

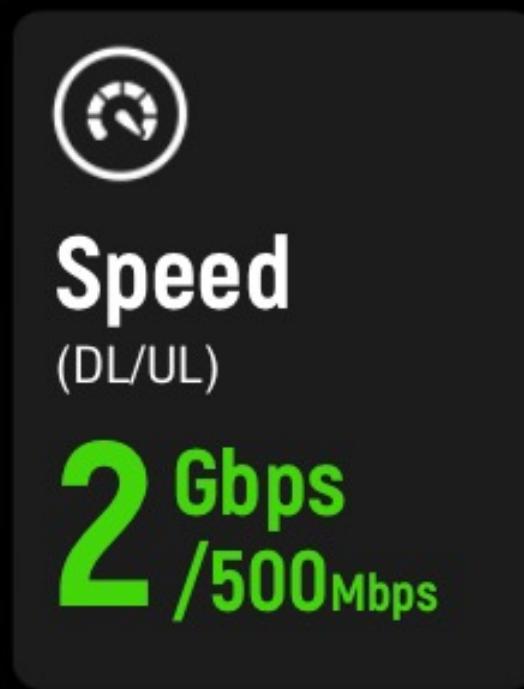
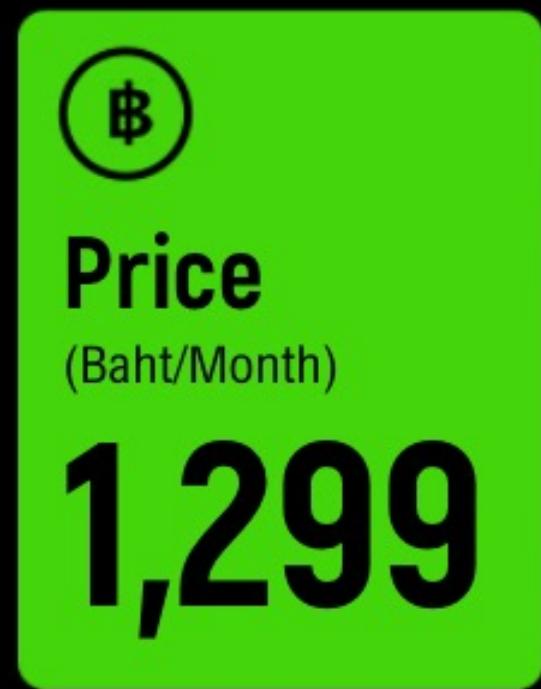
# ***TRANSMISSION*** ***Cabling***

**Layer 1 Physical Layer**

cable and structure cabling

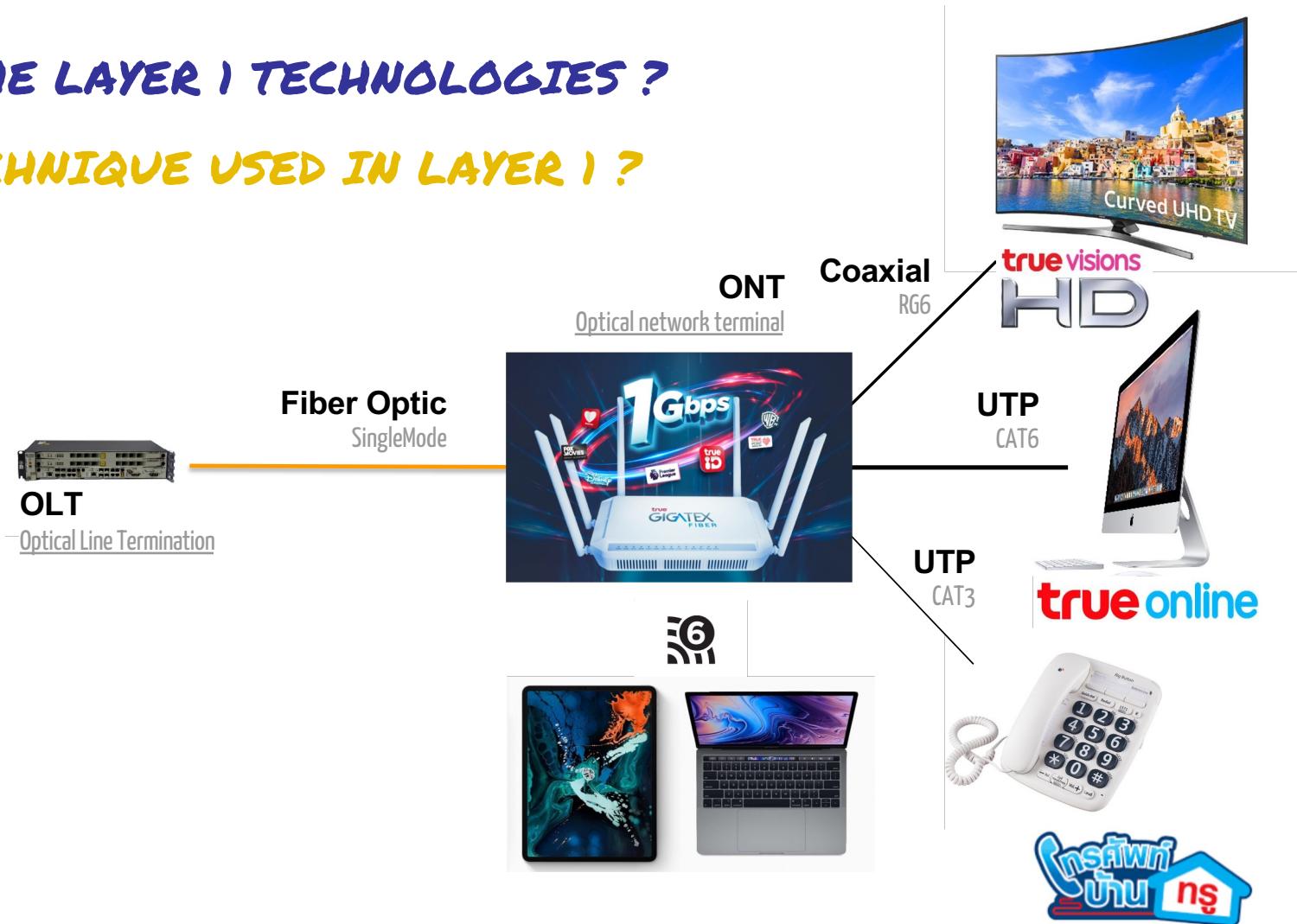
**NETWORK  
PERFORMANCE**

แพ็คเกจเน็ตบ้าน ที่ให้คุณนำอุปกรณ์ Router ตบเองมาใช้  
พร้อมสัมผัสประสบการณ์ระดับ  
**2Gbps**

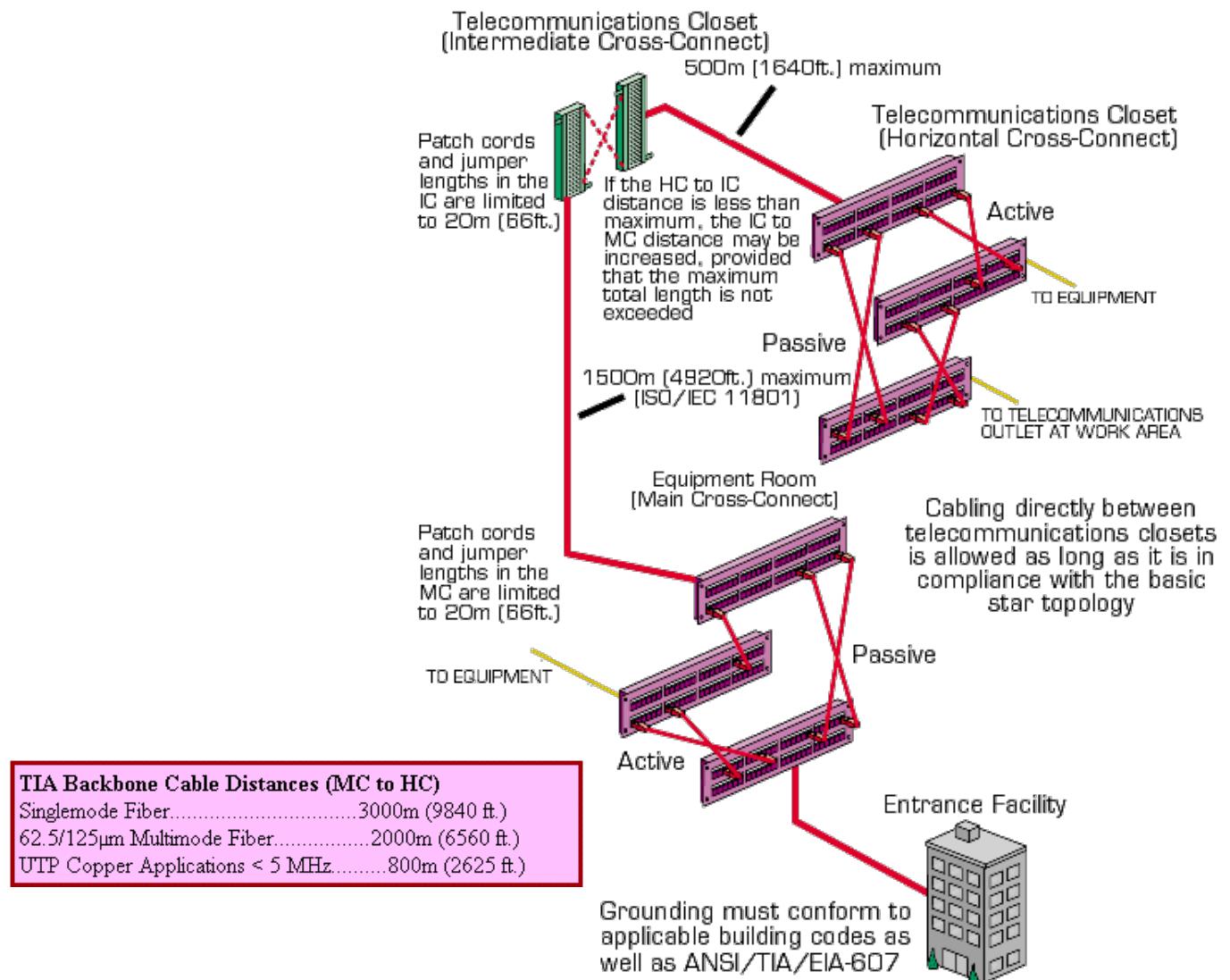


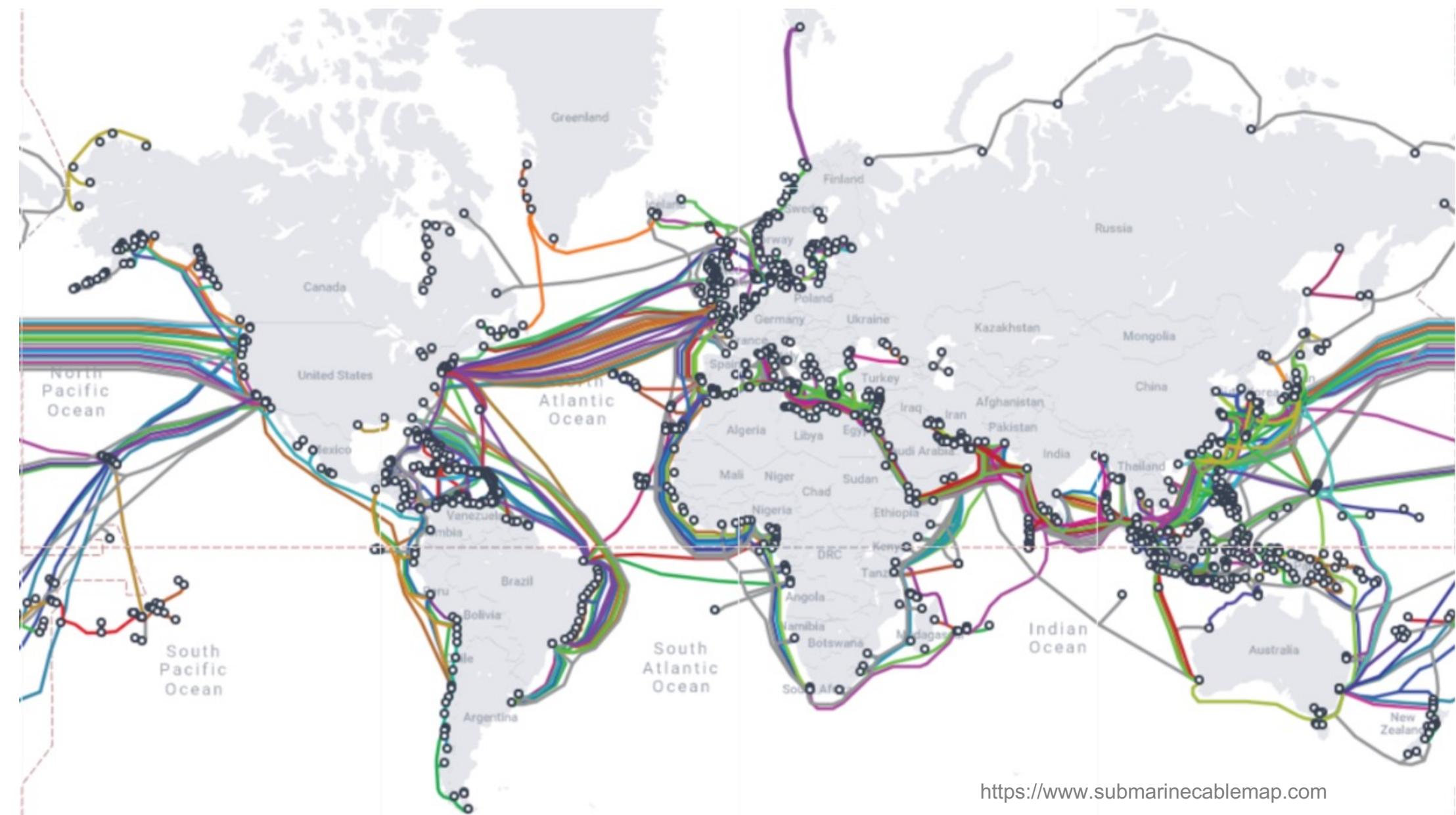
## WHAT ARE THE LAYER 1 TECHNOLOGIES ?

## HOW THE TECHNIQUE USED IN LAYER 1 ?









<https://www.submarinecablemap.com>

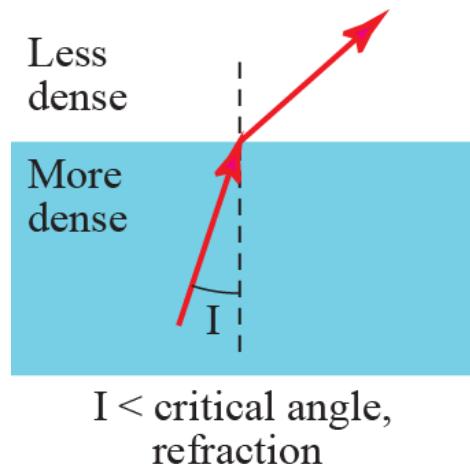
# **DON'T BLAME SHARKS FOR ASIAN INTERNET PROBLEMS**

<https://www.computerworld.com/article/2872728/dont-blame-sharks-for-asian-internet-problems.html>

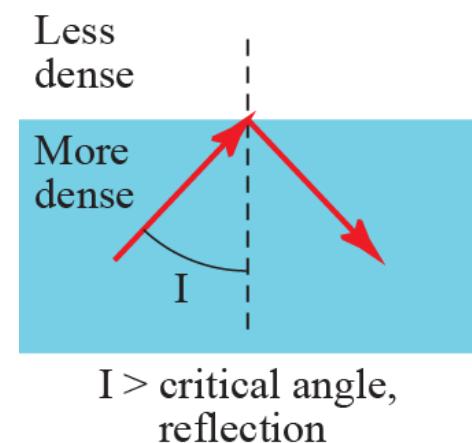
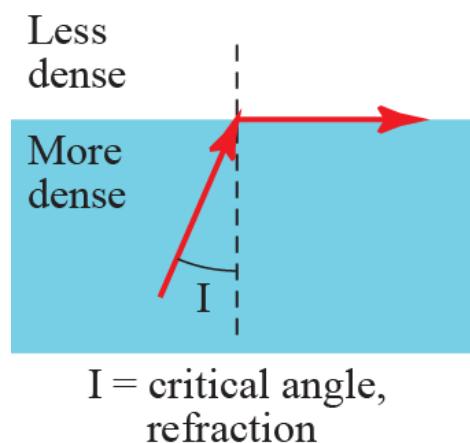
<https://youtu.be/1ex7uTQf4bQ>



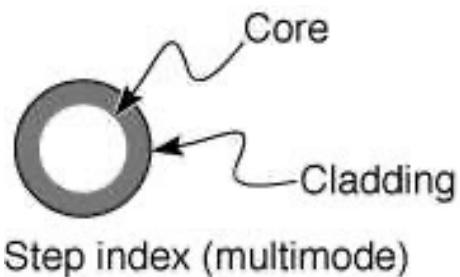
Figure 7.10: Bending of light ray



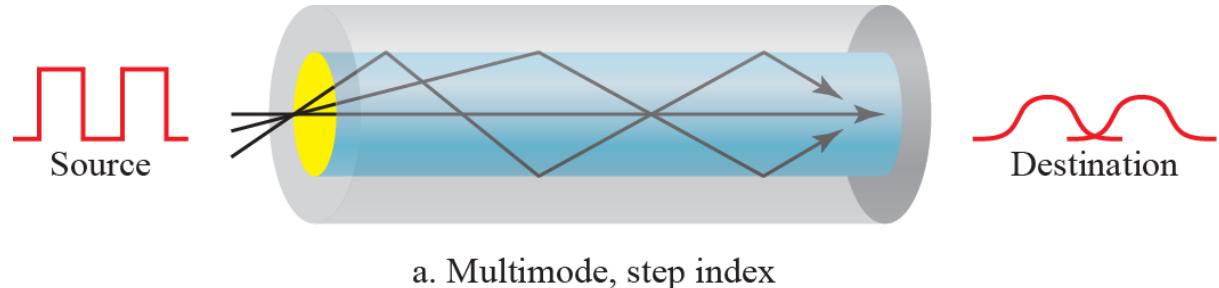
Shows how a ray of light changes direction when going from a more dense to a less dense substance.



# Differences in fiber optic cables



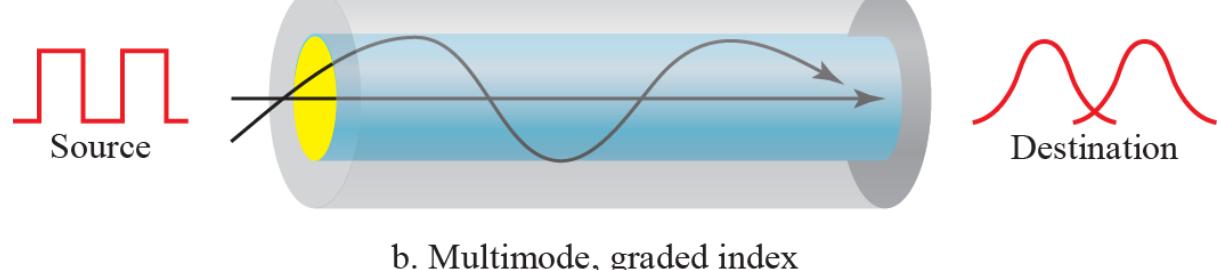
Step index (multimode)



a. Multimode, step index



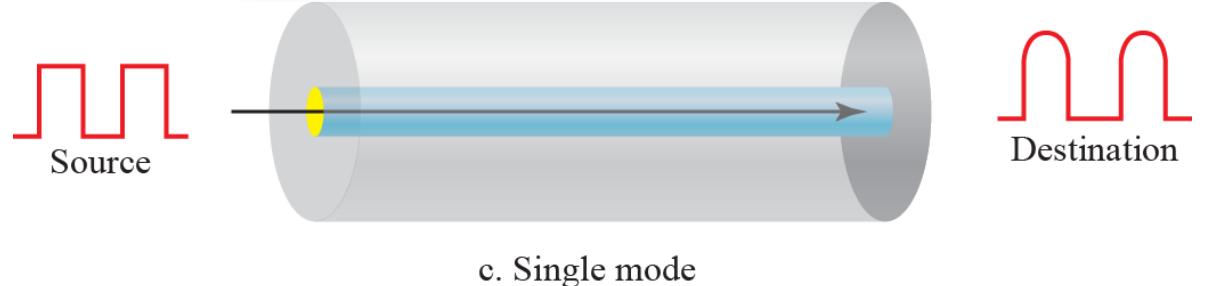
Graded index (multimode)



b. Multimode, graded index



Single mode



c. Single mode

Interconnect	AKA	Connector	Medium	Media Type	Wavelength	Max range
10GBASE-USR	ultra short reach	X2, SFP+	fiber	serial multi-mode	850 nm	100 or 150 m
<u>10GBASE-SR</u>	<u>short reach</u>	<u>XENPAK, X2, XFP, SFP+</u>	<u>fiber</u>	<u>serial multi-mode</u>	<u>850 nm</u>	<u>OM3: 300 m</u> <u>OM4: 400 m</u>
<u>10GBASE-LR</u>	<u>long reach</u>	<u>XENPAK, X2, XFP, SFP+</u>	<u>fiber</u>	<u>serial single-mode</u>	<u>1310 nm</u>	<u>10 km</u>
10GBASE-ER	extended reach	XENPAK, X2, XFP, SFP+	fiber	serial single-mode	1550 nm	40 km
10GBASE-ZR		XENPAK, X2, XFP, SFP+	fiber	serial single-mode	1550 nm	80 km
10GBASE-LX4		XENPAK, X2, SFP+	fiber	WDM multi-mode or single-mode	1310 nm	300 m (multi-mode) 10 km (single-mode)
<u>SFP+ Direct Attach</u>	<u>DA, "10GBASE-CR"</u>	<u>SFP+</u>	<u>copper</u>	<u>twinaxial 2-pair</u>	-	<u>15 m</u>
10GBASE-T		8P8C	copper	Class E channel using category 6, Class Ea channel using <u>6a or 7 twisted pair</u>	-	<u>55 m (Class E cat 6)</u> <u>100 m (Class Ea cat 6a or 7)</u>
10GBASE-PR	802.3av		fiber	Passive Optical Network	1270 nm/ 1577 nm	20 km

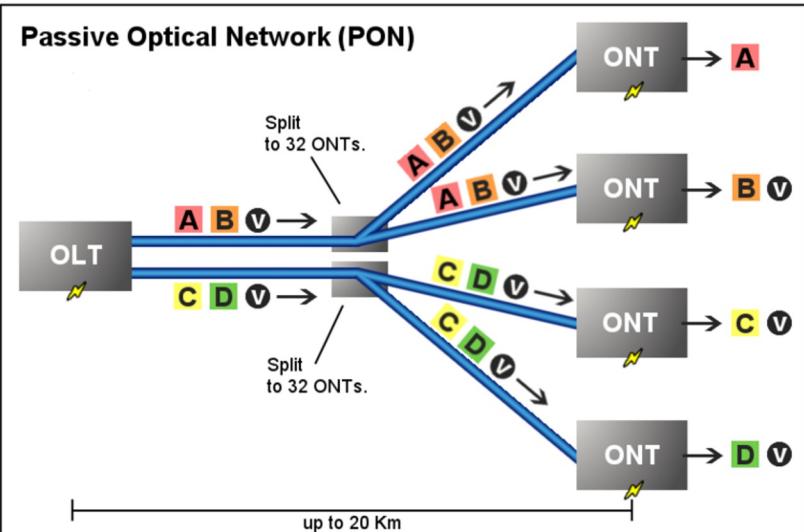
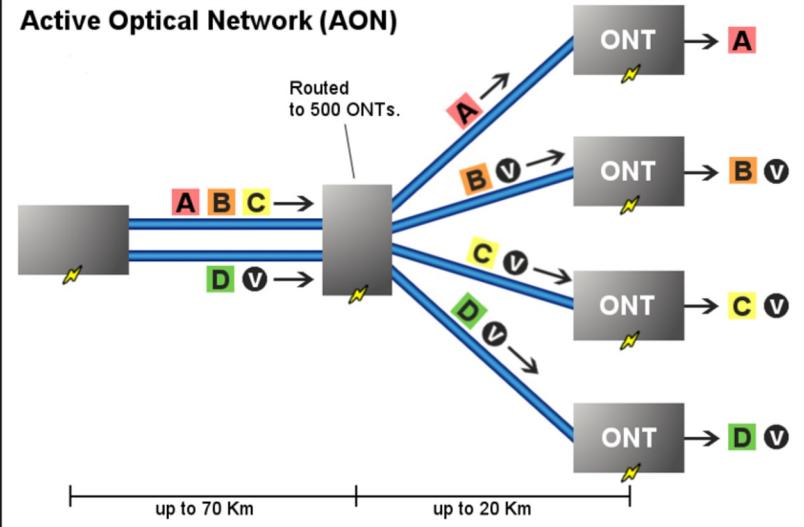


[https://en.wikipedia.org/wiki/10\\_Gigabit\\_Ethernet](https://en.wikipedia.org/wiki/10_Gigabit_Ethernet)



**OLT**

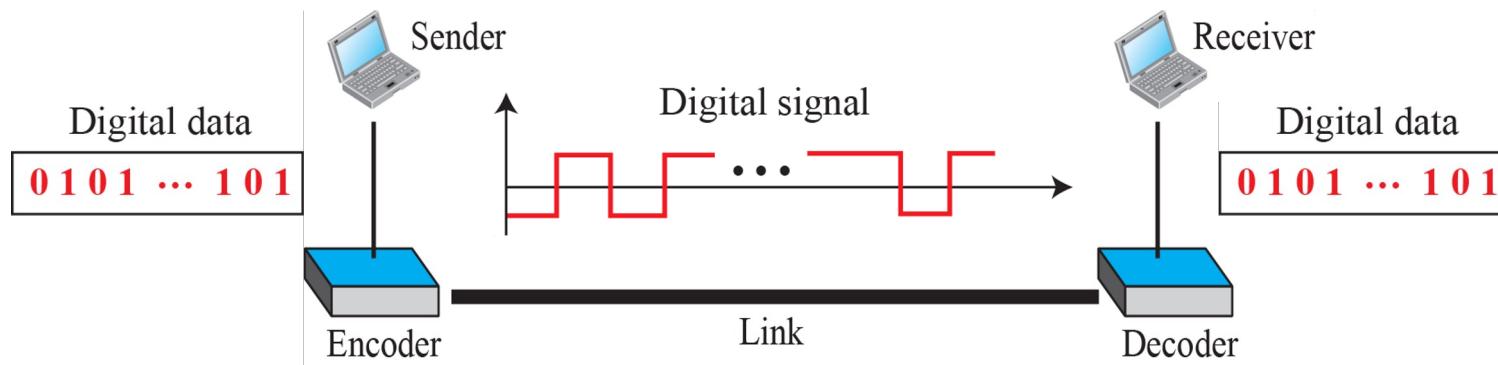
Optical Line Termination



Key: **A** - Data or voice for a single customer. **V** - Video for multiple customers.

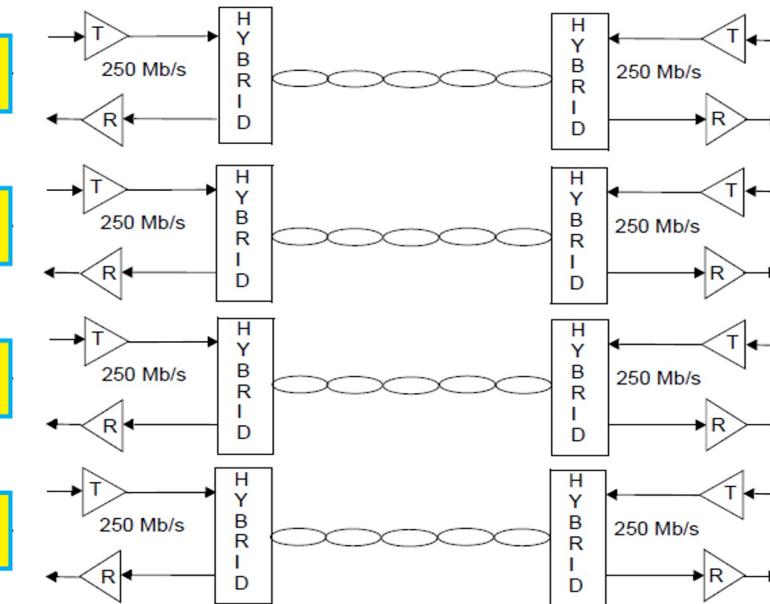
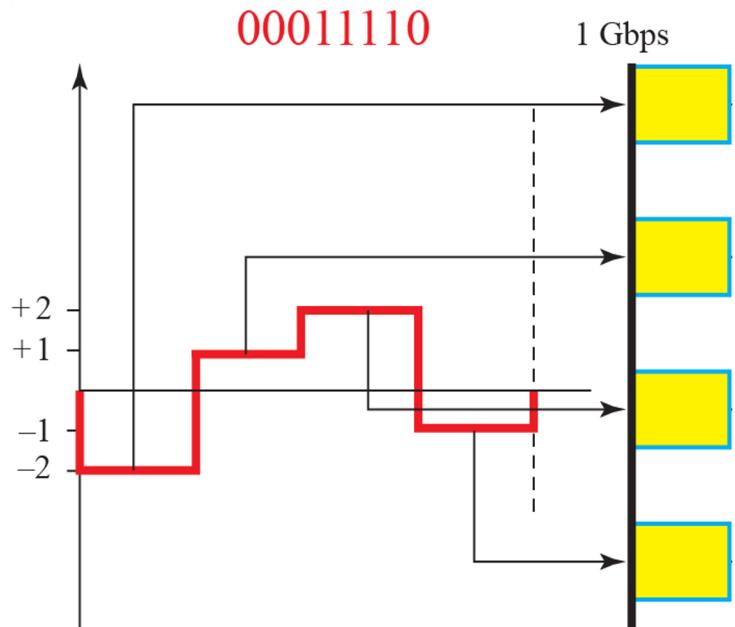


## **Digital** to **Digital** conversion



*Line coding and decoding*

## Multilevel schemes cont.



**Multilevel: 4D-PAMS**

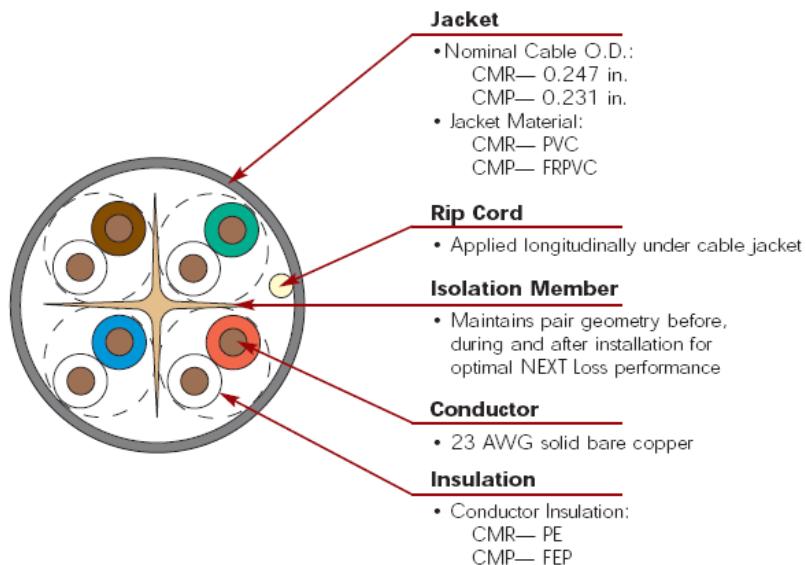
<https://en.wikipedia.org/wiki/ANSI/TIA-568#:~:text=Under%20TIA%2FEIA%2D568%2D,be%20longer%20than%205%20meters>

TIA/EIA-568-B.1-2001 T568B Wiring<sup>[2]</sup>

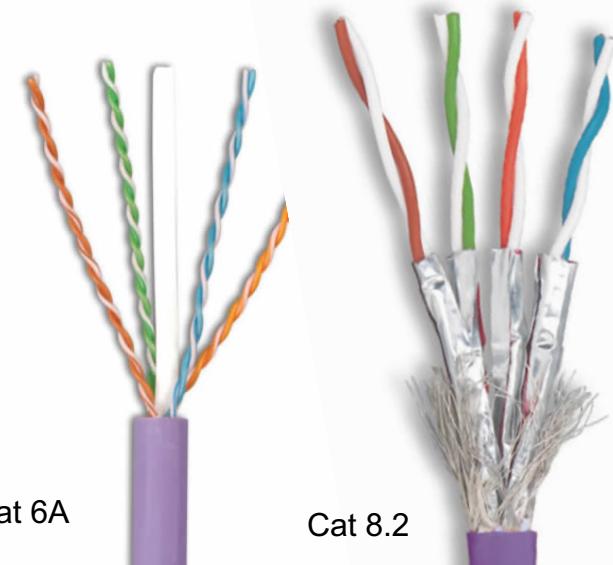
Pin	Pair	Wire	Color
1	2	1	white/orange
2	2	2	orange
3	3	1	white/green
4	1	2	blue
5	1	1	white/blue
6	3	2	green
7	4	1	white/brown
8	4	2	brown



ANSI/TIA-568.2-D: Balanced Twisted-Pair Telecommunications Cabling and Components



RJ-45 plugs and jacks



**Category 1 / Class A:** (100kHz) - basic twisted-pair cabling used in telephone system.

**Category 2 / Class B:** (1MHz) suitable for voice and for data transmission of up to 4 Mbps.

**Category 3 / Class C:** (16MHz) data transmission of up to 10 Mbps.

**Category 4** up to 16 Mbps.

**Category 5 (100MHz)** data transmission up to 100 Mbps.

**Category 5e / Class D:** (100MHz) Gigabit speed data, 100m.

**Category 6 / Class E:** (250MHz) Gigabit speed data, 10Gb/s-55m.

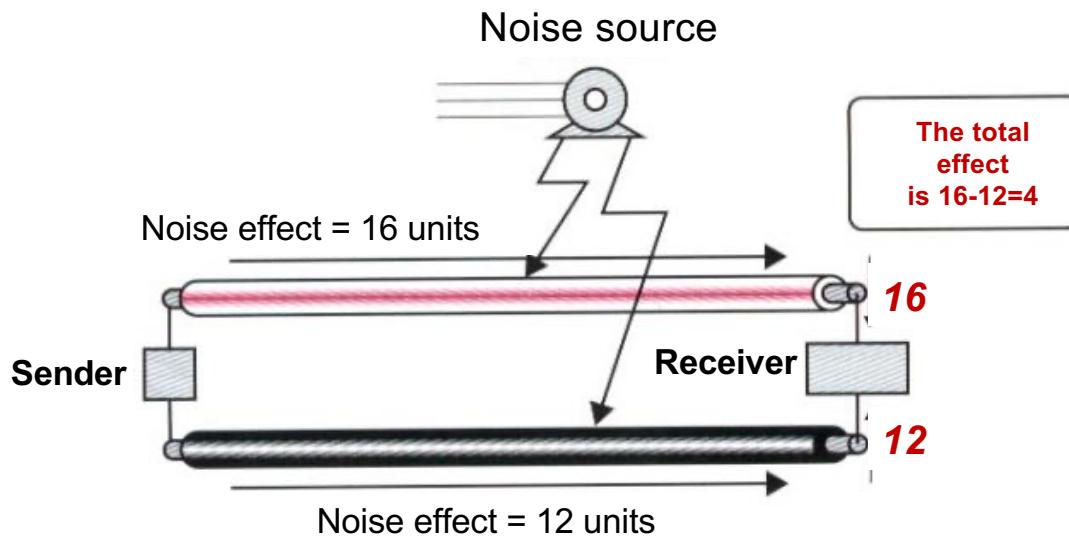
**Category 6A / Class E<sub>A</sub>:** (500MHz) 10Gb/s (Augmented Cat 6)

**Category 7 / Class F:** (600MHz) 10Gb/s-40Gb/s

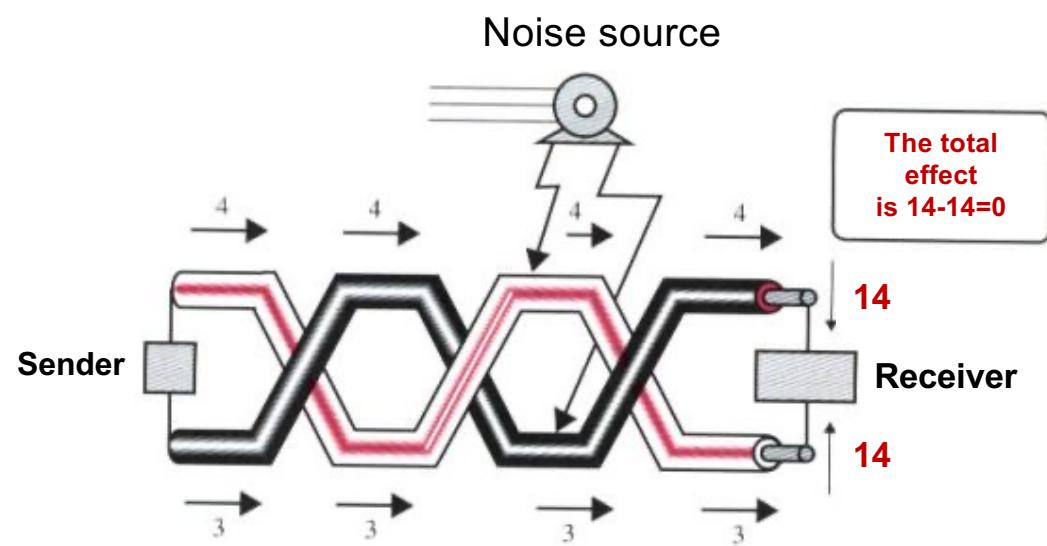
**Category 7A / Class F<sub>A</sub>:** (1000MHz) 40Gb/s 50m., 100Gb/s 15m.

**\*Category 8.1-8.2 / Class I-II:** (1600MHz-2000MHz)

# WHY ARE WIRES TWISTED ???



***Effect of noise on parallel line***



***Effect of noise on twisted-pair lines***

# **256QAM DL / 64QAM UL**

## **ดาวน์โหลด อัพโหลดแรงขึ้น 30%**

กับเทคโนโลยี Download Modulation 256QAM / Upload Modulation 64QAM  
ซึ่งทำให้สามารถดาวน์โหลด อัพโหลดข้อมูลแรงขึ้นเมื่อเทียบกับ 4G ปกติ

MIMO 4x4

256QAM DL/64QAM UL

MASSIVE MIMO 32T32R



CA

## เร็ว แรงขึ้น 3 เท่า

กับ CA (Carrier Aggregation)  
การรวมคลื่นความถี่ 1800 MHz, คลื่นความถี่ 2100 MHz, คลื่นความถี่ 900 MHz  
ทำให้ เร็ว แรงขึ้น 3 เท่า เมื่อเทียบกับการใช้คลื่นความถี่ 1800 MHz เพียงคลื่นเดียว

## MIMO 4x4 รับส่งข้อมูลแรงขึ้น 2 เท่า

กับ MIMO 4x4 ที่เป็นเทคโนโลยีการรับส่งสัญญาณ  
จากสถาปัตยาน ด้วยการใช้งานระบบ 4 เสา ซึ่งทำให้  
สามารถรับส่งข้อมูลจำนวนมากพร้อม ๆ กันได้  
มากขึ้น 2 เท่า เมื่อเทียบกับเทคโนโลยี MIMO 2x2

Uplink Frequency	900 MHz (10 MHz)	1800 MHz (20 MHz)	2100 MHz (15 MHz)	2100 MHz TOT (15 MHz)
Downlink Frequency	900 MHz (10 MHz)	1800 MHz (20 MHz)	2100 MHz (15 MHz)	2100 MHz TOT (15 MHz)
<hr/> <p>120 MHz (60 MHz x 2)</p> <hr/>				

# NETWORK PERFORMANCE

BANDWIDTH IN HERTZ (Hz) / BITS PER SECOND (BPS) / BYTES

Uplink Frequency	900 MHz (10 MHz)	1800 MHz (20 MHz)	2100 MHz (15 MHz)	2100 MHz TOT (15 MHz)
Downlink Frequency	900 MHz (10 MHz)	1800 MHz (20 MHz)	2100 MHz (15 MHz)	2100 MHz TOT (15 MHz)
120 MHz (60 MHz x 2)				

THE **THROUGHPUT** IS A MEASURE OF HOW FAST WE CAN ACTUALLY SEND DATA THROUGH A NETWORK.

ค่าบริการ  
รายเดือน  
(บาท)

1,999

1,699

1,399

1,199

899

699

599

499

449

349

เบ็ดเตล็ด

5G | 4G | 3G

เร็วสูงสุด 1Gbps

ไม่จำกัด

5G

80 GB

50 GB

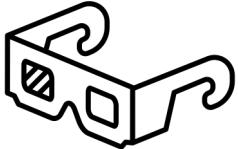
50 GB

40 GB

30 GB (4G/3G)

20 GB (4G/3G)

4G



**LATENCY OR DELAY** DEFINES HOW LONG IT TAKES FOR AN ENTIRE MESSAGE TO COMPLETELY ARRIVE AT THE DESTINATION FROM THE TIME THE FIRST BIT IS SENT OUT FROM THE SOURCE

**LATENCY = PROPAGATION TIME + TRANSMISSION TIME + QUEUING TIME + PROCESSING DELAY**

