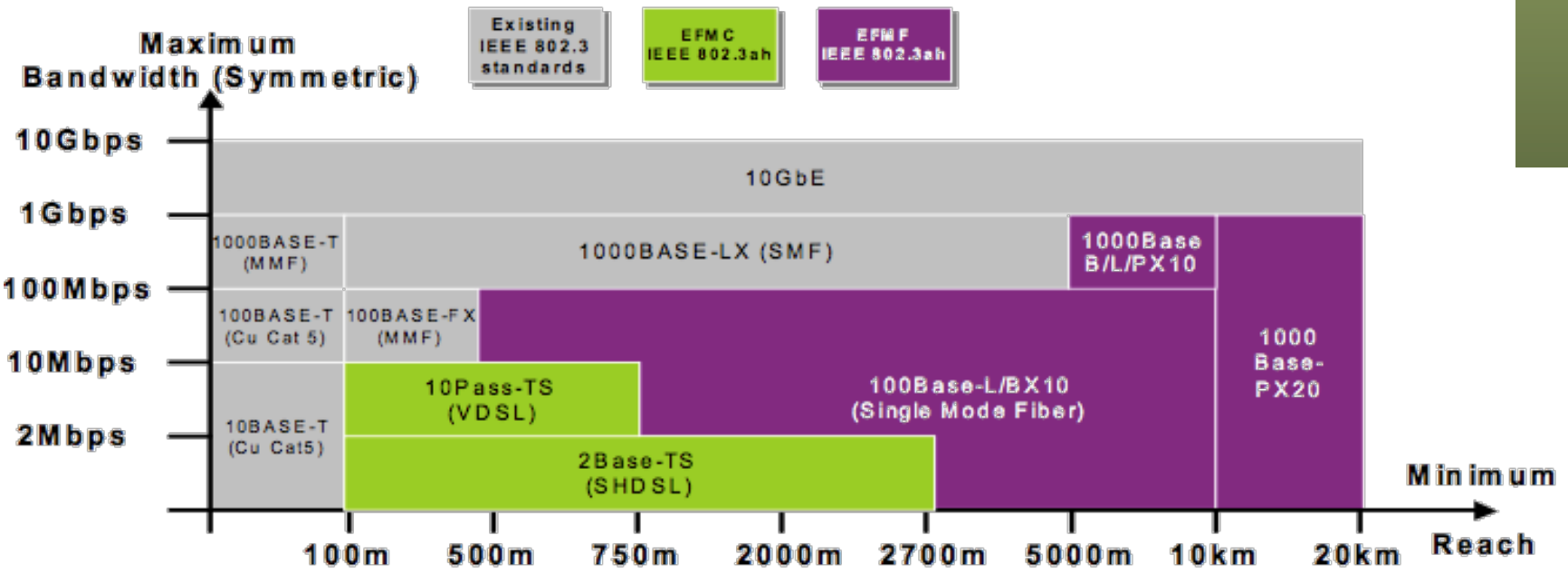
Ethernet in the First Mile

¿Dónde encaja?

- 802.3ah (ya es parte de 802.3)
- EFMC: Ethernet in First Mile for voice-grade Copper
- EFMF: Ethernet in First Mile using point-to-point Fiber topology
- EFMP: Ethernet in First Mile using point-to-multipoint topology, based on Passive optical networks (PONs)



http://metroethernetforum.org/PDFs/EFMA/efm%20optical%20tutorial%20v3.pdf

Sobre Cobre

- Punto-a-punto, solo full-duplex
- V*oice grade copper*
- Los interfaces de ambos extremos son diferentes (CO side y CPE side) pero velocidad simétrica
- 2BASE-TL: 2Mb/s@2700m, mínimo 192Kb/s, máx 5.7Mb/s, basado en SHDSL
- 10PASS-TS: 10Mb/s@750m, basado en VDSL
- Son mínimos, equipos comerciales suelen soportar valores superiores

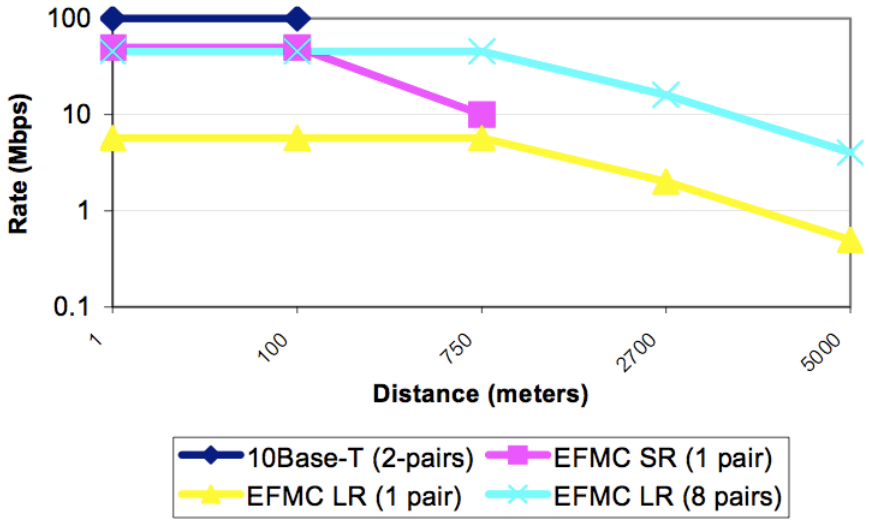
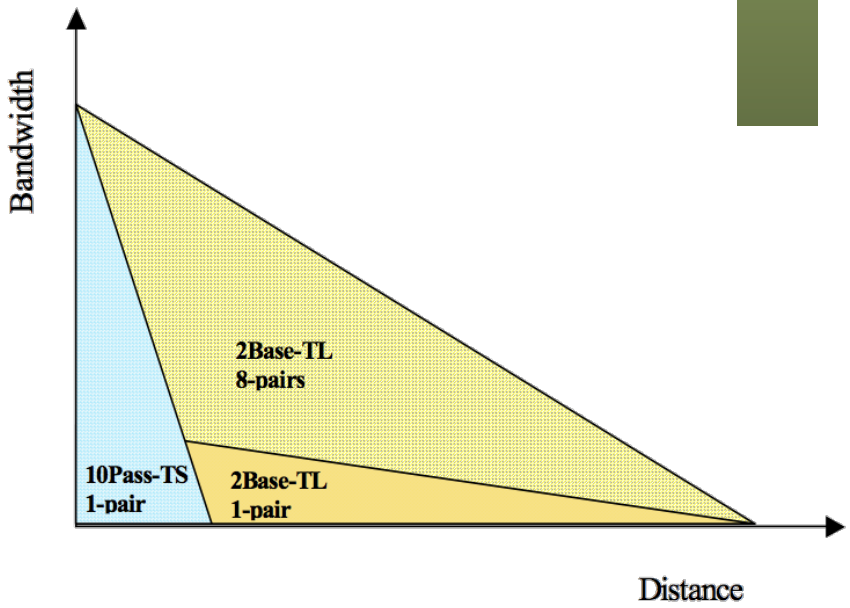


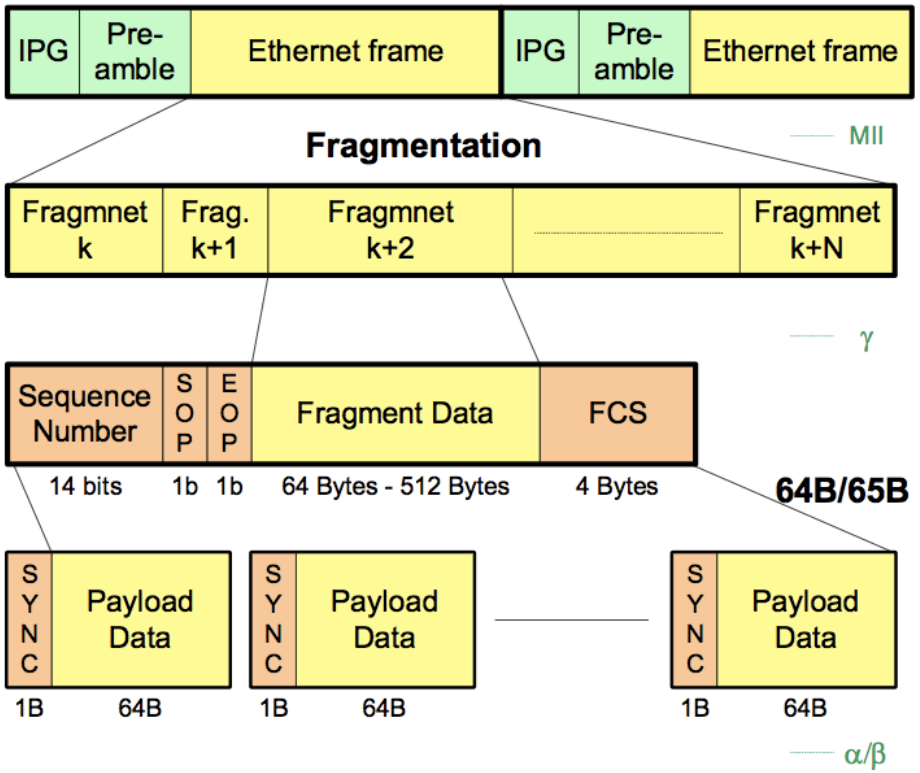
Figure 1: Distances and bandwidth for 10BASE-T, EFMC SR and EFMC LR



http://metroethernetforum.org/PDFs/EFMA/efm%20copper%20tutorial%20v2.pdf

Sobre Cobre

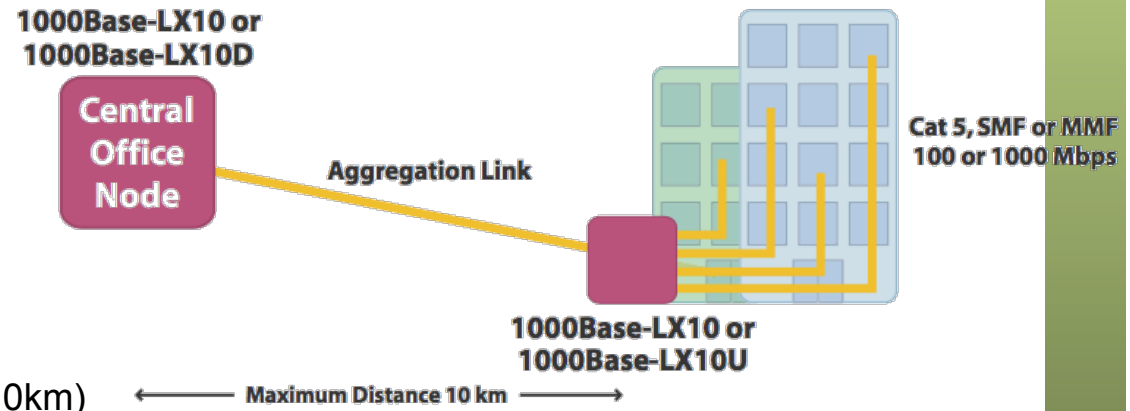
- Conectables a otras Ethernet mediante puentes
- Puede usar *bonding*
- Mecanismos OAM
  - Monitorizar estado del enlace
  - Emplea OAMPDUs que se multiplexan con las de datos
  - Entre subnivel MAC y LLC

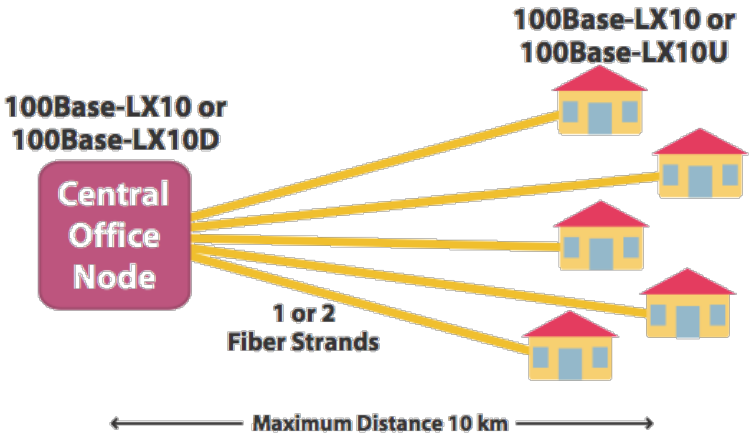


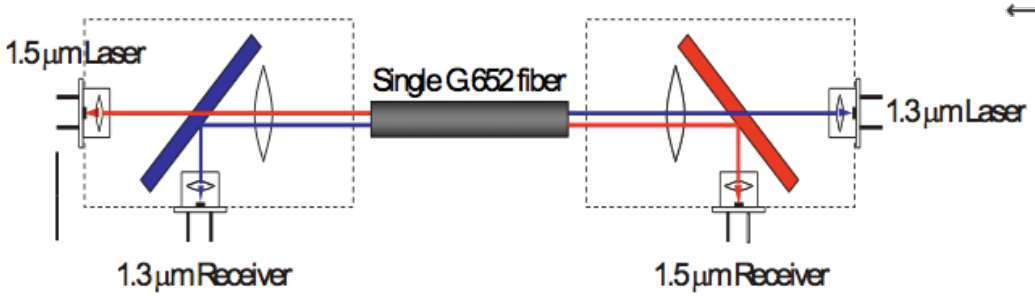
Sobre Fibra

Punto-a-punto:

- 100Mb/s y 1000Mb/s
- 100BASE-LX10:
  - Dos SMF (10km)
- 100BASE-BX10:
  - Una SMF
  - Diferente λ cada sentido (10km)
- 1000BASE-LX10:
  - Dos SMF (10km) o dos MMF (550m)
- 1000BASE-BX10:
  - Una SMF (10km)





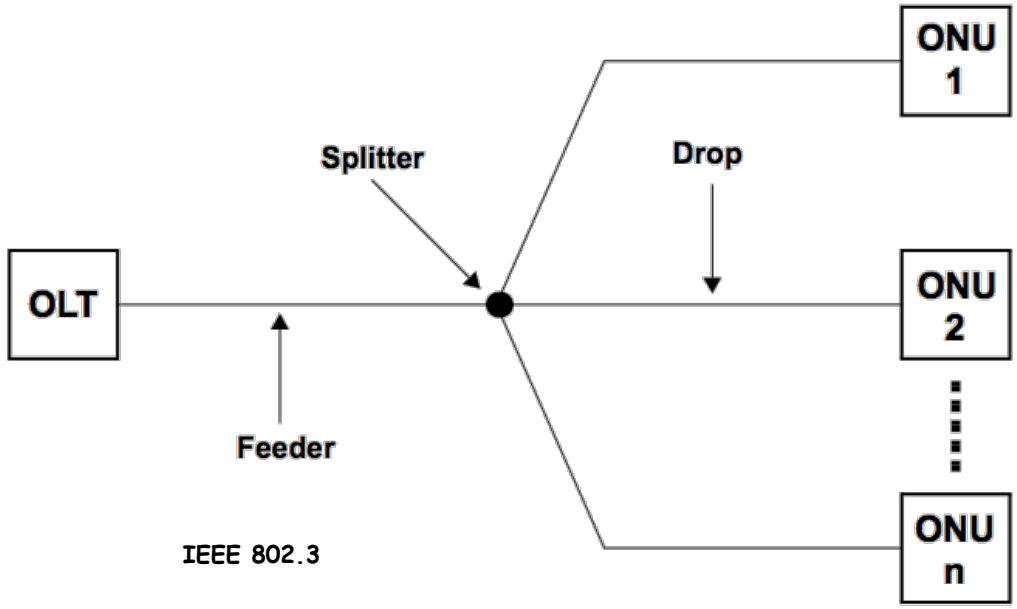


Sobre Fibra

EPON:

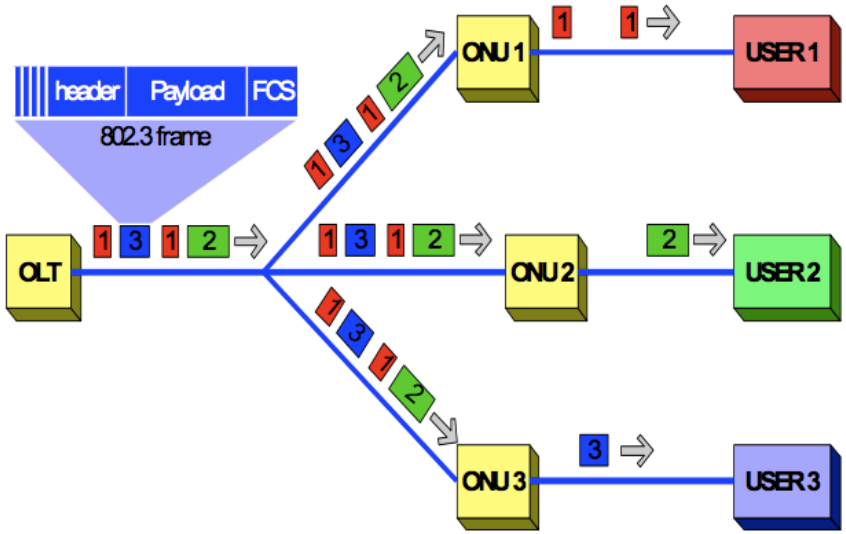
- Punto-a-multipunto pasiva
- Full-duplex
- Diferente λ uplink y downlink
- Los interfaces extremos son diferentes (*CO side* y *CPE side*)
- 1000BASE-PX10:
  - Monomodo, 10km
- 1000BASE-PX20:
  - Monomodo, 20km
- Al menos 1:16

- OLT controla cuándo pueden transmisir las ONUs
- MAC
  - Modificado para p2mp
  - No CSMA/CD
  - MPCP (Multi-Point Control Protocol)



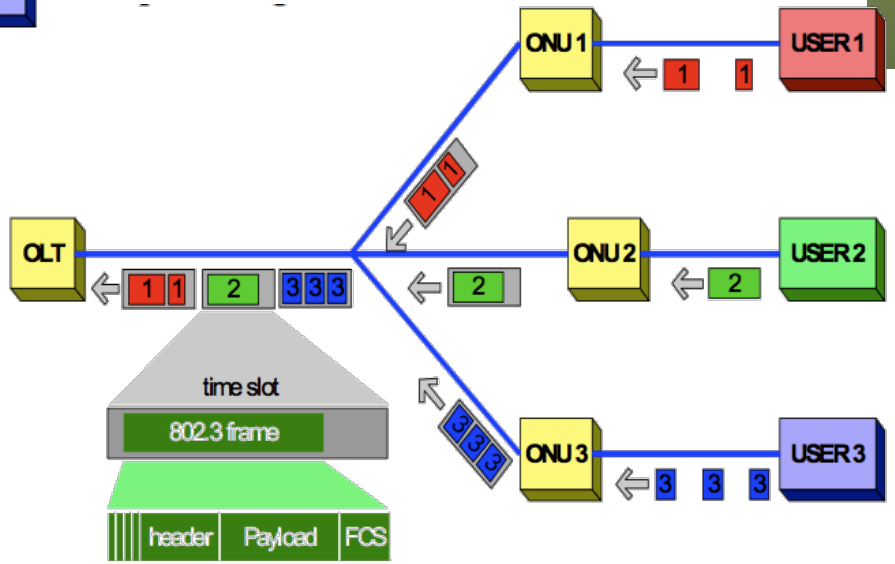
Sobre Fibra

Downstream



Upstream

- TDMA



- Discovery processing: of ONUs
- Report procesings: BW requests from ONU to OLS
- Gate processing: asignación de tiempos para transmitir en uplink

Tramas de control MPCP

- Mismo tipo de tramas que para flow-control con 802.3x
- Ethertype 0x8808
- Campo de 2 bytes para indicar la función de control concreta

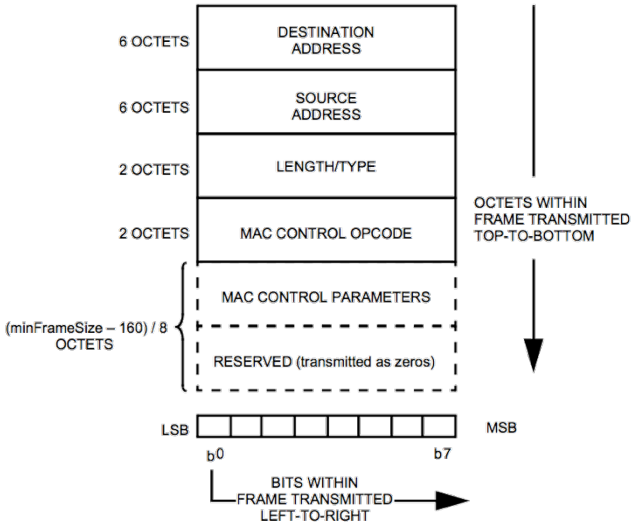


Figure 31–3—MAC Control frame format

Table 31A–1—MAC Control opcodes

Opcode (Hexadecimal)	MAC Control function	Specified in	Value/Comment	Timestamp[a]
00-00	Reserved			
00-01	PAUSE	Annex 31B	Requests that the recipient stop transmitting non-control frames for a period of time indicated by the parameters of this function.	No
00-02	GATE	Clause 64	Request that the recipient allow transmission of frames at a time, and for a period of time indicated by the parameters of this function.	Yes
00-03	REPORT	Clause 64	Notify the recipient of pending transmission requests as indicated by the parameters of this function.	Yes
00-04	REGISTER_REQ	Clause 64	Request that the station be recognized by the protocol as participating in a gated transmission procedure as indicated by the parameters of this function.	Yes
00-05	REGISTER	Clause 64	Notify the recipient that the station is recognized by the protocol as participating in a gated transmission procedure as indicated by the parameters of this function.	Yes
00-06	REGISTER_ACK	Clause 64	Notify the recipient that the station acknowledges participation in a gated transmission procedure.	Yes
00-07 through FF-FF	Reserved			

[a]The timestamp field is generated by MAC Control and is not exposed through the client interface.

IEEE 802.3

Ethernet OAM

- Operation, Administration and Maintenance
- 802.3ah, opcional
- Compatible con cualquier Ethernet full-duplex
- Objetivos:
  - Remote failure indication
    - Indicar al otro extremo que el camino de recepción del DTE local no funciona
  - Remote loopback
  - Link monitoring

- OAMPDU
  - MAC Destino reservada, filtrada
  - Ethertype 0x8809 (Slow Protocols)

Octets		
6	Destination Address = 01-80-c2-00-00-02	Common, fixed header for all OAMPDUs
6	Source Address	
2	Length/Type = 88-09 [Slow Protocols]	
1	Subtype = 0x03 [OAM]	
2	Flags	
1	Code	
42-1496	Data/Pad	
4	FCS	

10G-EPON

- 802.3av-2009
- Modificación a 802.3-2008
- Extiende EPON:
  - 10Gbps simétricos
  - 10Gbps downstream y 1Gbps upstream
  - Compatible con 1Gbps EPON: Cambia capa física, no MAC
  - Al menos 10 y 20Km (según velocidad)
  - Split ratio de 1:16 y 1:32