Ethernet a 100Mbps+

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

Grado en Ingeniería en Tecnologías de Telecomunicación, 3º

Temario

1. Introducción
2. **Tecnologías LAN**
   - **Tecnologías Ethernet**
   - Conmutación Ethernet
   - VLANs
   - Spanning Tree Protocol
   - Otros mecanismos en LANs Ethernet
   - WiFi
   - Diseño de redes campus
3. Tecnologías WAN
4. Redes de acceso

Objetivos

- Conocer el funcionamiento de la Ethernet a mayores velocidades de 10Mbps
- Comprender los límites de esas versiones de Ethernet
- Comprender los cambios en los hubs

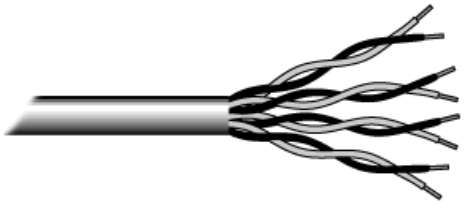
Contenido

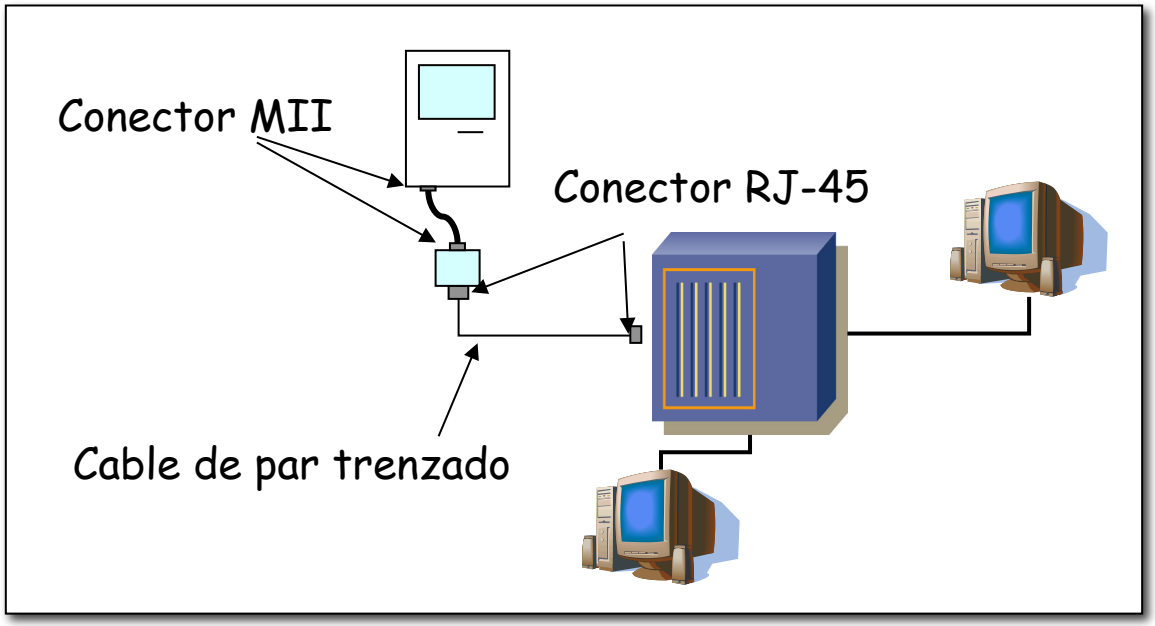
- Fast Ethernet
- Gigabit Ethernet y superiores
- Equipos

Tecnologías Ethernet

100Base-TX (Fast Ethernet)

- IEEE 802.3u
- MII = *Medium Independent Interface*
- Cables de par trenzado Cat.5 (100m)
- Usa 2 pares
- Transceiver opcional
- Conector RJ-45

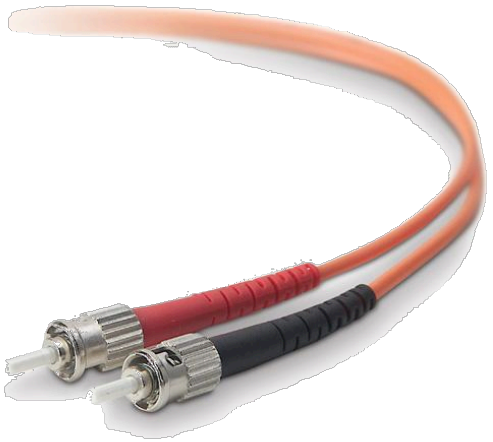


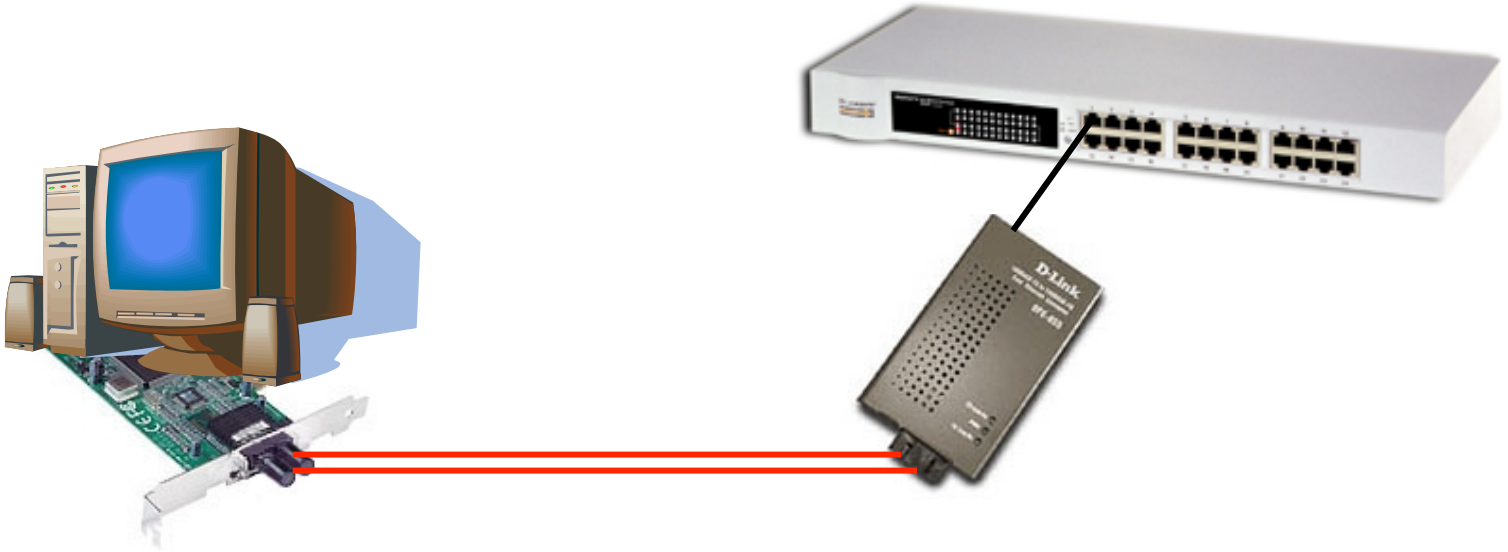


Tecnologías Ethernet

100Base-FX

- Fibra multimodo (50 ó 62.5 µm)
- 2 Km (full-duplex)
- 412 m (half-duplex)





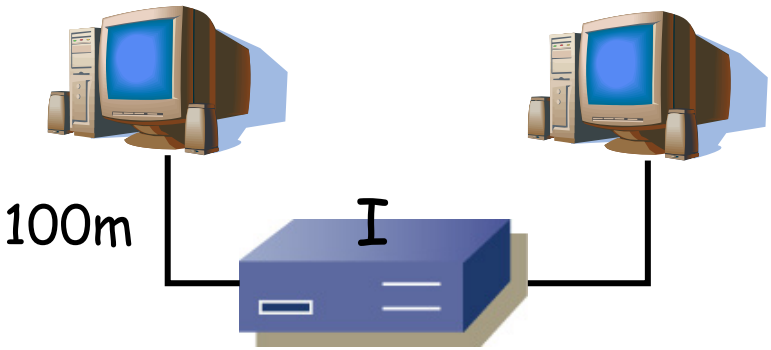
Repetidores FastEthernet

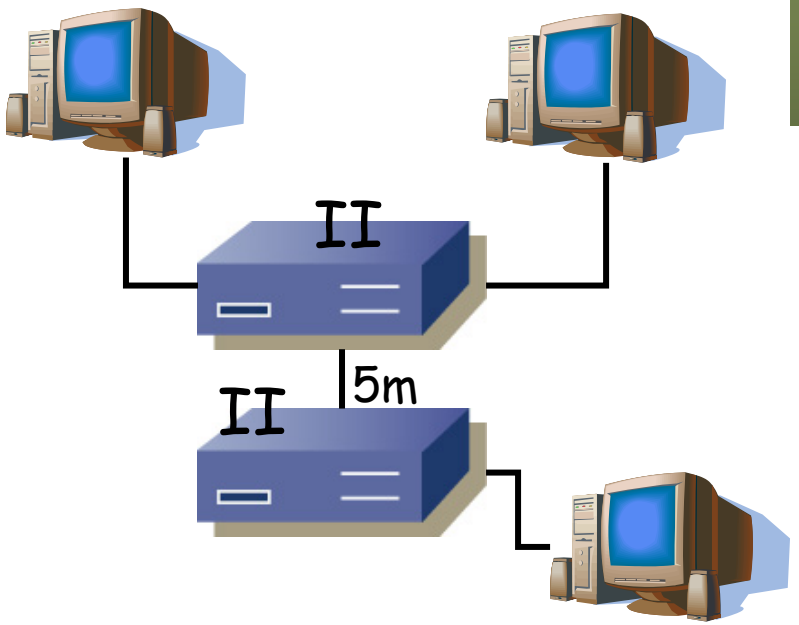
Clase I

- Convierte a digital
- Permiten diferentes medios físicos
- Mayor retardo
- Solo puede haber 1

Clase II

- Menos retardo
- Todos los puertos misma tecnología
- Máximo de 2
- Máximo 5m entre ellos





Repetidores FastEthernet

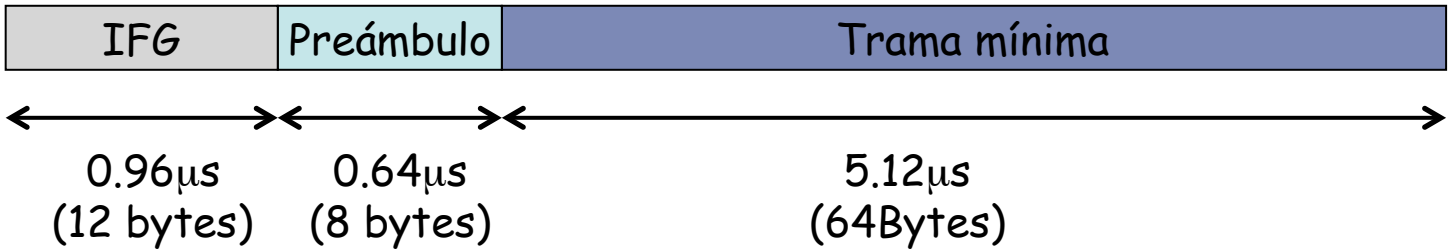
¿ Por qué tan corta distancia ?

- CSMA/CD
- FastEthernet mantiene la longitud mínima de la trama
- *Collision Window* ↓
- Elección: Aumentar el tamaño mínimo o reducir el diámetro máximo
- Se redujo el diámetro: velocidad x10 ⇒ diámetro ÷10

Tamaño de trama (bytes)	Tiempo de Tx (μseg) 10Mbps	Tiempo de Tx (μseg) 100Mbps
64	51.2	5.12
512	409.6	40.96
1000	800	80
1518	1214.4	121.44

Frame rate

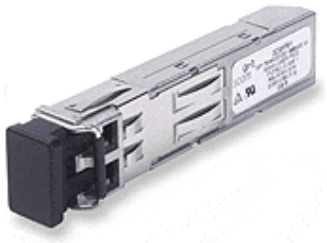
- ¿Máximo número de tramas por segundo?

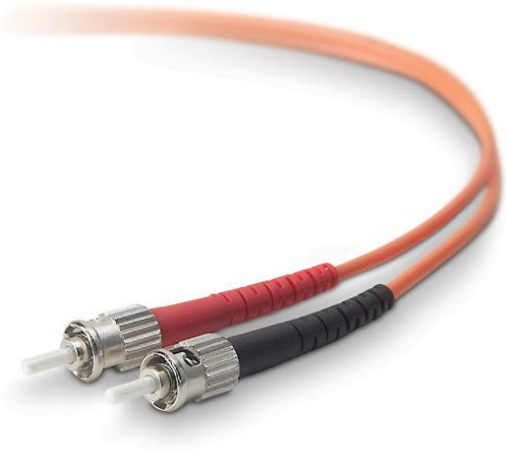


Gigabit Ethernet

1000Base-X

- IEEE 802.3z
- 1000Base-SX : Fibra multimodo (200-500 m)
- 1000Base-LX : Fibra monomodo (5-10 Km)
- Otras variantes (según fabricante, durante procesos de estandarización, para primera milla, etc)



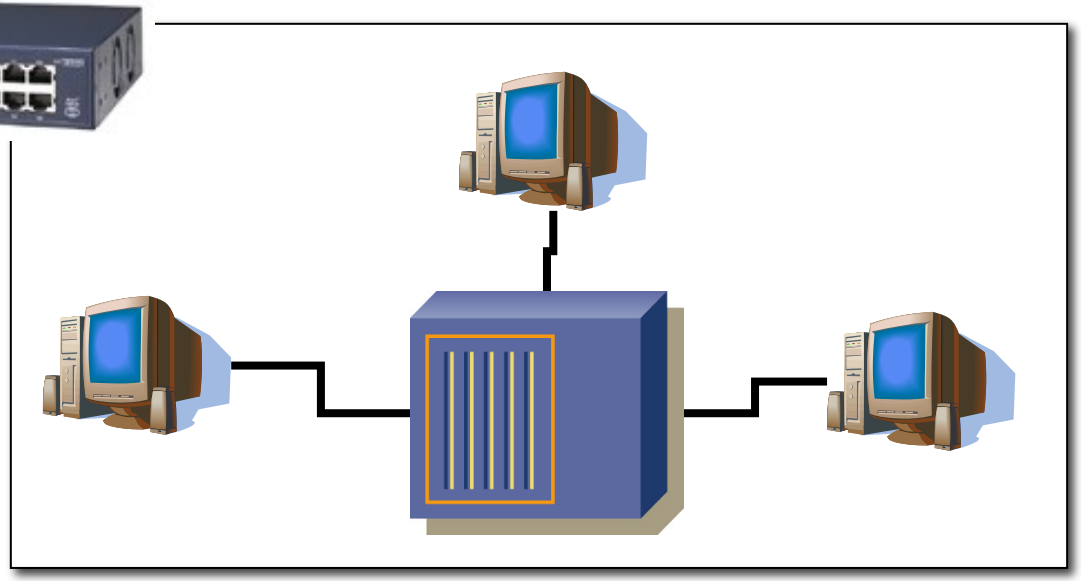


Gigabit Ethernet

1000Base-T

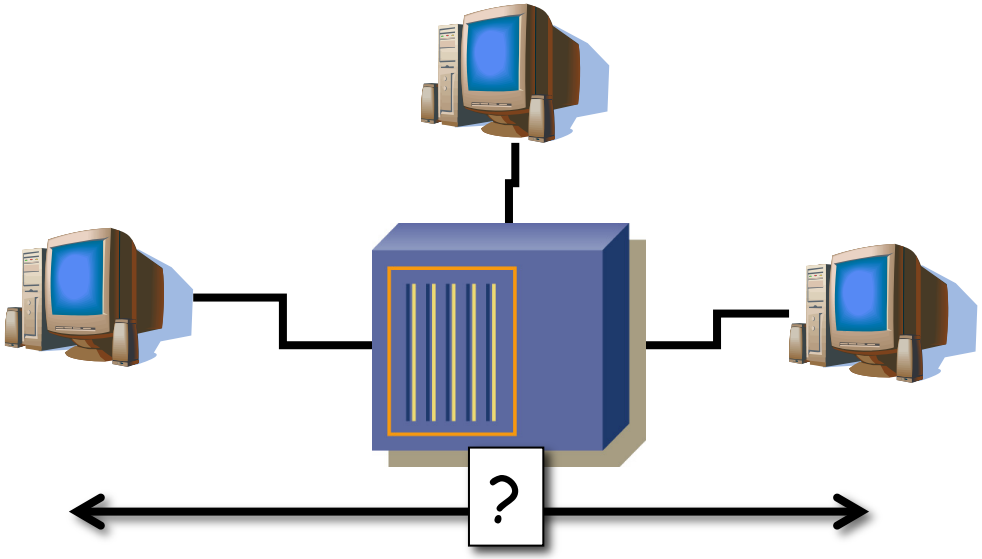
- IEEE 802.3ab
- 4 pares Cat.5 (100m)
- El *hub* existe en el estándar pero no se utiliza

GMII = Gigabit Medium Independent Interface



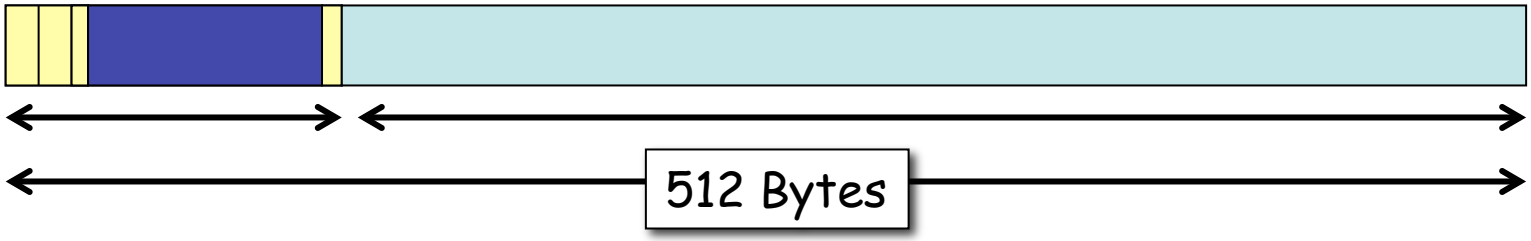
Gigabit Ethernet

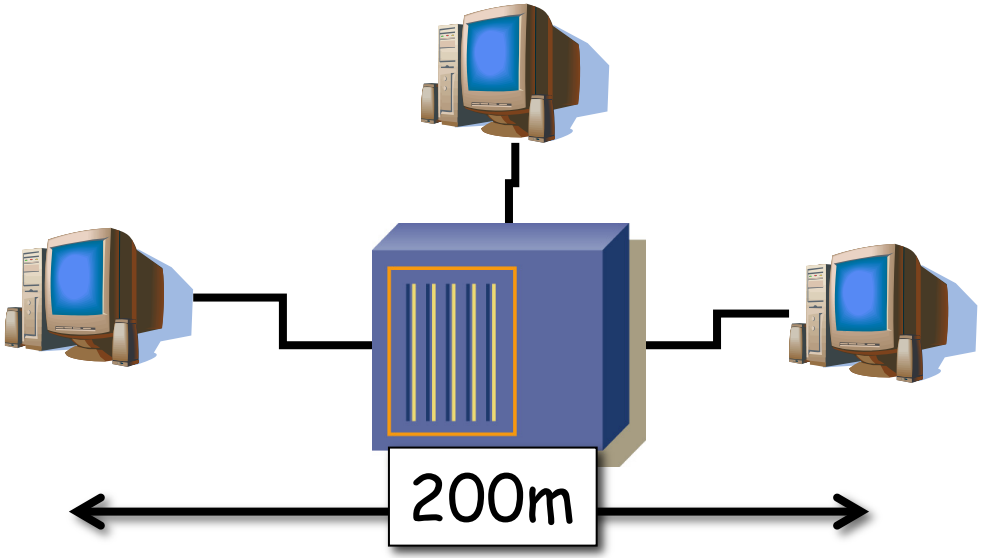
- Existe el *Hub* Gigabit
- Velocidad x10 frente a FastEthernet
- ¿ Diámetro ÷10 ?



Gigabit Ethernet

- ¿ Diámetro ÷10 ? **NO**
- *Carrier Extension*
- Mínimo tamaño 512 Bytes

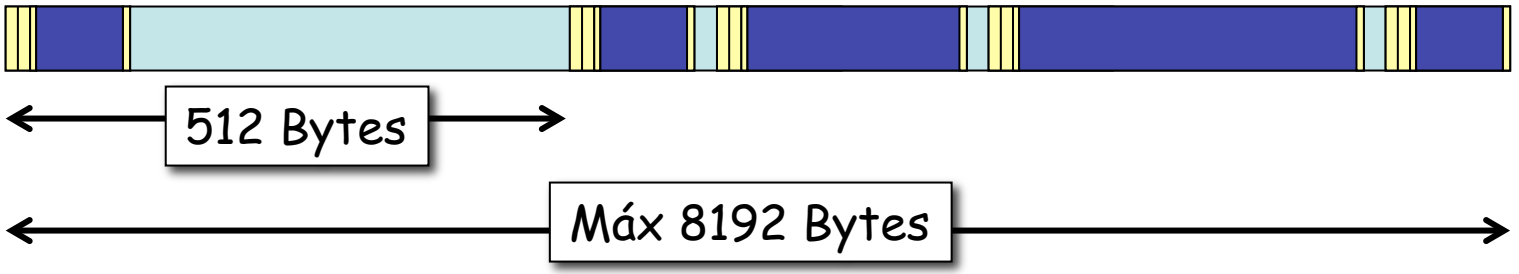




Gigabit Ethernet

Frame Bursting

- Puede trasmitir varias tramas seguidas
- Sin liberar el canal
- Hasta 8192 bytes
- La primera trama, si es demasiado corta, requiere extensión de portadora

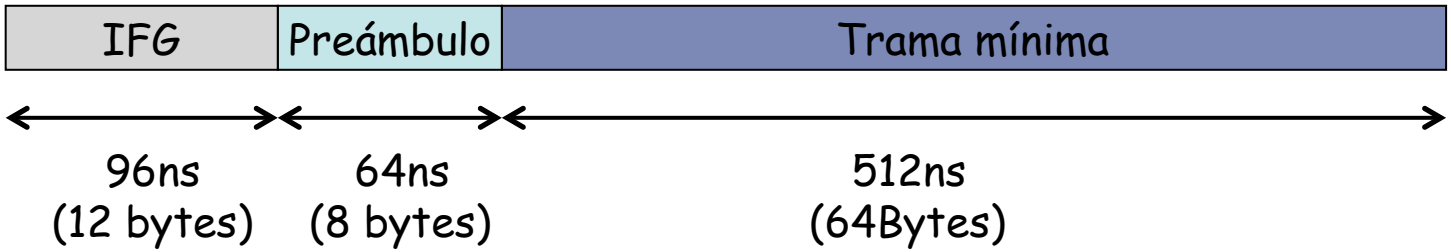


Gigabit Ethernet

- Se emplean switches (próxima clase)
- Full Duplex
- No-CSMA/CD
- Así que no hace falta *Carrier Extension* ni se usa *Frame Bursting*

Frame rate

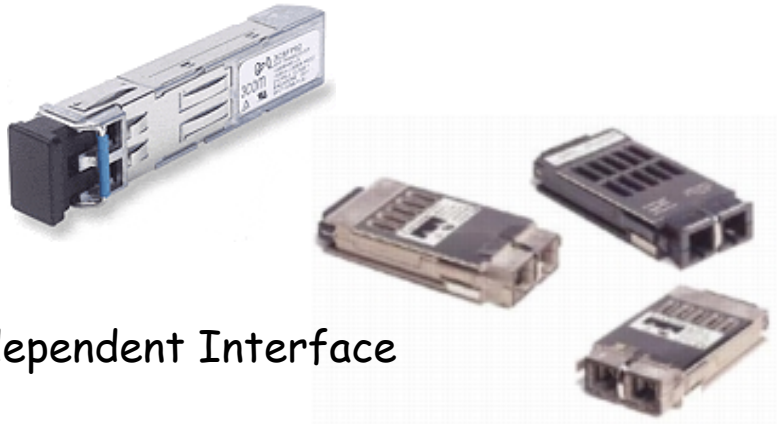
- ¿Máximo número de tramas por segundo? (enlace full-duplex)



Gigabit Ethernet

SFP

- Small Formfactor Pluggable transceiver
- Antes GBICs: GigaBit Interface Converter
- *Hot-swappable Transceiver*



GMII = Gigabit Medium Independent Interface

Gigabit Ethernet

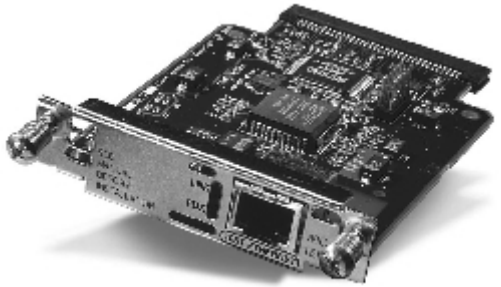
¿ Jumbo Frames ?

- MTU tradicional 1500 bytes
- *Jumbo Frames* la aumentan a unos 9 KBytes
- Reduce la carga de procesamiento (pkts/sec)

Autonegociación

- Opcional en IEEE 802.3u (Fast Ethernet)
- Extendida a 10Base-T
- Obligatorio en 1000Base-T
- Permite negociar:
  - Half/Full-Duplex
  - 10/100/1000 Mbps

- Mediante pulsos que se envían cuando no hay tramas
- Si un extremo lo soporta y otro no:
  - Extremo que lo soporta puede detectar la velocidad
  - No detecta el *duplex* así que escoge *half-duplex*



Tecnologías Ethernet

10GBase-X

- IEEE 802.3ae
- 10GBase-SR : F.O. Multimodo (30-300m)
- 10GBase-LR : F.O. Monomodo (10-20Km)
- 10GBase-ER : F.O. Monomodo (40Km)
- 10GBase-SW/LW/EW : WAN PHY (9.58Gbps), para mapearse directamente en un contenedor SONET/SDH (VC-4-64c)

Tecnologías Ethernet

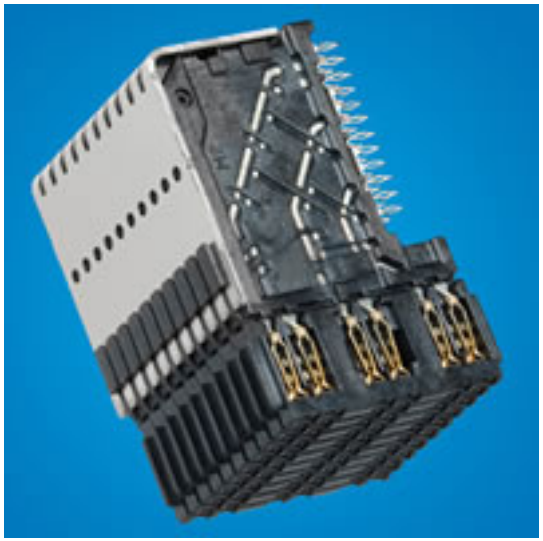
10GBase-T

- IEEE 802.3an
- Cable Categoría 6 (55m)
- Cable Categoría 6 aumentada o Cat.7 (100m)
- 10 Gigabit Ethernet solo Full-Duplex

Tecnologías Ethernet

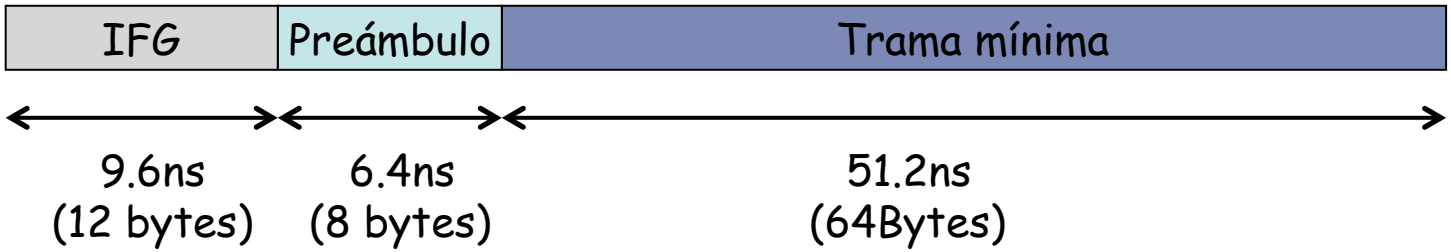
Otros 10GBase

- 802.3ak (cobre, 10GBASE-CX4, 15m)
- 802.3ap (Backplane Ethernet, cobre, 10GBASE-KX4, 10GBASE-KR, 1m)
- 802.3aq (10GBASE-LRM, fibra, 200-300m)



Frame rate

- ¿Máximo número de tramas por segundo?



Tecnologías Ethernet

IEEE 802.3ba

- Aprobado en Junio de 2010
- "Amendment 4: Media Access Control Parameters, Physical Layers and Management Parameters for 40Gb/s and 100 Gb/s Operation"
- Para: backplane (1m, solo 40Gb/s), cobre (10m), fibra multimodo (100m) y monomodo (10km y 40km solo 100Gb/s)
- Emplea varias wavelengths
- 40Gb/s para Data Centers, 100Gb/s para Backbones
- Ejemplo: 40GBASE-LR4

Prefix	Suffix				
Speed	Medium		Coding Scheme	Lanes	
	Copper	Optical		Copper	Optical
40G = 40 Gb/s 100G = 100 Gb/s	K = backplane C = cable assembly	S = short reach (100m) L = long reach (10km) E = extended long reach (40km)	R = 64/66B block coding	n = 4 or 10	n = # of lanes or wavelengths
				n = 1 not required, serial is implied	

Table 1: IEEE 802.3ba PHY Naming Nomenclature
http://www.ethernetalliance.org

Tecnologías Ethernet

- Con 100Gb/s Ethernet nos salimos claramente de lo que a día de hoy sería "Ethernet en LAN" que es este tema
- Máximo de 148.809.523 pps
- Eso son 6.7ns entre dos frames consecutivos
- Otros escenarios donde se está empleando Ethernet
  - En el enlace de tecnologías de acceso (Ethernet en la primera milla)
  - En WANs (Carrier Ethernet)

Módulo 10Gigabit

Módulo 10Gigabit

FEATURES

Functions:

- 10G Multi-Mode 300m XFP
- Compliant with 802.3ae 10GBASE-SR
- LC Port Types
- Full Duplex 802.3x Flow Control
- Wave Length: 850nm
- Power Support: 3.3V / 5V

Designed to support distances up to 300 meters, the DEM-421XT is a high performance 850nm Multi-Mode XFP transceiver. Supporting Full-duplex, 10Gigabit speeds on Multi-Mode fiber cables. The DEM-421XT is 802.3ae 10GBASE-SR compliant and supports Full-duplex 802.3x Flow control. The DEM-421XT provides the necessary signal amplification for data to be transmitted to the network cable from the port, and vice versa.
The DEM-421XT is hot swappable. You can remove or replace the transceiver with the system powered on. This permits modules and transceivers to be added or swapped without interrupting network systems.

Cabling Specifications

D-Link XFP	Product Code	Cable Type	Core Size (microns)	Modal Bandwidth (MHz/km)	Cable Distance
DEM-421XT	850	MMF	62.5 62.5 50.0 50.0 50.0	160 200 400 500 2000	26 meters 33 meters 66 meters 82 meters 300 meters

Ordering Information

Part Number	*Description*
DEM-421XT	10GBASE-SR Multi-mode XFP up to 300m

Dual Speed Hubs

LH8000A

LH8050A

Dual Speed Hubs

LH8000A

OVERVIEW

Integrate your 10
10-Mbps devices. T
chip technology cal
capability in a office

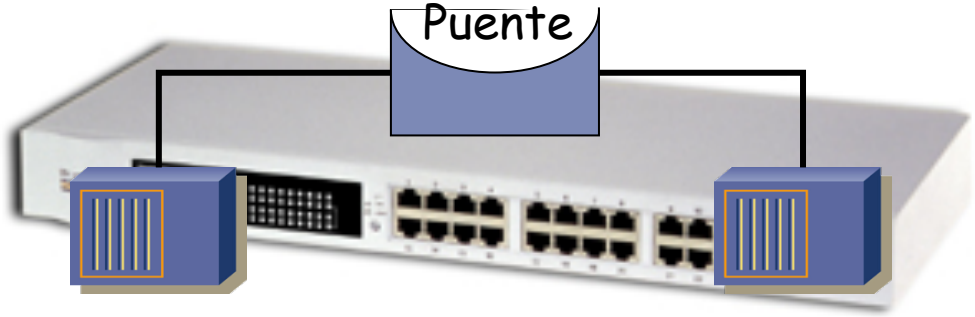
The Hub is ideal
from 10 to 100 Mb
10 to 100 Mbps at
as often as needed,
test situations, or cl

When a user co
automatically sense
with either the 10-M
hubs in one—both

And users can chang
100 Mbps—while the Hub operates, since its speed-sensing is continuous and each port is sensed independently. You don't need to power down the hub when you change the speed on a port.

Four models are available:

- Dual-Speed 10/100 Stackable Hub Master (LH8000A-M), has a 10/100 bridge built in. It filters and forwards packets, selectively allowing specifically addressed packets to cross domains.
- Dual-Speed 10/100 Stackable Hub Client (LH8000A-C) doesn't have a bridge inside, but its 10- and 100-Mbps users can talk to each other if they're connected to a stack that includes a master unit.
- Rackmount Dual Speed 10/100 Stackable Hub Master (LH8016A-M), features 16 RJ-45 ports, each autosensing for 100-Mbps or 10-Mbps operation. This unit also has an internal bridge to interconnect the two speed domains in the stack.



Puertos conectados a dispositivos a 10Mbps

Puertos conectados a dispositivos a 100Mbps

inside,
hey're
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with one
ports all
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Technically Speaking

About cabling

For 100-Mbps connections into the Hub, you'll need to use Category 5 cable. For 10-Mbps connections, you can use Category 3, 4, or 5 cable. However, the Hub senses only the speed of the signals on the cable (it does not sense the cable type). If you use the wrong cable, the Hub won't detect it.

Auto-negotiation vs. speed-sensing

The IEEE 802.3u standard defines "autonegotiation" or "autosensing" as offering all four modes of operation for point-to-point links—10-Mbps speed, 100-Mbps speed, shared (half-duplex), and full-duplex. Speed sensing differs from autonegotiation in that it does not include full-duplex.

For more information about speed-sensing technology and stackable hubs, request Product Data Sheet 20132.

Dual Speed Hubs

LH8000A

Performance:
Data Rate — 100 or 10 Mbps, per port, autosensing for speed. The hub supports two traffic domains, one at 10 Mbps and one at 100 Mbps, operating concurrently.
PDV (100 M Path Delay Value) — 80BT exceeds Class II specification
Auto-Reconnect — Occurs after one packet of error-free reception;
Internal Switch or Bridge in Master models (one Master per stack, optional, to interconnect the two traffic domains):
Processing Type— Store and forward
Address Table — 8 KB, self-learning
Packet Buffers — 2 MB, dynamically allocated and shared on both sides
Latency (not including packet time) — 10 to 100 Mbps: 5 microseconds, 100 to 10 Mbps: 5 microseconds

Network Standards:
100 Mbps — IEEE 802.3u, 100BASE-TX
10 Mbps — IEEE 802.3, 10BASE-T
Auto Speed-Sensing — IEEE 802.3u

Operating Environment:
Ambient Temperature — 32 to 120°F (0 to 50°C)
Storage — -5 to +140°F (-20 to +60°C)
Ambient Relative Humidity — 10 to 95% (noncondensing)
Network Cable Connectors: (8) or (16) RJ-45 shielded female; 100 Mbps: Category 5 UTP/STP; 10 Mbps: Category 3, 4, 5 UTP
NOTE: Use Media Converters to connect to fiber media.
Stacking Cable: A stacking cable with 50-pin HSSI male connectors, shielded, 9 inches (23 cm) long, is included with each client unit.
Switch, Manual: Uplink: Converts RJ-45 port #8 from a regular (= position) user-segment port to a crossover (X position) uplink port for on-off connection to a central hub or another cascaded hub.

Dual Speed Hubs

LH8050A

OVERVIEW

This is the must-have product for anyone who's gradually transitioning a small- to medium-sized network from 10-Mbps Ethernet to 100-Mbps Fast Ethernet. The Mixed-Media Fiber Hub accepts either 10- or 100-Mbps signals over fiber or copper cables, configured on a per-port basis.

Here's how it works. The hub supports two shared traffic domains—one at 10 Mbps and one at 100 Mbps. An internal bridge connects the two domains.

Each fiber port handles either 10- or 100-Mbps speeds. Mix and match any combination of front-mounted port modules (ST, SC, FC, MT-RJ, multimode, or single-mode) to fit your networking needs. Each RJ-45 port is also independently autosensing for 10/100 speed and adapts to match the speed of the connected devices.

And if 16 ports just aren't enough, you can add 16 more autosensing 10/100 twisted-pair ports: Just connect a Dual-Speed 10/100 Stackable Hub (LH8016A-C). Stacking the two hubs creates one 32-port hub. You can also stack one or two of the 16-Port Add-On Chassis (LH8050A-C) with a Base Chassis for a total of up to 48 ports.

The chassis is available with an additional switch-port module for switched 10- or 100-Mbps connection to high-speed devices, creating a third collision domain.

The Mixed-Media Fiber Hub includes the 16-Port Mixed-Media Fiber Hub Chassis (with additional switch port module installed, if ordered), a users' manual, an AC power cord (115-VAC), and one set of metal ears for optional 19" rackmounting.

NOTE: You can also stack these hubs with our 16-Port Dual-Speed 10/100 Stackable Hubs. The 16-Port Base Chassis is compatible with the Dual-Speed Master Hub (LH8016A-M), and the 16-Port Add-On Chassis is compatible with the Dual-Speed Client Hub (LH8016A-C).

Dual Speed Hubs

TECH SPECS

Auto-Reconnect — Occurs after one packet of error-free reception
Bridging — Store-and-forward processing; 8 KB, self-learning address table; 2-MB dynamic packet buffers
Compliance — CE, FCC Part 15 Subpart B Class A, UL® Listed (UL 1950), cUL
Cooling Method — Fan-cooled, internal @ 9 cfm
Enclosure — Rugged sheet metal, suitable for standalone or rackmounting; metal brackets for 1U rackmounting included
Manual Switches — Uplink switch: LH8056C-UP module only (for crossover and cascading);
Auto/100 switch: LH8056C and LH8056C-UP modules (for autonegotiation or fixed 100-Mbps speed operation)
Maximum Ethernet Segment (or Domain) Lengths —
10BASE-T (Category 3, 4, 5 UTP): 328 ft. (100 m);
100BASE-TX (Category 5 UTP): 328 ft. (100 m);
Shielded twisted pair: 492 ft. (150 m);
10BASE-FL multimode fiber optic: 6562 ft. (2 km);
10BASE-FL single-mode fiber optic: 32,810 ft. (10 km);
100BASE-FX half-duplex multimode: 1350 ft. (412 m);
100BASE-FX full duplex multimode: 6562 ft. (2 km);
100BASE-FX half-duplex single-mode: 1350 ft. (412 m);
100BASE-FX full duplex single-mode: 49,215 ft. (15 km)
Partitioning — Enforced after 63 consecutive collisions
PDV (100 MB Path Delay Value) — 80BT exceeds Class II specification
Speed — 10 or 100 Mbps per port
Standards — IEEE 802.3u: 100BASE-TX, 100BASE-FX;
IEEE 802.3: 10BASE-T, 10BASE-FL
Connectors — AC power connector: IEC-type, male, recessed;
Modular connectors on a per-port basis;
RJ-45 shielded female ports: 100 Mbps: Category 5 UTP/STP;
10 Mbps: Category 3, 4, 5 UTP/STP;
Fiber ports at 100 Mbps and 10 Mbps; Port modules for all fiber connector types; (2) DB25F stacking connectors
Indicators — Chassis: LEDs: Power, Bridge Inside, Packet Activity 10, Packet Activity 100, Collision 10, Collision 100;
Fiber Port Modules: Link, Activity;
UTP Port Modules: Link, Activity, Speed
Temperature — Operating: 32 to 120°F (0 to 49°C);
Storage: -5 to +140°F (-21 to +60°C)
Relative Humidity — 10 to 95% noncondensing
Power — 90 to 260 VAC (autosensing), 47 to 63 Hz, 25 watts typical (30 watts maximum)
Size — Chassis: 1.75"H x 17"W x 10.5"D (4.5 x 43.2 x 26.7 cm)
Weight — Chassis: 4 lb. (1.8 kg);
Modules: 0.5 lb. (0.2 kg)

LH8050A

Item	Code
Mixed-Media Fiber Hubs	
16-Port Base Chassis	**LH8050A**
16-Port Add-On Chassis	**LH8050A-C**
UTP Port Modules (RJ-45)	
10/100 Modules	**LH8056C**
10/100-Mbps, Switch-Selectable Uplink	**LH8056C-UP**
Fiber Port Modules	
10-Mbps, Multimode	
ST® Connector	**LE8055C-ST**
SC Connector	**LE8055C-SC**
10-Mbps, Single-Mode	
ST Connector	**LE8055C-SMST**
100-Mbps, Multimode	
ST Connector	**LH8051C-ST**
SC Connector	**LH8051C-SC**
MT-RJ Connector	**LH8053C-MTRJ**
FC Lucent Port Connector	**LH8052C-FC**
Blank Chassis Panel	**LH8057A-PNL**
You may also want to order cable...	
Bulk Category 5 Solid-Conductor Cable, 2-Pair, PVC	**EYN717A**
Duplex Fiber Optic Cable, PVC, ST–ST, Custom Lengths	**EFN062-CC**
You might also need...	
16-Port Dual-Speed 10/100 Stackable Hubs	
Dual-Speed Master Hub	**LH8016A-M**
Dual-Speed Client Hub	**LH8016A-C**

(The LH8016A-M is compatible with the 16-Port Base Chassis and the LH8016A-C works with the 16-Port Add-On Chassis.)

Resumen

- 100/1000Mbps sobre par trenzado: Cat.5, 100m
- 100/1000Mbps sobre fibra: cerca de 10km
- Hubs Fast Ethernet: 1 ó 2 en cascada
- Hubs Gigabit no se usan
- 10/40Gbps Ethernet
- 100Gbps Ethernet