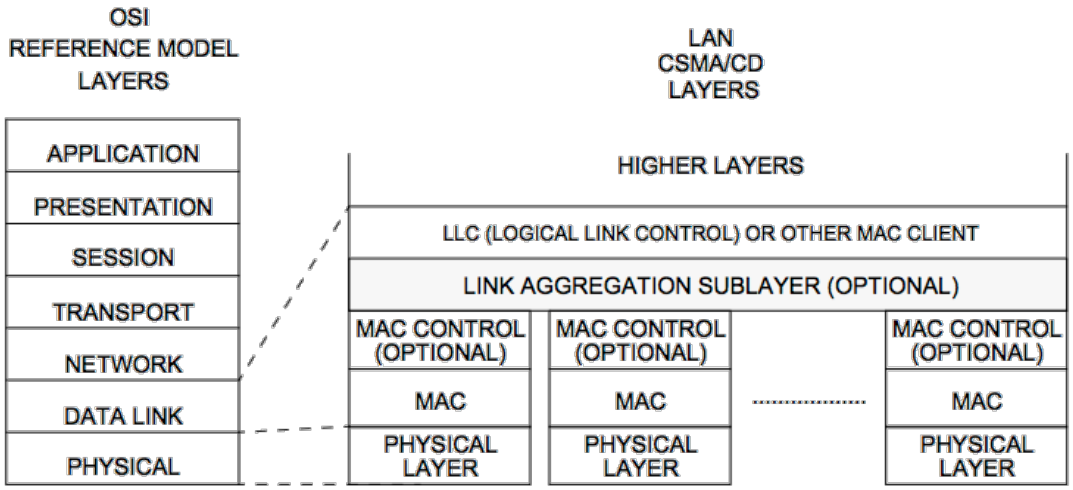
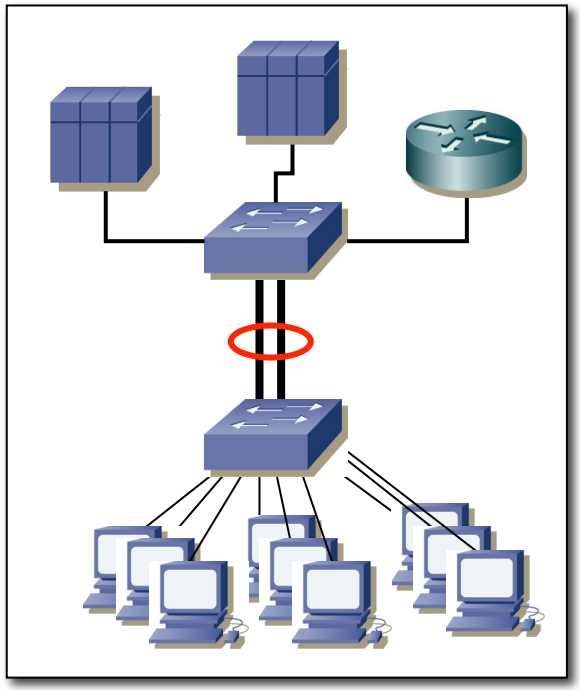


Figure 5–2—Architectural positioning of Link Aggregation sublayer

IEEE 802.1AX



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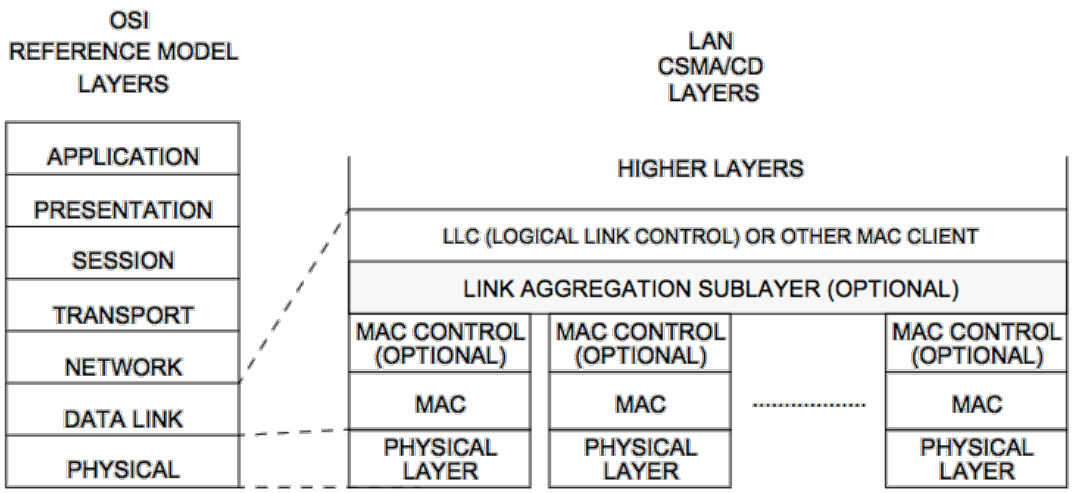
- ¿Cómo? Mandándolas siempre por el mismo enlace del grupo



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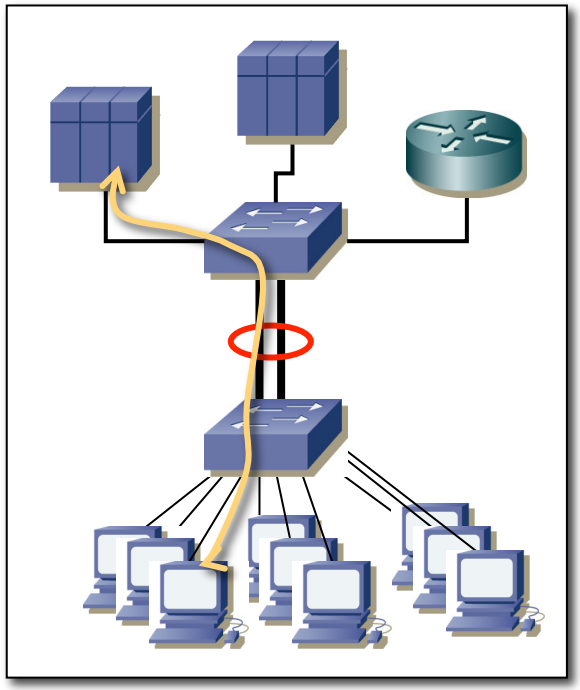
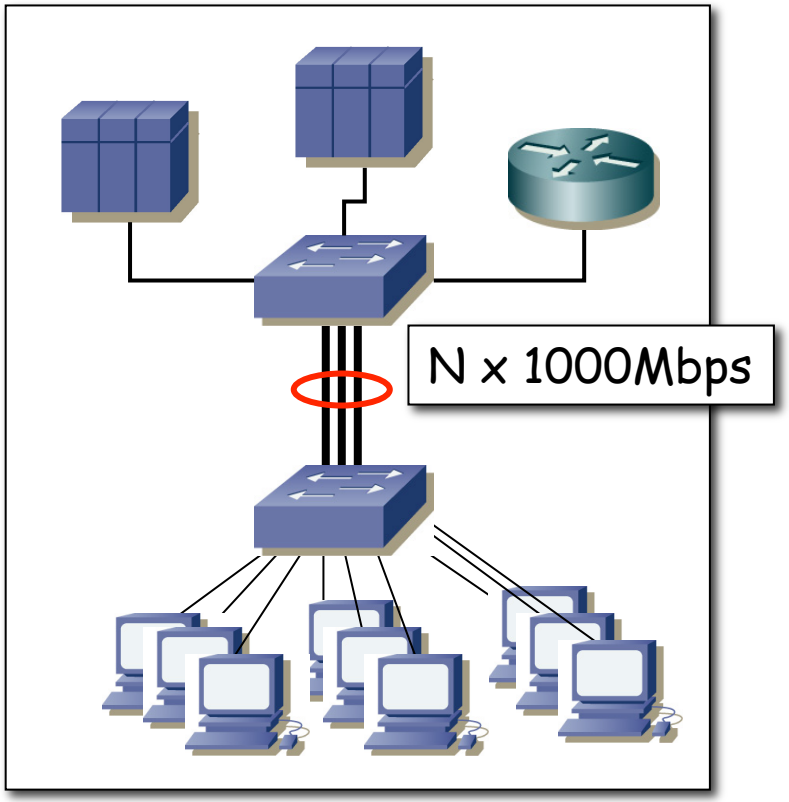


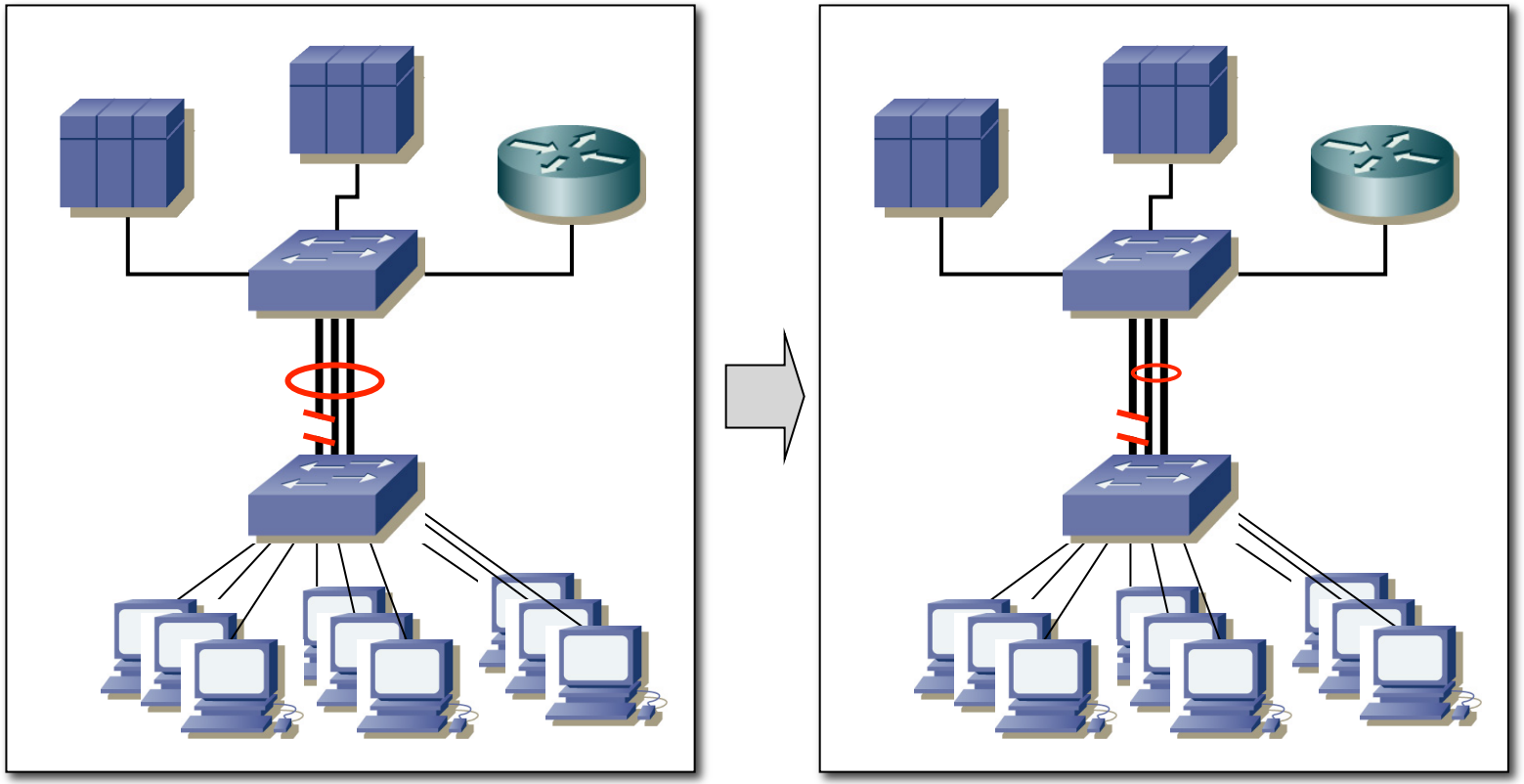
Link Aggregation

Mayor ancho de banda



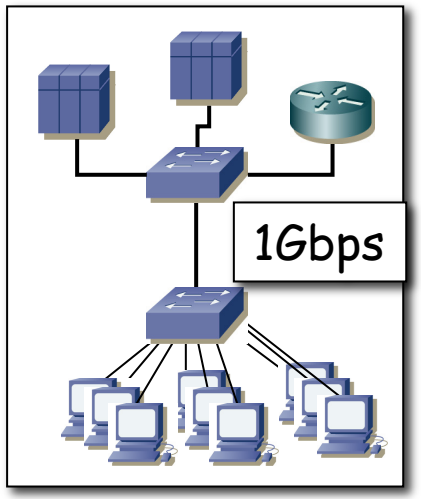
Link Aggregation

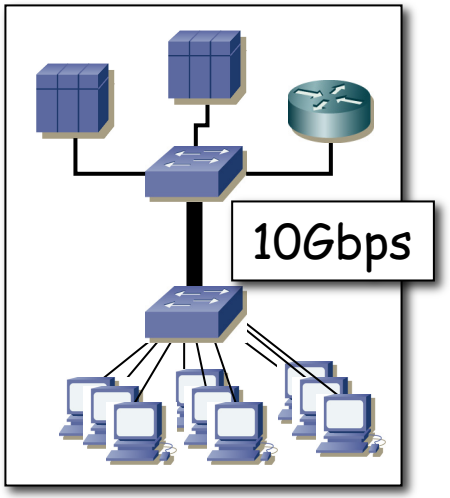
Mayor disponibilidad

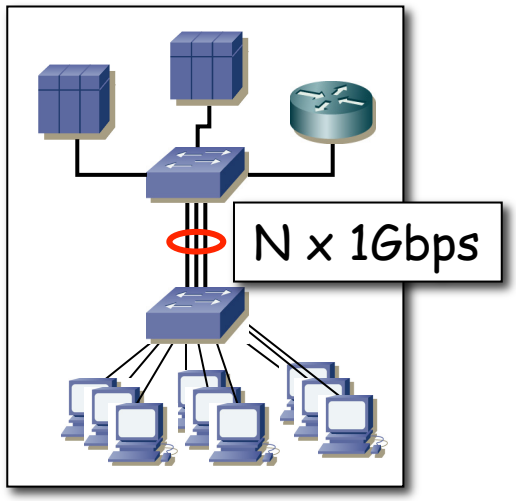


Link Aggregation

Mayor granularidad



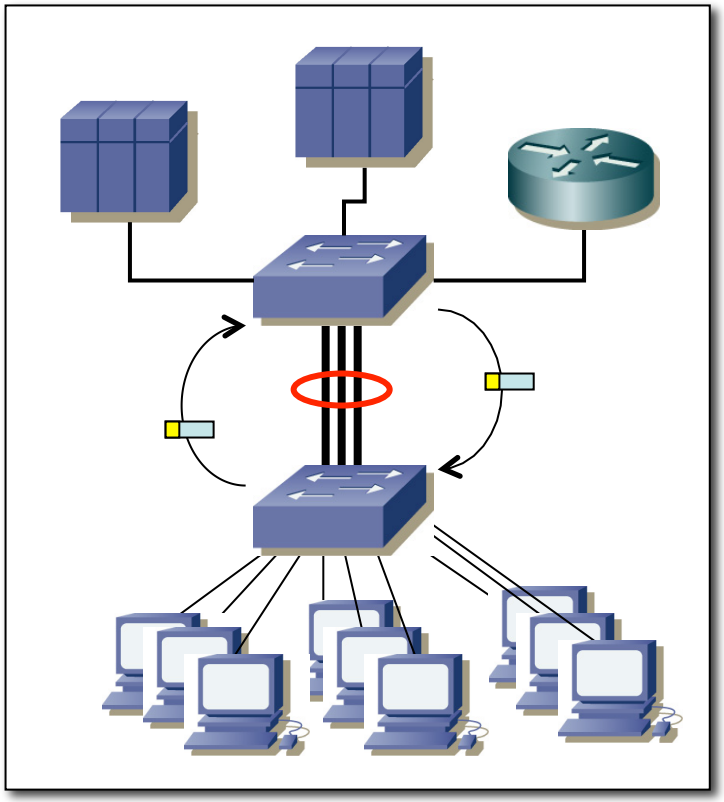




Link Aggregation

Configuración automática

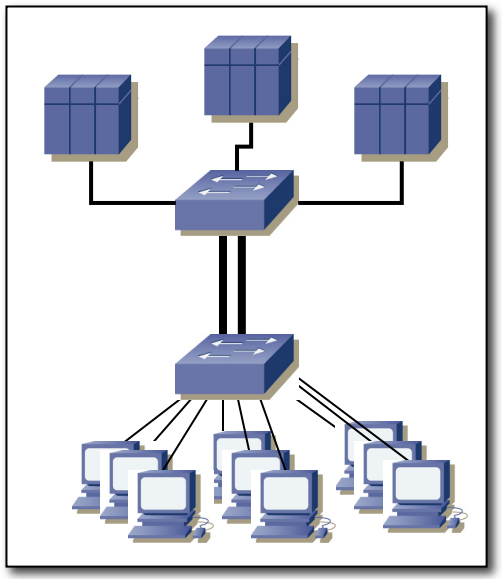
- Link Aggregation Control Protocol (LACP)
- Rápida reconfiguración (<1seg)



Link Aggregation

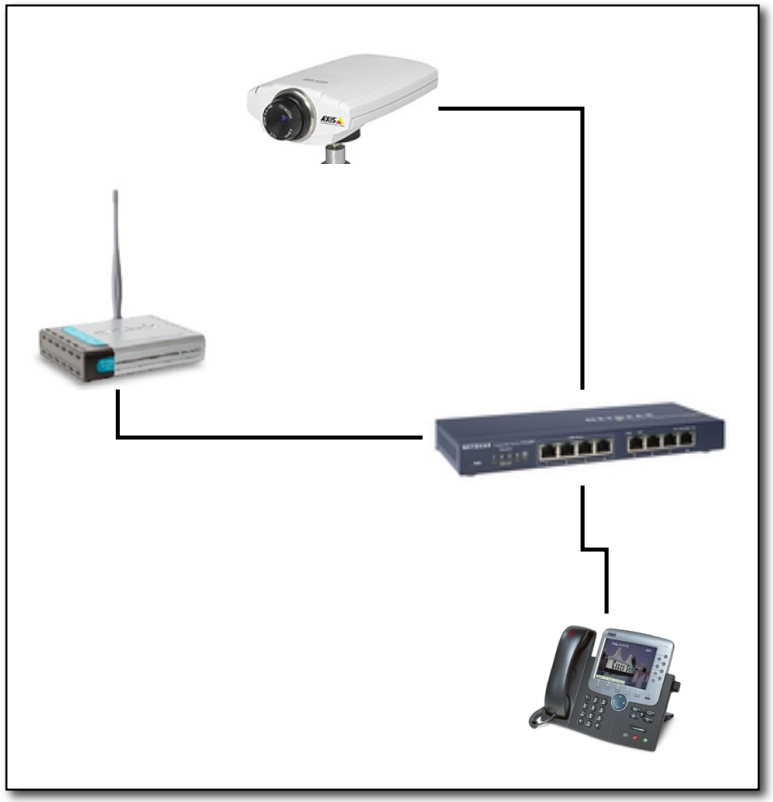
Limitaciones:

- No más de 2 extremos
- Solo 802.3 (ej. no FDDI)
- No soporta enlaces half-duplex
- No puede agregar enlaces de diferentes velocidades
- Si la conversación es directamente A➔B no puede repartir el flujo en más de un enlace (salvo con información de niveles superiores)



Power over Ethernet (PoE)

- IEEE 802.3af (cláusula 33 de 802.3-2005)
- Además de datos, corriente sobre cable Cat.3 ó 5 (15.4 W)
- PoE+ (802.3at) (30W)



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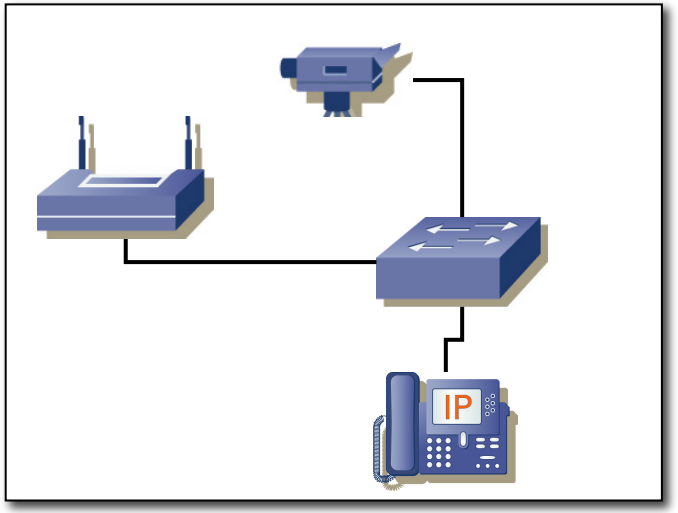

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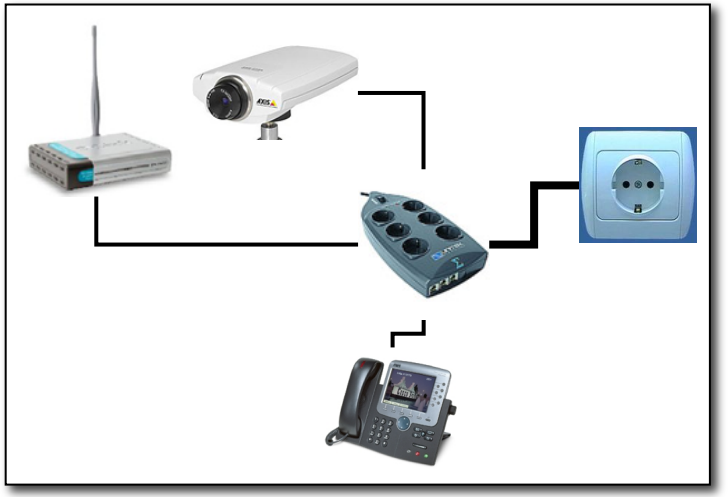
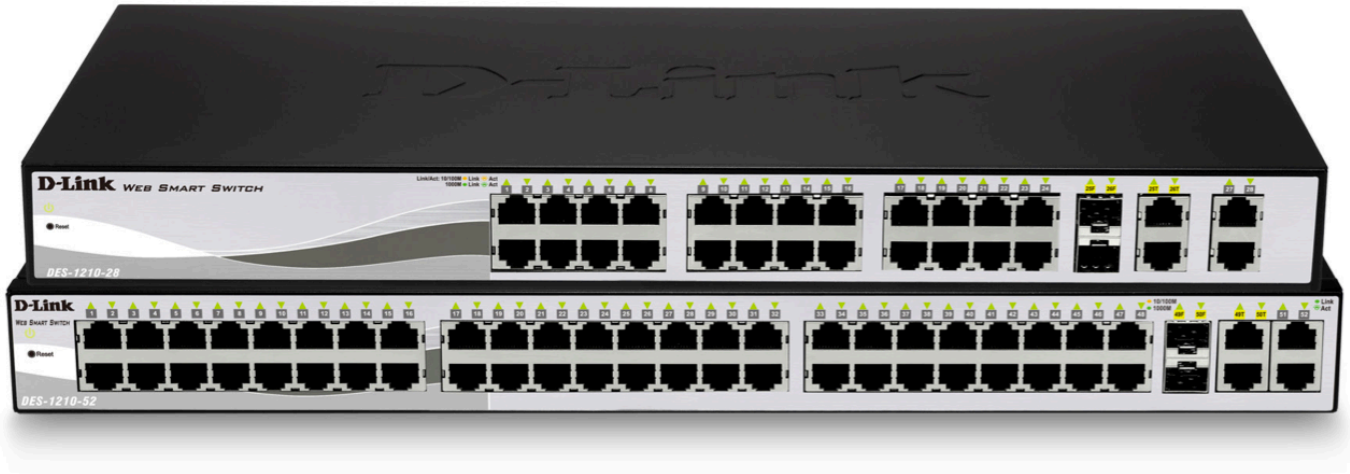


Conmutador gestionable

- D-Link DES-1210-28/52



D-Link DES-1210-28/52

Overview

The D-Link® DES-1210 Series is the latest generation of Web Smart Switches. Equipped with 24 or 48 10/100Mbps ports, two 10/100/1000BASE-T ports, and two combo 10/100/1000BASE-T/SFP ports, the series integrates advanced management and security functions to provide performance and scalability. While easy to use, the DES-1210 Series provides a complete and affordable solution for small and medium businesses. Management options for the switches include SNMP, Web Management, SmartConsole Utility, and compact Command Lines. The series also supports ACL filtering and the D-Link Safeguard Engine™. Furthermore, the DES-1210 Series uses Auto Voice VLAN, ensuring higher priority for voice traffic. Both models come with an innovative fanless design in 19" metal cases.

Seamless Integration

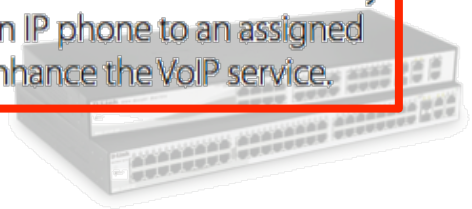
The Web Smart Switches are designed to provide SMB users complete control over the network. With Ethernet and Gigabit copper ports capable of connecting to existing Cat.5 twisted-pair cables, these switches eliminate the need for a complex reconfiguration process. The DES-1210 Series allows for a flexible connection to a backbone or servers. Additionally, all ports support auto-negotiation of MDI/MDI-X crossover, or configurable auto MDI, and therefore do away with crossover cables or uplink ports. This brings inexpensive and easy connectivity to your desktop.

Extensive Layer 2 Features

Equipped with a complete lineup of L2 features, these switches include IGMP Snooping, Port Mirroring, Spanning Tree and Link Aggregation Control Protocol (LACP). The IEEE 802.3x Flow Control function allows servers to directly connect to the switch for fast, reliable data transfer. At 2000Mbps Full Duplex, the Gigabit ports provide high-speed data pipes to servers with minimum data transfer loss. Network maintenance features include Loopback Detection and Cable Diagnostics. Loopback Detection is used to detect loops created by a specific port and automatically shut down the affected port. Cable Diagnostics are designed for network administrators to quickly examine the quality of the copper cables and determine the type of cable error.

QoS, Bandwidth Control

The switches are perfect for deployment in a VoIP environment, as they support Auto Voice VLAN and Differentiated Services Code Point (DSCP) QoS for VoIP application. Auto Voice VLAN will automatically place voice traffic from an IP phone to an assigned VLAN and by doing so enhance the VoIP service.



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With a higher priority and individual VLAN, this feature guarantees the quality and security of VoIP traffic.

DSCP marks parts of an IP packet, enabling different levels of service to be assigned for network traffic. With Bandwidth Control, the network administrator can reserve bandwidth for important functions that require a larger bandwidth or might have high priority.

Secure Your Network

The innovative D-Link Safeguard Engine function protects the switches against traffic flooding caused by virus attacks. The switches support 802.1X port-based authentication, allowing the network to be authenticated through external RADIUS servers. In addition, the Access Control List (ACL) feature enhances network security and helps to protect the internal IT network by allowing an administrator to restrict the access of a network through a variety of means including MAC address, IP, UDP/TCP, and even VLAN ID.

Fanless Design

- Provides silent operation
- Saves energy while lowering costs
- Provides continuous, reliable and eco-friendly operation

Security Features

- Access Control List secures network
- D-Link Safeguard Engine™ protects CPU from Broadcast/Multicast/ Unicast flooding
- Port security supports 64 MACs per port

Intuitive Management

- Manage using SmartConsole or web-based GUI
- Built-in MIB browser for SNMP Management
- D-View 6.0 module support
- Compact CLI through Telnet

VoIP Deployment

- Highest priority for VoIP services
- Auto Voice VLAN

QoS

- Ensure time-sensitive data gets delivered efficiently
- Supports IEEE 802.1p QoS up to four 802.1p Priority Queues
- DSCP QoS

Trap & Logs

- SNMP Trap supports link and STP state change
- Trap for SmartConsole Utility

Advanced Features

- Loopback detection auto disables port when loop is detected
- Cable Diagnostics allows administrator to determine cable status
- Configurable MDI/MDI-X

Online Help

- Link to local support web site
- Downloadable user guide
- Real-time manual checks

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Technical Specifications		
	DES-1210-28	DES-1210-52
Number of Ports	• 24 10/100Mbps • 2 10/100/1000BASE-T • 2 combo 10/100/1000BASE-T/SFP	• 48 10/100Mbps • 2 10/100/1000BASE-T • 2 combo 10/100/1000BASE-T/SFP
Port Standards & Functions	• IEEE 802.3 10BASE-T Ethernet (twisted-pair copper) • IEEE 802.3u 100BASE-TX Fast Ethernet (twisted-pair copper) • IEEE 802.3ab 1000BASE-T Gigabit Ethernet (twisted-pair copper) • IEEE 802.3z Gigabit Ethernet (fiber) ANSI/IEEE 802.3 • Auto-negotiation • IEEE 802.3x Flow Control	• IEEE 802.3 10BASE-T Ethernet (twisted-pair copper) • IEEE 802.3u 100BASE-TX Fast Ethernet (twisted-pair copper) • IEEE 802.3ab 1000BASE-T Gigabit Ethernet (twisted-pair copper) • IEEE 802.3z Gigabit Ethernet (fiber) ANSI/IEEE 802.3 • Auto-negotiation • IEEE 802.3x Flow Control
Network Cables	• UTP Cat.5, Cat.5e (100m max) • EIA/TIA-568 100-ohm STP (100m max)	• UTP Cat.5, Cat.5e (100m max) • EIA/TIA-568 100-ohm STP (100m max)
Full/Half Duplex	• Full/half duplex for 10/100Mbps speeds • Full duplex for Gigabit speed	• Full/half duplex for 10/100Mbps speeds • Full duplex for Gigabit speed
Media Interface Exchange	• Auto MDI/MDI-X adjustment for all twisted pair ports	• Auto MDI/MDI-X adjustment for all twisted pair ports
Switching Capacity	• 12.8Gbps	• 17.6Gbps
Transmission Method	• Store-and-forward	• Store-and-forward
MAC Address Table	• 8K entries per device	• 8K entries per device
MAC Address Update	• Up to 256 static MAC entries • Enable/disable auto-learning of MAC addresses	• Up to 256 static MAC entries • Enable/disable auto-learning of MAC addresses
Maximum 64 bytes packet forwarding rate	• 9.5Mpps	• 13.1Mpps

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RAM Buffer	• 512KB per device	• 1MB per device
AC Input	• 100 to 240 VAC 50/60 internal universal power supply	• 100 to 240 VAC 50/60 internal universal power supply
Maximum Power Consumption	• 17.6W	• 28.9W
Standby Power Consumption	• 7.6W/110V, 7.9W/240V	• 13.2W/110V, 13.3W/240V
Fan Quantity	• 0	• 0
Acoustics	• 0dBA	• 0dBA
Heat Dissipation	• 60.05 BTU/hr	• 98.61 BTU/hr
Operating Temperature	• 32o to 104oF (0o to 40oC)	• 32° to 104°F (0° to 40°C)
Storage Temperature	• 14o to 158oF (-10o to 70oC)	• 14° to 158°F (-10° to 70°C)
Operating Humidity	• 10% to 95% non-condensing	• 10% to 95% non-condensing
Storage Humidity	• 5% to 95% non-condensing	• 5% to 95% non-condensing
Dimensions	• 17.3in x 8.3in x 1.7in (440mm x 210mm x 44mm) • 19-inch standard rack mounting width, 1U height	• 17.4in x 9.8in x 1.7in (441mm x 250mm x 44mm) • 19-inch standard rack mounting width, 1U height
Weight	• 5.73 lbs (2.6kg)	• 7.27 lbs (3.3kg)
Diagnostic LEDs	• Power (per device) • Link/Activity/Speed (per 10/100/1000Mbps port, per 10/100Mbps port, per SFP port)	• Power (per device) • Link/Activity/Speed (per 10/100/1000Mbps port, per 10/100Mbps port, per SFP port)
Emission (EMI)	• FCC Class A, CE Class A, VCCI Class A, C-Tick	• FCC Class A, CE Class A, VCCI Class A, C-Tick
MTBF	• 419,467 hours	• 289,012 hours
Safety	• cUL, LVD	• cUL, LVD

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Software Features		
L2 Features		
MAC Address Table	• 8K	
Flow Control	• 802.3x Flow Control	• HOL Blocking Prevention
IGMP Snooping	• IGMP v1/v2 Snooping • Supports at least 64 static multicast addresses • Supports IGMP Snooping Querier	• Supports 256 IGMP groups • IGMP per VLAN
Spanning Tree Protocol	• 802.1D STP	• 802.1w RSTP
Loopback Detection	• Yes	
802.3ad Link Aggregetion	• 8 groups per device/8 ports per group	
Port Mirroring	• One-to-One, Many-to-One, Supports Mirroring for Tx/Rx/Both	
Cable Diagnostics	• Yes	
Configurable Auto MDI/MDI-X	• Yes	
VLAN		
802.1Q	• 2003 Edition	
VLAN Group	• Max 256 static VLAN groups, max 4094 VID	
Management VLAN	• Supports 1 Management VLAN	
Asymmetric VLAN	• Yes	
Auto Voice VLAN	• Max. 10 user defined OUI, Max. 8 default OUI	
QoS (Quality of Service)		
802.1p Quality of Service	• 4 Queues per port	
Queue Handling	• Strict, Weighted Round Robin (WRR)	
CoS based on	• 802.1p Priority Queues, DSCP	
Bandwidth Control	• Port-based (Ingress/Egress, min. granularity 64 Kb/s)	

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Access Control List	
Maximum profiles	• 50
Maximum rules shared by profiles	• 240
ACL based on	• MAC Address, IPv4 Address (ICMP/IGMP/TCP/UDP), VLAN ID, 802.1p Priority, DSCP
ACL Actions	• Permit, Deny
Security	
802.1X Port-based Access Control	• Default 802.1X forwarding
Port Security	• Supports up to 64 MAC addresses per port
Traffic Control	• Broadcast/Multicast/Unicast Storm Control
Static MAC	• Supports 256 Static MAC entries
D-Link Safeguard Engine	• Yes
MIB	
MIB	• 1213 MIB II, 1493 Bridge MIB, 1907 SNMP v2 MIB, 1215 Trap Convention MIB, 2233 Interface Group MIB, D-Link Private MIB
RFC Standard Compliance	
RFC	• RFC 768 UDP, RFC 791 IP, RFC 792 ICMP, RFC 793 TCP, RFC 826 ARP, RFC 854 Telnet Server, RFC 855 Telnet Server, RFC 856 Telnet Binary Transmission, RFC 858 Telnet Server, RFC 896 Congestion Control in TCP/IP Network, RFC 903 Reverse Address Resolution Protocol, RFC 951 BootP Client, RFC 1155 MIB, RFC 1157 SNMP v1, RFC 1191 Path MTU Discovery, RFC 1212 Concise MIB Definition, RFC 1213 MIB II, IF MIB, RFC 1215 Traps for use with the SNMP, RFC 1239 Standard MIB, RFC 1350 TFTP, RFC 1493 Bridge MIB, RFC 1519 CIDR, RFC 1945 HTTP/1.0, RFC 2131 DHCP, RFC 2132 DHCP Options and BOOTP Vendor Extensions, RFC 2138 Radius Authentication, RFC 2233 Interface MIB, RFC 2578 Structure of Management Information Version 2 (SMIv2), RFC 2647 802.1p, RFC 3416 SNMP, RFC 3417 SNMP

Ordering Information	
Part Number	*Description*
DES-1210-28	• Web Smart 24-Port 10/100 Switch, 4GbE, 2 Combo SFP Slots
DES-1210-52	• Web Smart 48-Port 10/100 Switch, 4GbE, 2 Combo SFP Slots
DEM-211	• 100BASE-FX Multimode LC Transceiver, up to 2Km
DEM-310GT	• 1000BASE-LX SFP Module, up to 10Km
DEM-311GT	• 1000BASE-SX SFP Module, up to 550m