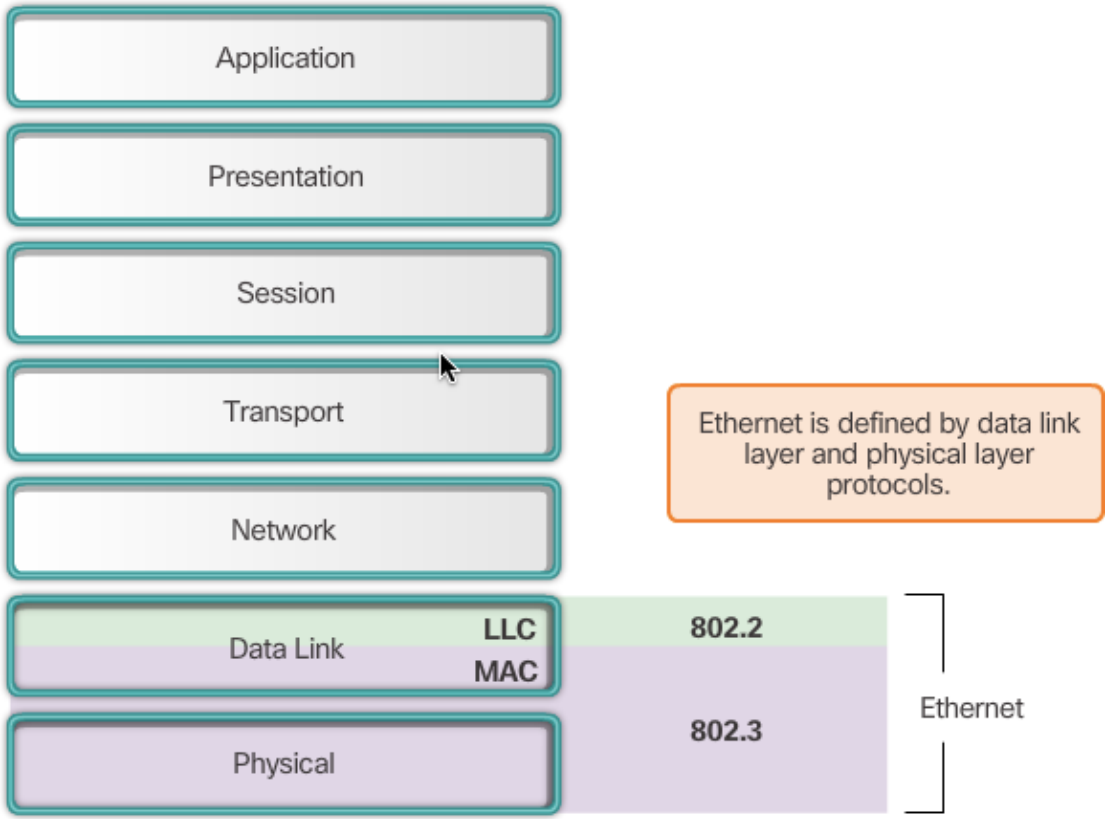
Wired LAN and Wireless LAN

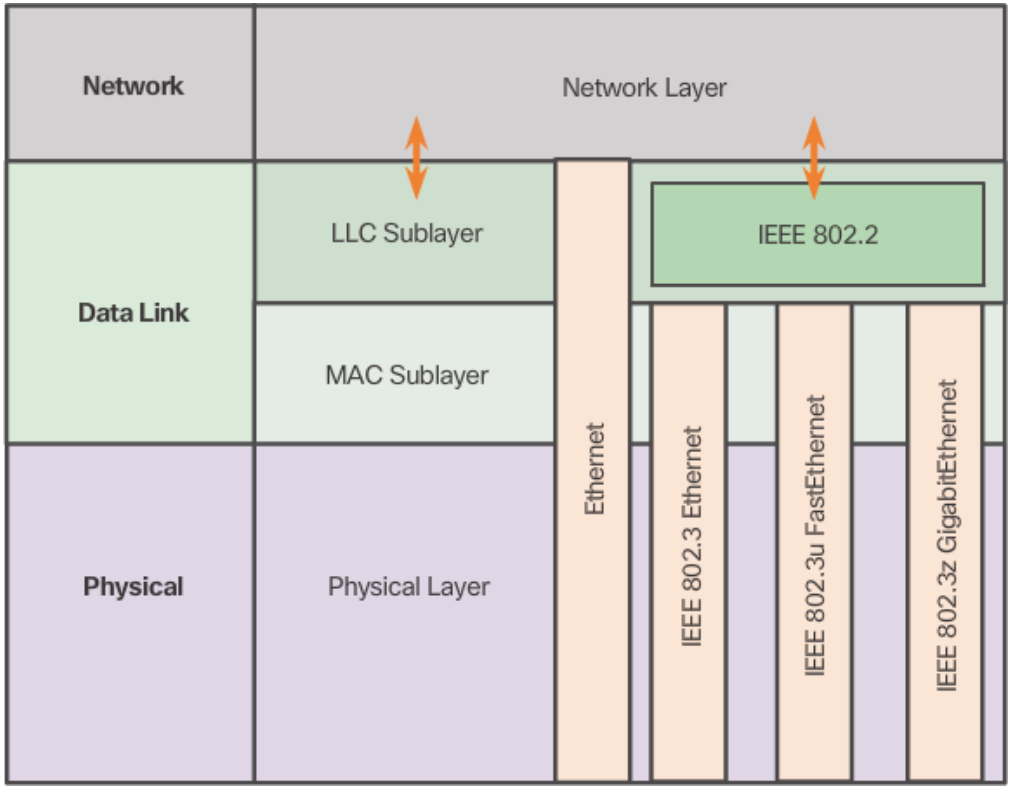
IEEE Standard

- In 1985, the Computer Society of the IEEE started a project, called Project 802, to set standards to enable intercommunication among equipment from a variety of manufacturers. Project 802 is a way of specifying functions of the physical layer and the data link layer of major LAN protocols.

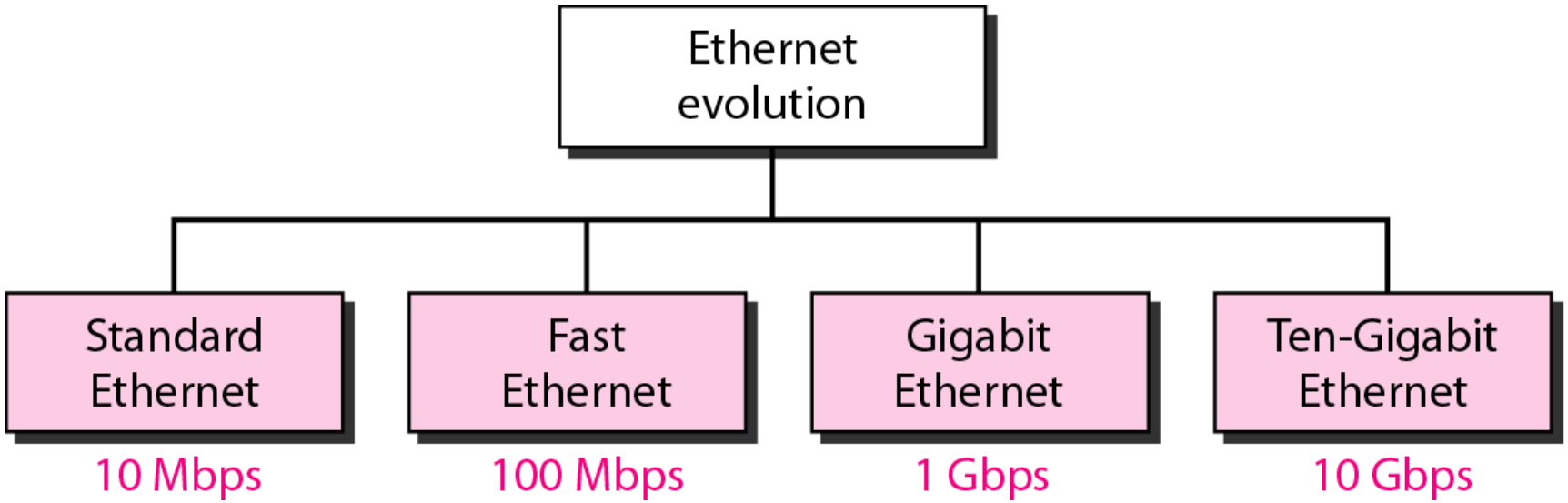


Wired LAN

- Ethernet is now the predominant LAN technology in the world. Ethernet operates in the data link layer and the physical layer. The Ethernet protocol standards define many aspects of network communication including frame format, frame size, timing, and encoding. When messages are sent between hosts on an Ethernet network, the hosts format the messages into the frame layout that is specified by the standards.

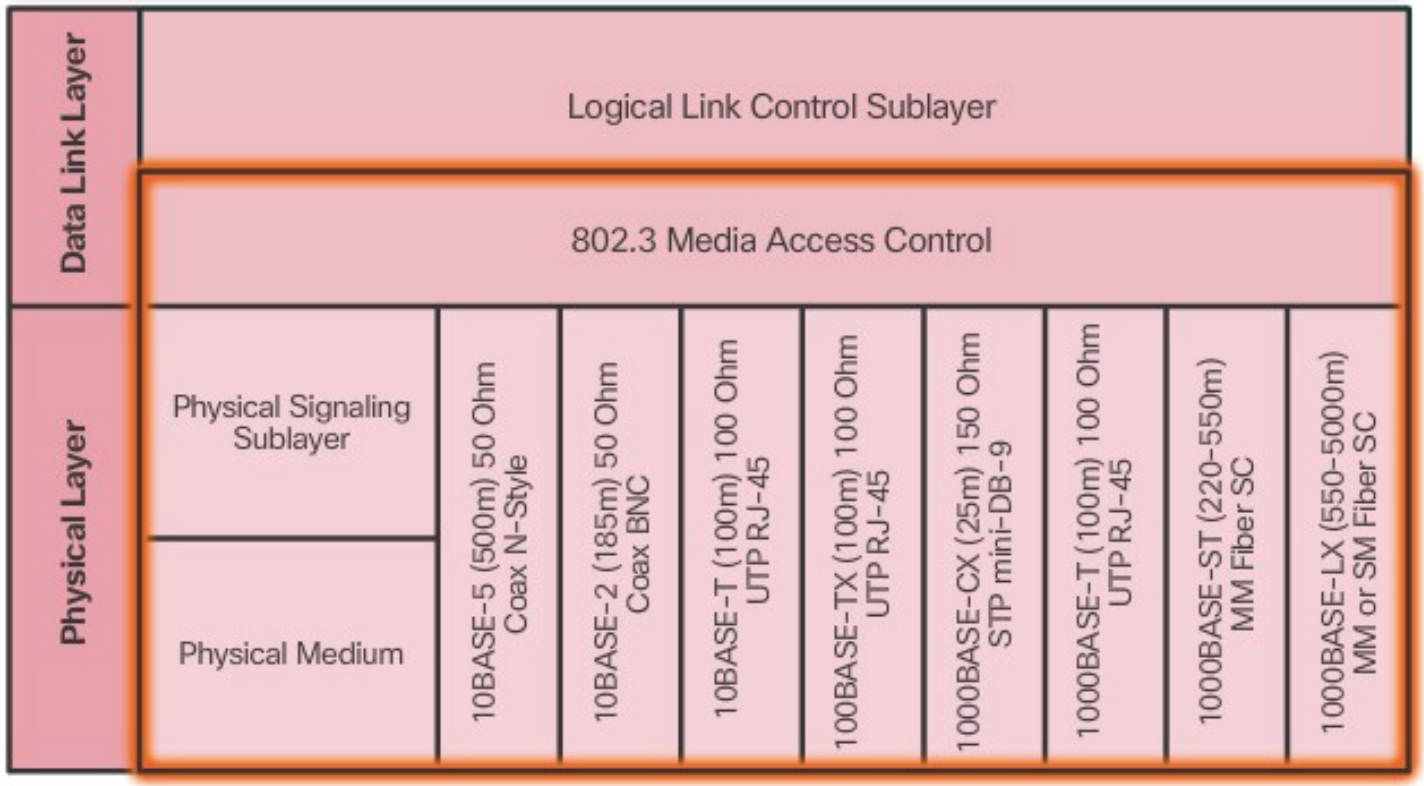


Ethernet evolution through four generations



Data Encapsulation
- Frame delimiting
- Addressing
- Error detection

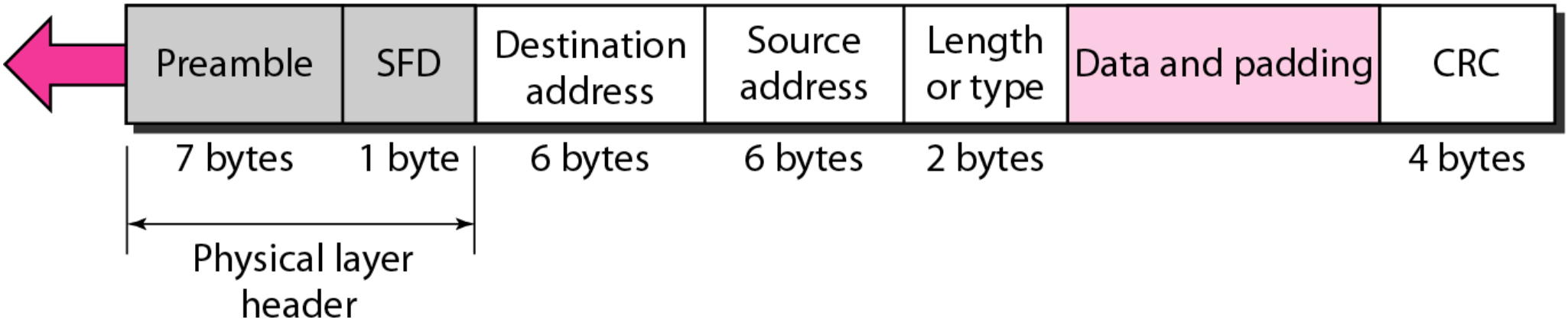
Media Access Control



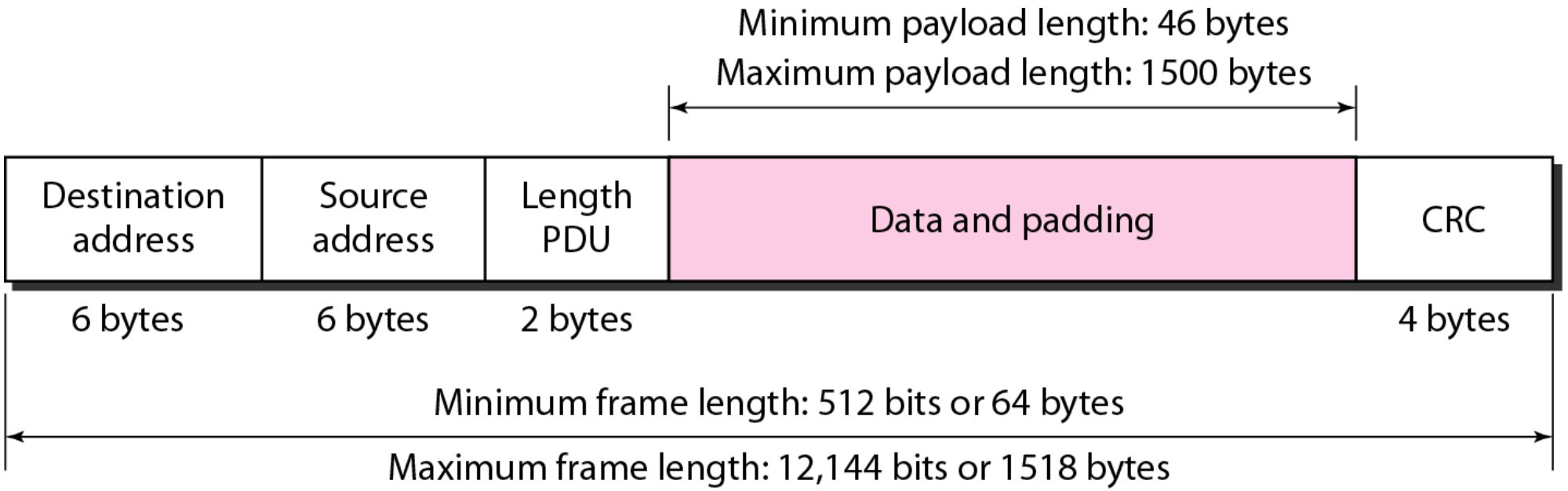
802.3 MAC Header

Preamble: 56 bits of alternating 1s and 0s.

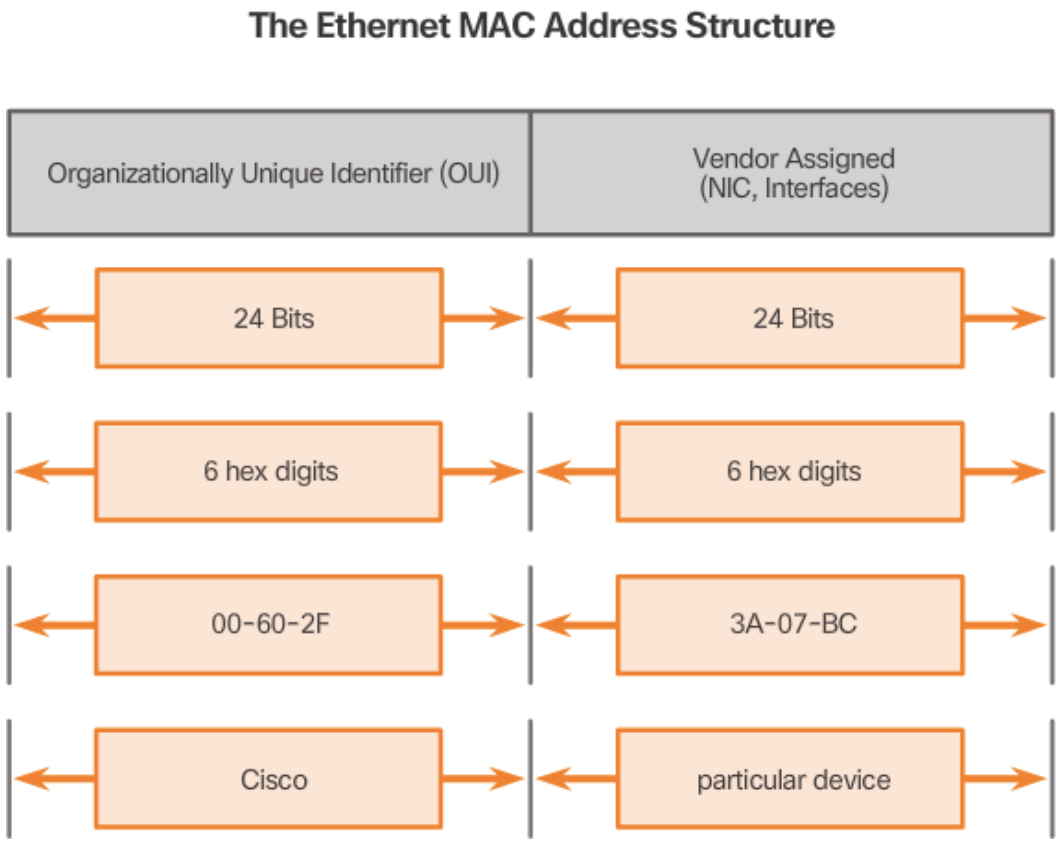
SFD: Start frame delimiter, flag (10101011)



Minimum and Maximum Lengths



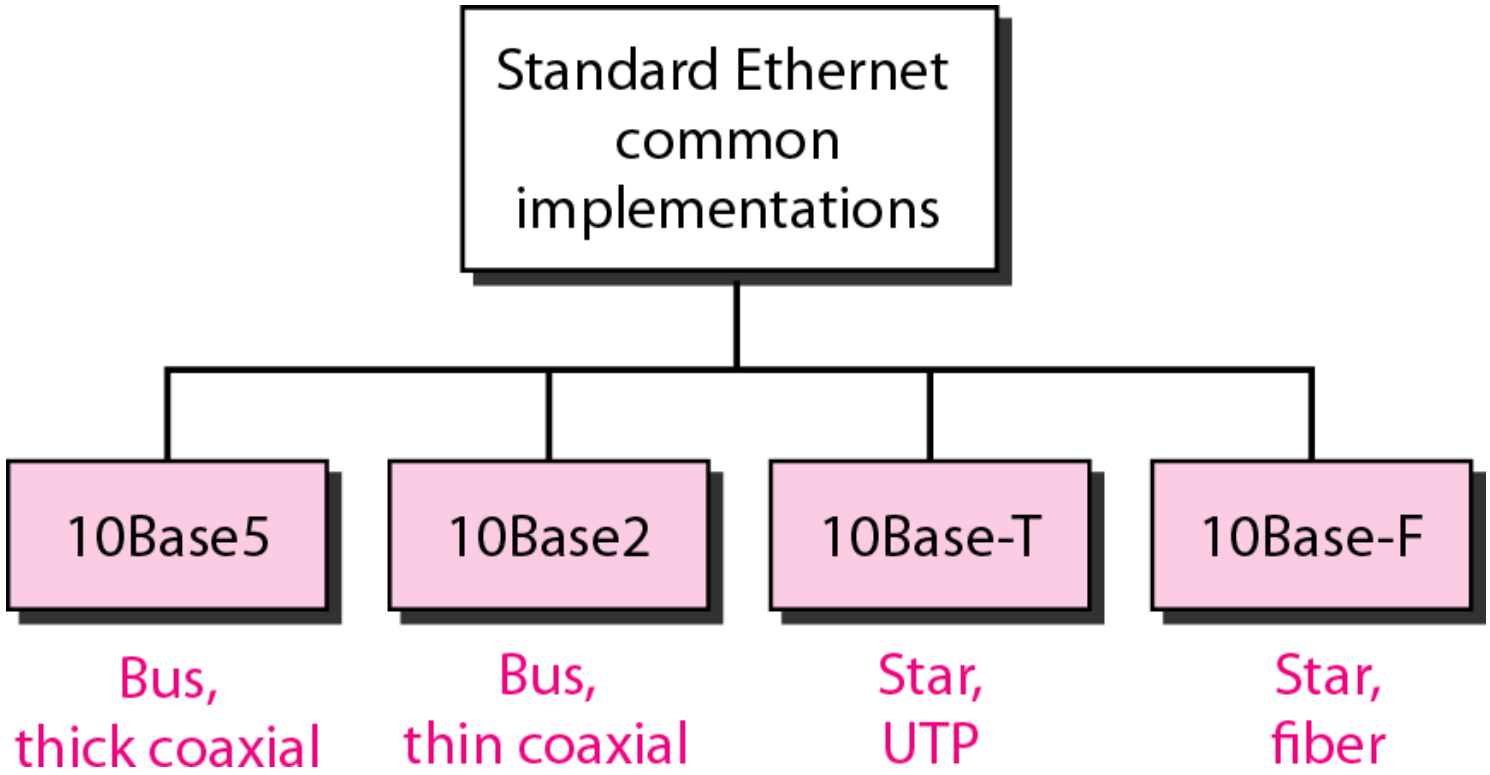
Ethernet MAC Address Structure



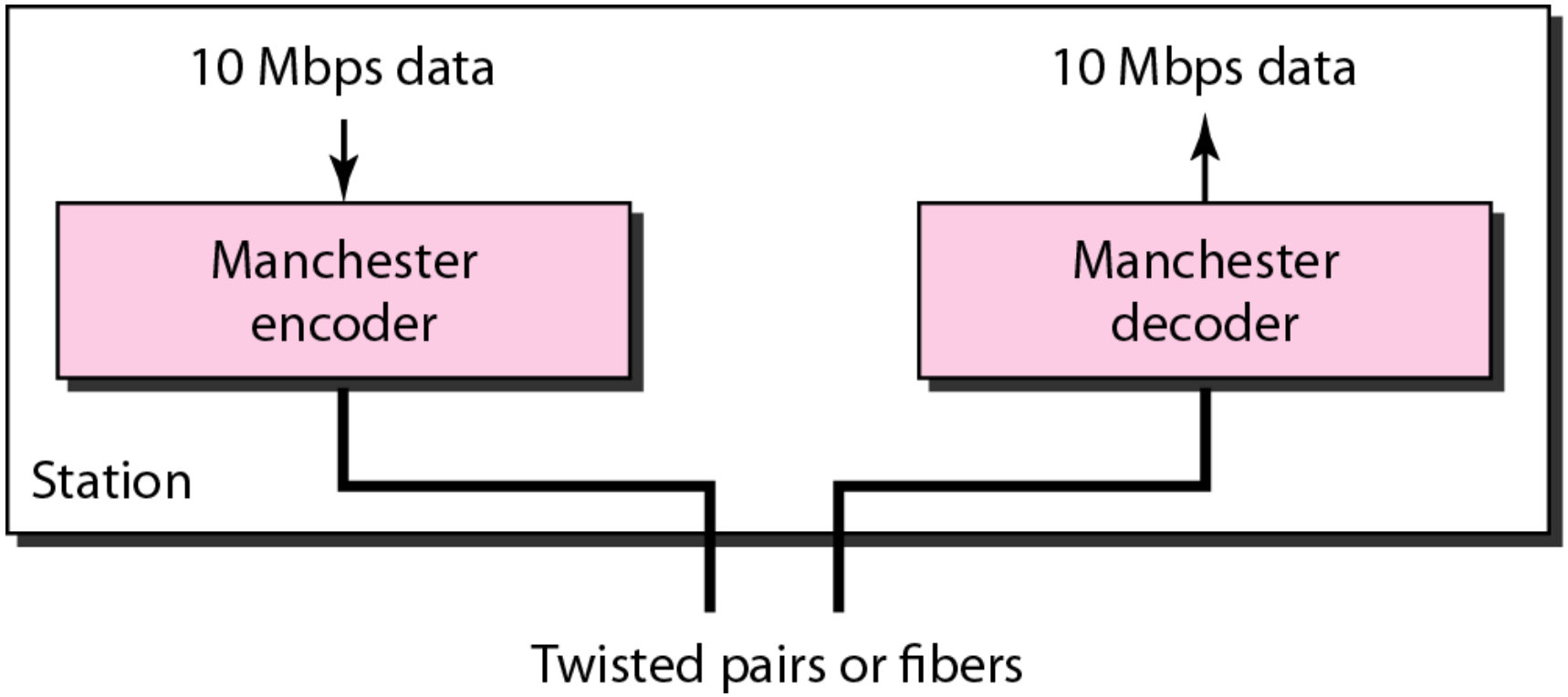
- The IEEE assigns the vendor a 3-byte (24-bit) code, called the Organizationally Unique Identifier (OUI).
- IEEE requires a vendor to follow two simple rules, as shown in the figure:
  1. All MAC addresses assigned to a NIC or other Ethernet device must use that vendor's assigned OUI as the first 3 bytes.
  2. All MAC addresses with the same OUI must be assigned a unique value in the last 3 bytes.

Example of an Ethernet address in hexadecimal notation

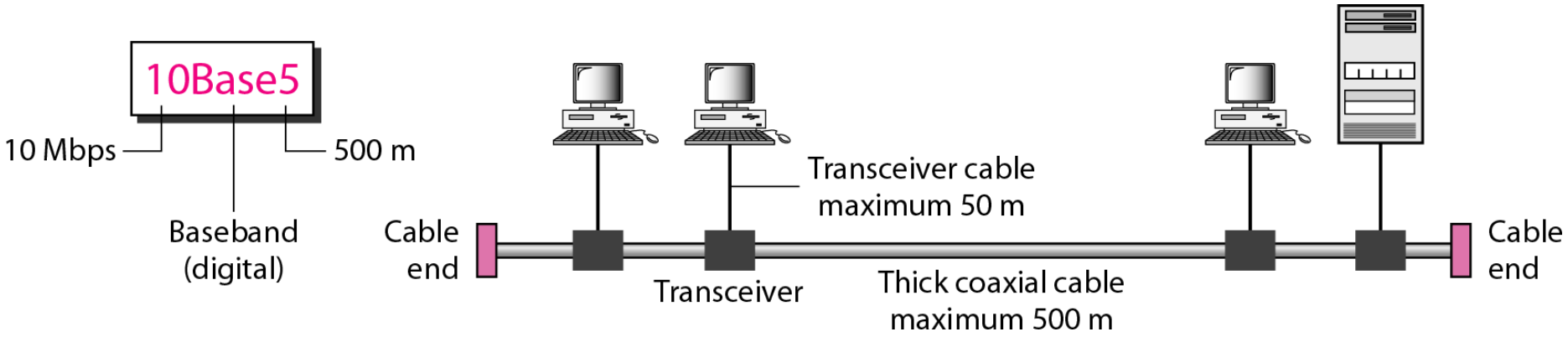
Categories of Standard Ethernet



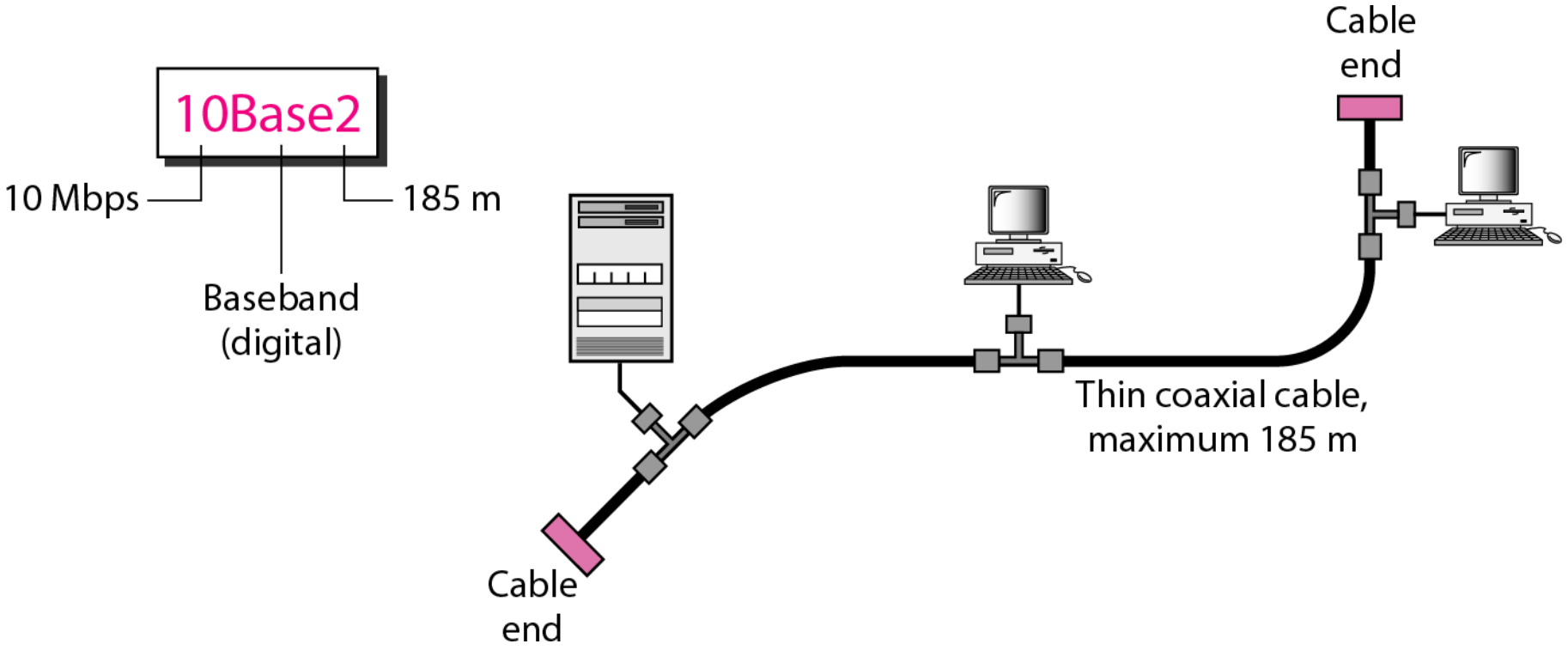
Encoding in Standard Ethernet Implementation



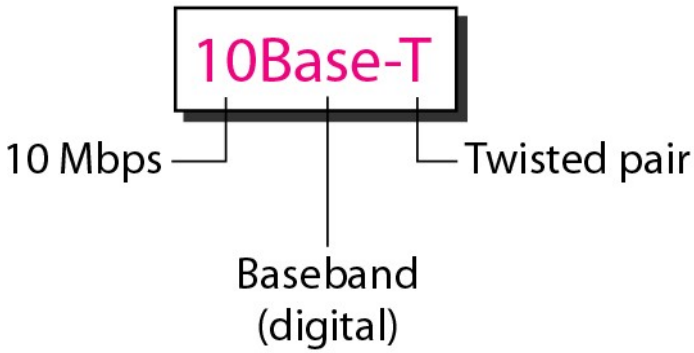
10Base5 Implementation

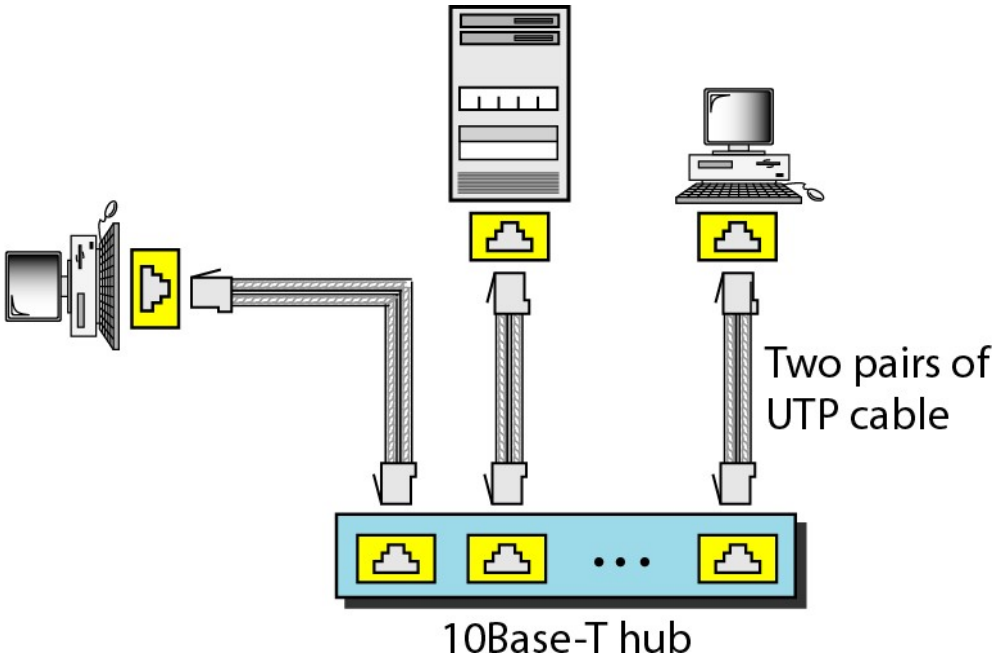


10Base2 Implementation

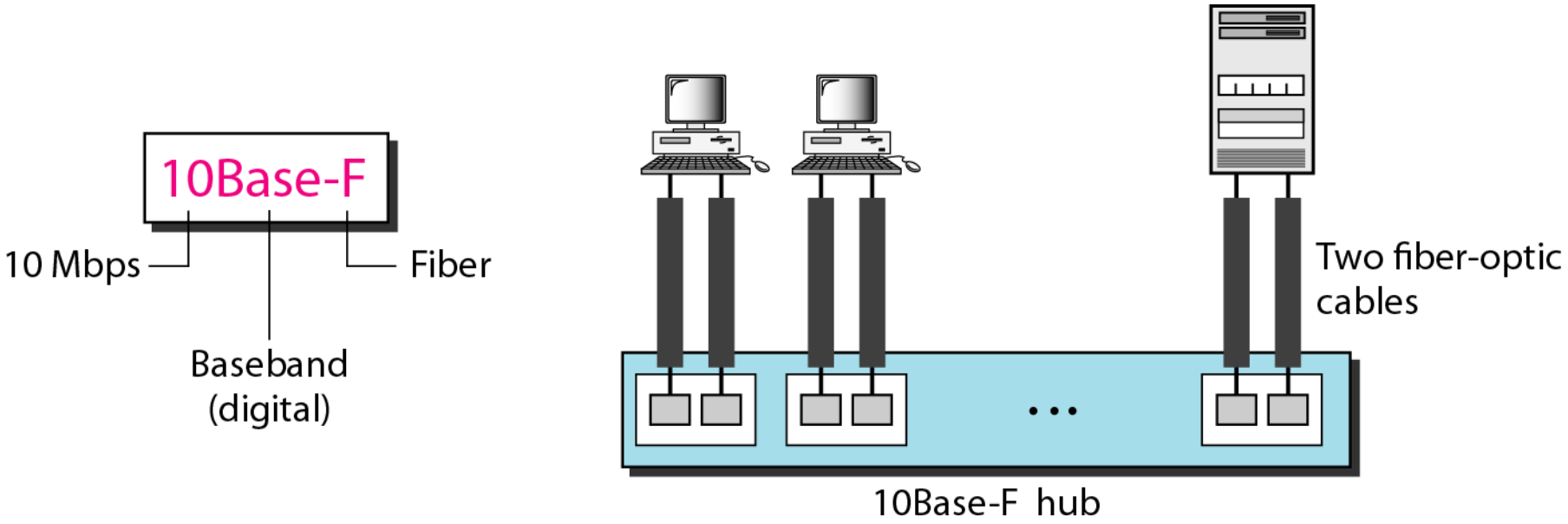


10BaseT Implementation





10BaseF Implementation

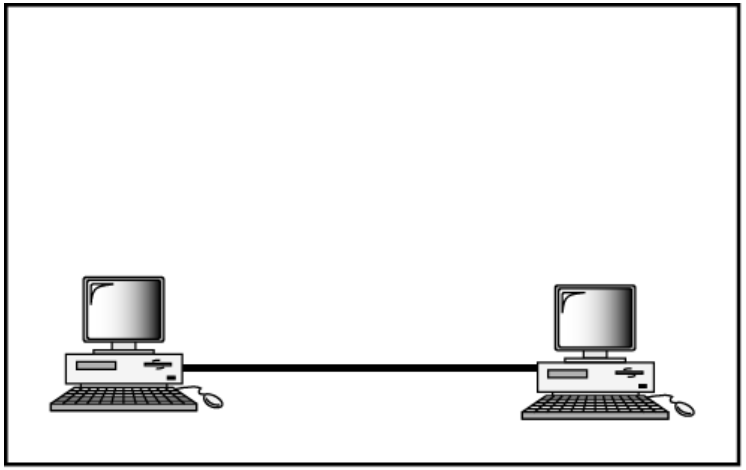


Summary of Standard Ethernet Implementations

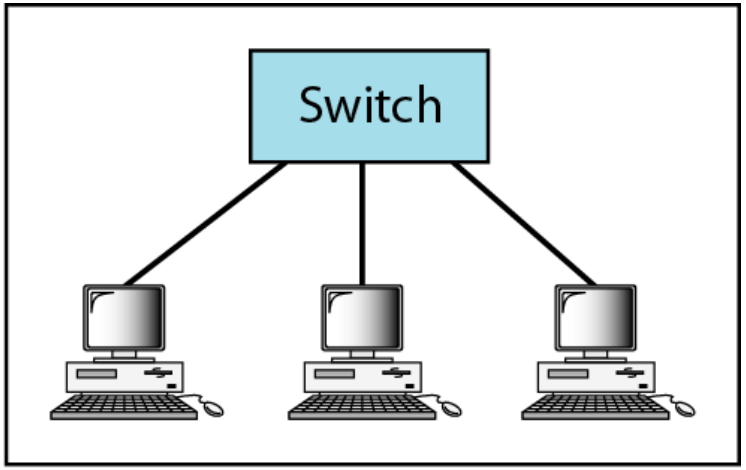
Characteristics	*10Base5*	*10Base2*	*10Base-T*	*10Base-F*
Media	Thick coaxial cable	Thin coaxial cable	2 UTP	2 Fiber
Maximum length	500 m	185 m	100 m	2000 m
Line encoding	Manchester	Manchester	Manchester	Manchester

Fast Ethernet

- Fast Ethernet was designed to compete with LAN protocols such as FDDI or Fiber Channel. IEEE created Fast Ethernet under the name 802.3u. Fast Ethernet is backward-compatible with Standard Ethernet, but it can transmit data 10 times faster at a rate of 100 Mbps.

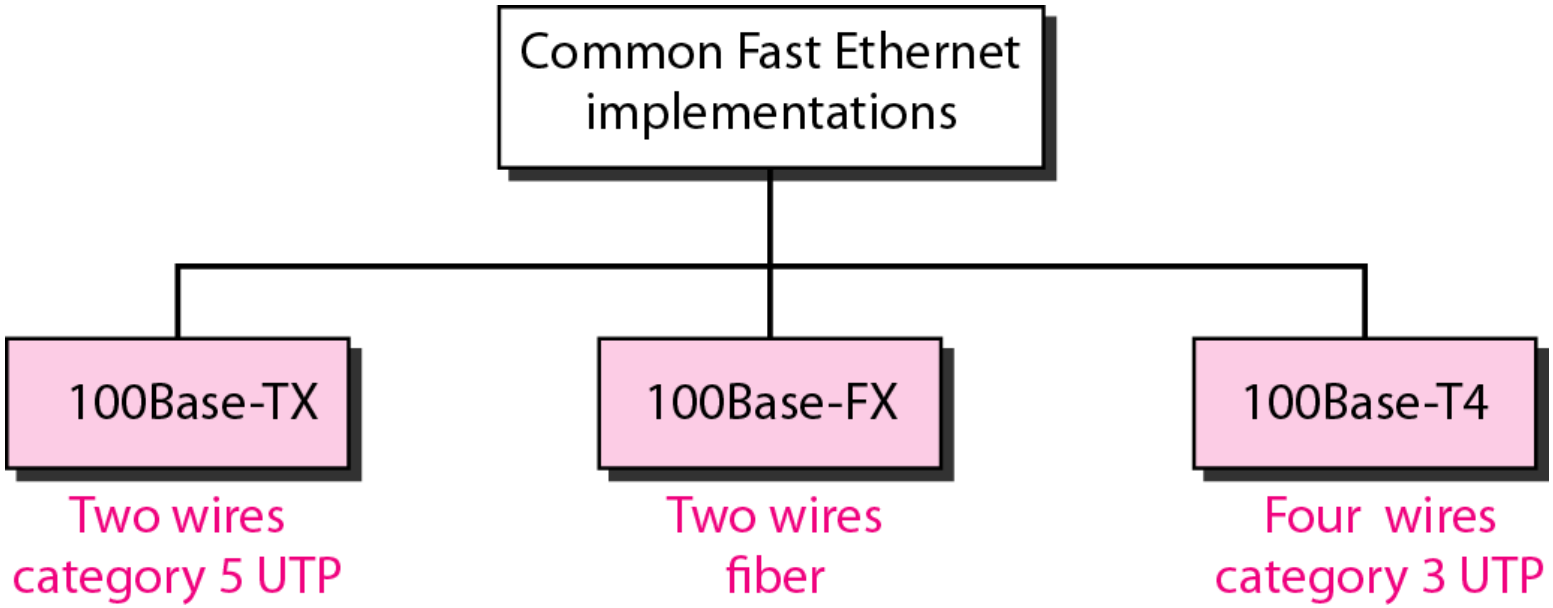


a. Point-to-point

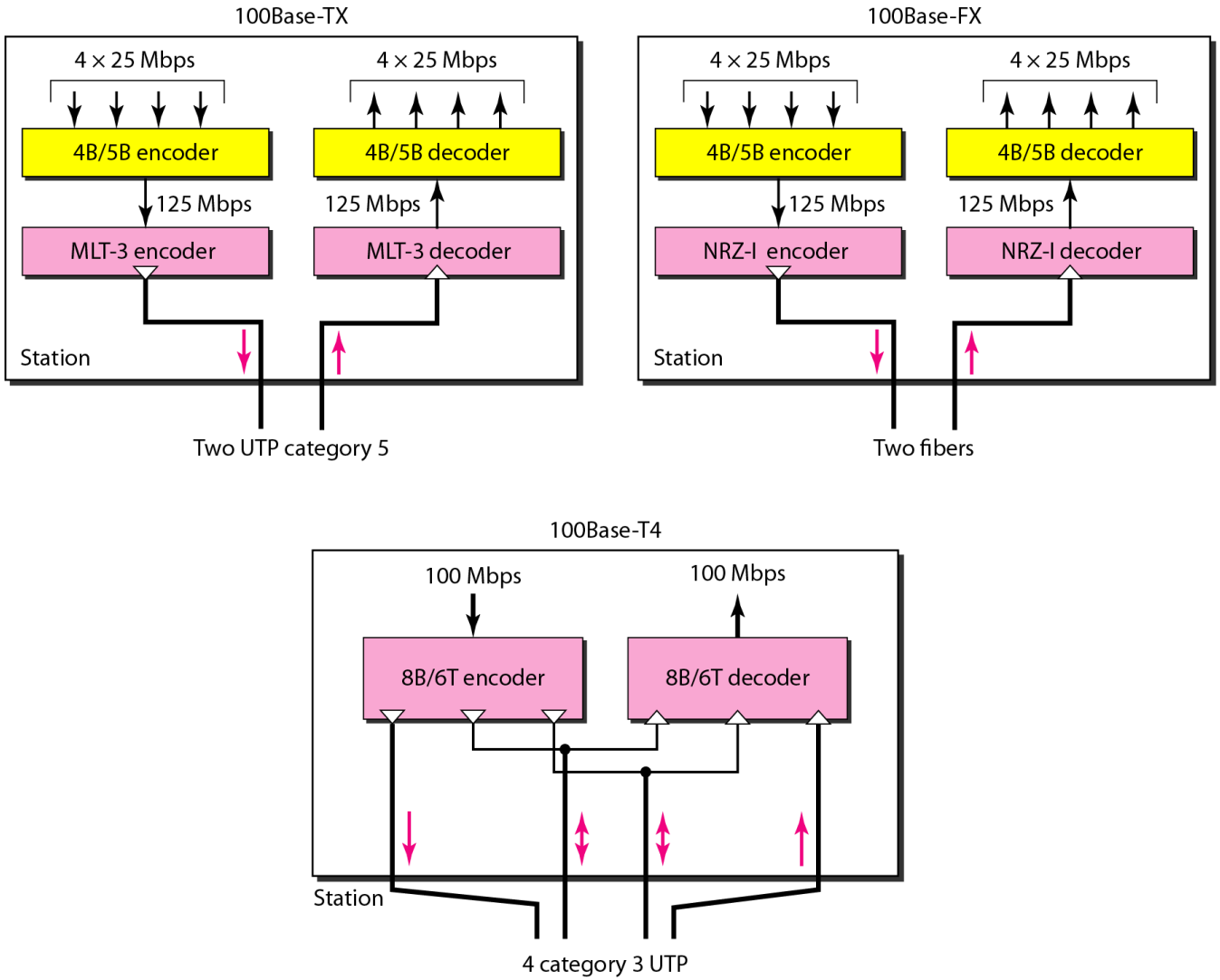


b. Star

Fast Ethernet Implementations



Encoding for Fast Ethernet Implementation

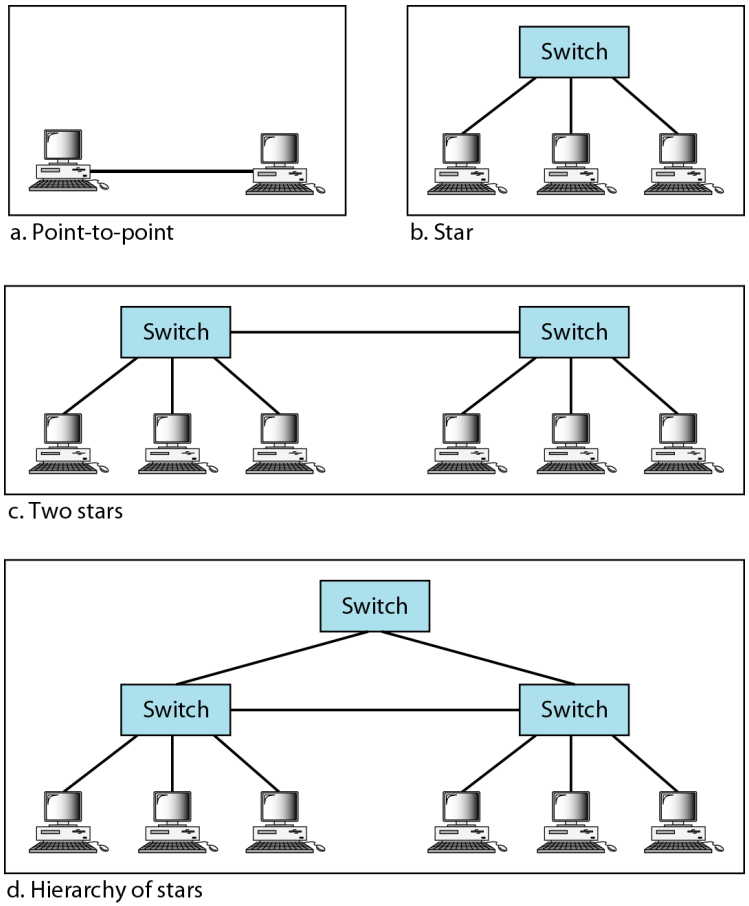


Summary of Fast Ethernet implementations

Characteristics	*100Base-TX*	*100Base-FX*	*100Base-T4*
Media	Cat 5 UTP or STP	Fiber	Cat 4 UTP
Number of wires	2	2	4
Maximum length	100 m	100 m	100 m
Block encoding	4B/5B	4B/5B	
Line encoding	MLT-3	NRZ-I	8B/6T

Gigabit Ethernet

- The need for an even higher data rate resulted in the design of the Gigabit Ethernet protocol (1000 Mbps). The IEEE committee calls the standard 802.3z.



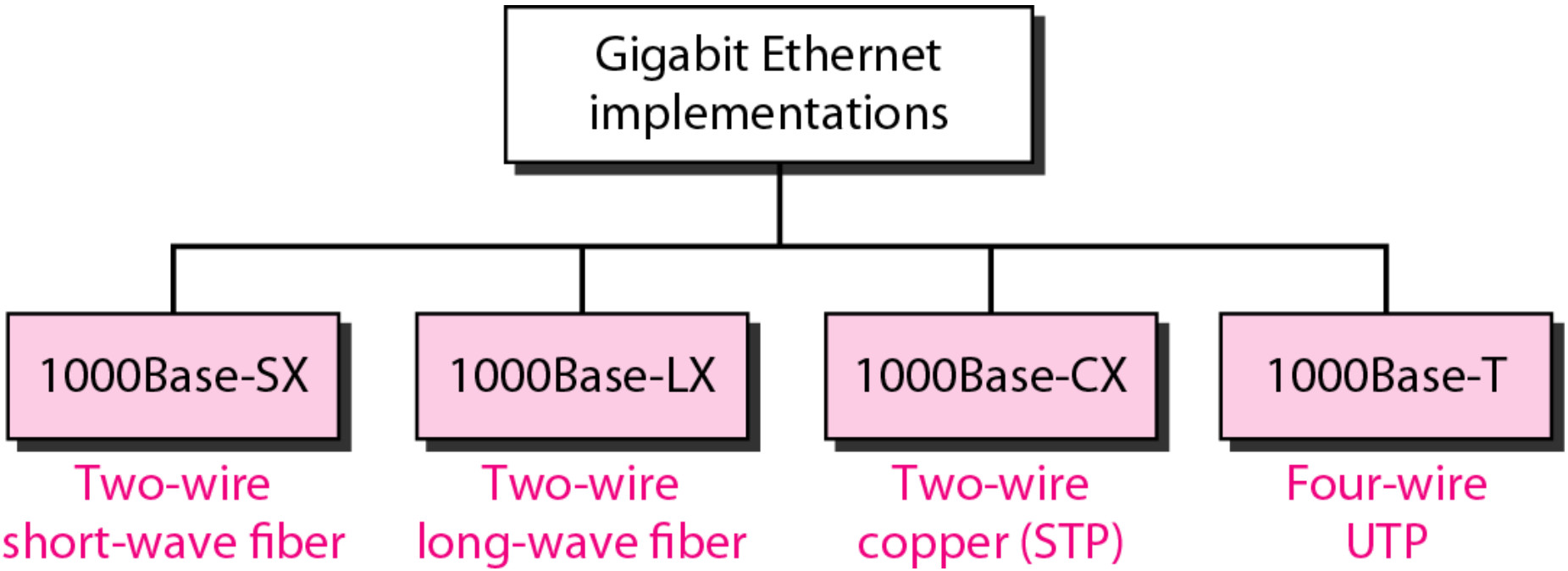
a. Point-to-point

b. Star

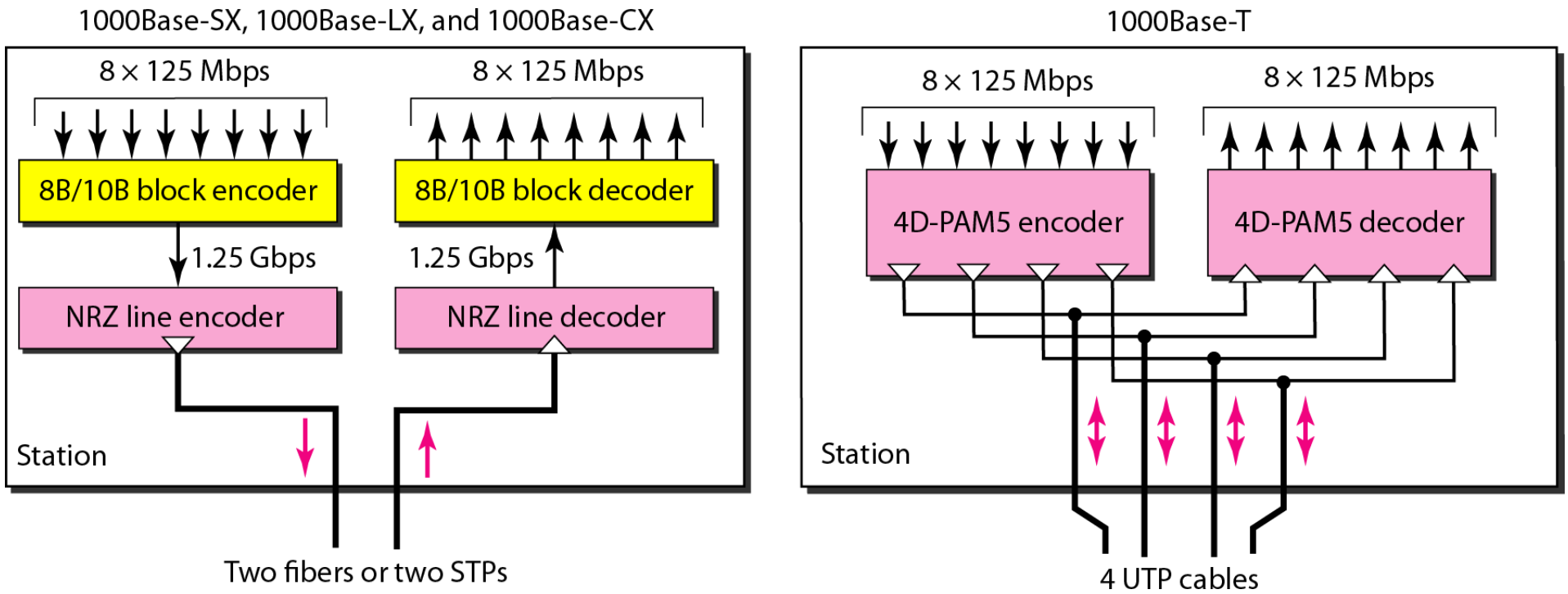
c. Two stars

d. Hierarchy of stars

Gigabit Ethernet Implementations



Encoding in Gigabit Ethernet implementations



Summary of Ten-Gigabit Ethernet implementations

Characteristics	*1000Base-SX*	*1000Base-LX*	*1000Base-CX*	*1000Base-T*
Media	Fiber short-wave	Fiber long-wave	STP	Cat 5 UTP
Number of wires	2	2	2	4
Maximum length	550 m	5000 m	25 m	100 m
Block encoding	8B/10B	8B/10B	8B/10B	
Line encoding	NRZ	NRZ	NRZ	4D-PAM5

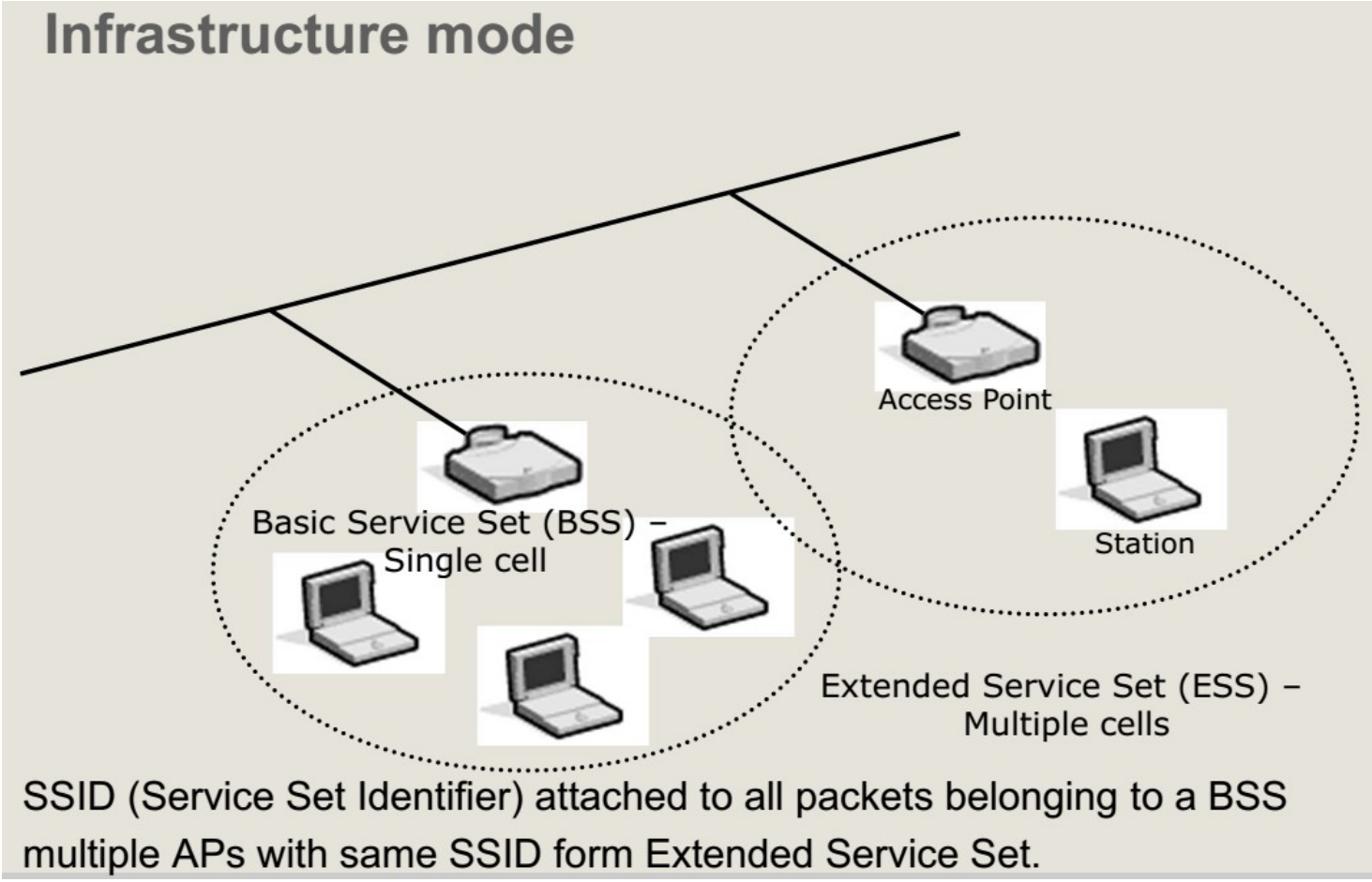
Wireless LAN (WLAN)

- IEEE ratified 802.11 in 1997
  - also known as Wi-Fi
  - Last ratified version in 2007
- Wireless LAN at 1 Mbps and 2 Mbps
- WECA (Wireless Ethernet Compatibility Alliance) promote interoperability
  - Now Wi-Fi Alliance

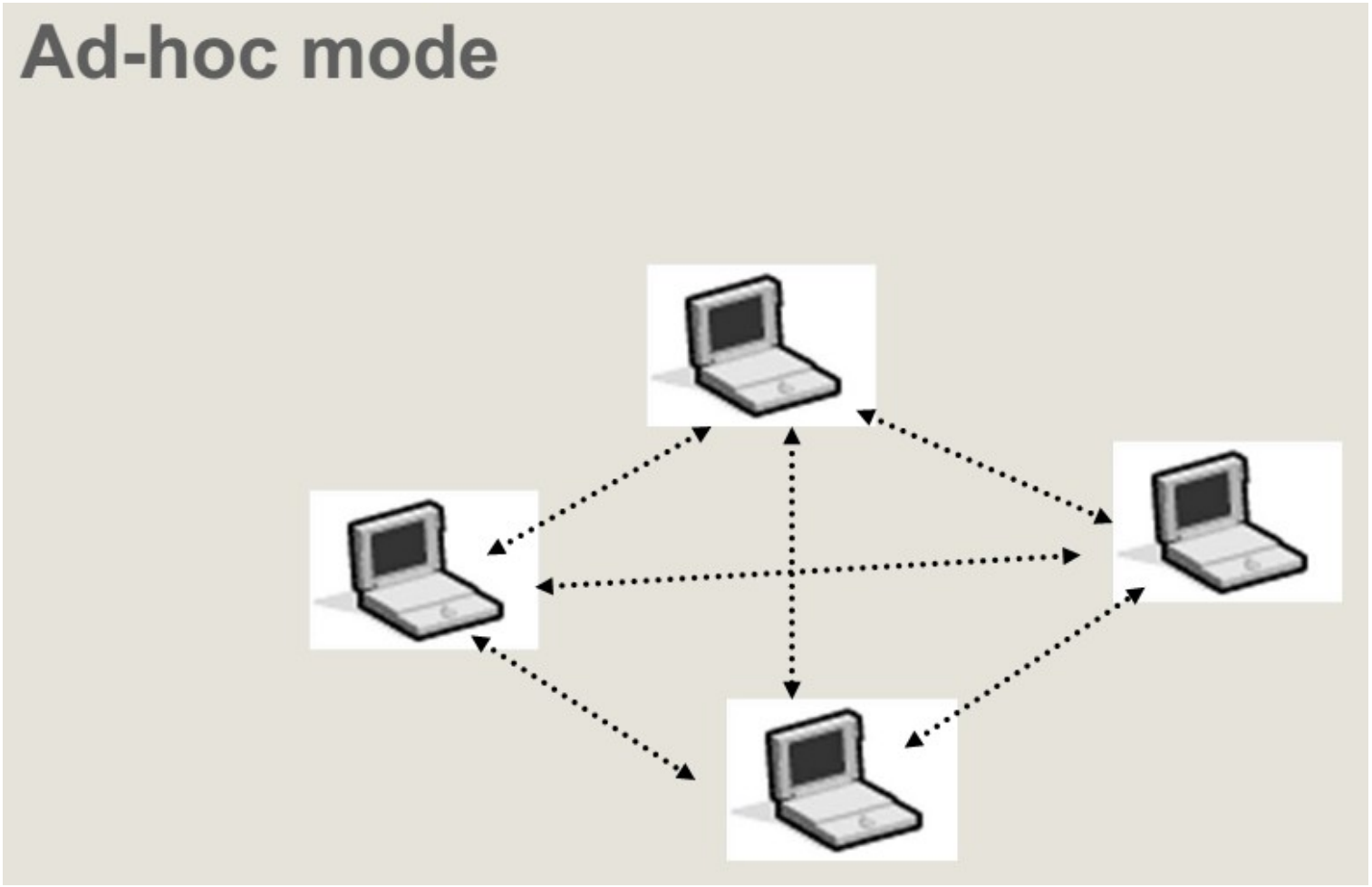
WLAN Mode

- **Infrastructure mode**
  - Basic Service Set
    - One Access Point
  - Extended Service Set
    - Two or more BSS forming a single subnet
  - Most corporate LANs in this mode
- **Ad-hoc mode**
  - Independent Basic Service Set
  - Set of 802.11 wireless stations that communicate directly without an Access Point
    - useful for quick and easy wireless networks

Infrastructure Mode



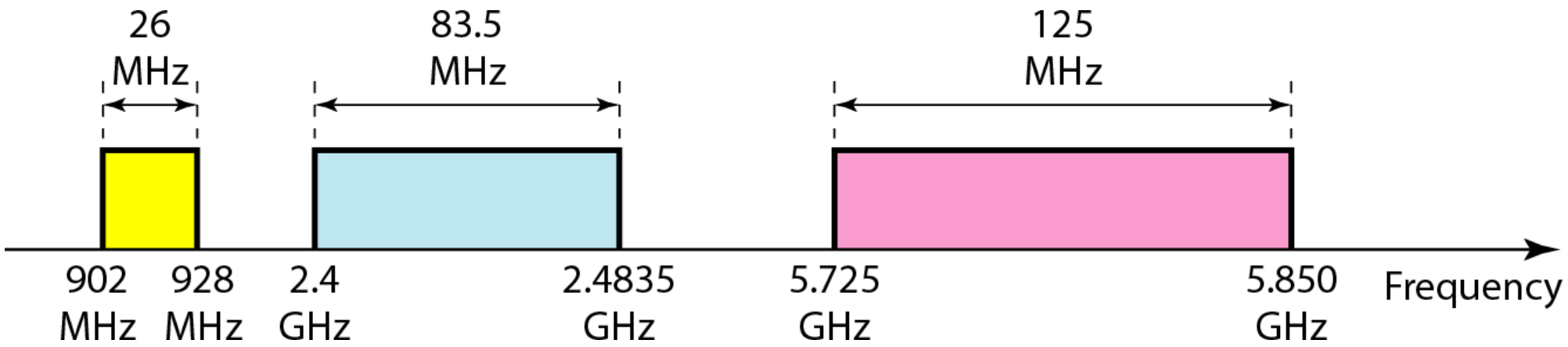
Ad-hoc Mode



Physical Layers

IEEE	*Technique*	*Band*	*Modulation*	*Rate (Mbps)*
802.11	FHSS	2.4 GHz	FSK	1 and 2
	DSSS	2.4 GHz	PSK	1 and 2
		Infrared	PPM	1 and 2
802.11a	OFDM	5.725 GHz	PSK or QAM	6 to 54
802.11b	DSSS	2.4 GHz	PSK	5.5 and 11
802.11g	OFDM	2.4 GHz	Different	22 and 54

Industrial, scientific, and medical (ISM) band



Example of WLAN Network for Home/SOHO

Democratization of Enterprise Wireless Infrastructure

Bring Your Own Device

66%

Enterprises allow employees to bring their own device into the enterprise today

Bring Your Own Cloud

90%

Cloud applications will account for 90% of mobile data traffic by 2019 (Video, Audio, Social, Web, Storage)

Bring Your Own Collaboration

53%

53% of all mobile voice communications will happen over Wi-Fi by 2019

Your Wireless Network Is Consumed Beyond Your Control

Source: Gartner, Cisco VNI 2015

SAMSUNG