



Ethernet/IEEE 802.3 evolution

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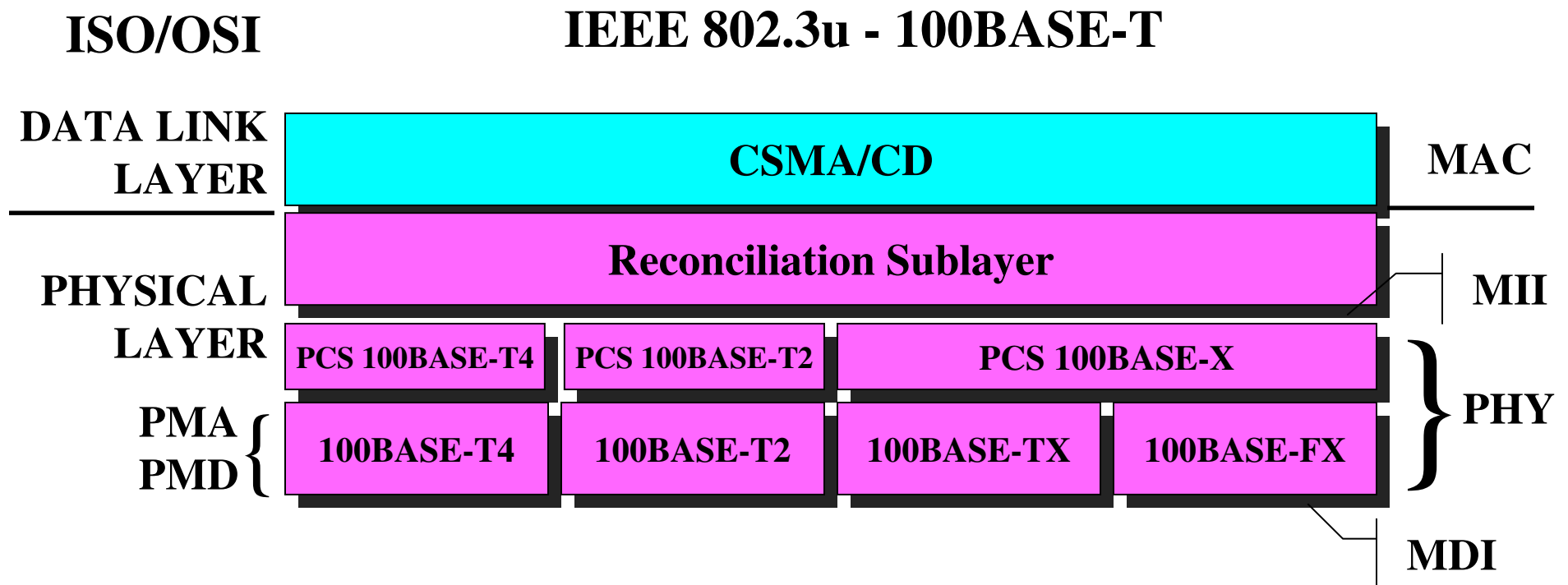


Fast Ethernet - IEEE 802.3u

- IEEE 802.3u
 - Ethernet 802.3 evolution of 10BASE-T e 10BASE-F
 - 4 sub-standard for different cable type:
 - 100BASE-T4 (UTP cat 3, over 4 pairs)
 - 100BASE-T2 (UTP cat 3, over 2 pairs)
 - 100BASE-TX (UTP cat 5, over 2 pairs)
 - 100BASE-FX (fiber optic)
 - Same MAC CSMA/CD of IEEE 802.3
 - Same frame format of IEEE 802.3
- ← Not used
- } 100BASE-X



Architectural Model



MDI: Medium Dependent Interface
 MII: Medium Independent Interface
 PCS: Physical Coding Sublayer

PHY: Physical Layer Device
 PMA: Physical Medium Attachment
 PMD: Physical Medium Dependent

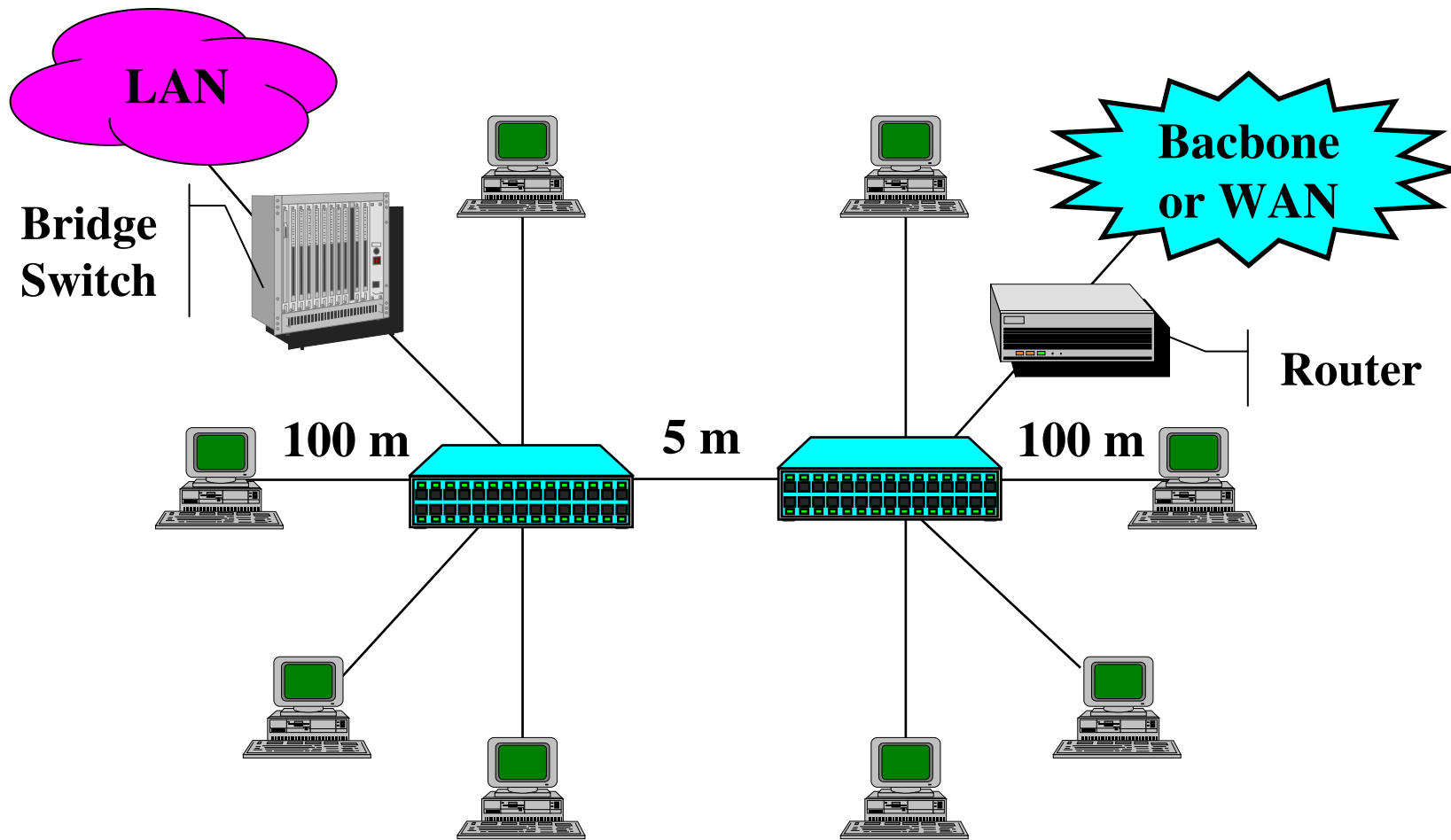


LAN extension and limits

- Speed 10 times faster
 - Data Rate 100Mb/s
 - Bit time 10ns
 - Interpacket gap 0.96 μ s
 - Slot time 512 bit (5.12 μ s)
- Reduced LAN diameter (200 m + 5 m)



Maximum LAN extension



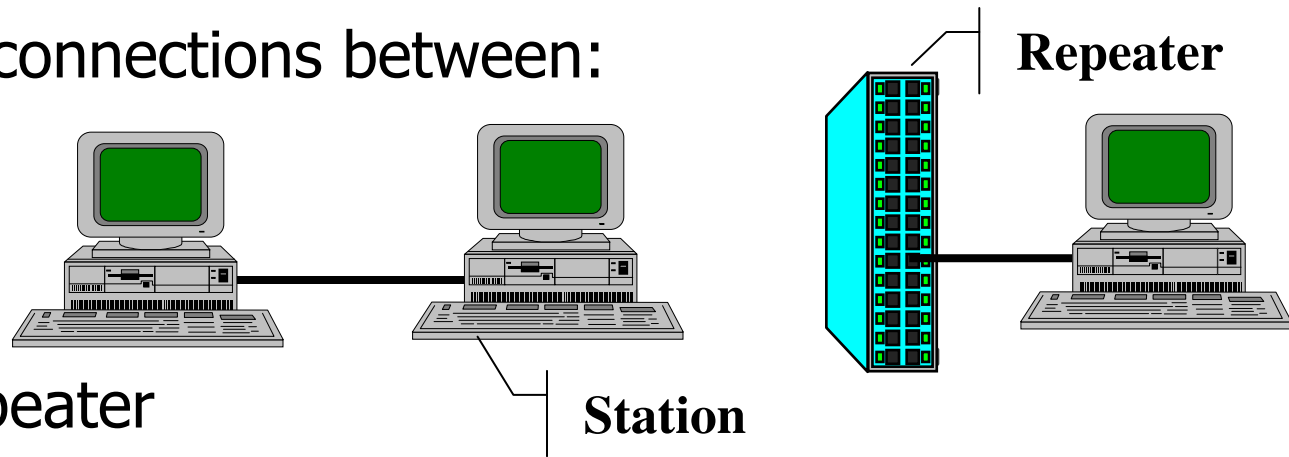
← Collision domain (max 205 m) →



Physical Layer

Point-to-Point connections between:

- stations
- bridge
- switch
- station & repeater



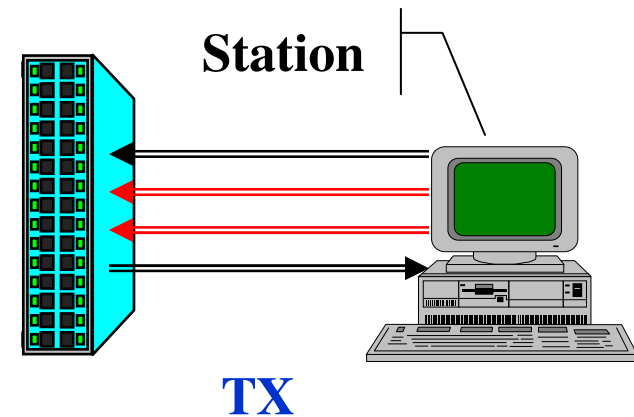
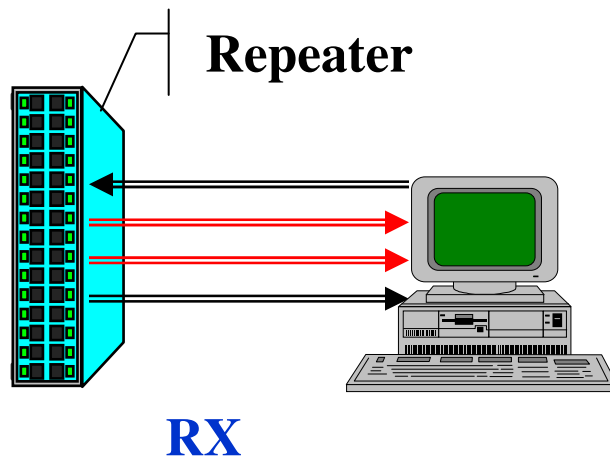
Standard	Media type	use	Max length	Code
100BASE-T4	UTP or STP cat 3 or superior	4 pair	100 m	8B6T
100BASE-T2	UTP or STP cat 3 or superior	2 pair	100 m	PAM5x5
100BASE-TX	UTP or STP cat 5 or superior	2 pair	100 m	FDDI: 4B5B
100BASE-FX	multimode fiber optic (62.5/125 μm)	2 fiber	400 m – HD 2000 m - FD	FDDI: 4B5B



100BASE-T4

4 pairs used

- Half duplex transmission
- 1 for TX
- 1 for RX
- 2 for TX or RX

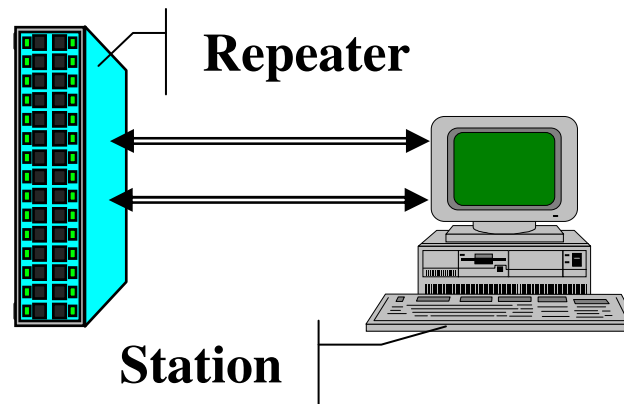




100BASE-T2

2 pairs used

- Half and full duplex transmission
- Hybrid transformer
- 5-level pulse amplitude modulation PAM 5x5





100BASE-X

- Transmission half and full duplex
- 100BASE-X derived from FDDI physical layer specifications (ISO/IEC 9314)
 - 100BASE-TX for copper and 100BASE-FX for fiber
- 100BASE-TX for UTP or STP cables (Shielded Twisted Pair)
 - Maximum segment length: 100 m
 - Maximum LAN diameter 205 m with 2 repeater
- 100BASE-FX for fiber optic cable
 - Maximum segment length (station-to-station): 400 m
 - Limit of CSMA/CD
 - Maximum LAN diameter with 1 repeater 300 m



Auto negotiation

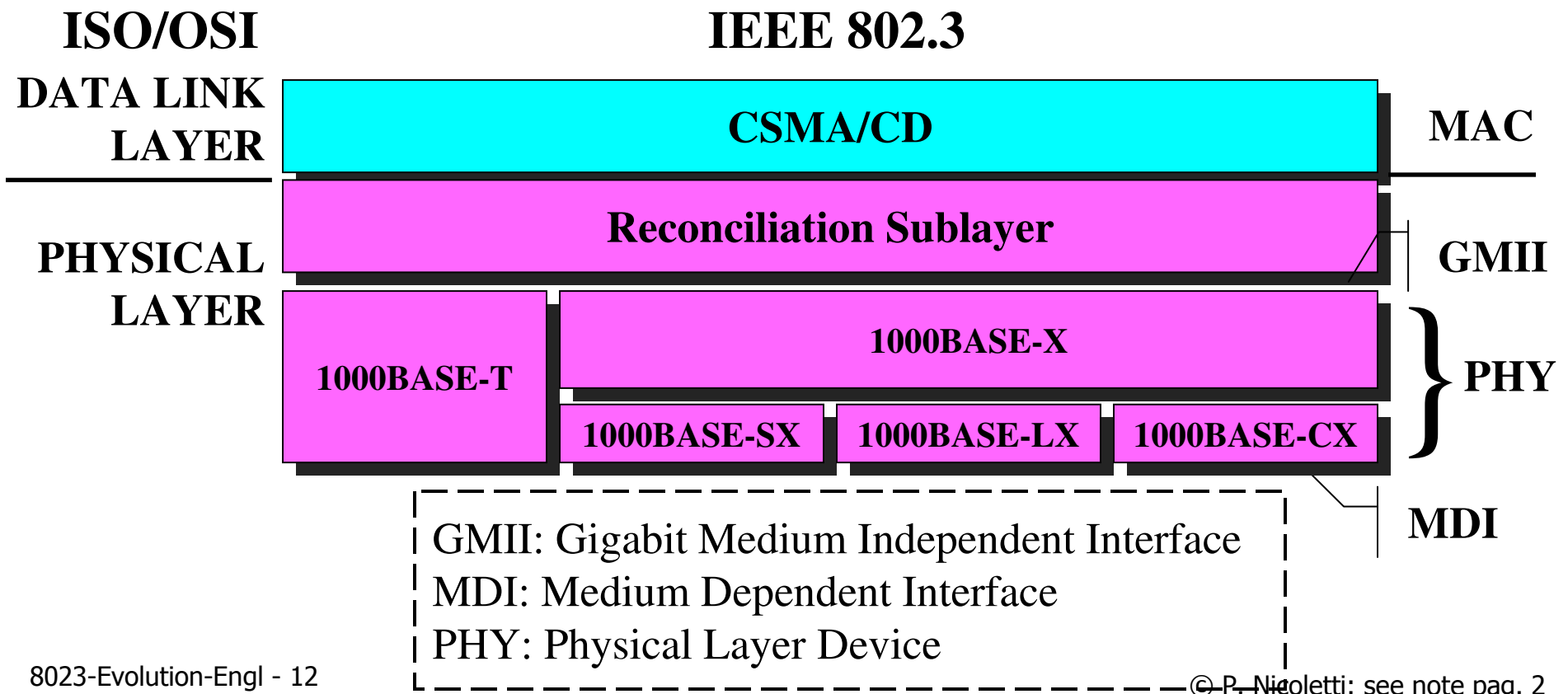
- Auto negotiation possibilities:
 - speed (only over copper)
 - half/full duplex (over copper and fiber optic)
- Negotiation sequence:
 - 1 Gb/s full-duplex
 - 1 Gb/s half-duplex
 - 100 Mb/s full-duplex
 - 100 Mb/s half-duplex
 - 10 Mb/s full-duplex
 - 10 Mb/s half-duplex



Gigabit Ethernet

IEEE 802.3z e IEEE 802.3ab

- Protocol extension for collision detection (MAC)
- GMII (Gigabit Media Independent Interface) between Physycal and MAC Layers





New functions

■ *Carrier extension*

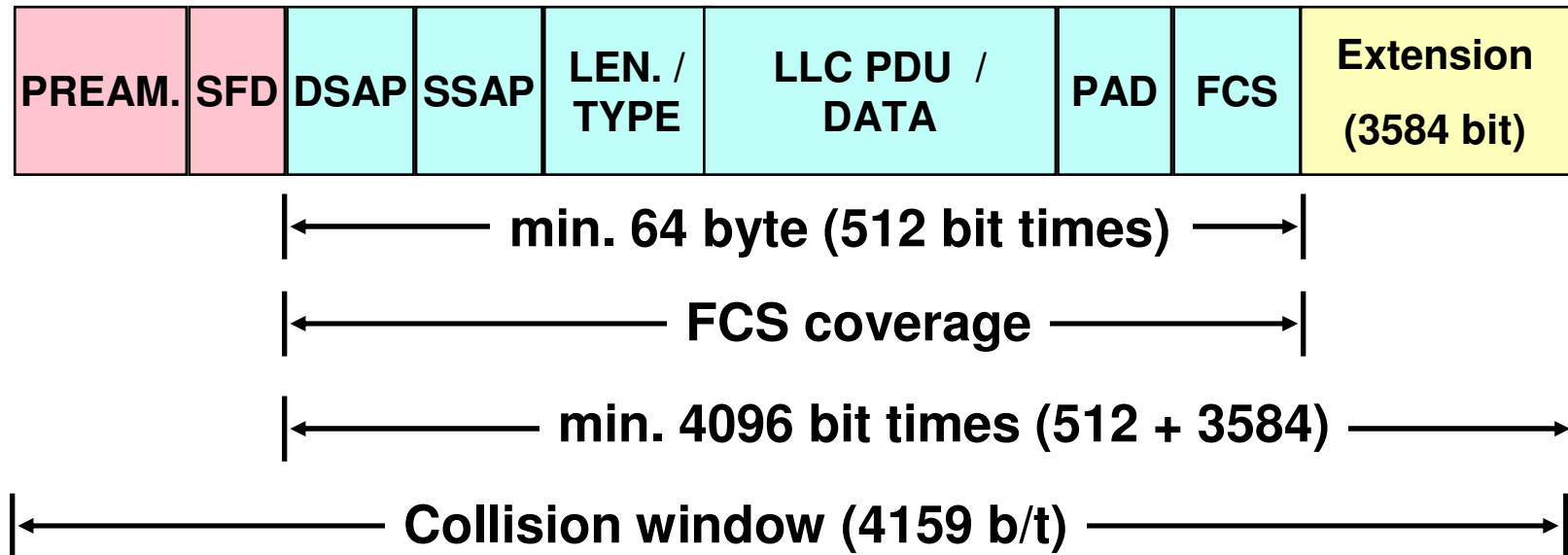
- Increase the dimension of frames shortest than 4096 bit
- data + *extension bit* = 4096 bit
- Collision Window = 4.1 μ s

■ *Burst mode*

- Fill bit transmission instead of Inter Frame Gap between frames during burst window
- Continuous transmission up to 77 Kbit (65 K + 12 K)

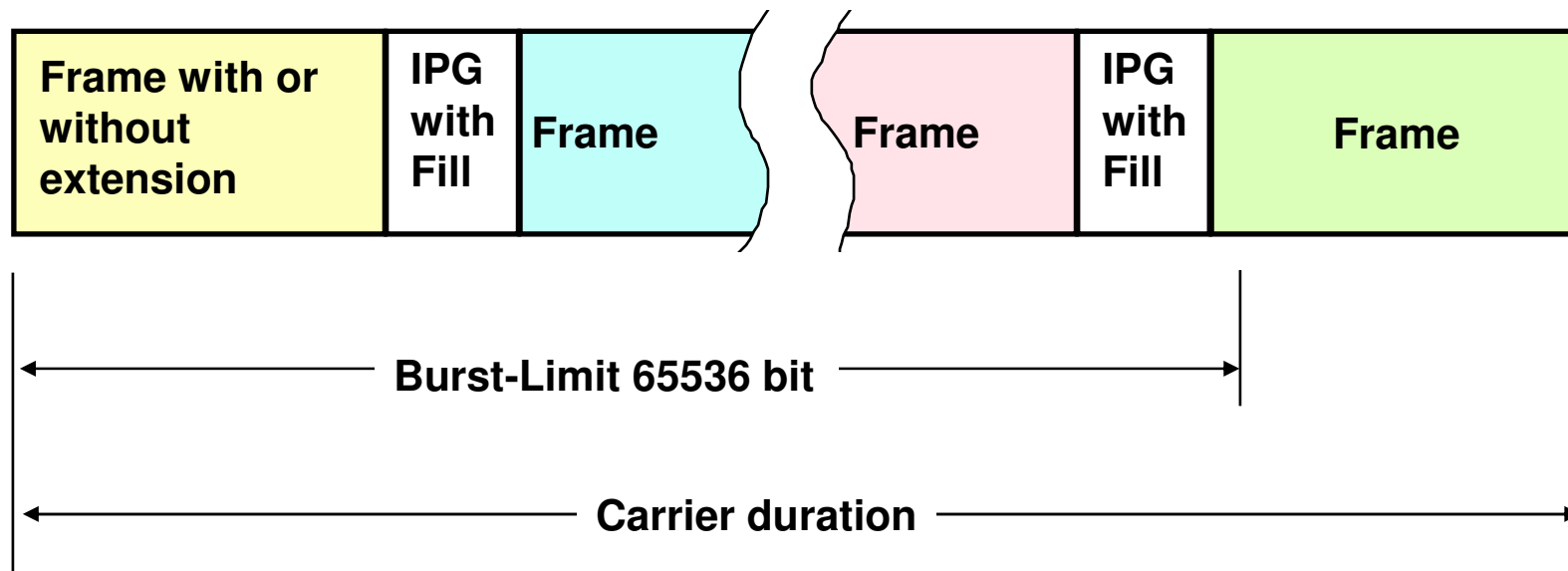


Carrier Extension





Frame Bursting





Gigabit Ethernet Physical layer

MMF = Multi Mode Fiber
SMF = Single Mode Fiber

Standard	Media	Use	Max leng.	Code
1000BASE-SX	MMF 50/125 μm (400 MHz * Km a 850nm)	2 fibers	500 m	FC: 8B10B
	MMF 50/125 μm (500 MHz * Km a 850nm)		550 m	
	MMF 62.5/125 μm (160 MHz * Km a 850nm)		220 m	
	MMF 62.5/125 μm (200 MHz * Km a 850nm)		275 m	
1000BASE-LX	MMF 50/125 μm (400/500 MHz * Km a 1300nm)	2 fibers	550 m	FC: 8B10B
	MMF 62.5/125 μm (500 MHz * Km a 1300nm)		550 m	
	SMF 10/125 μm		5000 m	
1000BASE-CX	STP (jumper cable) 150 Ω	2 pairs	25 m	FC: 8B10B
1000BASE-T	UTP balanced 100 Ω Cat. 5E	4 pairs	100 m	PAM5

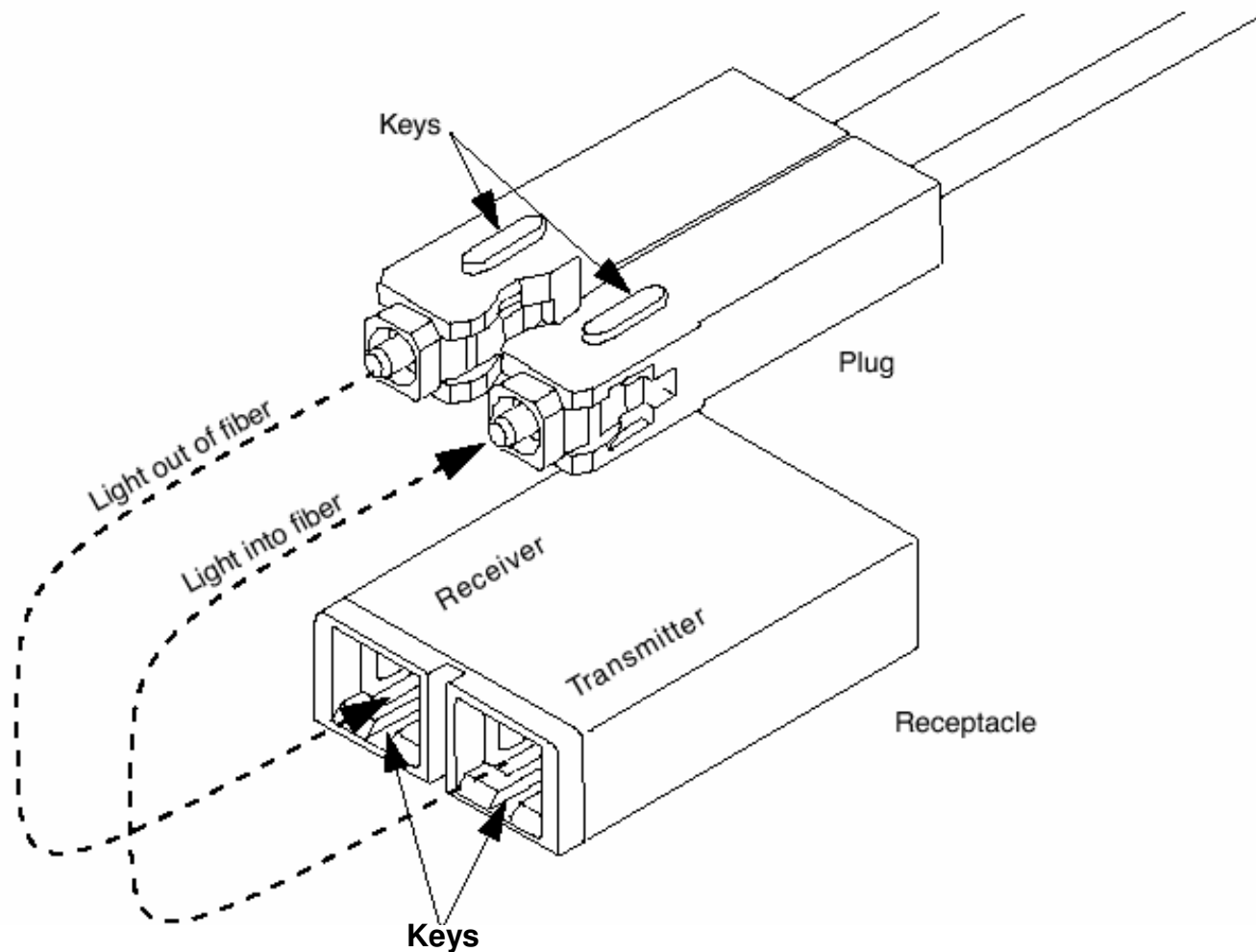


1000BASE-X

- Sub Standard
 - 1000BASE-CX (copper short range)
 - 1000BASE-SX (short wavelength)
 - 1000BASE-LX (long wavelength)
- Based on Fiber Channel (FC) Physical Layer
 - Code 8B10B
 - Redundancy code: control symbol and transitions

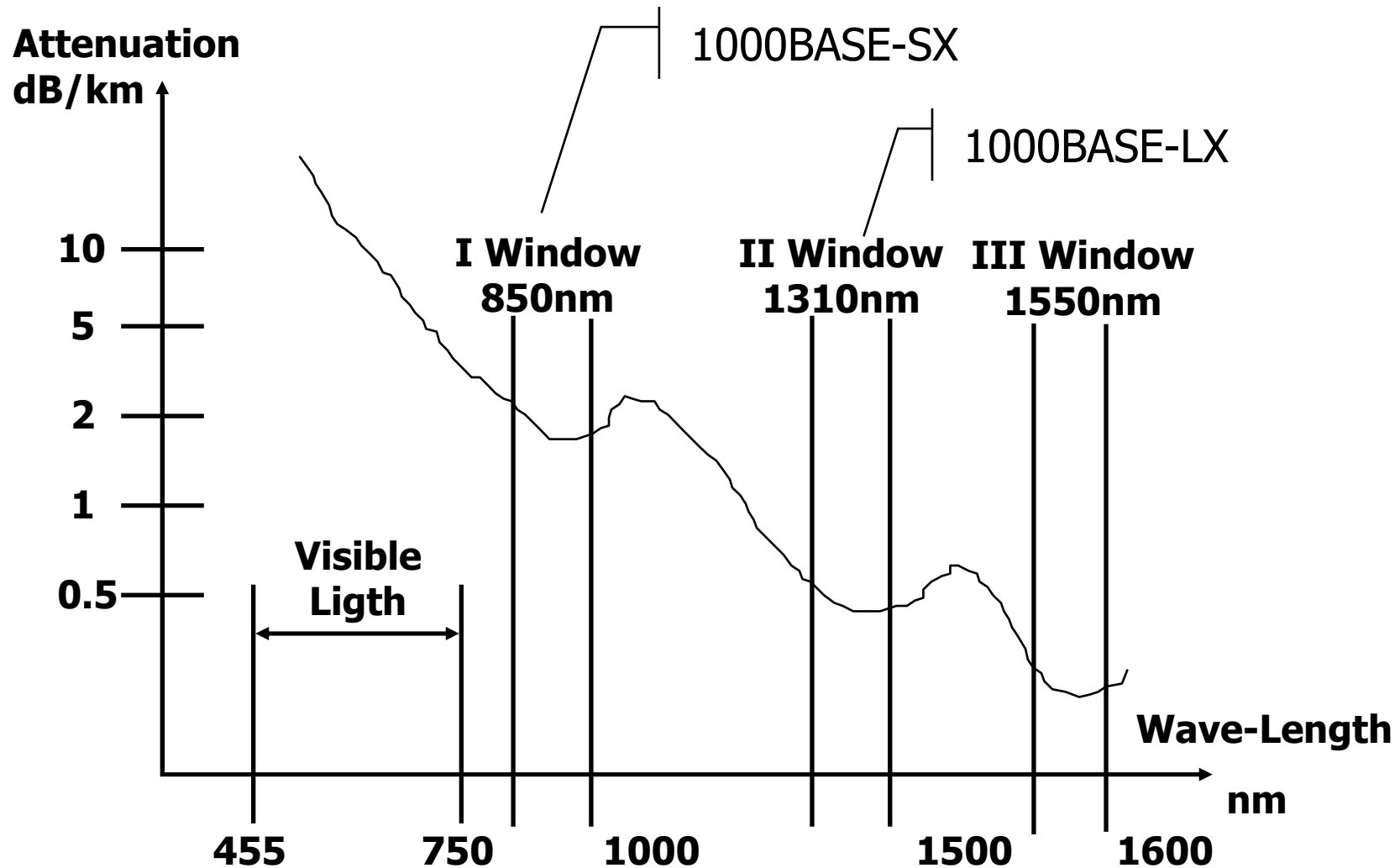


1000BASE-SX e 1000BASE-LX connectors



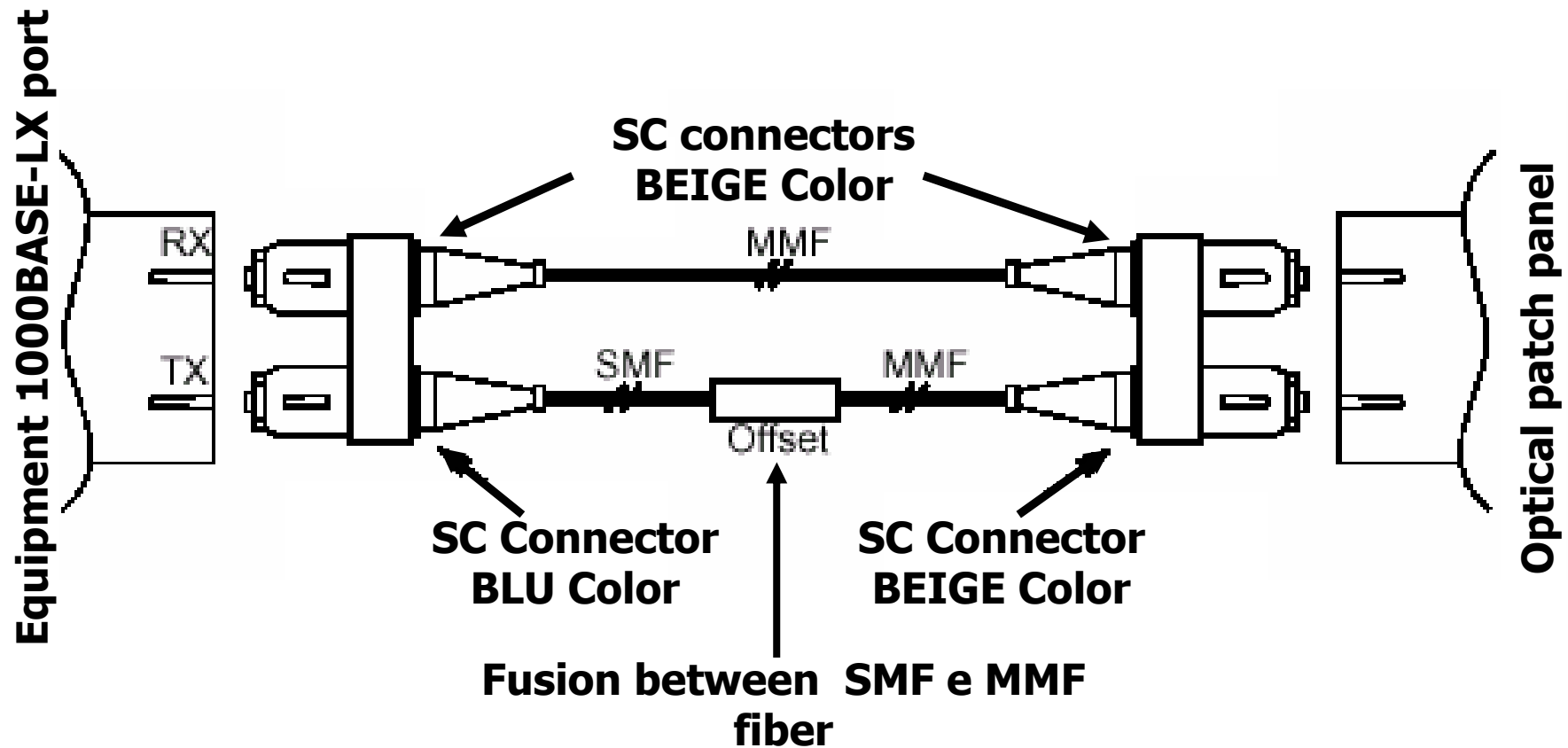


Wave-Length and standard





1000BASE-LX & multimode fiber: Mode Conditioning Patch Cord

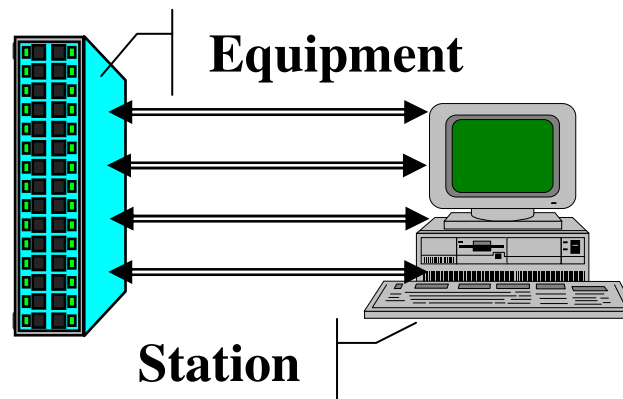


MMF = Multi Mode Fiber
SMF = Single Mode Fiber



IEEE 802.3ab – 1000BASE-TX

- Full-duplex transmission over 4 pairs
 - 250 Mb/s per pairs
 - Hybrid transformers
- Code PAM5 (5-level Pulse Amplitude Modulation)





Non standard products

- 1310 nm single-mode fiber: 10 Km
 - Example Cisco GBIC 1000BASE-LX/LH
- 1550 nm single-mode fiber dispersion shift: 100 Km
 - Example Cisco GBIC 1000BASE-LZ