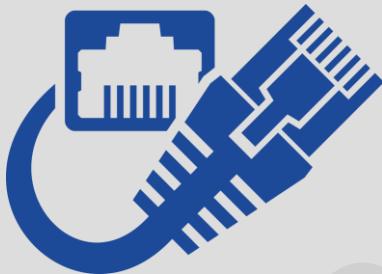


Introduction to Ethernet

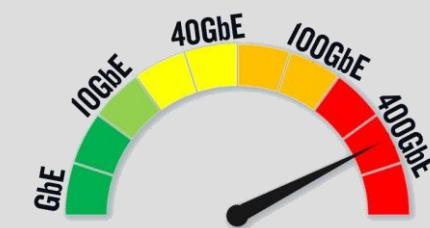
- **Ethernet** is a family of computer networking technologies and standards for connecting devices in Wired LAN, MAN and WAN.



- **Ethernet** provides higher bit rates, a greater number of nodes, and longer link distances.



- **Ethernet** makes use of coaxial cable, twisted pair cable and fiber optic cable in conjunction with switches to connect nodes.



- **Ethernet** provides data transfer rate up to 400 Gigabits per second (Gbit/s)

The Evolution of Ethernet - 1

1980

The first standard of Ethernet was published by Digital Equipment Corporation (DEC), Intel, and Xerox (DIX), It has 10 Mbit/s speed in a shared medium.

1982

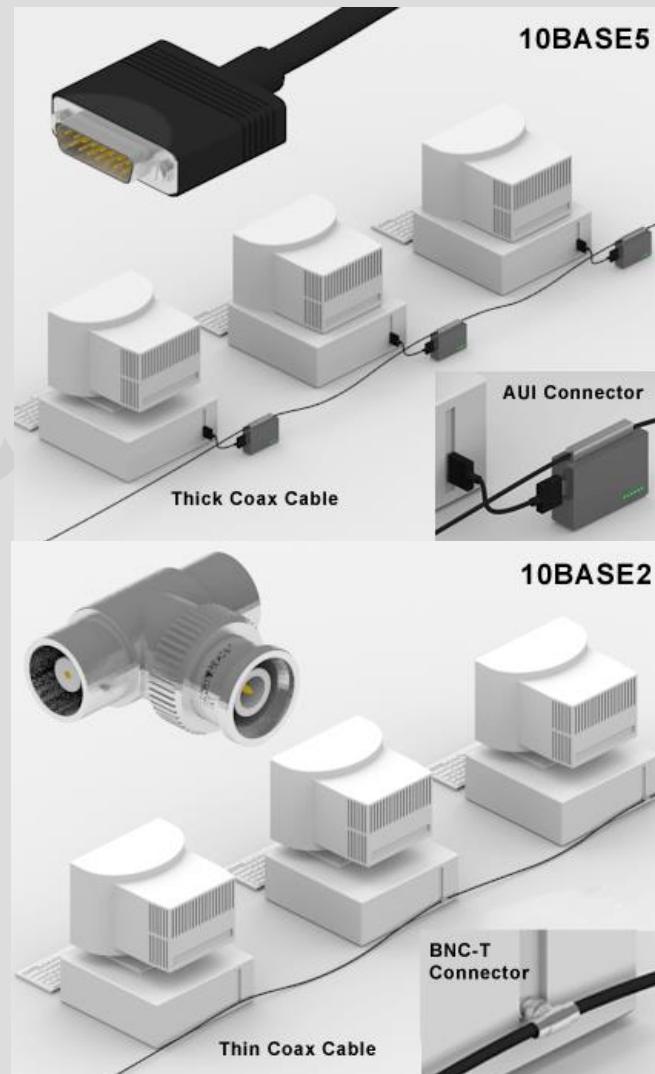
DIX published the second version of Ethernet which known as Ethernet II and it is commonly used today.

1983

The Institute of Electrical and Electronics Engineers (IEEE) published the first standard of (Ethernet 802.3) which known as ThickNet or 10Base5.

1985

IEEE published their second standard of Ethernet 802.3 which known as ThinNet or 10Base2.



The Evolution of Ethernet - 2

1990

IEEE developed 10BaseT Ethernet standard which runs over twisted-pair cables (CAT 3 UTP) and RJ-45 plugs.

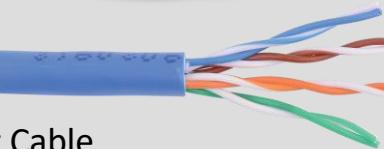
10: Bandwidth
Base: Baseband
T : Twisted Pair Cable



1995

IEEE developed 100Base-TX Ethernet standard which uses two wire-pairs (Cat-5) or higher and 100BASE-FX standard which run over MMF fiber cables.

100: Bandwidth
Base: Baseband
TX : Twisted Pair Cable
FX : Fiber



1998

IEEE developed 1000Base-X Ethernet standard which runs over fiber cables (MMF and SMF).

1000: Bandwidth
Base: Baseband
X : -CX, -SX, -LX



1999

IEEE developed 1000Base-T Ethernet which uses four wire-pairs cables(CAT-5) or higher.

1000: Bandwidth
Base: Baseband
T : Twisted Pair Cable



The Evolution of Ethernet - 3

2002

IEEE developed 10 Gbit/s Ethernet over fiber cable for LAN (10GBase-SR, 10GBase-LR, 10GBase-ER, 10GBase-LX4)



XFP Module

2002

IEEE developed 10 Gbit/s Ethernet over fiber cable for WAN (10GBase-SW, 10GBase-LW, 10GBase-EW).



X2 Module

2006

IEEE developed 10GBase-T Ethernet standard which runs over UTP cable (Cat 7).



XENPAK Module

2010

IEEE developed 40 Gbit/s Ethernet which runs over fiber cables (MMF and SMF).



SFP+ Module



SFP+ Module

The Evolution of Ethernet - 4

2015

IEEE developed 100 Gigabit Ethernet (100GbE) standard which runs over fiber cables (MMF and SMF) and twin-axial (Twinax) cable.



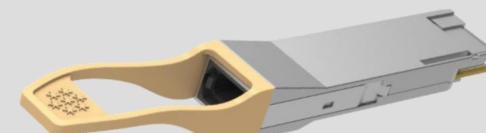
100G QSFP28 Module

2017

IEEE developed 200 Gigabit Ethernet (200G, 200GbE) standard which runs over fiber cables (MMF and SMF) and twin-axial (Twinax) cable.



Twinax Cable



200G QSFP-DD SR8 Module

2020

IEEE developed 400 Gigabit Ethernet (400G, 400GbE) standard which runs over fiber cables (MMF and SMF).



400G CFP8 Module

The Evolution of Ethernet (Summary)

10GBase-T



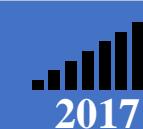
40GBASE-T



100GBASE-SR4



200 GigE



400 GigE



WAN
10GBase-SW,
LW, EW



LAN
10GBase-SR,
LR, ER, LX4



1000Base-T



1000Base-X
X : -CX, -SX, -LX



100Base-TX
100BASE-FX



Ethernet I
(DIX)
10 Mb



Ethernet II
(DIX)
10 Mb



ThickNet, 10Base5
(IEEE)
10 Mb



ThinNet, 10Base2
(IEEE)
10 Mb



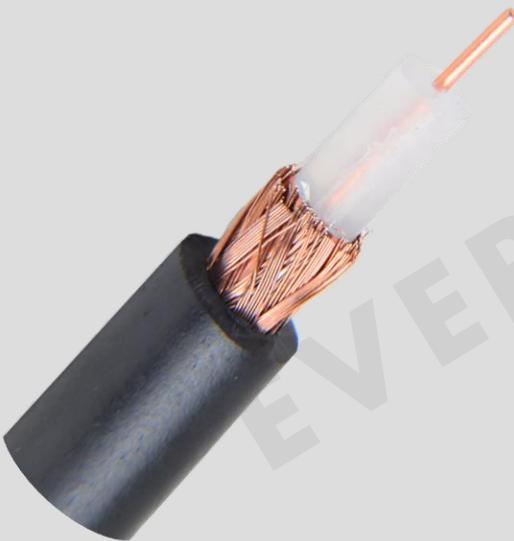
10BaseT
(IEEE)
10 Mb



Ethernet Physical Transmission Media

- Physical transmission media used in Ethernet includes twisted-pair cable, coaxial cable, and fiber-optic cable.

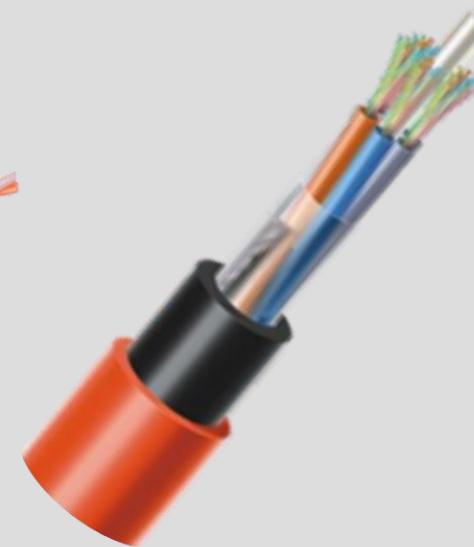
Coaxial Cable



Twisted Pair Cable



Fiber-Optic Cable

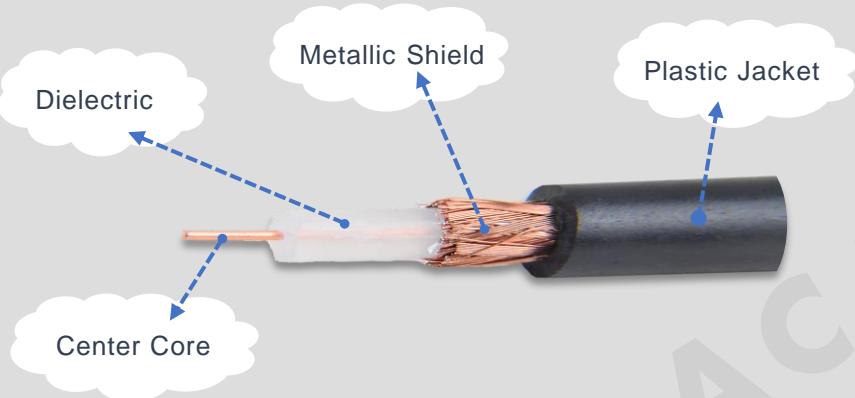


Coaxial Cable



Coaxial Cable

- A **coaxial cable** is a type of electrical cable consisting of an inner conductor surrounded by a metallic shield, with the two separated by a dielectric (insulating material).



F-connector



BNC connector



Specifications

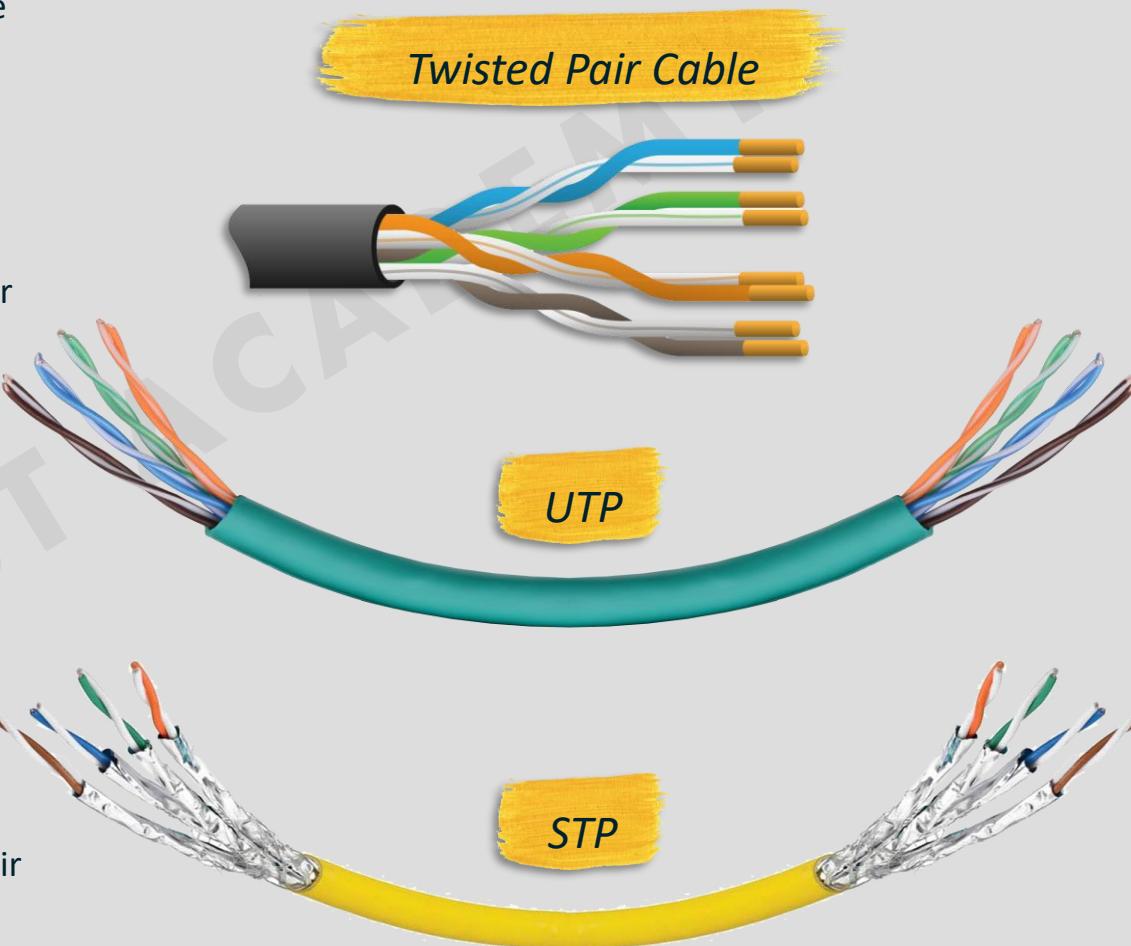
Type	Impedance	Uses	Connector
RG-6	75 ohms	Cable Modem	F Connector
RG-58	50 ohms	10Base2 (ThinNet)	BNC Connector
RG-59	75 ohms	Cable TV	F Connector

Twisted-Pair Cable



Twisted-Pair Cable

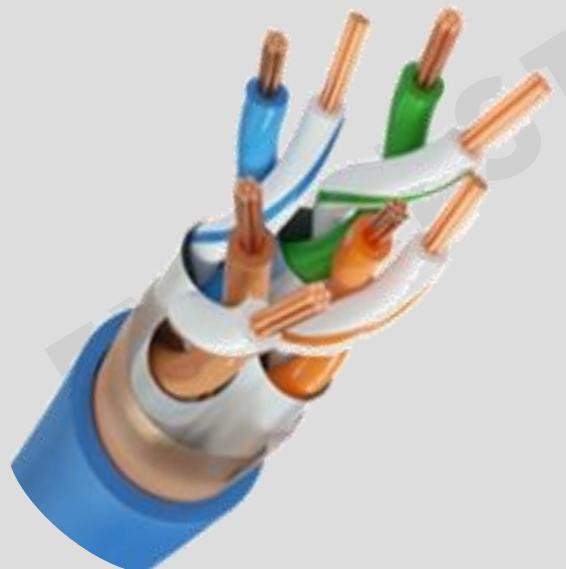
- A **twisted pair cable** is a type of cable made by putting two separate insulated wires together in a twisted pattern and running them parallel to each other.
- There are two different types of twisted pair cable, Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP).
- **Unshielded Twisted Pair (UTP)** is a cable with wires that are twisted together to reduce noise and crosstalk.
- **Shielded Twisted Pair (STP)** is a twisted pair cable confined in foil or mesh shield that guards the cable against external electromagnetic interference (EMI).



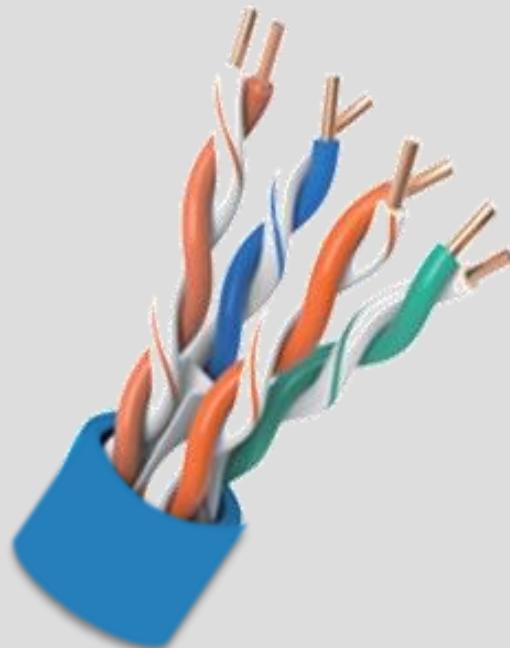
Solid and Stranded Cable

- A **stranded cable** has multiple wires wrapped around each other in each conductor
- A **solid cable** has one solid wire per conductor.

Stranded Cable



Solid Cable



Categories of Copper Twisted Pair cable

Category	Bandwidth /Data Rate	Length	Frequency	Shielding	Application
CAT 3	10 Mbps	100 m	16 MHz	UTP	Ethernet
CAT 4	16 Mbps	100 m	20 MHz	UTP	Token Ring
CAT 5	100 Mbps	100 m	100 MHz	UTP	Ethernet and Fast Ethernet
CAT 5e	1 Gbps	100 m	100 MHz	UTP, STP	Ethernet, Fast Ethernet and Gigabit Ethernet
CAT 6	10 Gbps	100 m	250 MHz	UTP, STP	Gigabit Ethernet (100 m) and 10 Gigabit Ethernet (55 m)
CAT 6a	10 Gbps	100 m	500 MHz	STP	Gigabit Ethernet (100 m) and 10 Gigabit Ethernet (55 m)
CAT 7	10 Gbps	100 m	600 MHz	STP	Gigabit Ethernet(100 m) and 10 Gigabit Ethernet (100 m)
CAT 8	40 Gbps	100 m	2000 MHz	STP	10 Gigabit Ethernet and 40 Gigabit Ethernet (30 m)

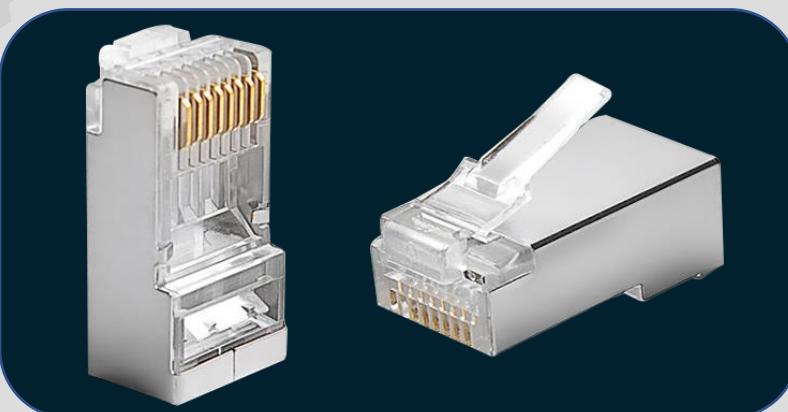
8P8C and RJ45 Wiring Standards

- **8P8C** describes a type of plastic connector with 8 possible connections (8 positions 8 contacts). It also defines the design and dimensions of the clear plastic plug that terminates the cable.



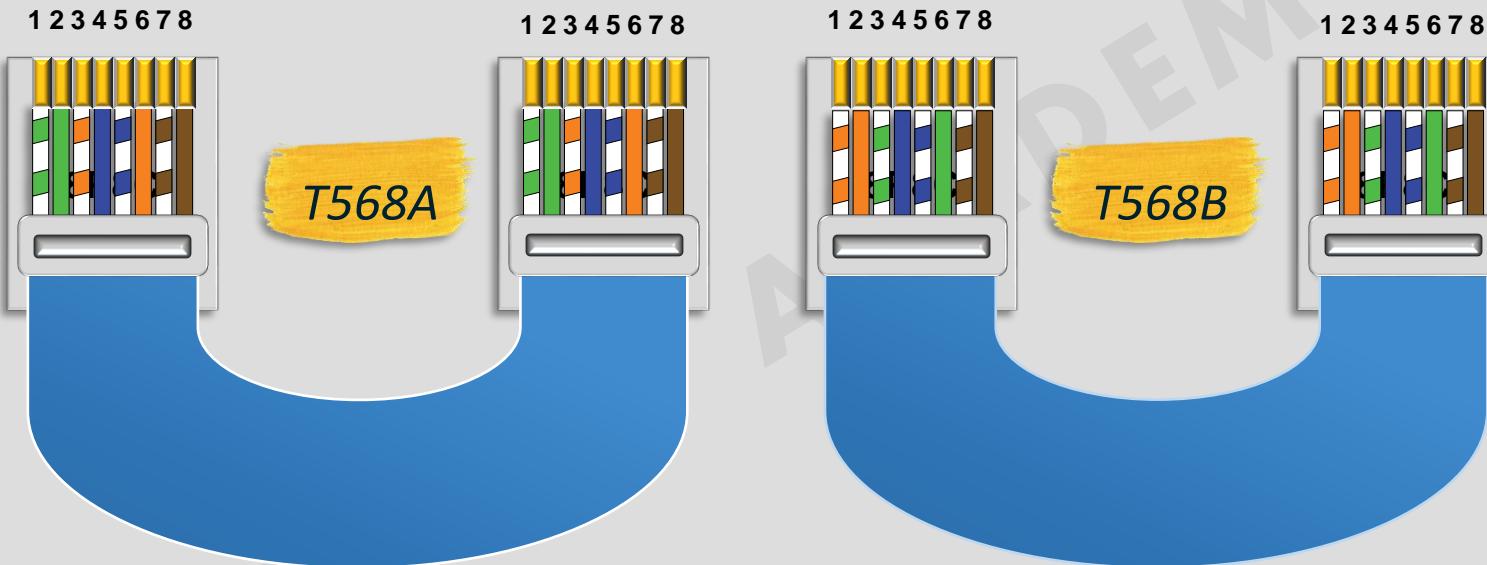
8P8C Connector,
Modern RJ45 connector

- **Registered Jack standard number 45** specifies the amount of wires in the cable, the order in which they appear, and the usage of the 8P8C physical connector T568A and T568B.



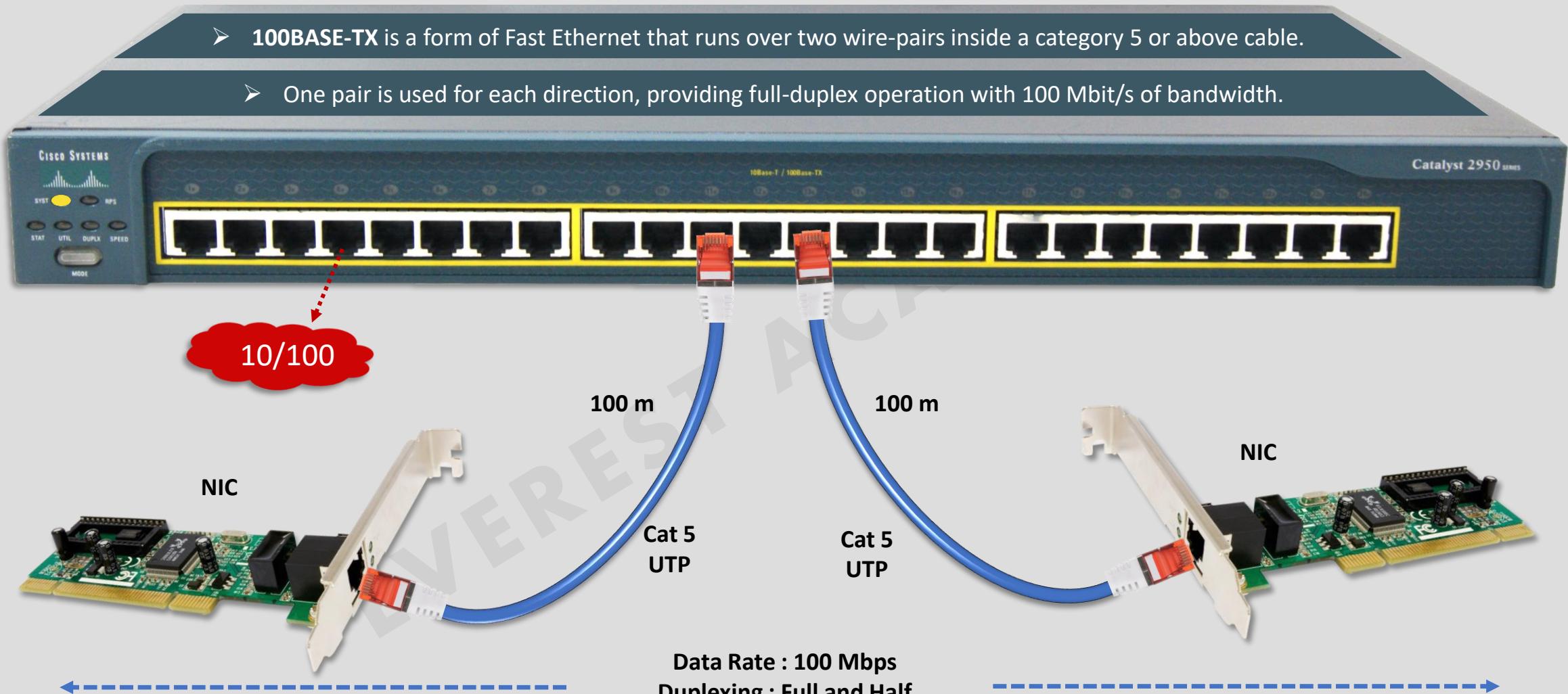
Shielded 8P8C Connector

T568A And T568B Wiring Standards

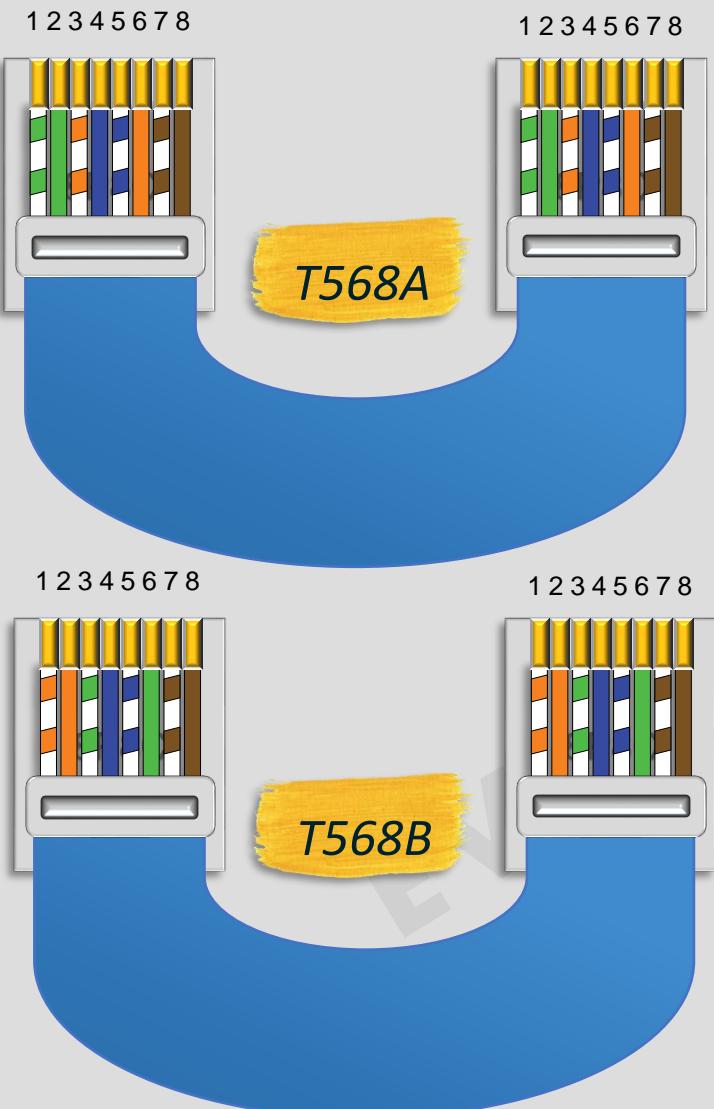


Ethernet Standard (100BASE-TX)

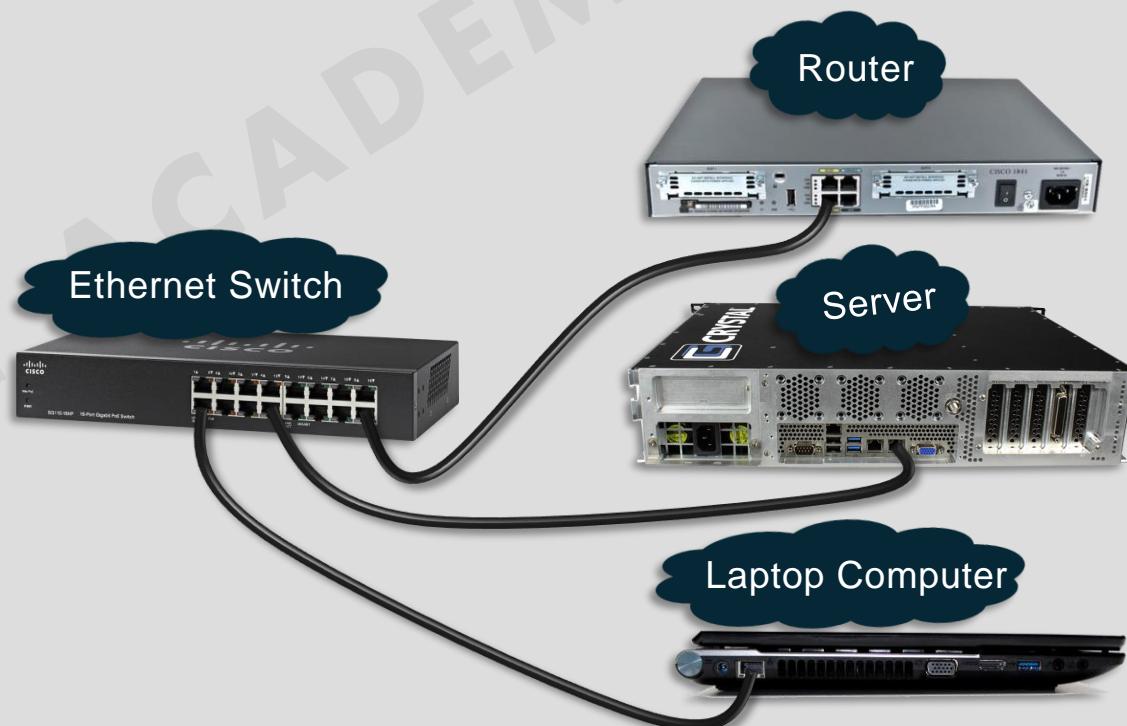
- 100BASE-TX is a form of Fast Ethernet that runs over two wire-pairs inside a category 5 or above cable.
- One pair is used for each direction, providing full-duplex operation with 100 Mbit/s of bandwidth.



Straight Through Cable (100BASE-TX)

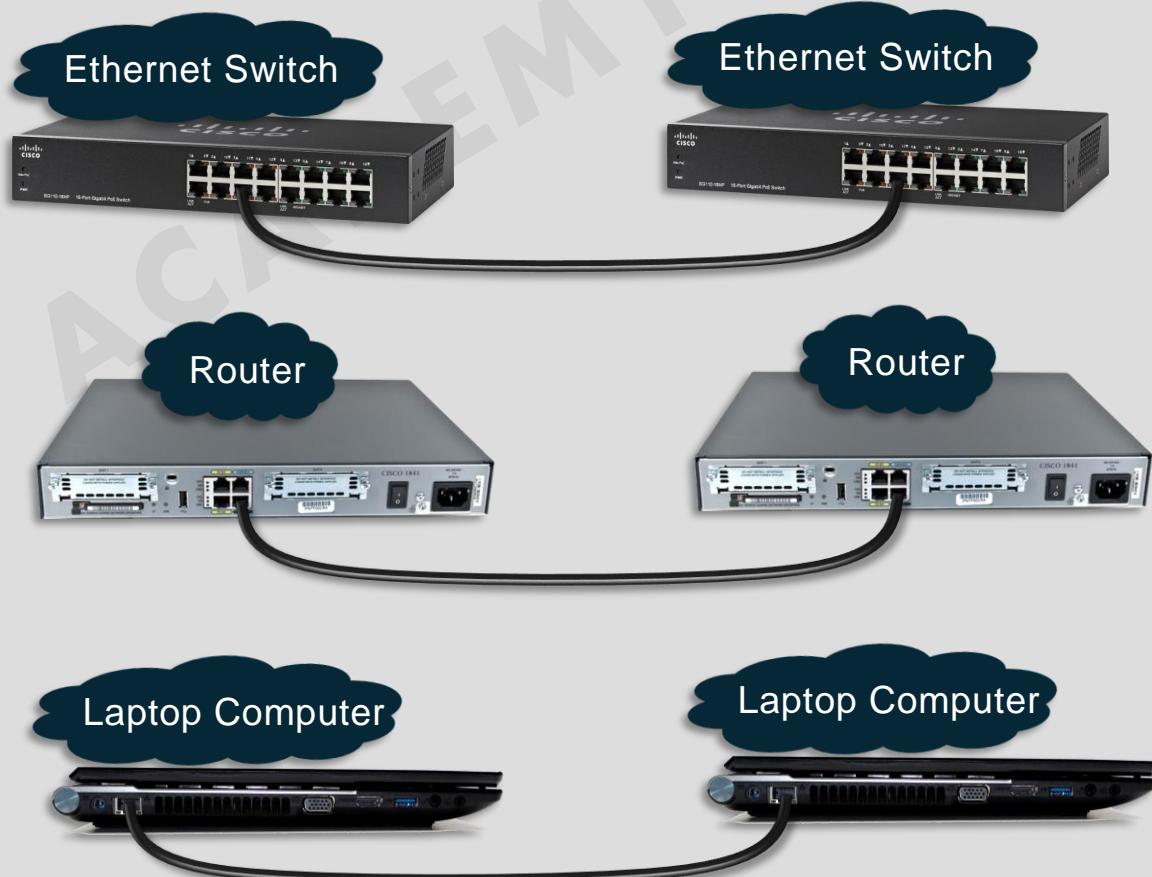
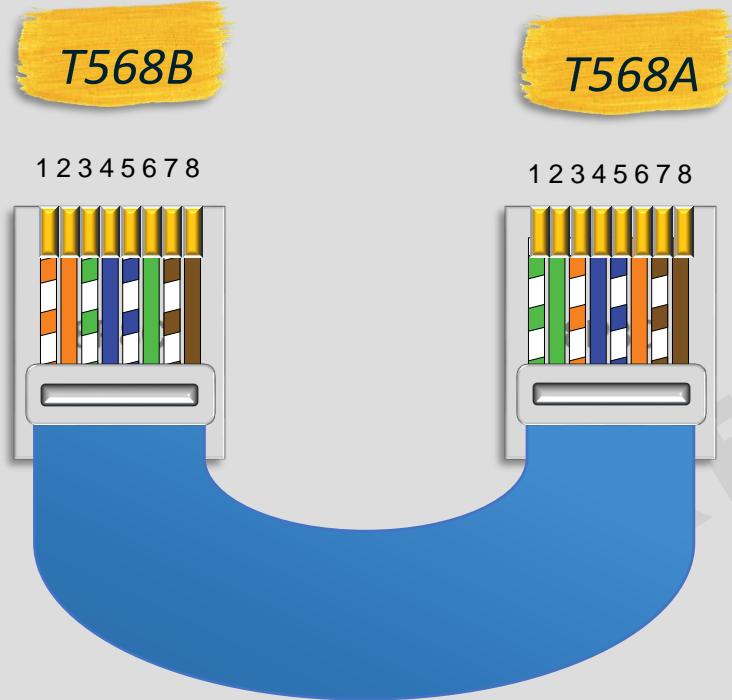


- A Straight Through Ethernet cable is used for connecting :



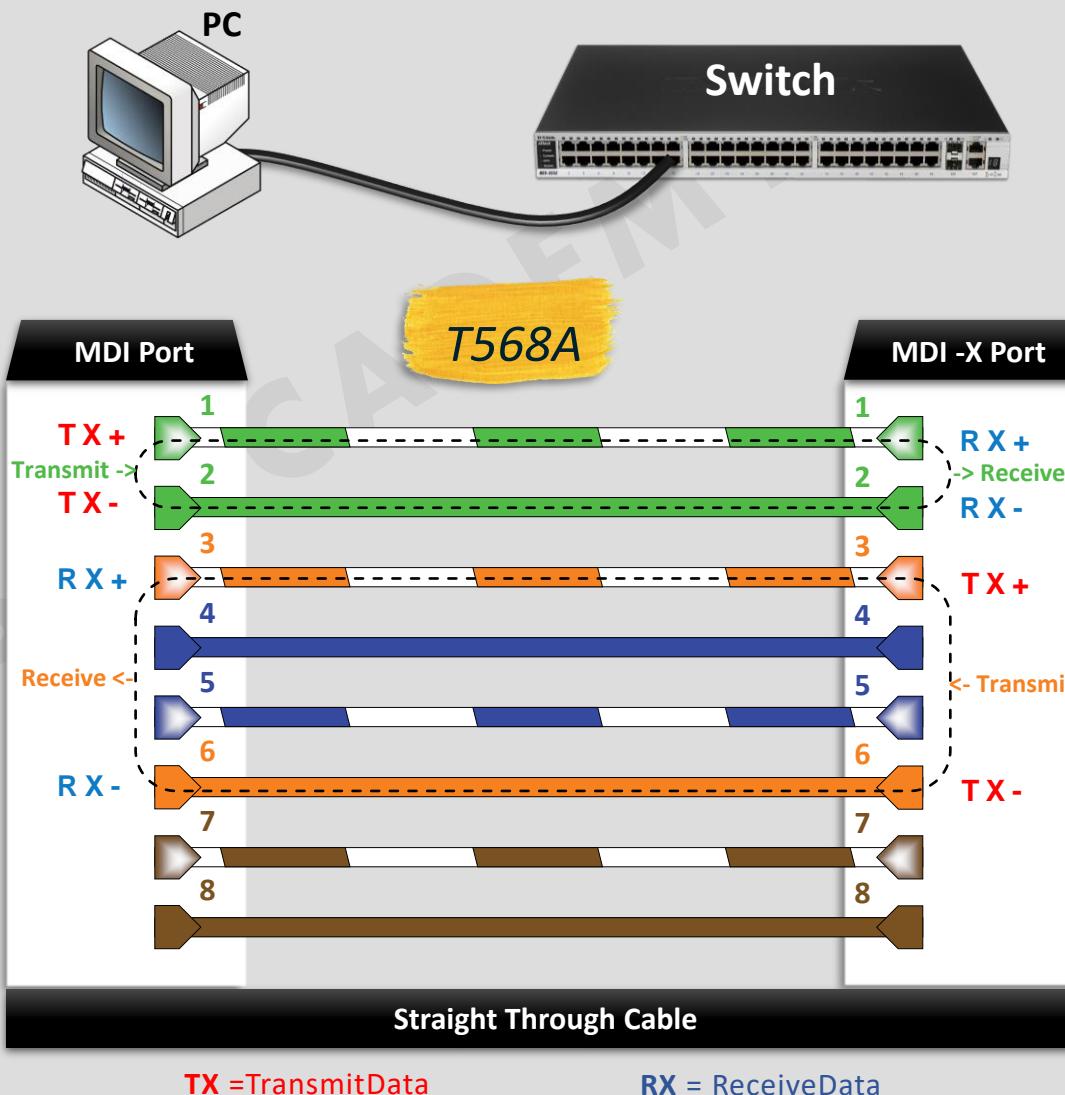
Crossover Cable (100BASE-TX)

➤ Crossover Ethernet cable is used for connecting :



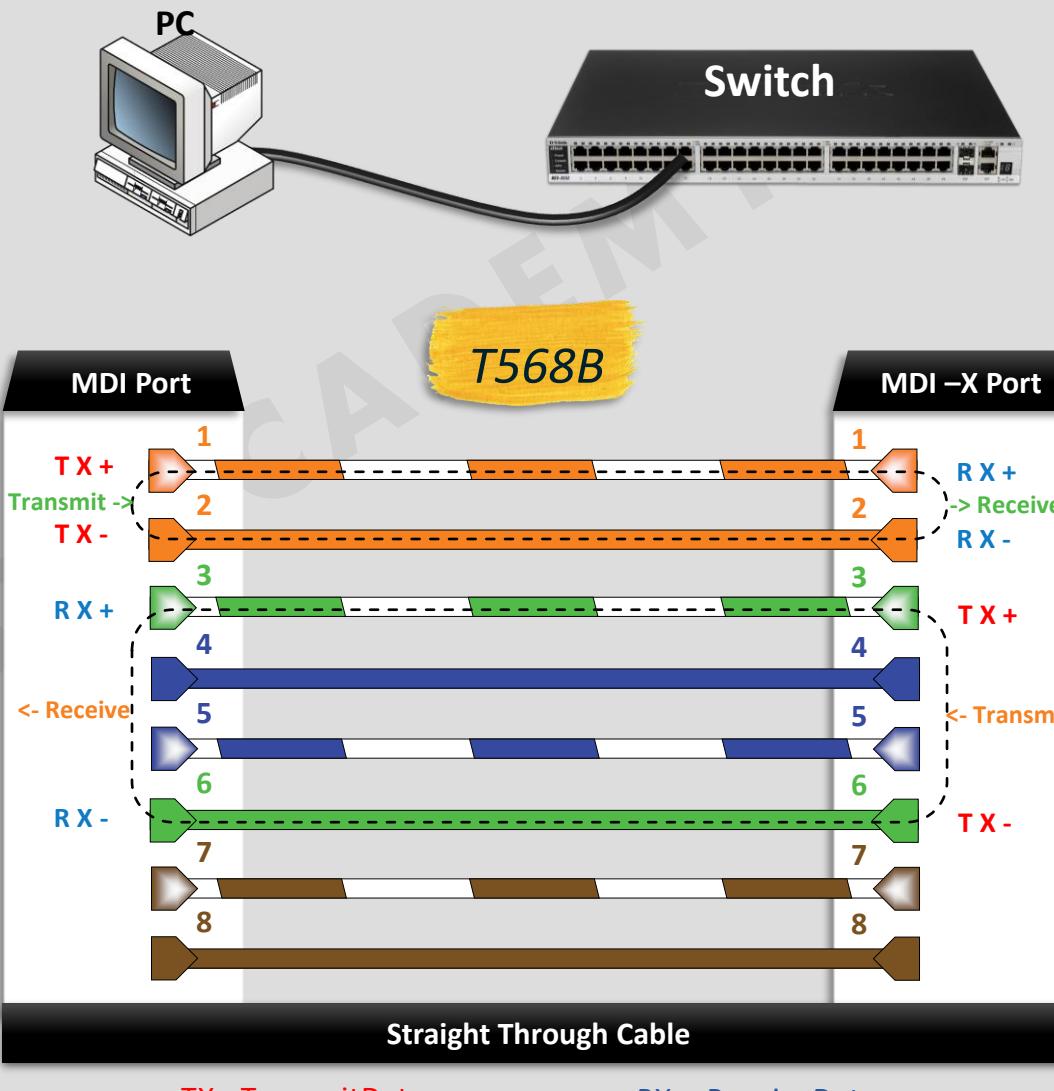
MDI and MDI-X Ports

- **Medium Dependent Interface (MDI) Port** is an ethernet port that can be connected to a twisted pair cable .
- A **MDI Port** uses pins (1, 2) to send data and pins (3, 6) to receive data.
- **An Example of MDI Port** is a PC's ethernet port and a Router's ethernet interface.
- **A Medium Dependent Interface Crossover (MDI-X) port** is an ethernet port that can be connected to a twisted pair cable .
- A **MDI-X Port** uses pins (3, 6) to send data and pins (1, 2) to receive data.
- **An Example of MDI-X port** is a switch's ethernet interface and an hub's ethernet interface.

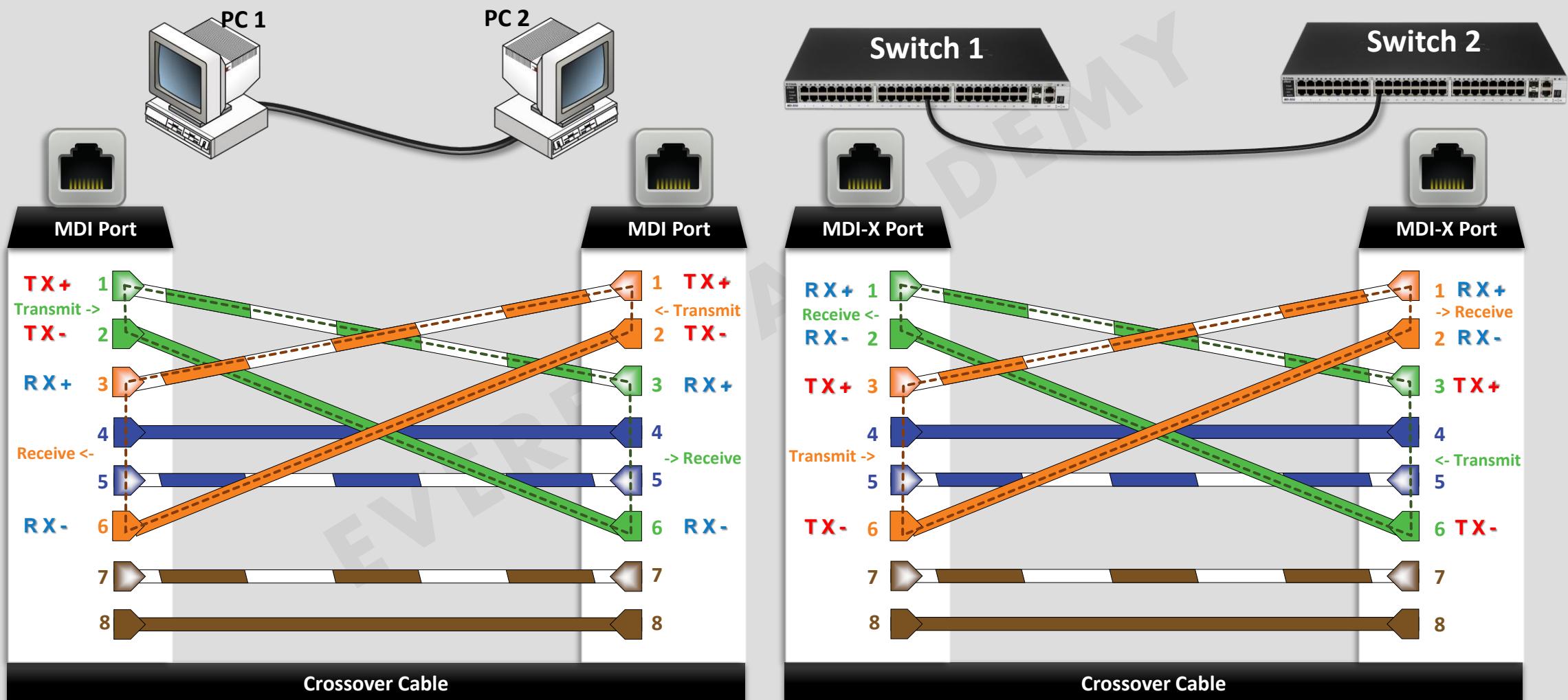


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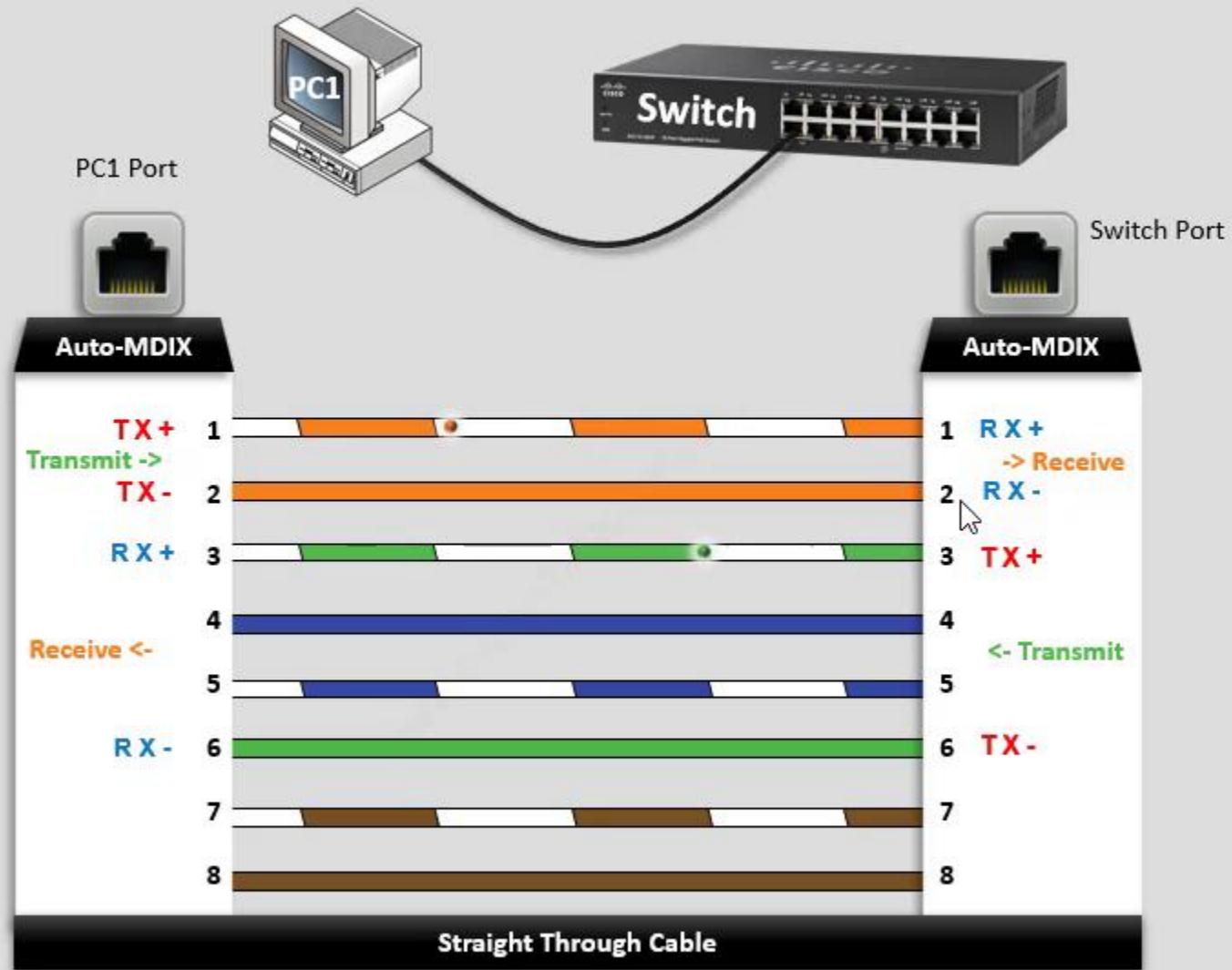


MDI to MDI Ports and MDI-X to MDI-X Ports



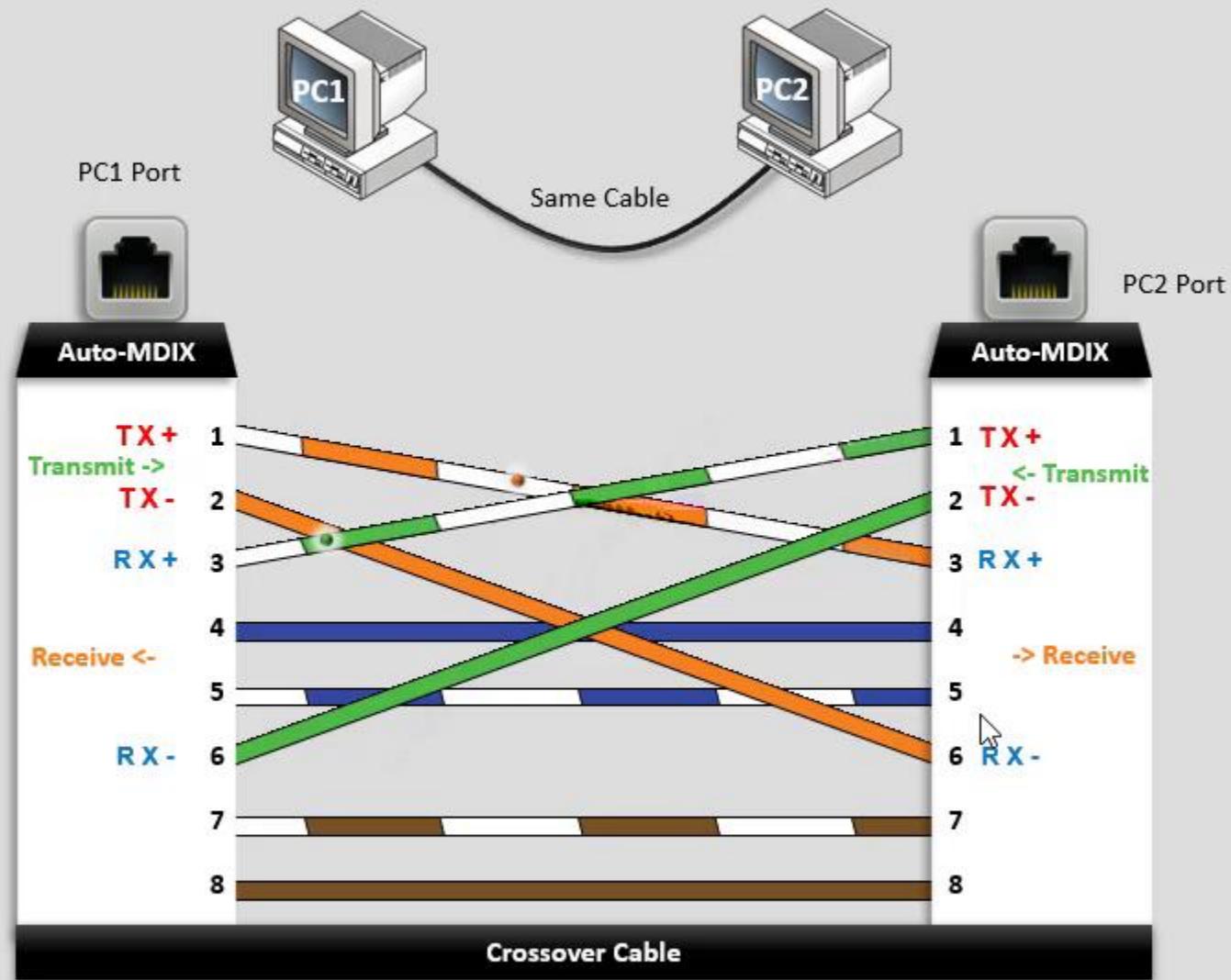
Auto-MDIX Ports

- **Auto-MDIX** automatically detects the required cable connection type and configures the connection appropriately, removing the need for crossover cables to interconnect switches or connecting PCs peer-to-peer. As long as it is enabled on either end of a link,
- **The Requirements** For auto MDIX to operate correctly, the data rate on the interface and duplex setting must be set to "auto".



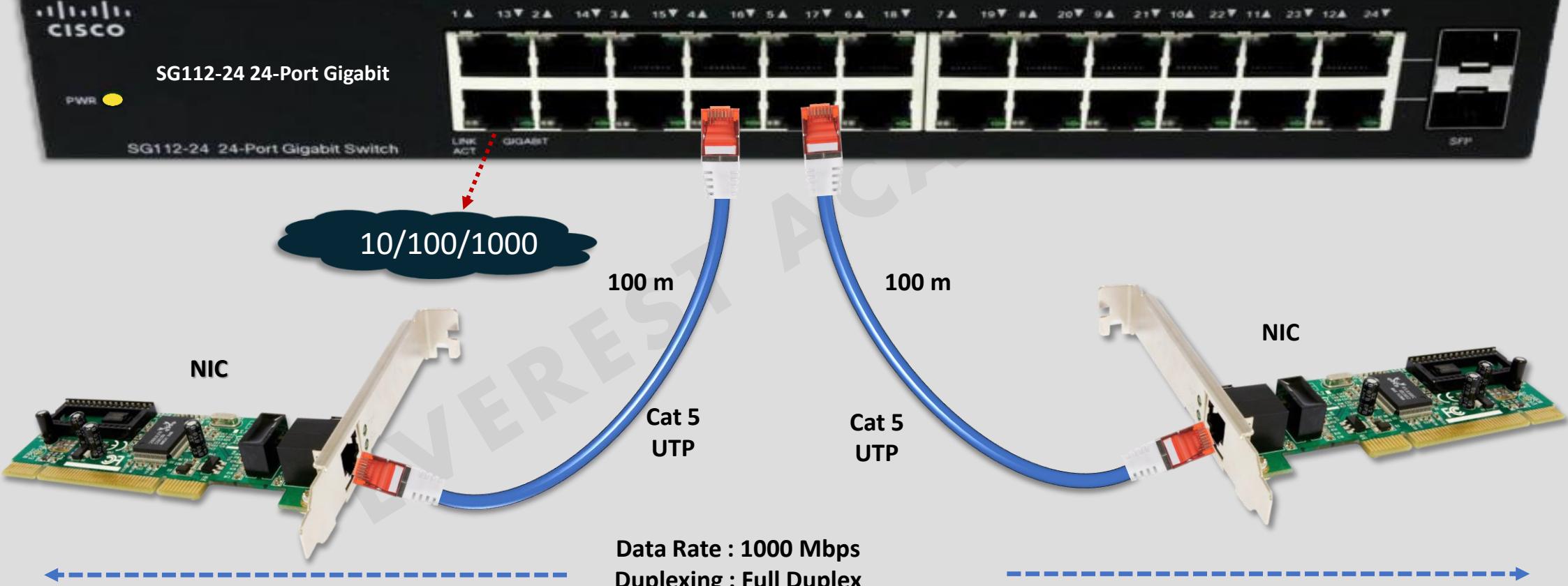
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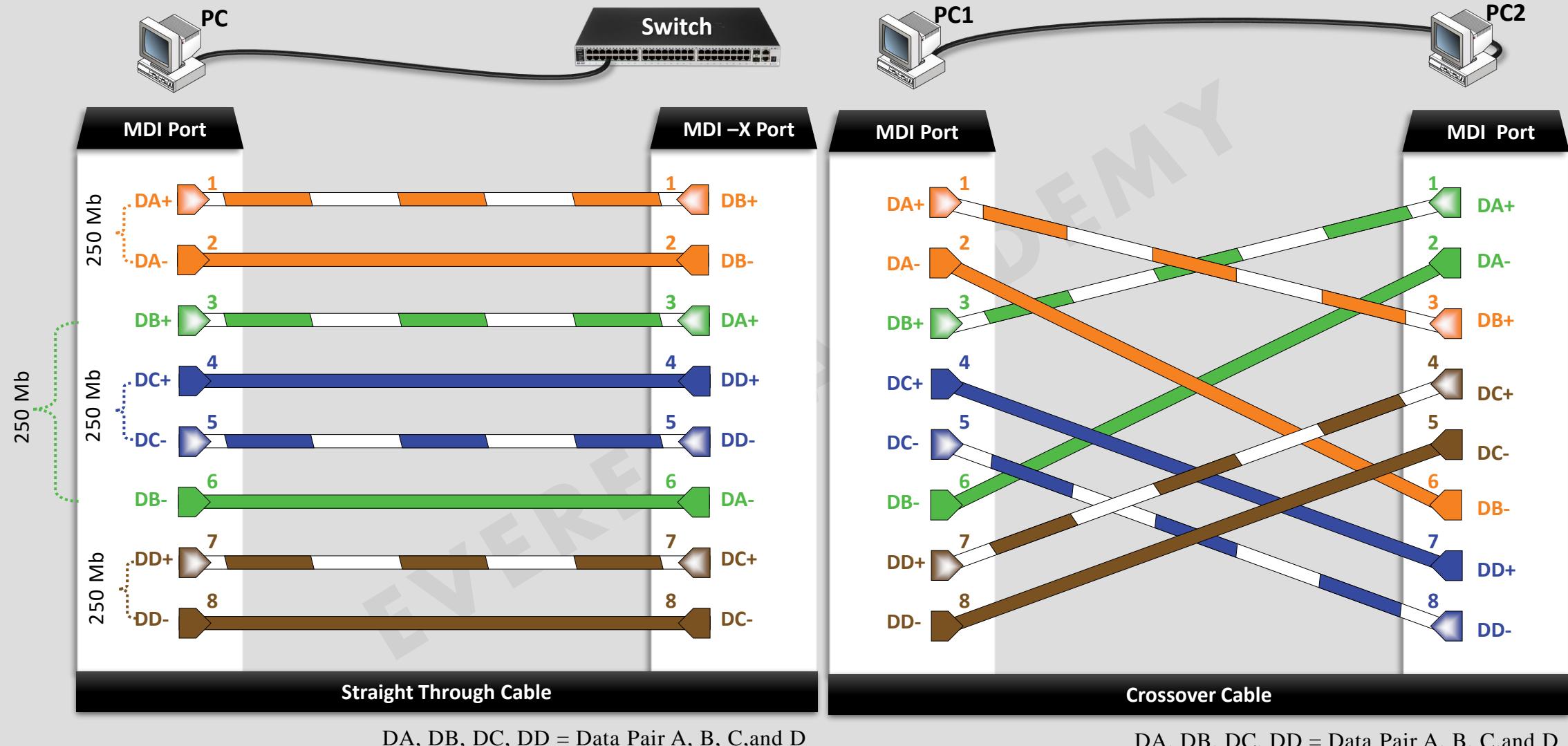


Ethernet Standard (1000BASE-T)

- 1000BASE-T is a form of Gigabit Ethernet that runs over four wire-pairs inside a category 5e or above cable.
- Each of the four pairs can be used for both RX and TX, at the same time through the use of echo cancellation.



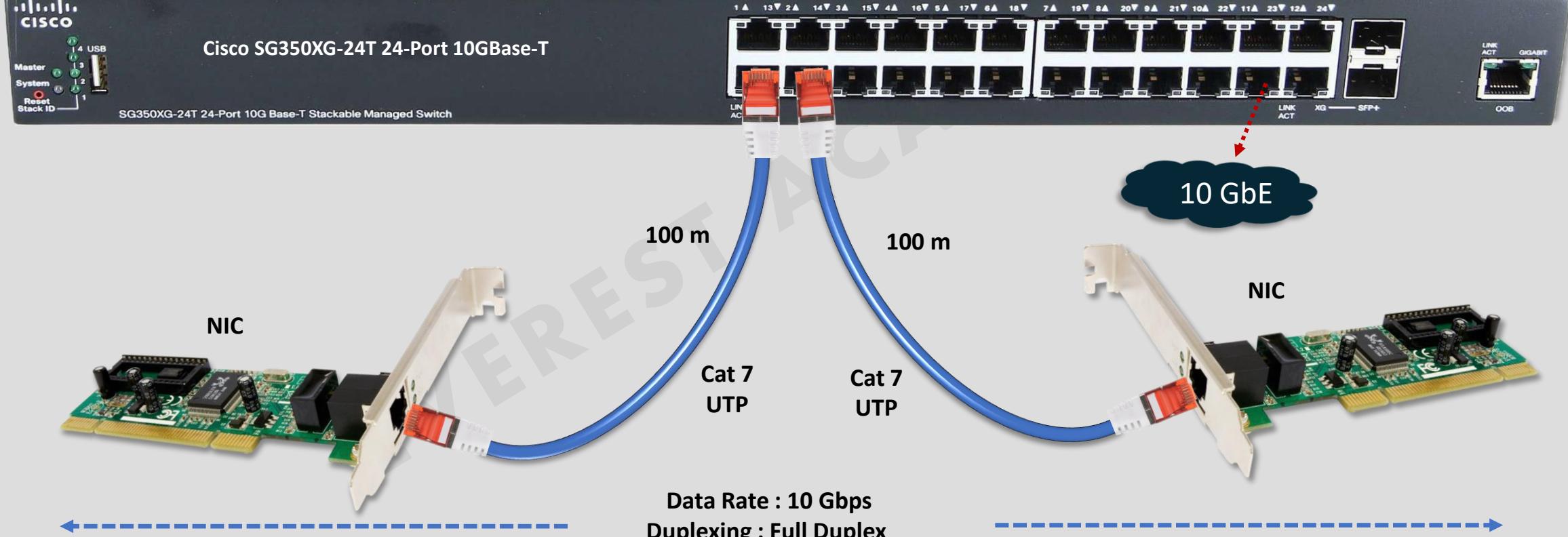
Straight Through and Crossover Cables (1000BASE-T)



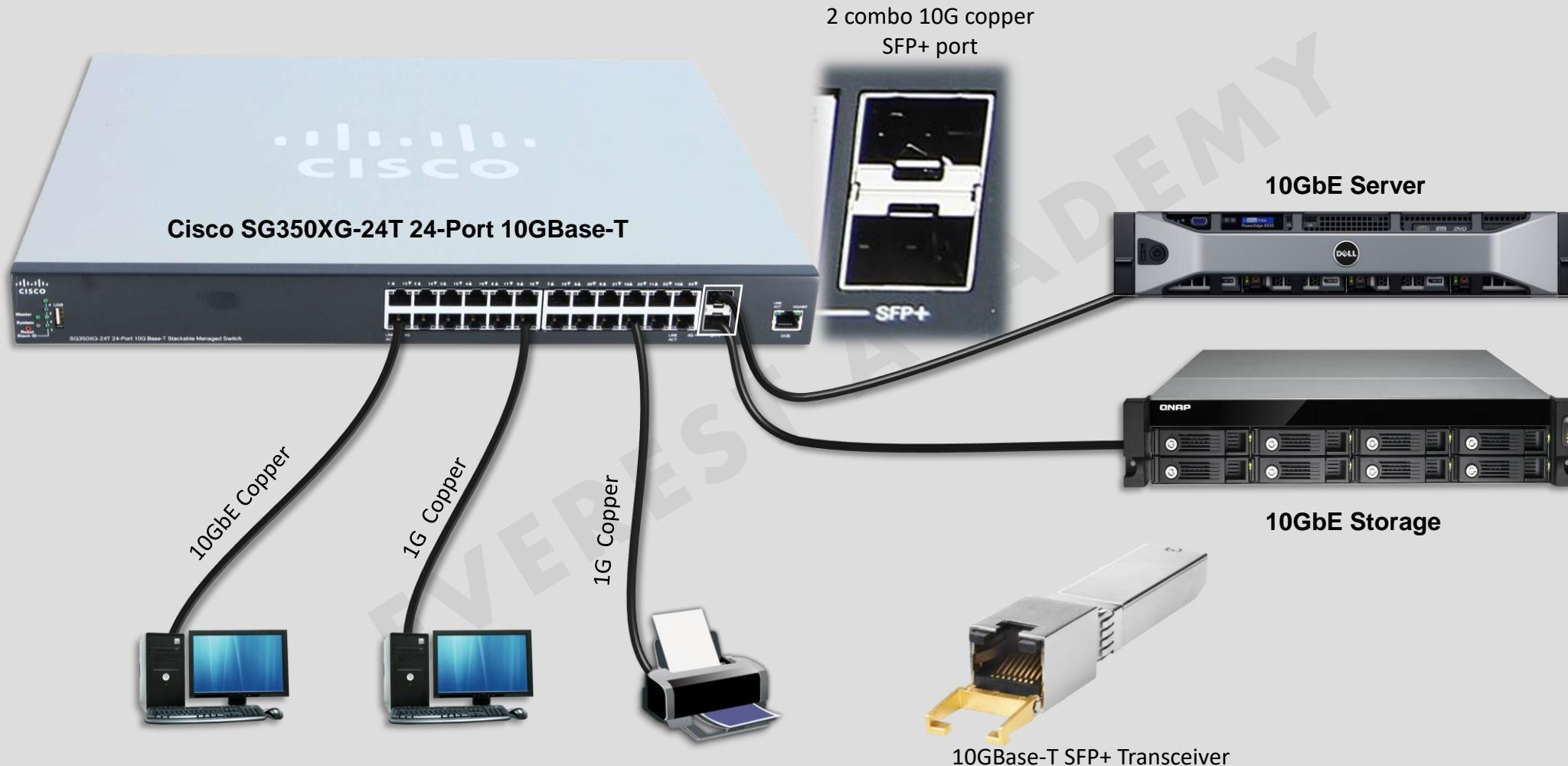
Ethernet Standard 10GBASE-T

10GBASE-T is a form of Gigabit Ethernet that runs over four wire-pairs inside a category 7 cable for distance of 100m.

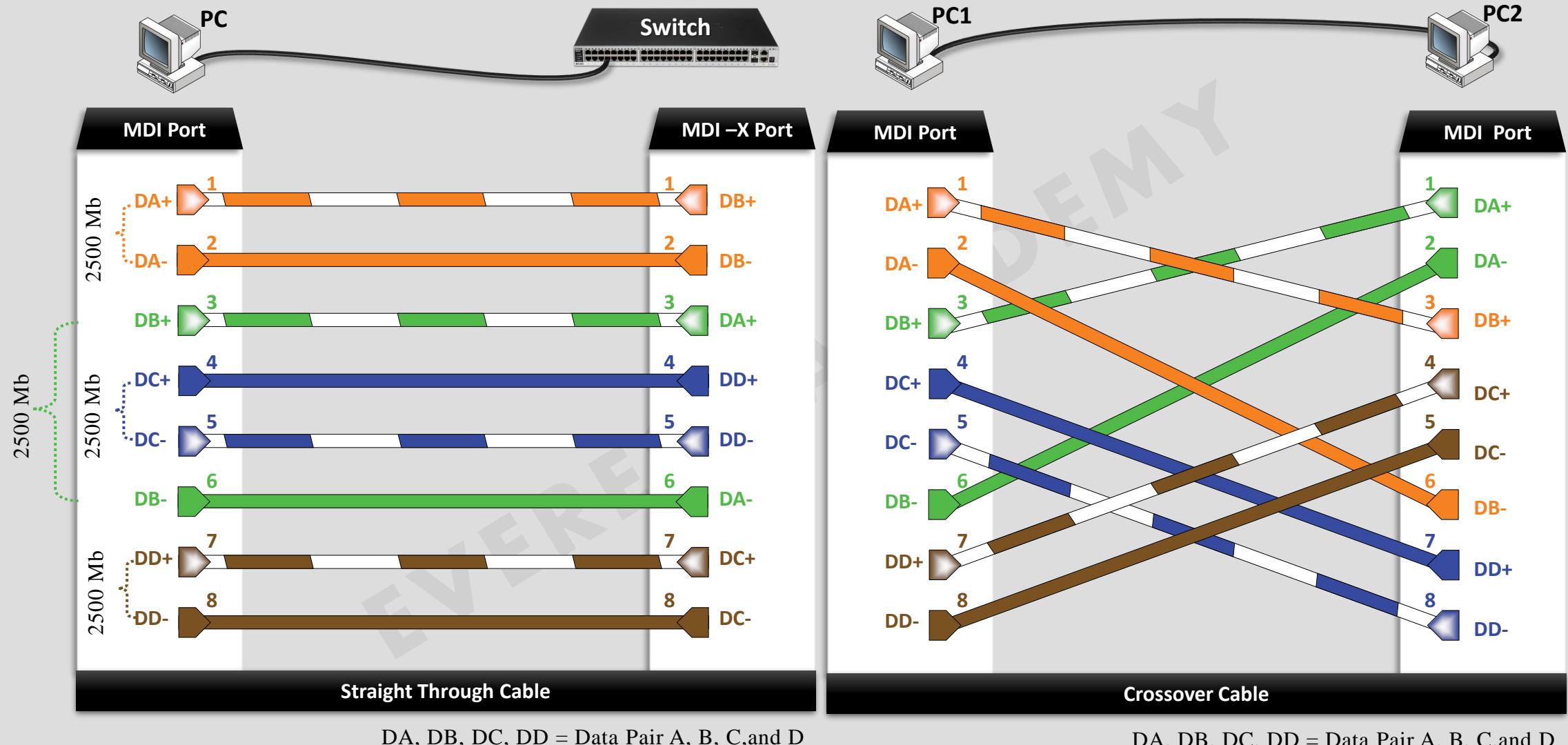
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Ethernet Standard 10GBASE-T

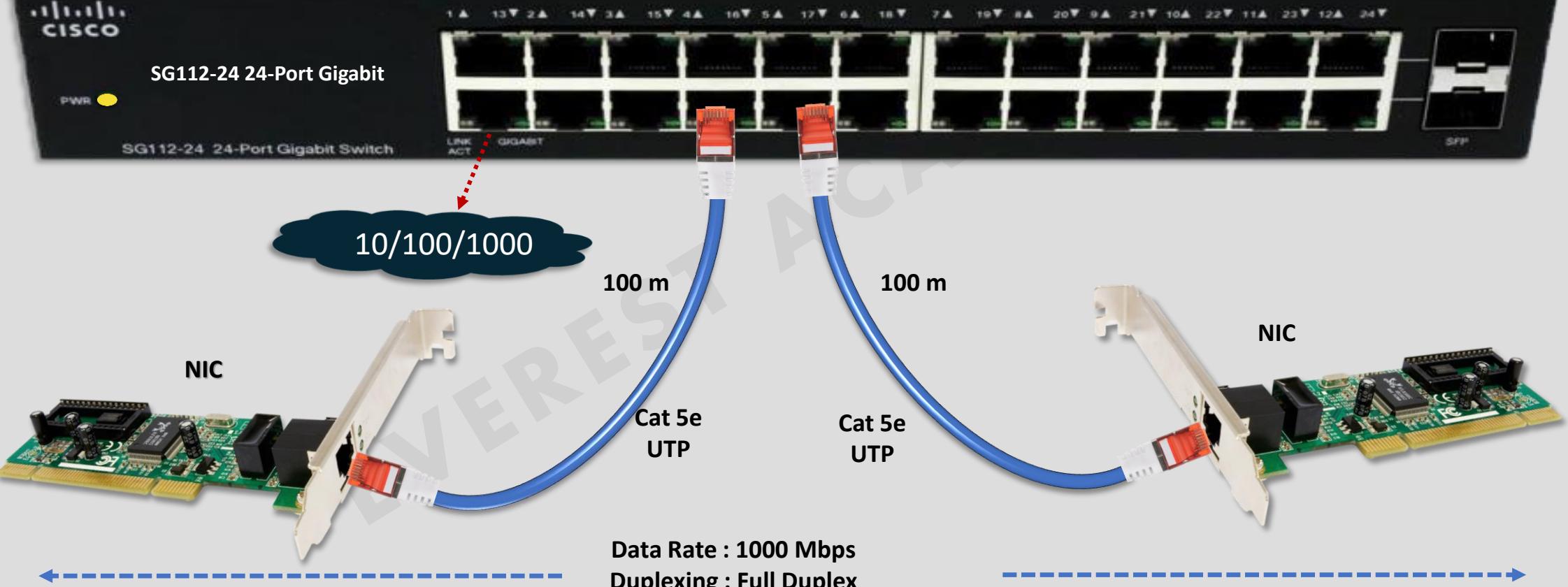


Straight Through and Crossover Cables (10GBASE-T)



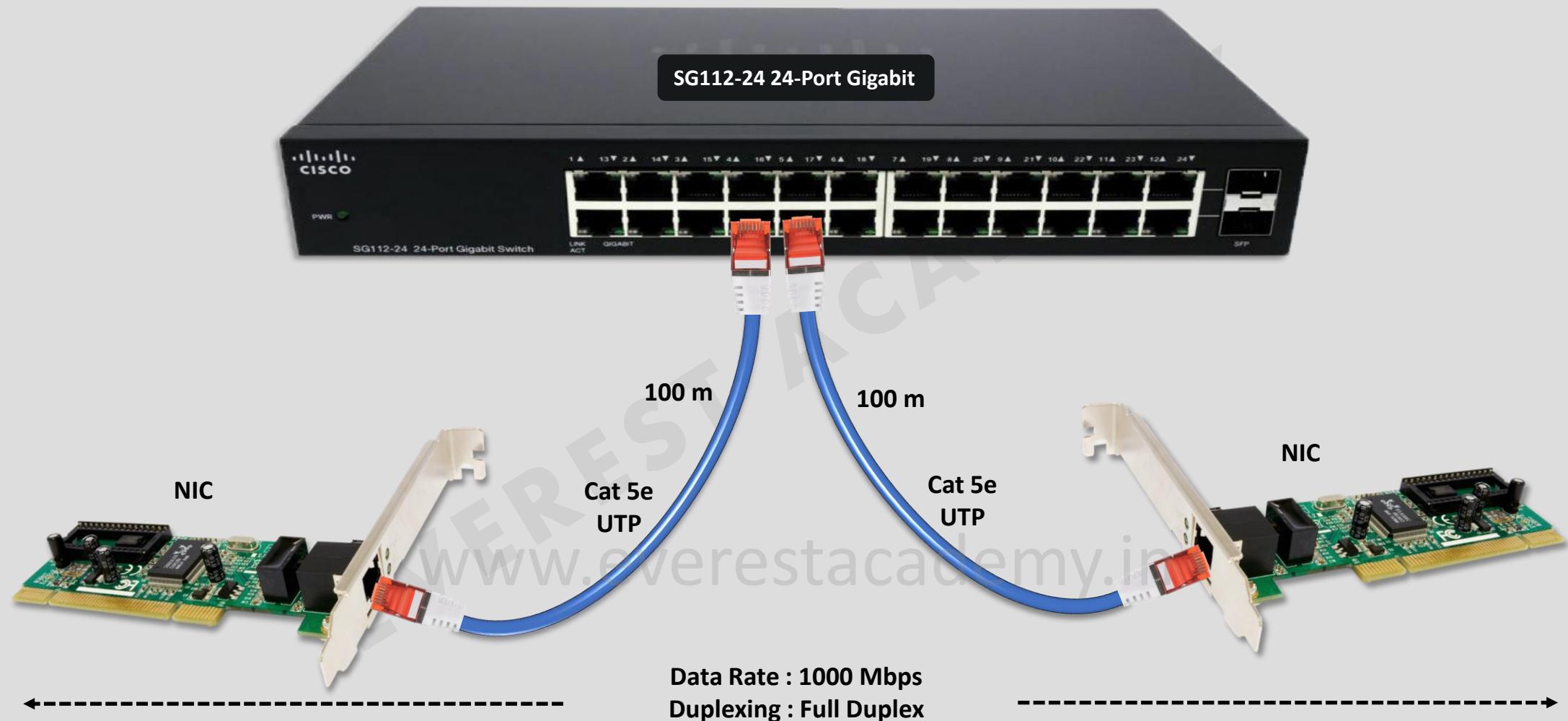
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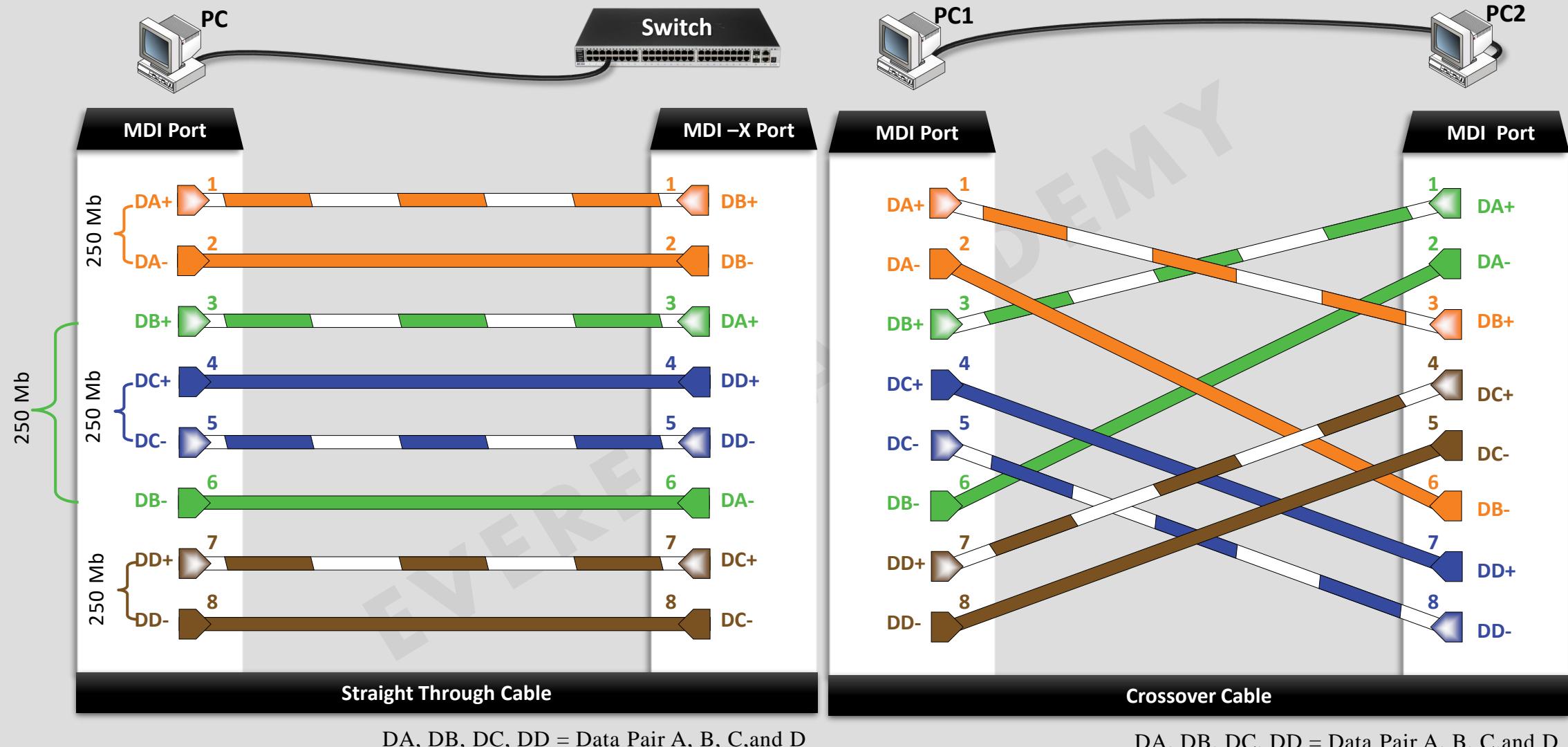


Ethernet Standard (1000BASE-T)

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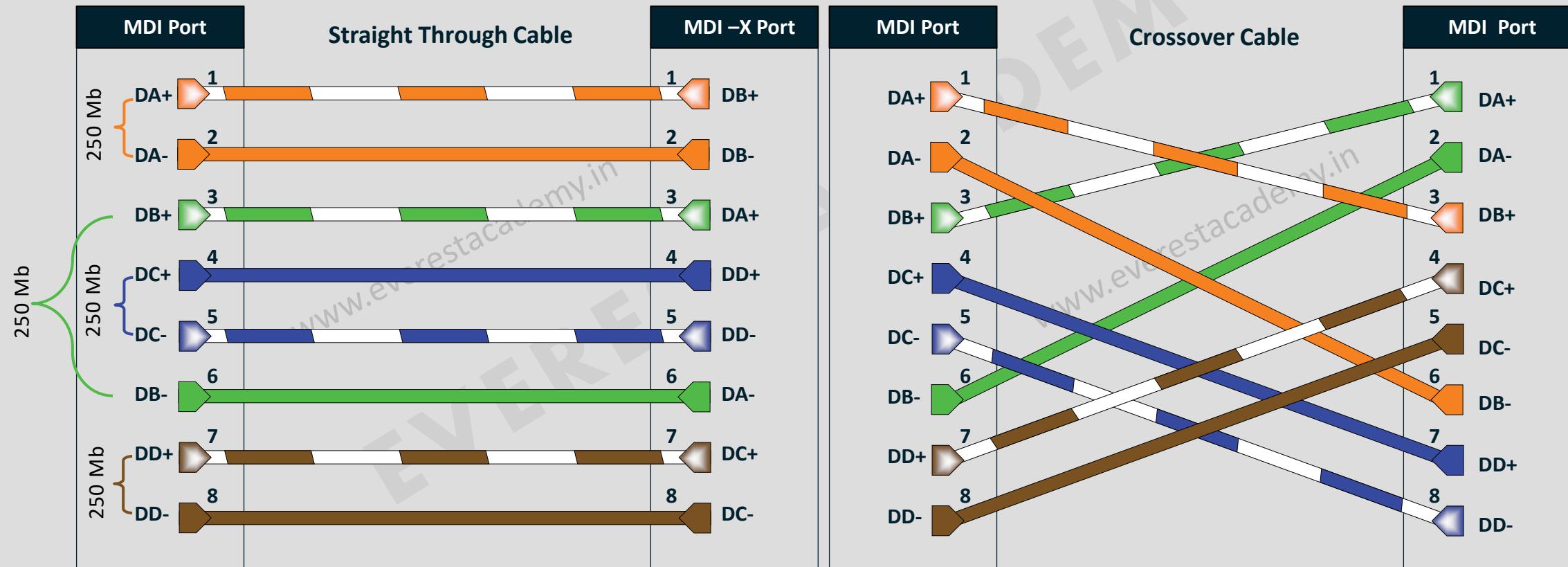
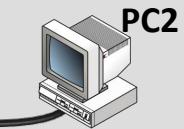
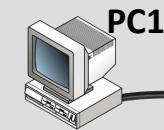
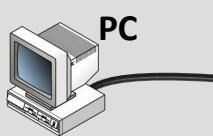


Straight Through and Crossover Cables (1000BASE-T)



Ethernet (1000BASE-T)

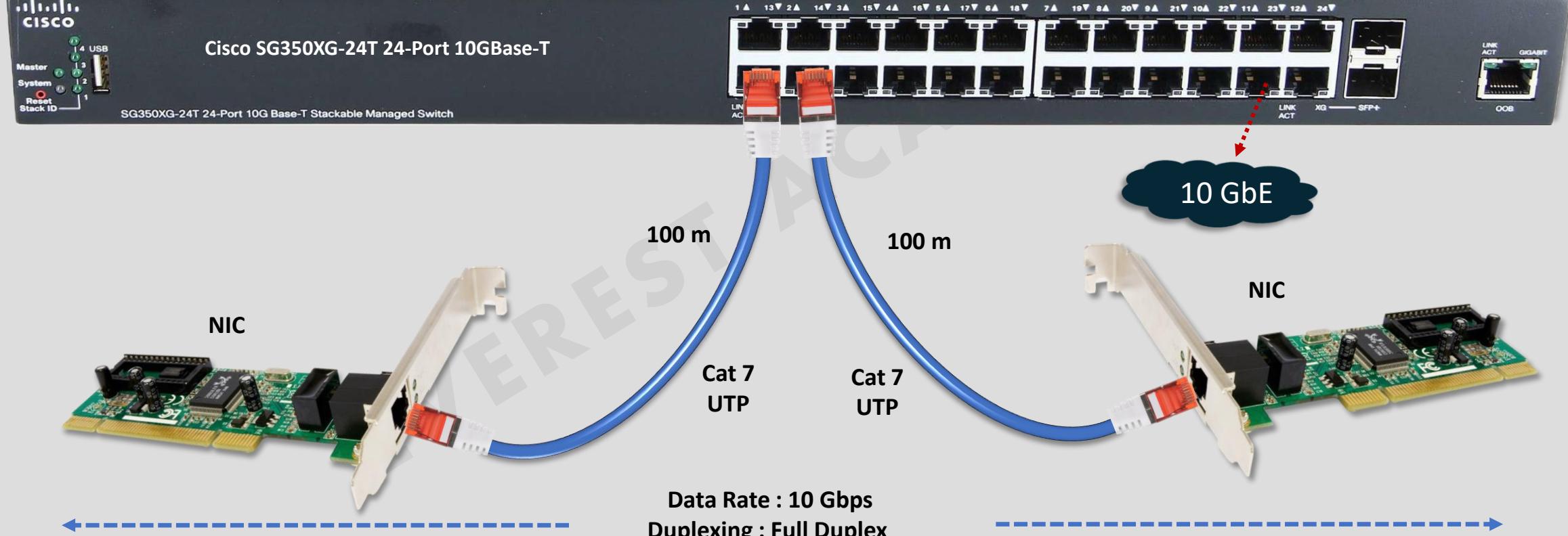
www.everestacademy.in



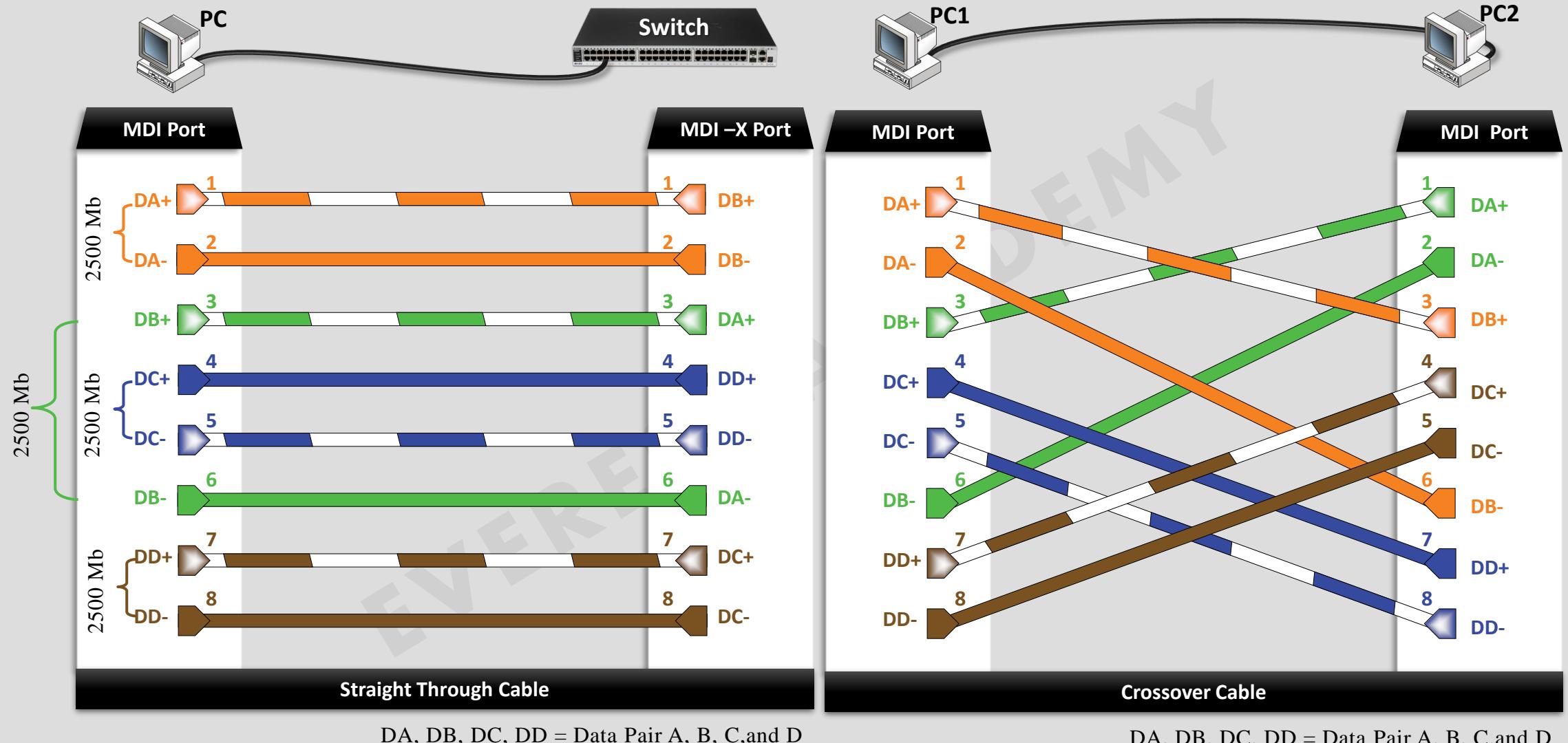
Ethernet Standard 10GBASE-T

10GBASE-T is a form of Gigabit Ethernet that runs over four wire-pairs inside a category 7 cable for distance of 100m.

Each of the four pairs can be used for both RX and TX, at the same time through the use of **echo cancellation**.



Straight Through and Crossover Cables (10GBASE-T)



Ethernet Auto-negotiation

- **Auto-Negotiation** is the feature that allows an ethernet port on a switch or a router or a server, or a PC to communicate with the device on the other end of the link to determine the optimal duplex mode and speed for the connection.



Ethernet Port

Auto-negotiation



Ethernet Port

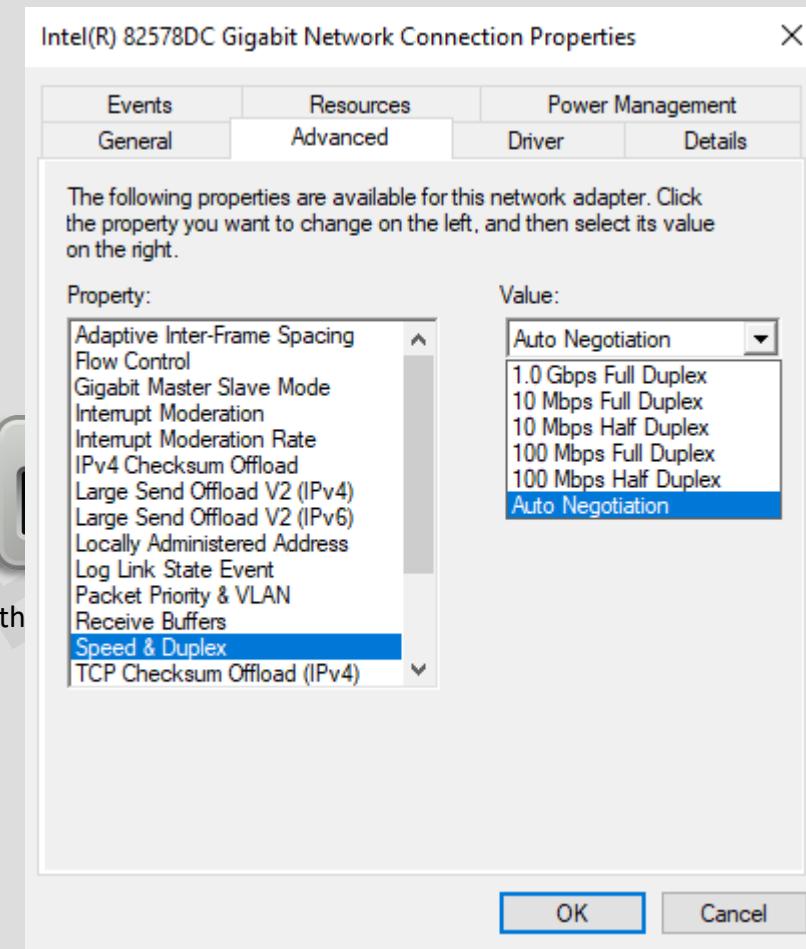
Duplex : Half /Full

Speed : 10/ 100 /1000 /10000



Ethernet Auto-negotiation

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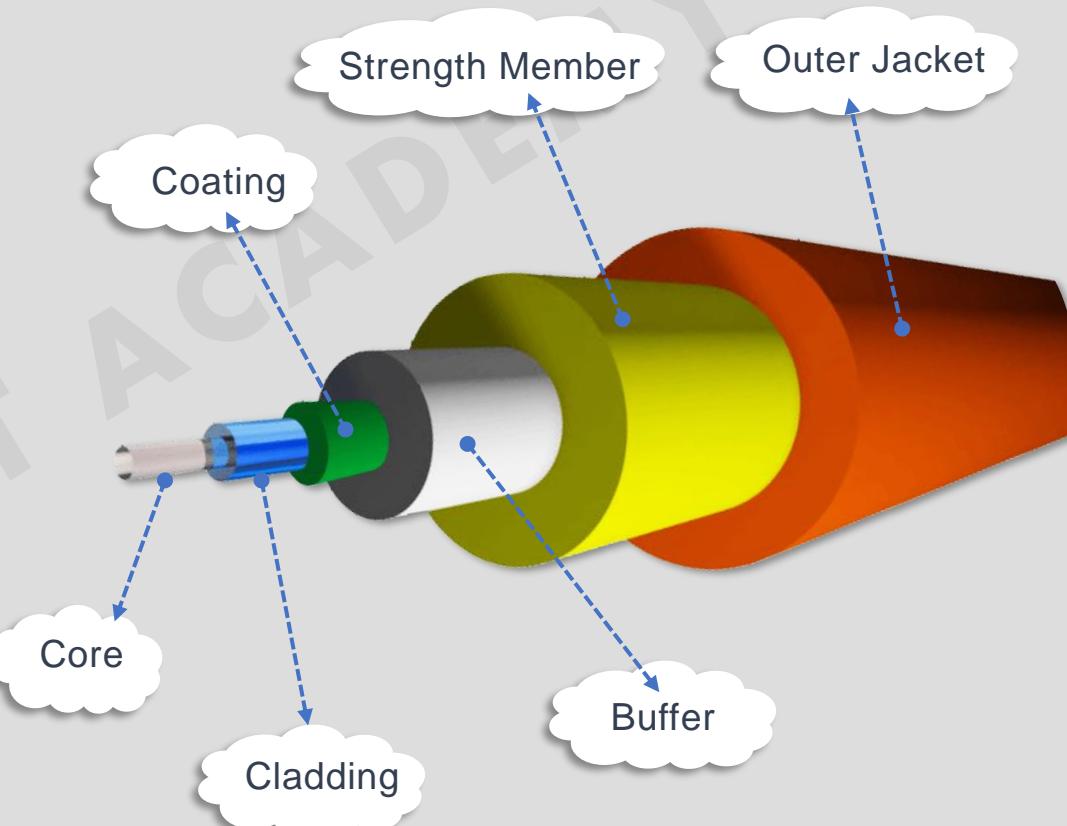
Fiber-Optic Cable

- **Fiber optic cable** is a high-speed data transmission medium. It contains tiny glass or plastic filaments that carry light beams.
- There are two different types of Fiber optic cable , Multi-mode fiber (MMF) and Single mode fiber (SMF).
- **Multi-mode fiber (MMF)** : Consists of a larger core and uses LED emitters to send light pulses.
- **Single mode fiber (SMF)** : Consists of a very small core and uses expensive laser technology to send a single ray of light.



Fiber-Optic Cable Structure

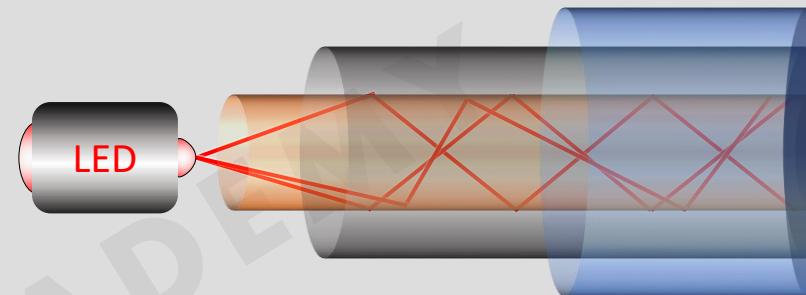
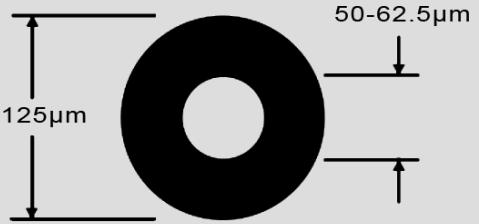
- **The core** is a cylinder of glass or plastic that is surrounded by a medium with a lower index of refraction.
- **The cladding** causes light to be confined to the core of the fiber by total internal reflection at the boundary between the two.
- **The coating** is the protective layer of the optical fiber. It absorbs the shocks, scrapes, and moisture that could damage the cladding.
- **The buffer** provides mechanical isolation, protection from physical damage and fiber identification.



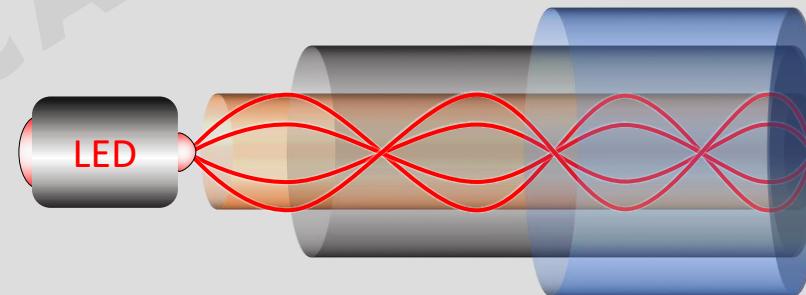
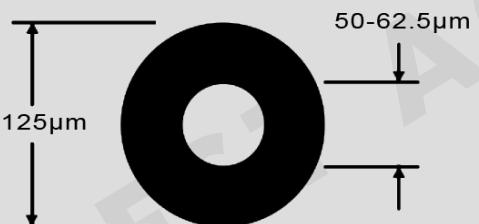
Multimode and Single Mode Fiber

- The micrometer (μm) also commonly known as a **micron**, is a unit of length equaling 1×10^{-6} (0.000 001) of a meter, that is, one millionth of a meter.

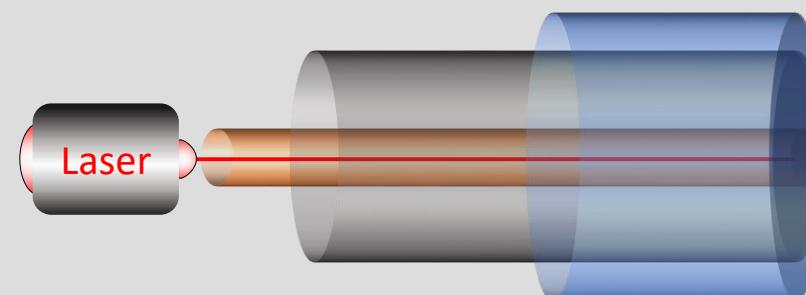
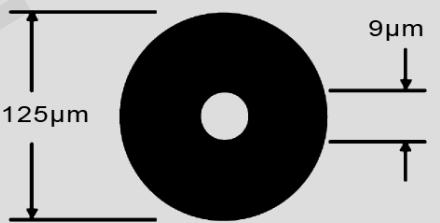
Multimode Step-Index



Multimode Graded-Index



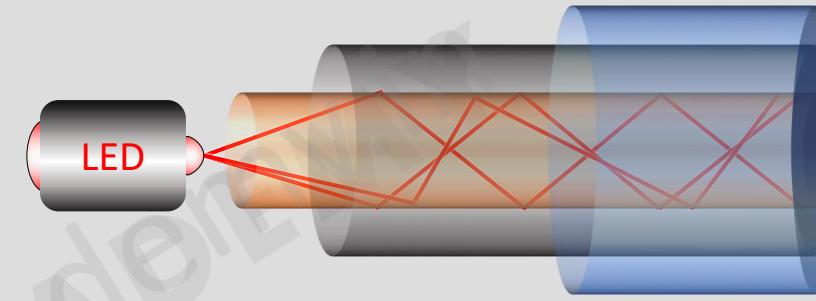
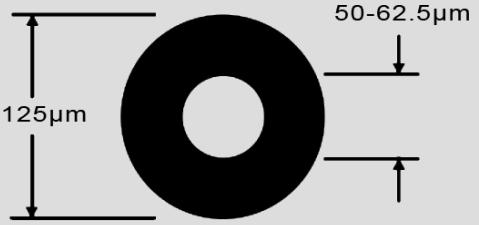
Single Mode Step-Index



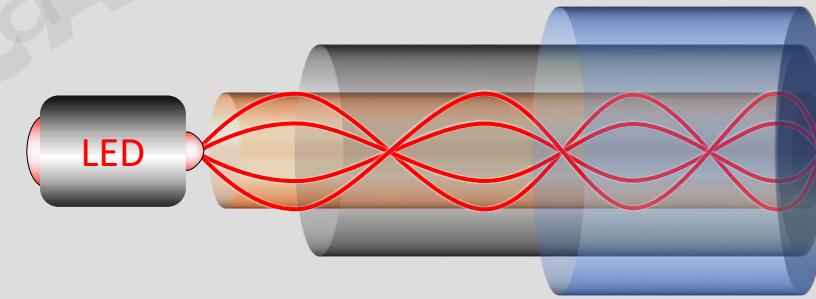
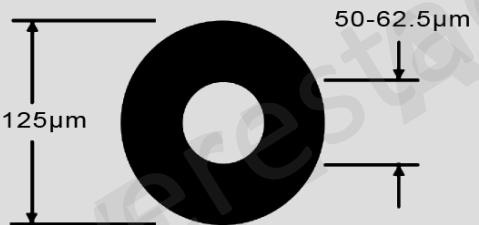
Multimode and Single Mode Fiber

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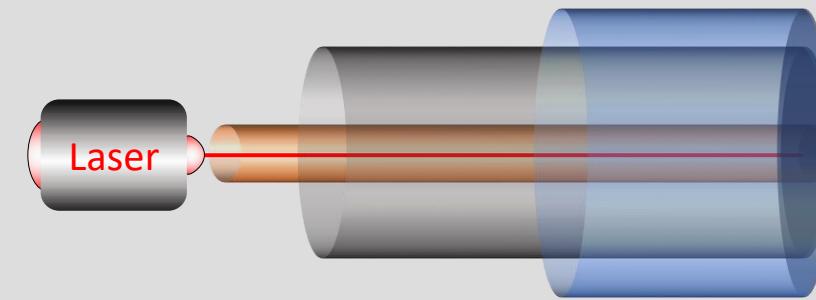
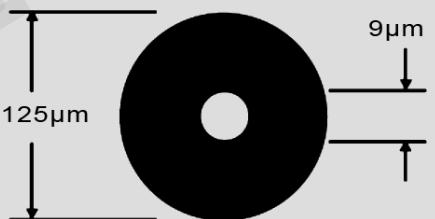
Multimode Step-Index



Multimode Graded-Index



Single Mode Step-Index



Fiber Optic Cable Types

Category	Color	100 Mb/s	1 Gb/s	10Gb/s	25 Gb/s	40 Gb/s	100 Gb/s	Application
OM1	Orange	2000 m	275 m	33 m	---	---	---	LAN
OM2	Orange	2000 m	550 m	82 m	---	---	---	LAN
OM3	Aqua	2000 m	550 m	300 m	70 m	240	100 m	LAN
OM4	Aqua	2000 m	550 m	400 m	100 m	350 m	150 m	Data Center
OM5	Lime Green	2000 m	550 m	400 m	100 m	350 m	150 m	Data Center
OS1/OS2	Yellow	40 km	100 Km	40 Km	40 Km	40 Km	40 Km	Telecom Networks

Fiber Optic Cable Connectors



ST Connector

Straight Tip connector



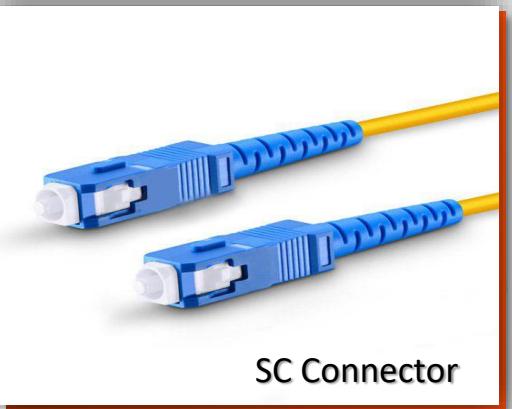
LC Connector

Lucent Connector, Little Connector
Local Connector



MTRJ Connector

Mechanical Transfer Registered Jack
Media Termination - Recommended jack



SC Connector

Subscriber Connector
Square Connector
Standard Connector



FC Connector

Ferrule Connector
Fiber Channel

Ethernet Fiber 100Base and 1000Base

Version	Cable Type	Network	Length
100Base-FX	MMF	LAN	2 km
1000Base-SX	MMF	LAN	550 m
1000Base-LX	MMF/SMF	LAN/ WAN	550 m / 5 km
1000Base-LX10	SMF	WAN	10 Km
1000Base-BX10	SMF	WAN	10 Km
1000Base-ZX	SMF	WAN	70 Km

*SX : Short Wavelength ---> MMF

*L X: Long Wavelength ---> SMF

Ethernet Fiber 10GBase

10GBase version	Cable Type	Network	Length
10GBase-SR	MMF	LAN	300 m
10GBase-SW	MMF	WAN	300 m
10GBase-LR	SMF	LAN	10 Km
10GBase-LW	SMF	WAN	10 Km
10GBase-ER	SMF	LAN	40 Km
10GBase-EW	SMF	WAN	40 Km

*S : Short Wavelength ---> MMF

*L : Long Wavelength ---> SMF

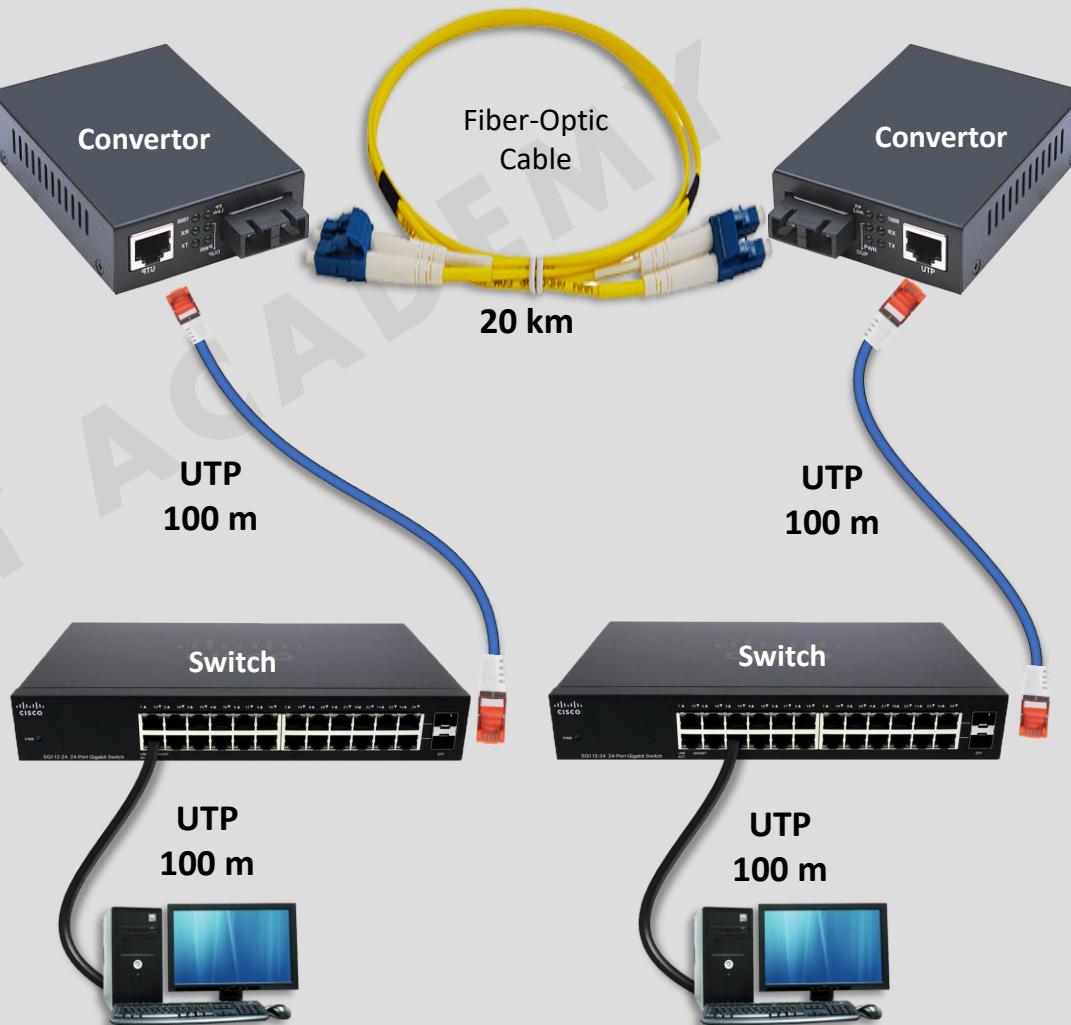
*E : Extra Long Wavelength ---> SMF

*R : Range ---> LAN

*W : Wide ---> WAN

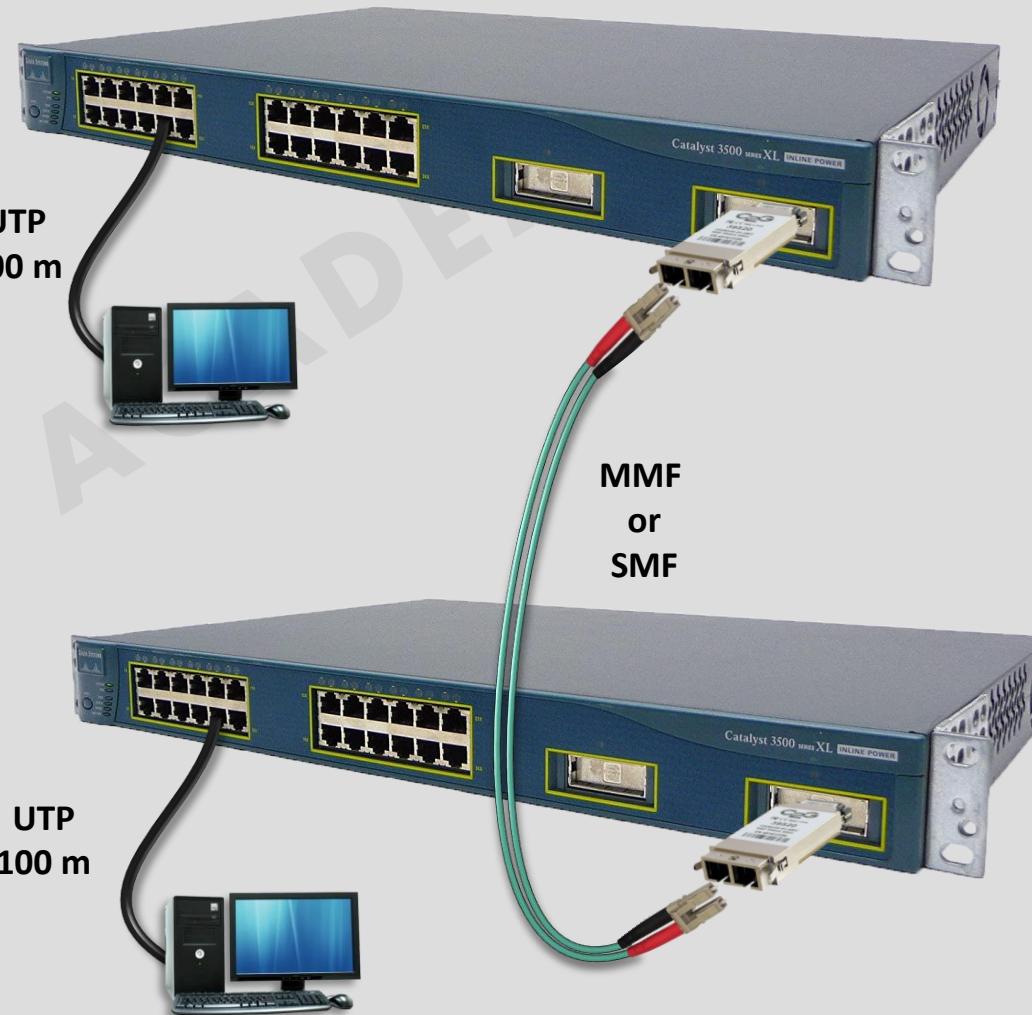
Ethernet Media Converters

- An **Ethernet media converter** is a device designed to interconnect different networking media such as multimode or single mode fiber and UTP cables to facilitate communication between them.
- **Copper-based Ethernet connections** are limited to a data transmission distance of only 100 meters when using UTP cable. By using an Ethernet to fiber conversion solution, fiber optic cabling can be used to extend this link over a greater distance.
- An **Ethernet media converter** can also be used where there is high level of electromagnetic interference (EMI) which is a common phenomenon found in industrial plants.



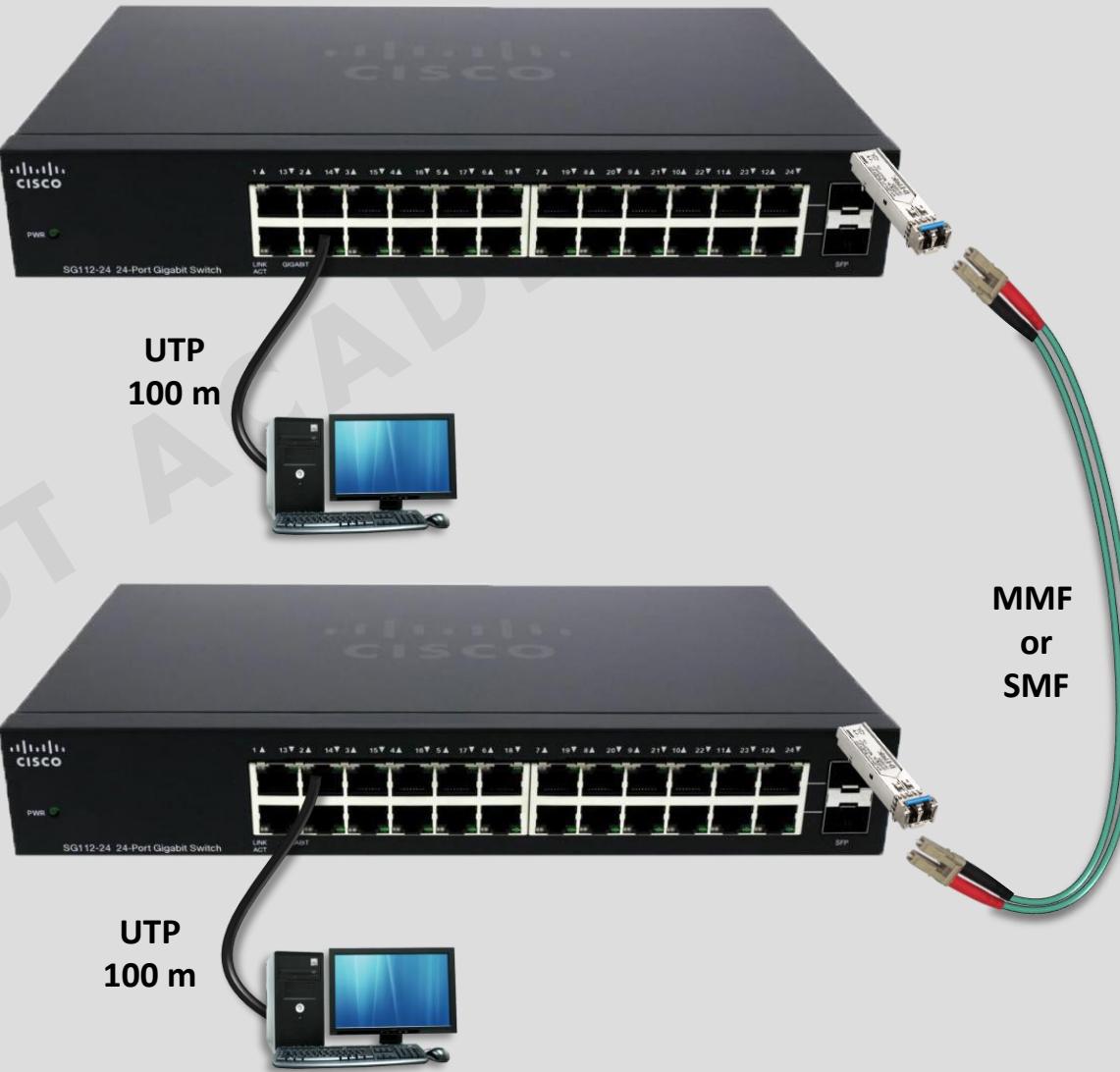
GigaBit Interface Converter (GBIC)

- A GigaBit Interface Converter is A small transceiver that plugs into the GBIC port of a network switch and connects to Fiber Channel and Gigabit Ethernet (GbE) optical fiber cables at the other end.
- The GBIC converts an electrical signal into an optical signal and the receiving end transforms the optical signal into an electrical signal so that the information could transmit in the optical fiber. It is used with Gigabit Ethernet and fiber channel for some
- The principle of GBIC is the same as ethernet media converter, but it is safer and more efficient than ethernet media converter and it is hot swappable electrical interface.
- GBIC is slowly becoming more of a legacy in the fiber optic technology and is being replaced by SFP.



Small Form-Factor Pluggable (SFP) Transceiver

- A **small form-factor pluggable (SFP)** is The replacement for GBICs, used on Gigabit interfaces, with a smaller size, taking less space on the side of the networking card or switch.
- **Fiber SFP Module** is a solution for switches with optical port, fiber optic cables (SMF fiber / MMF fiber) with duplex LC connector are needed to support the connection.
- **1000BASE-T Copper SFP Module** is a solution for switches with copper port, Cat5e must be used for 1Gbit/s data transmission.
- **Fiber SFP Module** is ideal for short distance less than 100m.
- **SFP+** is the new version of SFP that support 10GbE.



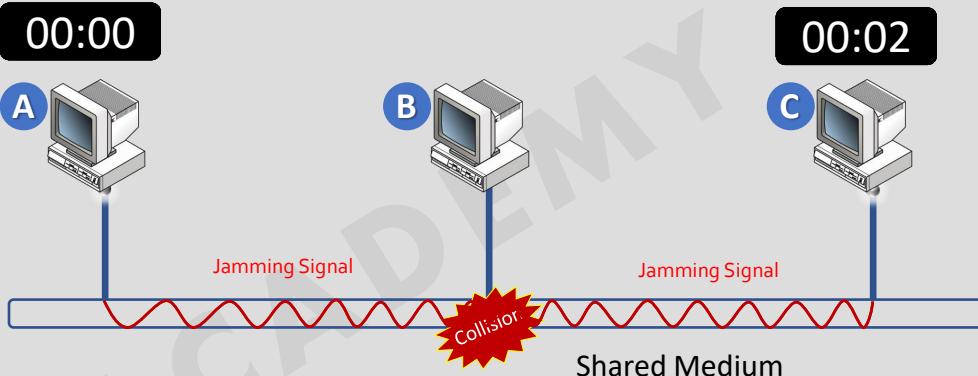
SFP Types

Name	Standard	Introduced	Size	Media	Connector
100 Mbit/s SFP	SFF INF-8074i	2001-05-01	113.9 mm ²	Fiber, copper	LC, RJ45
1 Gbit/s SFP	SFF INF-8074i	2001-05-01	113.9 mm ²	Fiber, copper	LC, RJ45
10 Gbit/s SFP+	SFF SFF-8431 4.1	2009-07-06	113.9 mm ²	Fiber, copper, DAC	LC, RJ45
25 Gbit/s SFP28	SFF SFF-8402	2014-09-13	113.9 mm ²	Fiber, DAC	LC
100 Gbit/s QSFP28	SFF SFF-8665	2014-09-13	156 mm ²	Fiber, DAC	LC, MTP/MPO-12
200 Gbit/s QSFP56	SFF SFF-8665	2015-06-29	156 mm ²	Fiber, DAC	LC, MTP/MPO-12
400 Gbit/s QSFP-DD	SFF INF-8628	2016-06-27	156 mm ²	Fiber, DAC	LC, MTP/MPO-16

*DAC : Direct Attach Copper

Carrier-sense Multiple Access With Collision Detection (CSMA/CD)

- CSMA/CD is a method used the early Ethernet technology for local area networking (Half Duplex Mode).
- CSMA/CD uses **carrier-sensing** to defer transmissions until no other stations are transmitting.
- CSMA/CD uses **collision detection** in which a transmitting station detects collisions by sensing transmissions from other stations while it is transmitting a frame.
- When a **collision condition** is detected, the station stops transmitting that frame, transmits a **jam signal**, and then waits for a random time interval before trying to resend the frame.



- 1 Node A wants to send data.
- 2 Node A listens for traffic on the transmission link.
- 3 If the link is idle, Node A starts sending data & checks for a collision.
- 4 If node C sends data at the same time it cause a collision.
- 5 A collision causes a power spike that can be heard by all nodes.
- 6 Both node A and node C send Jamming signal to inform other nodes.
- 6 Both node A and node C set a random time and wait Before trying to resend data again .

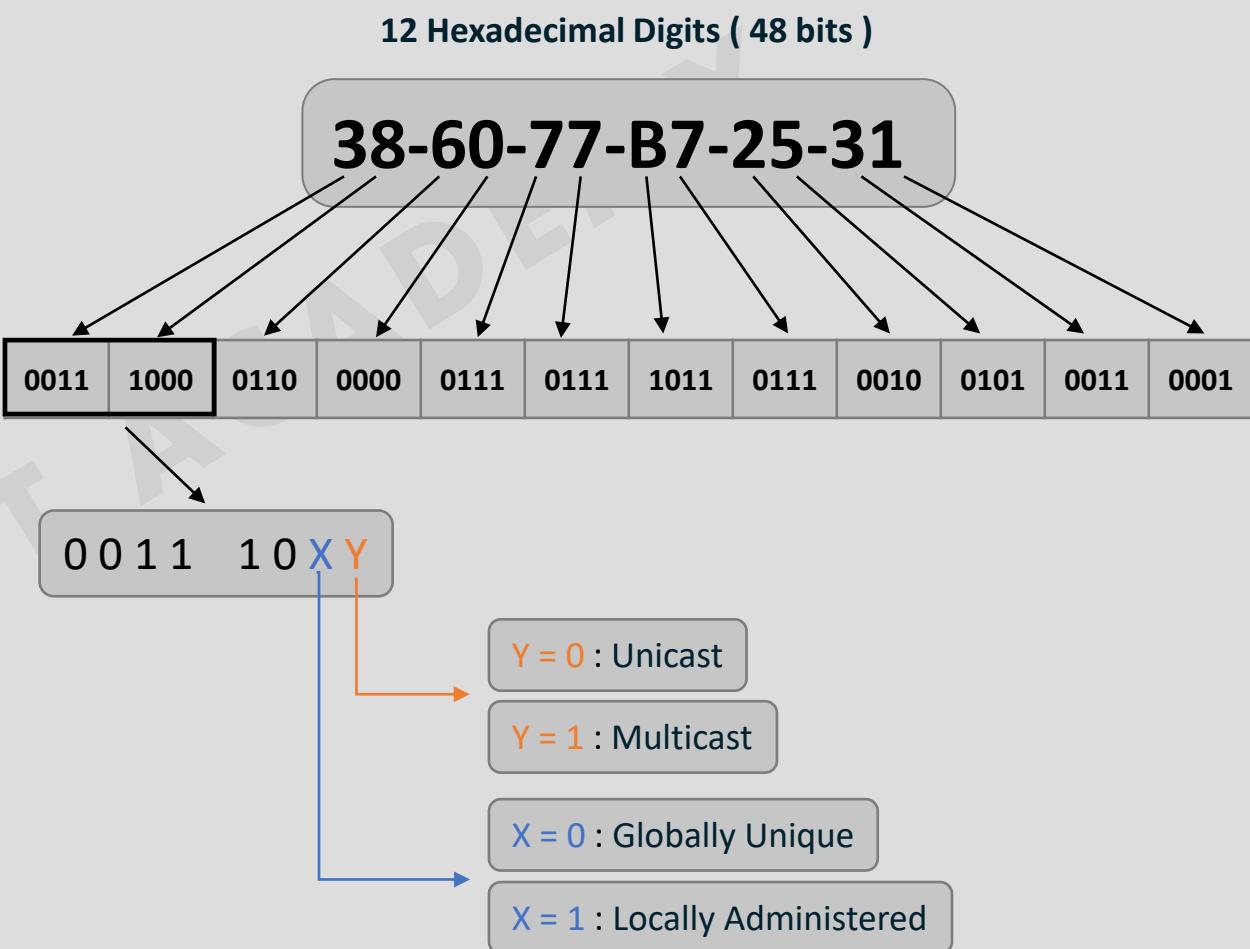
Ethernet Addressing

- Ethernet Technologies, Wi-Fi and Bluetooth use unique identifiers in communications within a network segment .
- An Identifiers is called media access control address (**MAC address**) and each NIC or WNIC or ethernet port is assigned a unique address by the manufacturer.
- A **MAC Address** is 48-bits hardware number recognizable as six groups of two hexadecimal digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F), separated by hyphens, colons, period or without a separator.
- A **MAC Address** is used in the (MAC) sublayer of the data link layer of OSI Model. It is often referred to as a hardware address or a physical address.



Hexadecimal Numbering

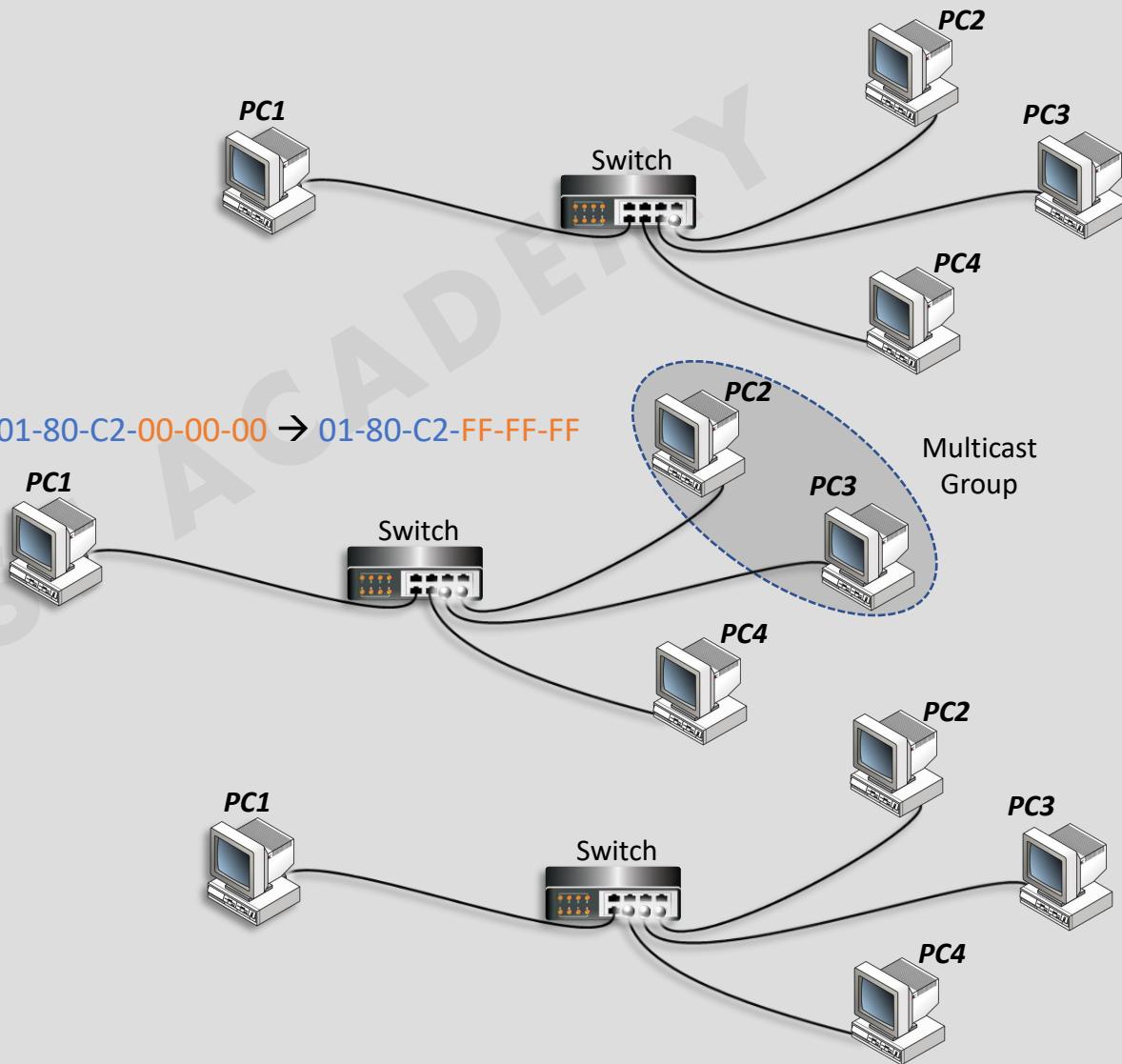
Hexadecimal	Decimal	Binary			
		8	4	2	1
0	0	0	0	0	0
1	1	0	0	0	1
2	2	0	0	1	0
3	3	0	0	1	1
4	4	0	1	0	0
5	5	0	1	0	1
6	6	0	1	1	0
7	7	0	1	1	1
8	8	1	0	0	0
9	9	1	0	0	1
A	10	1	0	1	0
B	11	1	0	1	1
C	12	1	1	0	0
D	13	1	1	0	1
E	14	1	1	1	0
F	15	1	1	1	1



X = 1 indicates that the MAC address is changed by local machine administrator.

Types of MAC address

- A **unicast MAC Address** is the unique address used when a frame is sent from a single transmitting device to a single destination device.
- A **multicast MAC Address** allows a device to send a frame to a group of devices. Devices that belong to a multicast group can receive the frame.
- A **broadcast MAC Address** allows a device to send a frame to all hosts on the local network, this address is **FFFF.FFFF.FFFF**



MAC Address Structure

- A MAC Address is a number represented in hexadecimal format, it consists of 12 hexadecimal digits that equal to 48 bits or 6 Bytes.
- A MAC Address has two portions :
 1. Organizationally Unique Identifier (OUI).
 2. Vendor-assigned.
- The organizationally unique identifier (OUI) portion is a 24-bit number that uniquely identifies the manufacturer, OUI is assigned by IEEE.
- The vendor-assigned portion of the MAC address is just that, the alphanumeric identifier assigned by the vendor.

12 Hexadecimal Digits (48 bits) or (6 Bytes)

38-60-77-B7-25-31

6 Hexadecimal Digits
(24 bits)

38-60-77

6 Hexadecimal Digits
(24 bits)

B7-25-31

Organizationally Unique
Identifier (OUI)

Vendor-assigned

- <https://dnschecker.org/mac-lookup.php>

Address Prefix : 38:60:77

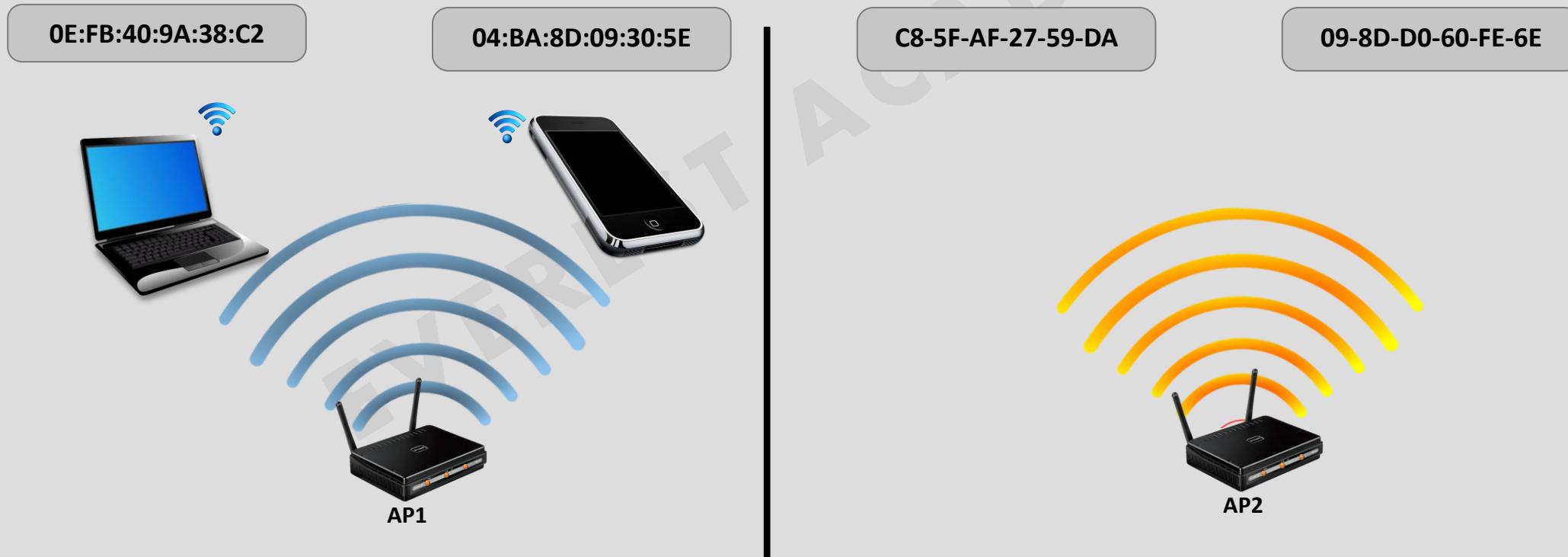
Vendor / Company : Pegatron corporation

Start Address : 386077 000000

End Address : 386077 FFFFFF

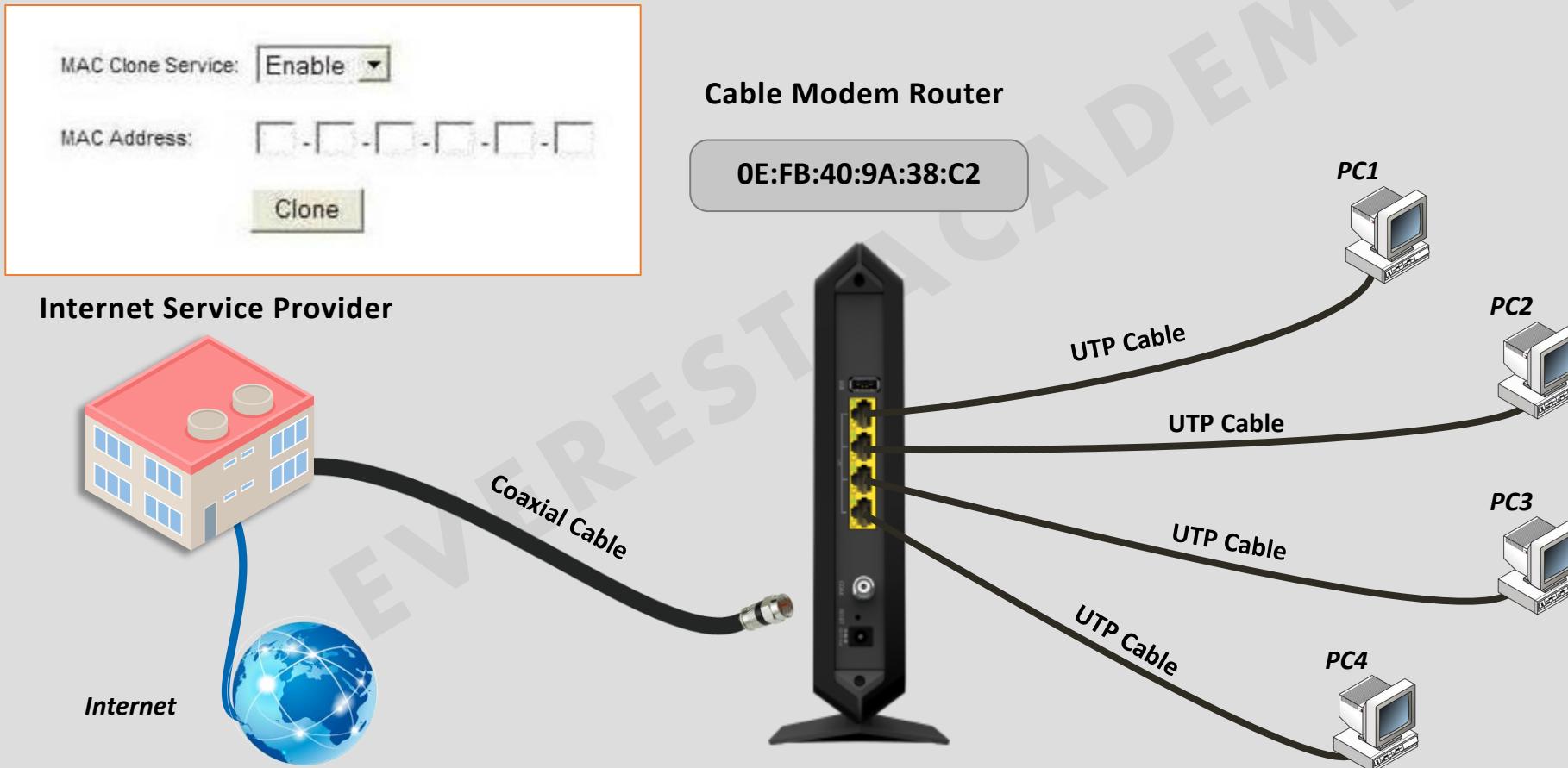
MAC Address Randomization

- Android, iOS, and Windows 10 use randomized MAC addresses when connecting to a new Wi-Fi network .
- MAC Address Randomization feature can be disabled.
- MAC Address Randomization increases user privacy.

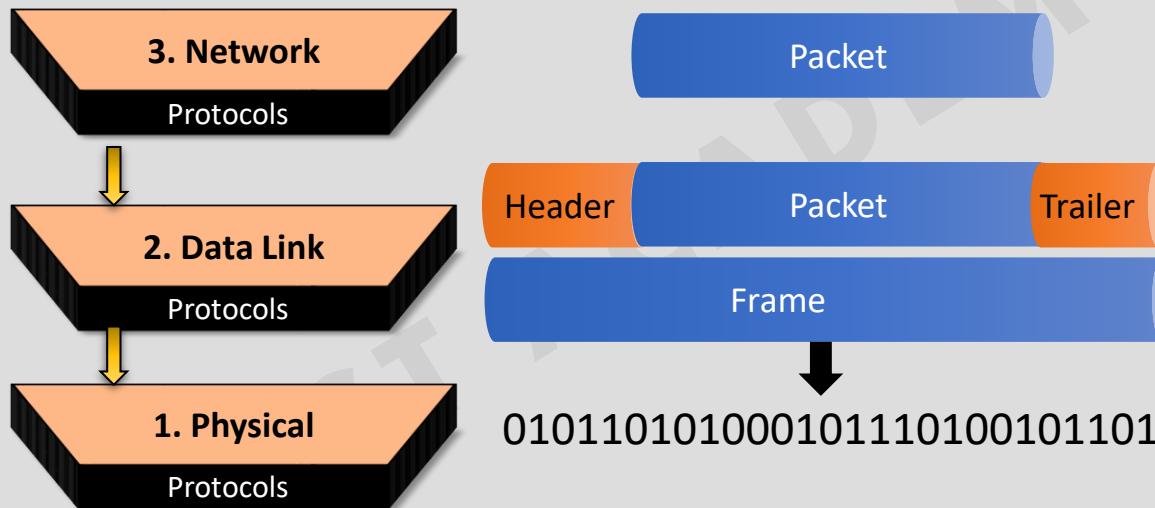


MAC Address Cloning/Spoofing

- Some cable companies authorize your cable modem based on its MAC address. Every DOCSIS cable modem has a unique one. When your modem boots up, it attempts to talk to your cable provider, and the provider will either grant or deny it access based on its MAC.

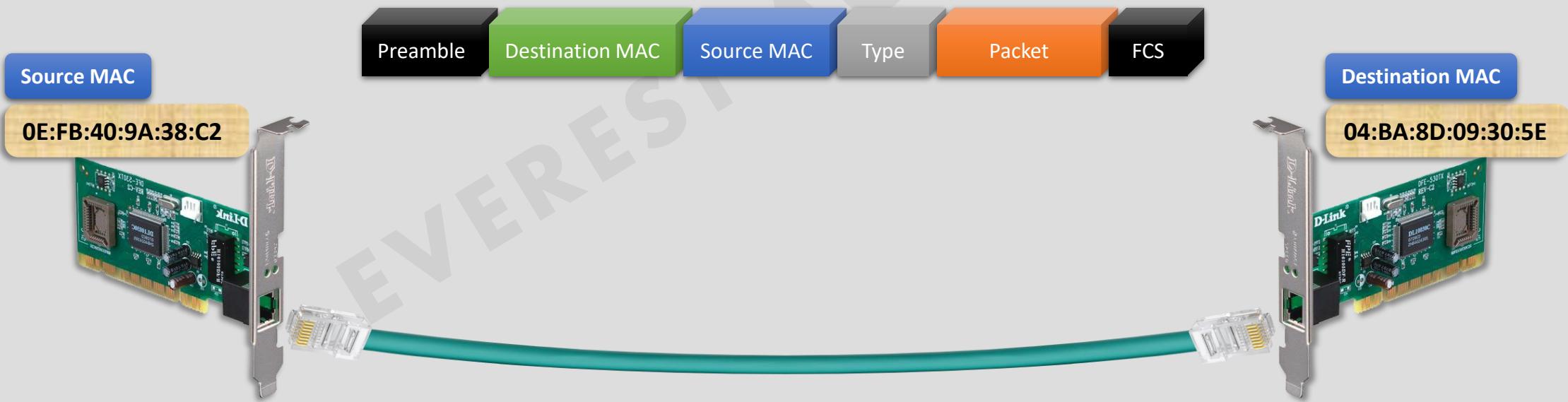


Ethernet Frame Formats



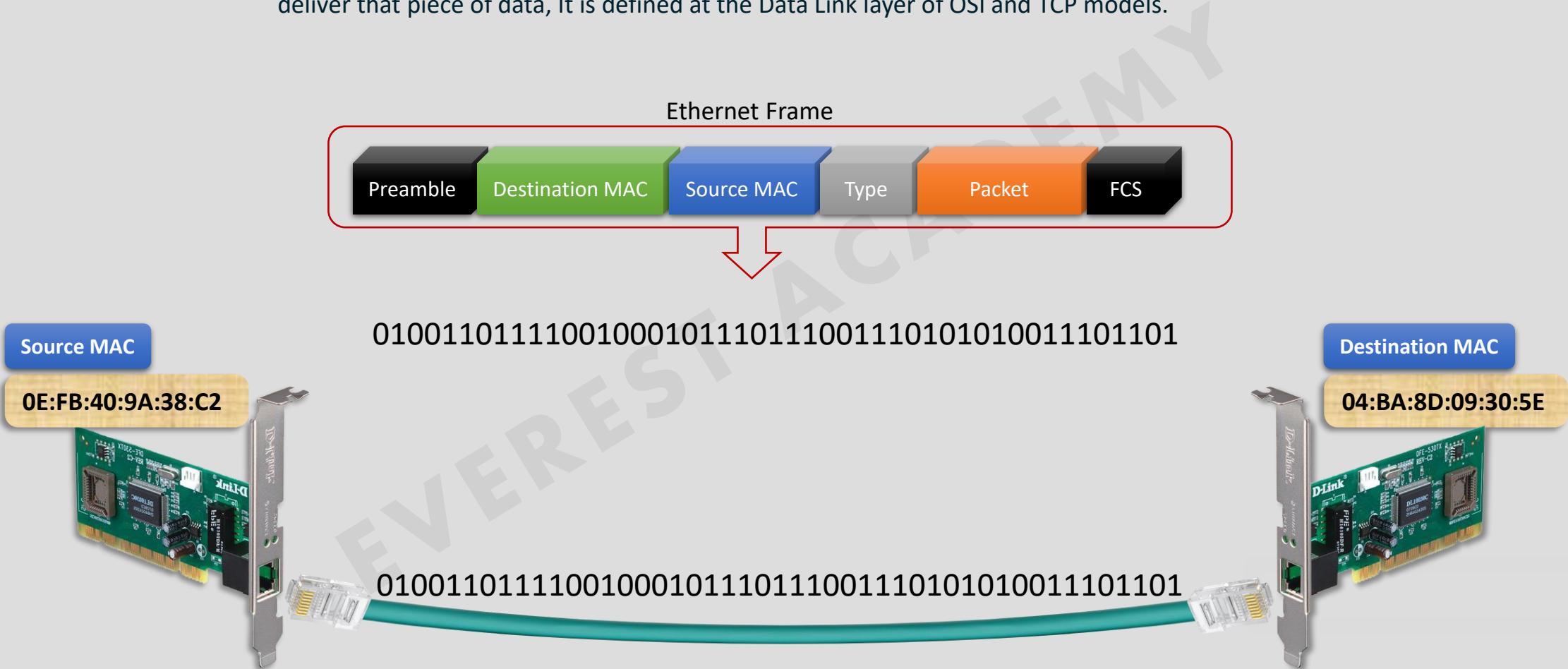
Ethernet Frame Formats

- An Ethernet frame is a piece of data along with the information that is required to transport and deliver that piece of data, It is defined at the Data Link layer of OSI and TCP/IP models.

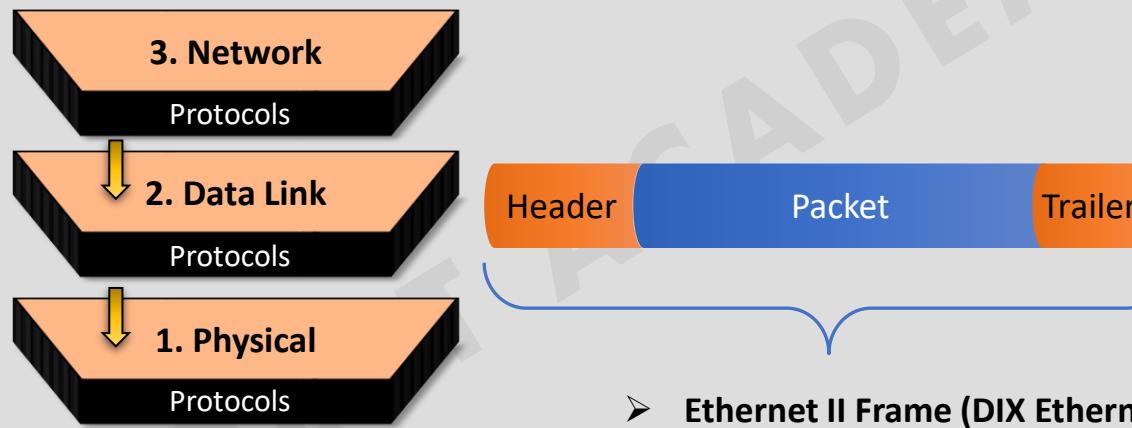


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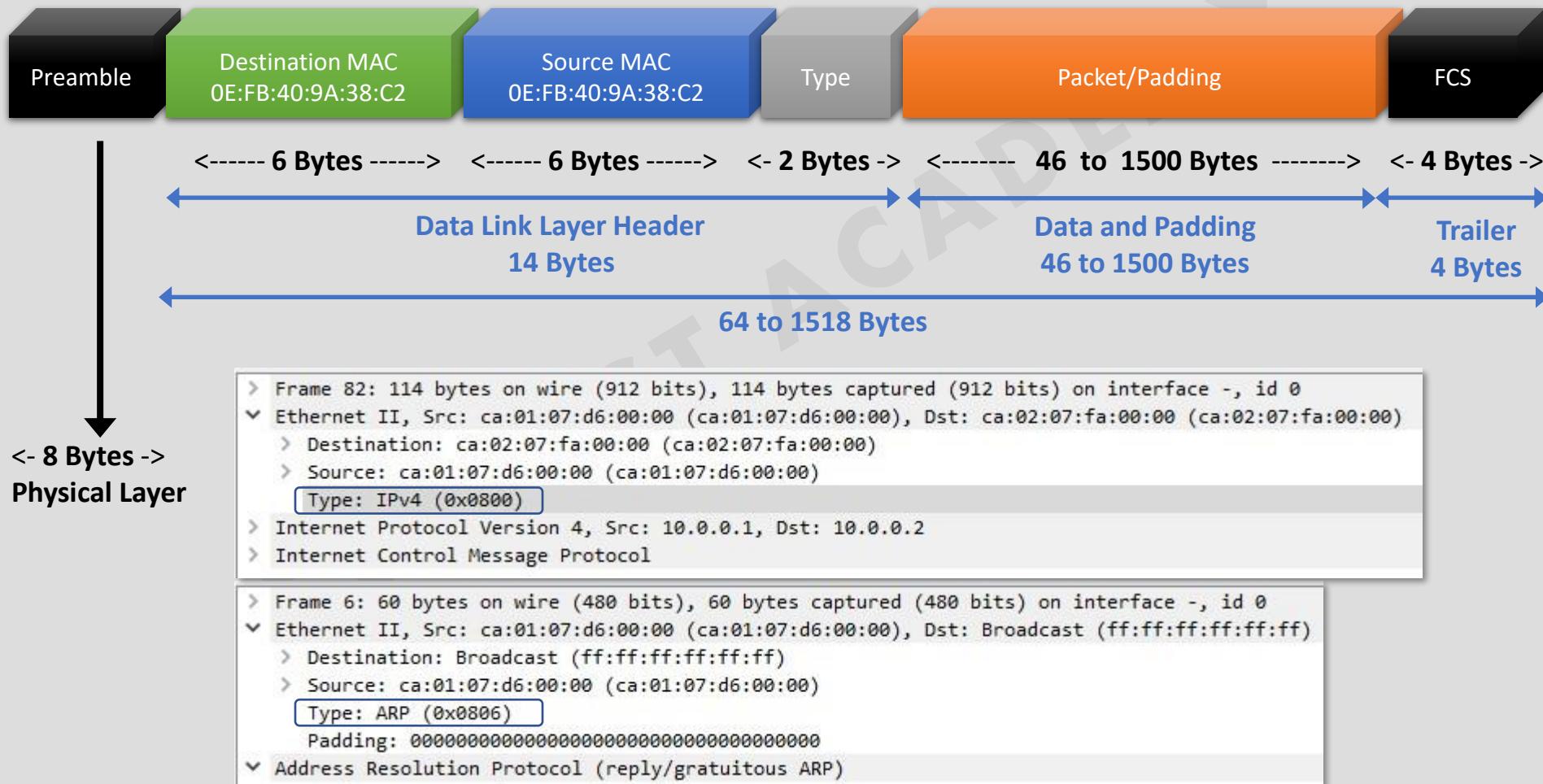
Ethernet Frame Types



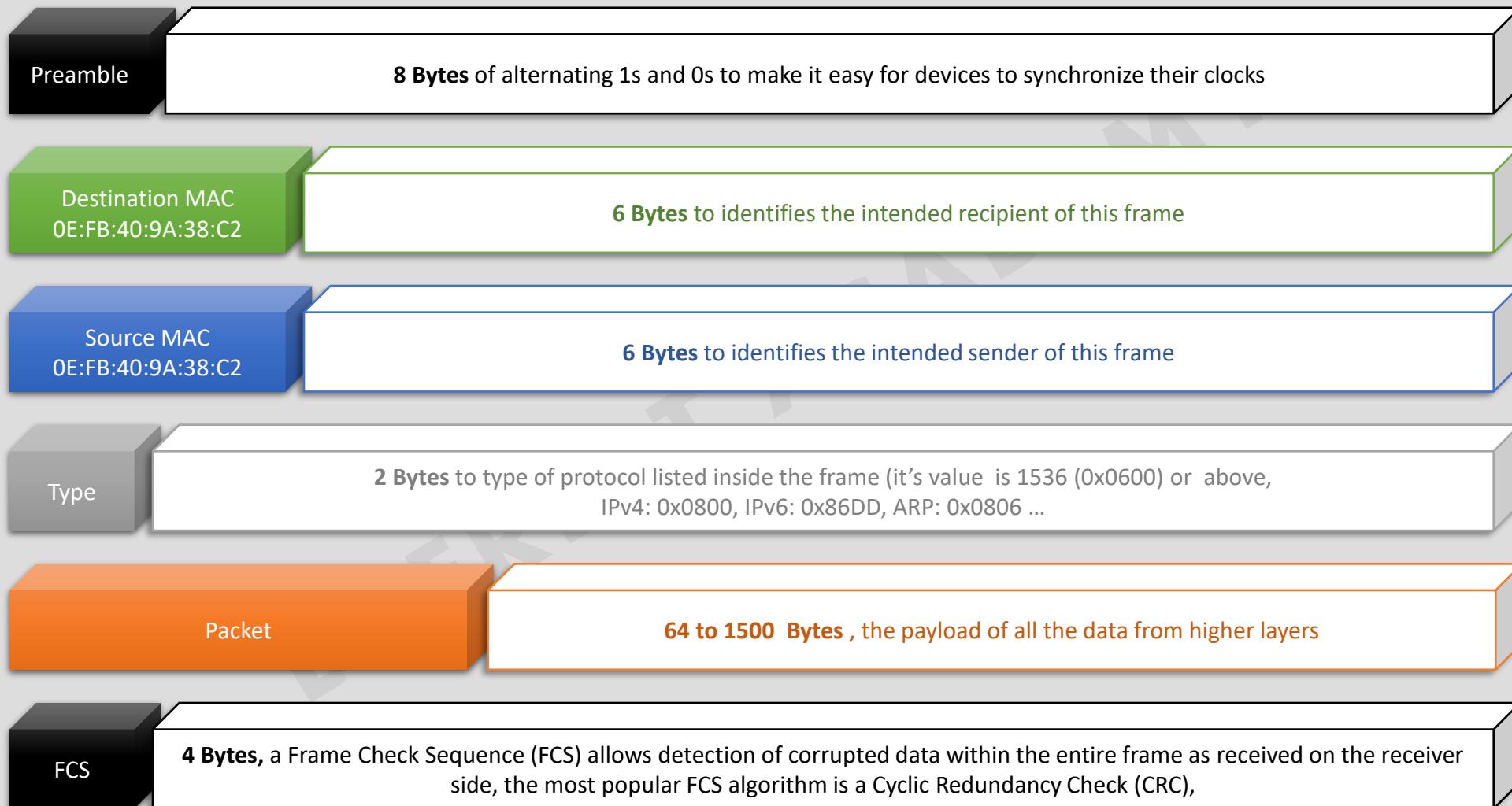
- **Ethernet II Frame (DIX Ethernet)**
- **Ethernet 802.3 Frame (IEEE)**
- **Ethernet 802.3 SNAP Frame (IEEE)**

Ethernet II Frame Format

- Devices running TCP/IP typically use the Ethernet II implementation. The Ethernet II standard covers both the physical and data link layer functions.

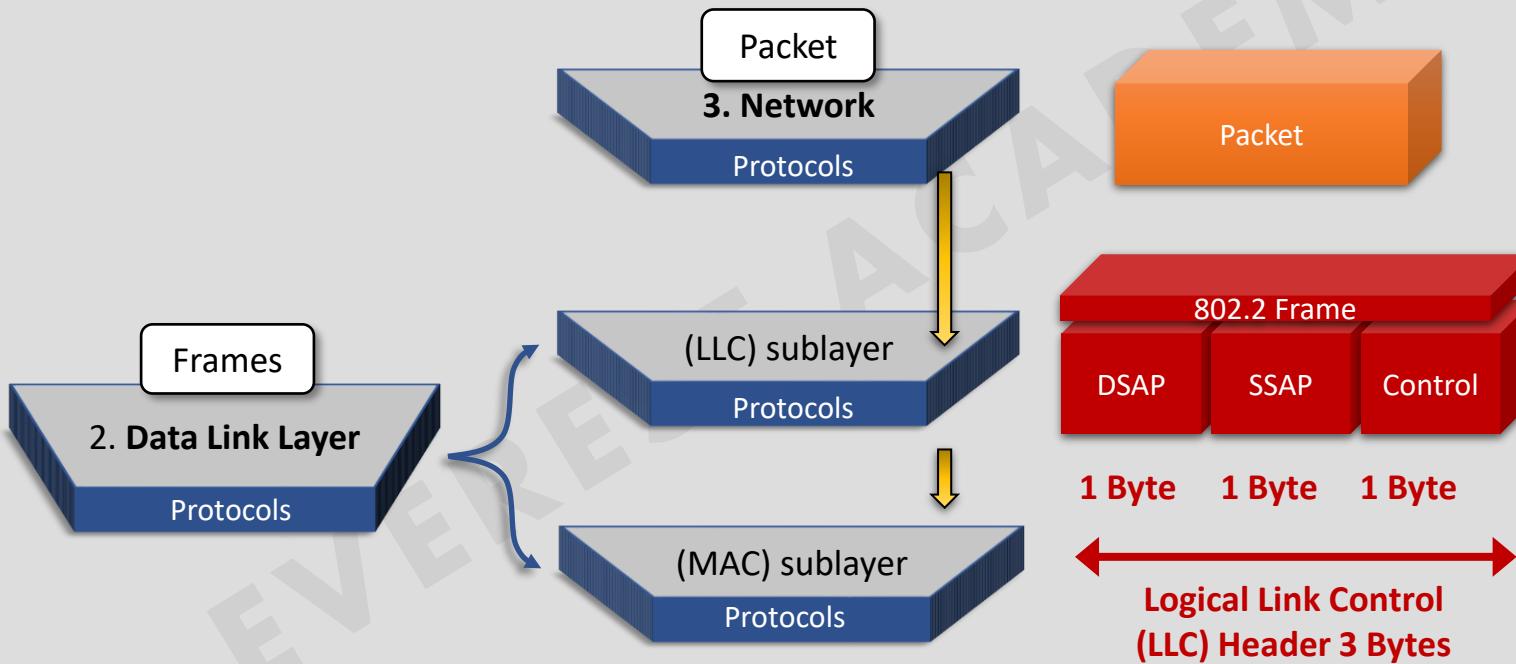


Ethernet II Frame Format



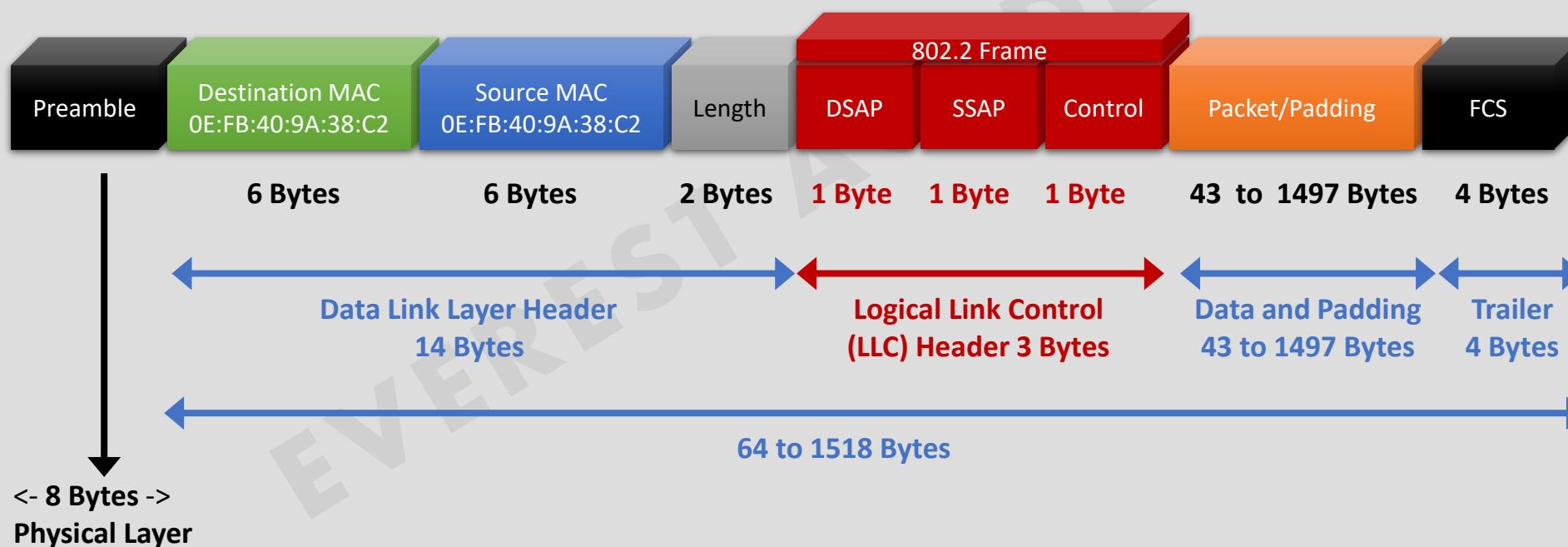
Ethernet 802.3 Frame Format

- The Ethernet 802.3 Frame has a 14 bytes Data Link Header followed by a Logical Link Control Header.

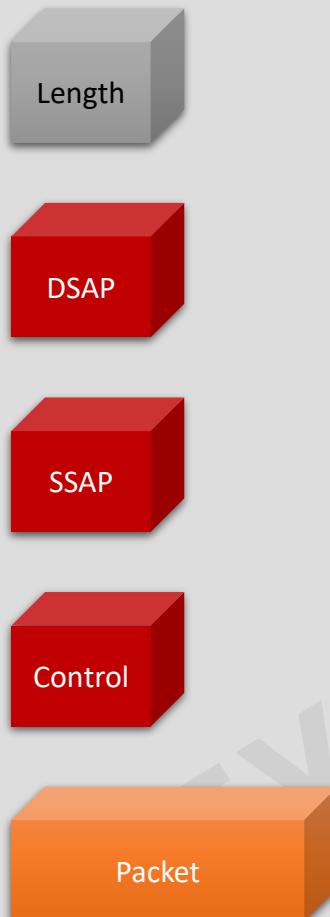


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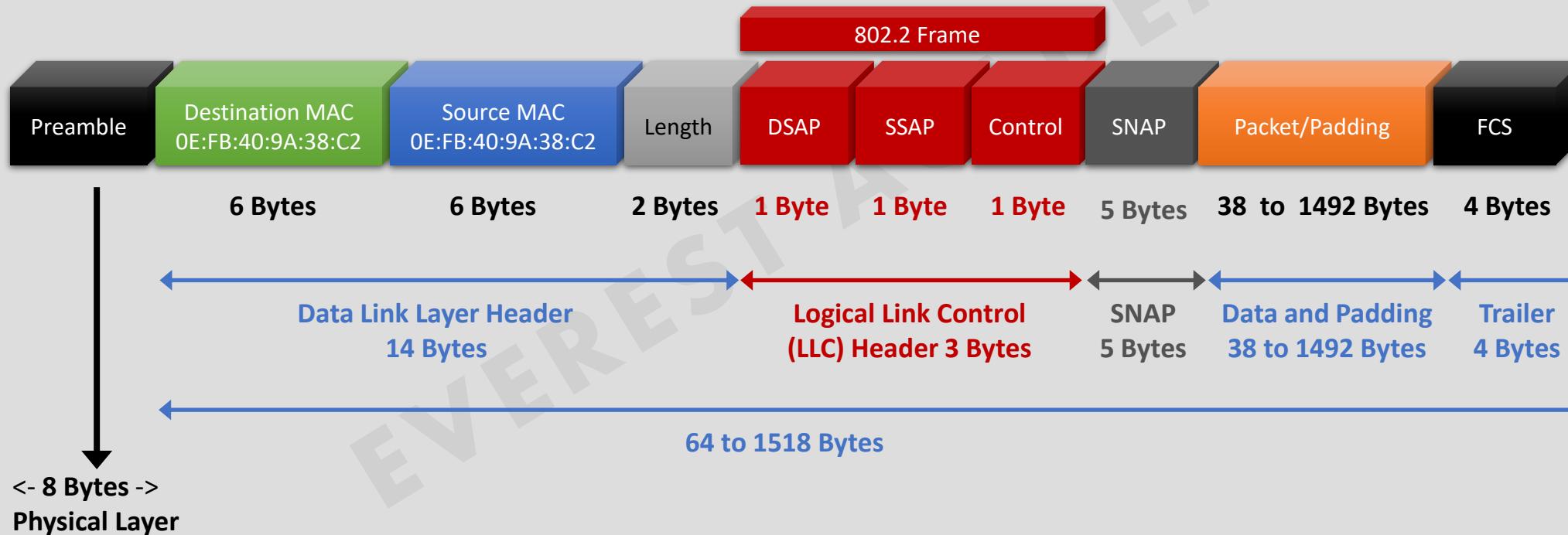
Ethernet 802.3 Frame Format



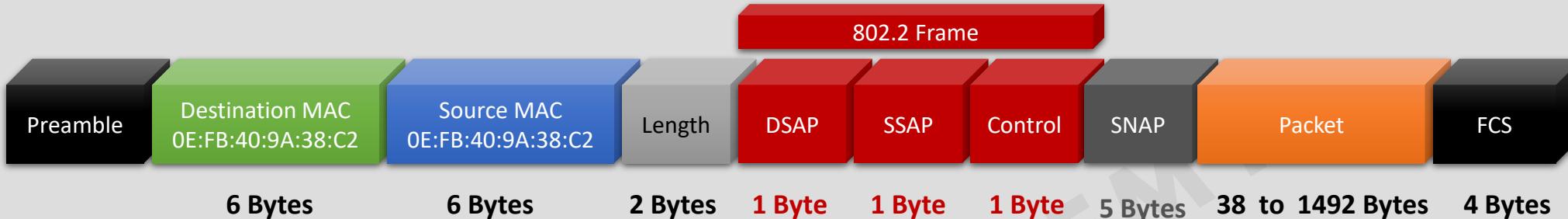
- **The Length Field** is 2 Bytes contain the length of the **data** in the frame, not including the preamble, FCS, LLC addresses, or the Length field itself.
- **The Destination Service Access Point (DSAP) Field** is 1 Byte field that simply acts as a pointer to a memory buffer in the receiving station.
- **The Source Service Access Point (SSAP) Field** is 1 Bytes pacifies the Source of the sending process.
- **The Control Field** is 1 Byte specifies the type of LLC frame.
- **The Packet Field** is 43 to 1497 Bytes , the payload of all the data from higher layers.

Ethernet 802.3 SNAP Frame Format

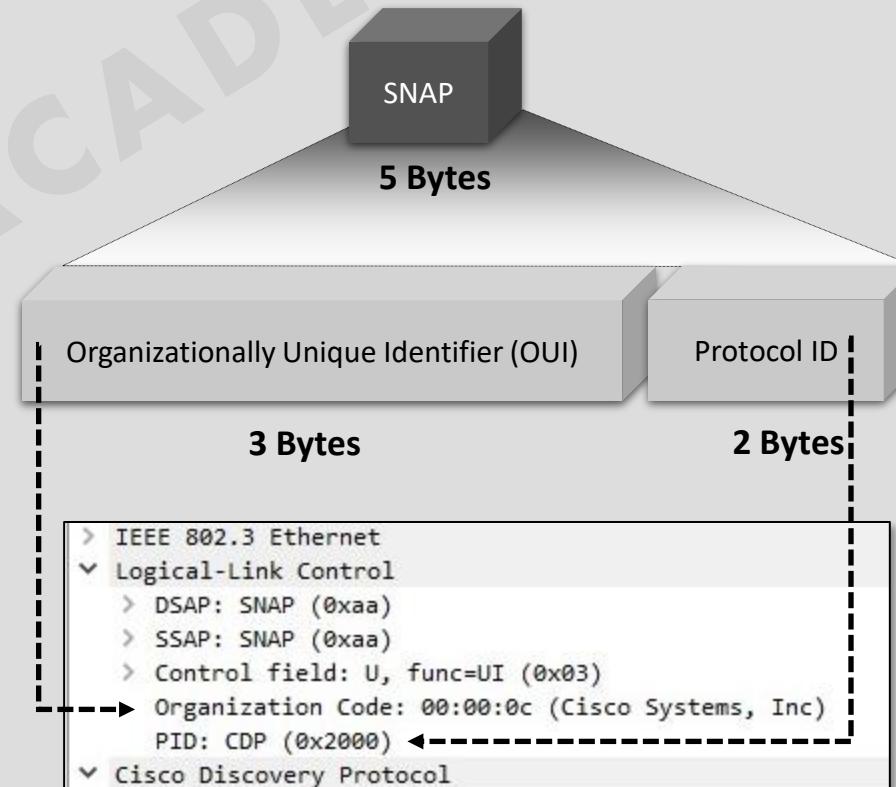
- The 802.3 SNAP (SubNetwork Access Protocol) format was created by IEEE to work with Ethernet II which uses EtherType to differentiate between upper layer protocols such as (IPv4, IPv6, ARP ...).
- Cisco Devices use Ethernet 802.3 SNAP frame with CDP, STP, and DTP protocols. The 802.3 Specification defines a 14 bytes Data Link Header followed by a Logical Link Control Header (LLC).



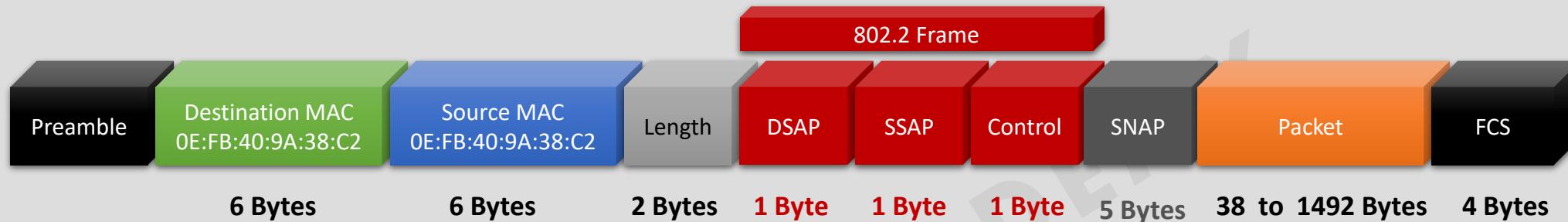
Ethernet 802.3 SNAP Frame Format



- The **SNAP header** consists of a 3 Bytes IEEE organizationally unique identifier (OUI) followed by a 2 Bytes protocol ID.
- If the OUI is hexadecimal 00:00:00, the **protocol ID** is the Ethernet type (EtherType) field value for the protocol running on top of SNAP
- if the **OUI** is an **OUI for a particular organization**, the protocol ID is a value assigned by that organization to the protocol running on top of SNAP.



Ethernet 802.3 SNAP Frame Format



cdp				
No.	Source	Destination	Protocol	
20	ca:01:06:76:00:08	CDP/VTP/DTP/PAgP/UDLD	CDP	
<				
>	Frame 93: 349 bytes on wire (2792 bits), 349 bytes captured (2792 bits) on interface -, id 0			
`	IEEE 802.3 Ethernet			
>	Destination: CDP/VTP/DTP/PAgP/UDLD (01:00:0c:cc:cc:cc)			
>	Source: ca:01:06:76:00:08 (ca:01:06:76:00:08)			
>	Length: 335			
`	Logical-Link Control			
>	DSAP: SNAP (0xaa)			
>	SSAP: SNAP (0xaa)			
>	Control field: U, func=UI (0x03)			
>	Organization Code: 00:00:0c (Cisco Systems, Inc)			
>	PID: CDP (0x2000)			
`	Cisco Discovery Protocol			

Ethernet II Frame Format



arp				
No.	Source	Destination	Protocol	
7	Private_66:68:00	ca:01:06:76:00:08	ARP	
> Frame 7: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0				
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: ca:01:06:76:00:08 (ca:01:06:76:00:08)				
> Destination: ca:01:06:76:00:08 (ca:01:06:76:00:08)				
> Source: Private_66:68:00 (00:50:79:66:68:00)				
Type: ARP (0x0806)				
Padding: 00				
> Address Resolution Protocol (reply)				

Ethernet Jumbo Frame

- A **jumbo frame** is an Ethernet frame with a payload greater than the standard maximum transmission unit (MTU) of 1,500 bytes

- **Jumbo frames** are used on local area networks that support at least 1 Gbps and can be as large as 9,000 Bytes.

- Because **jumbo frames** are not defined in the IEEE 802.3 specifications, vendor support for jumbo frames and their maximum transmission units may vary.

- A **single 9000 Bytes jumbo frame** replaces six 1500 standard frames, producing a net reduction of five frames, with fewer CPU cycles consumed end to end.

