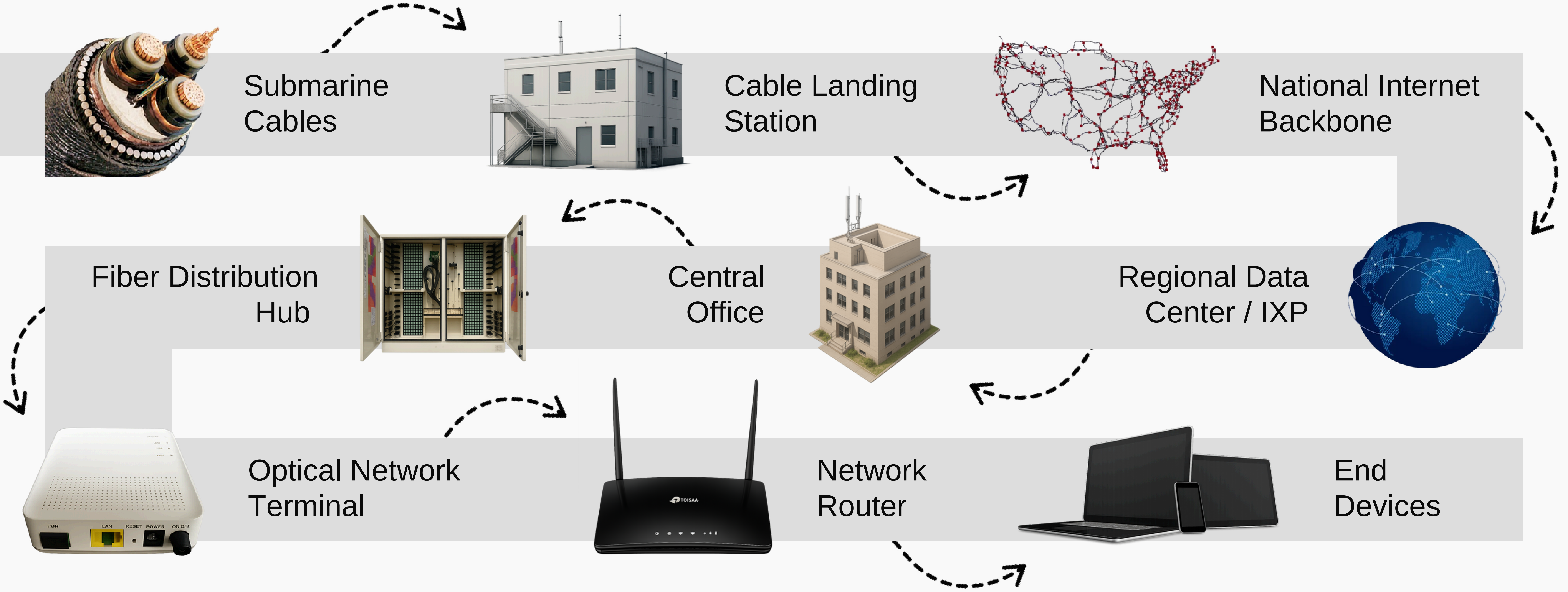
01 Submarine to Home Journey



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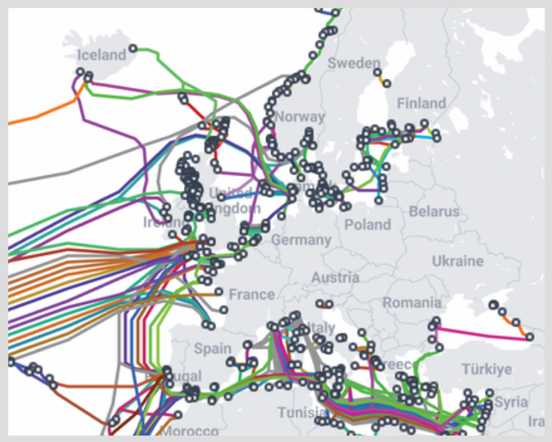
02 Submarine to Home Journey



Submarine Cables

Submarine cables are fiber-optic links on the ocean floor, with repeaters every 50–100 km and landing stations for routing. They enable intercontinental internet by carrying most traffic.

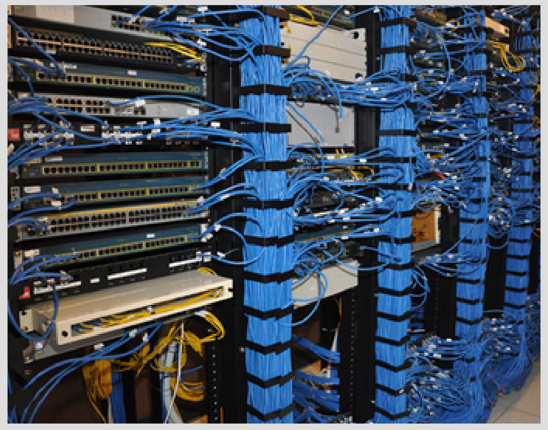
Cable Landing Station

Cable landing stations are facilities where subsea fiber optic cables connect to terrestrial infrastructure, enabling data transfer to datacenters, ISPs, and local networks for global connectivity.

National Internet Backbone

A national internet backbone is a high-speed fiber-optic network connecting major cities, regional networks, and ISPs within a country, ensuring reliable, nationwide connectivity.

03 Submarine to Home Journey

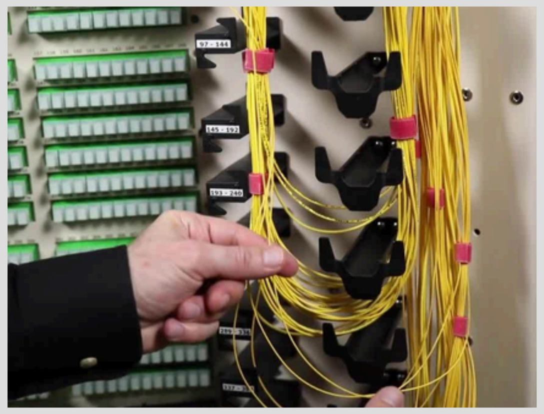


Regional Data Center / IXP

Regional data centers provide localized data storage, processing, and networking services, improving speed, reliability, and business continuity in specific geographic areas.

Central Office

A Central Office houses switching and routing equipment, including OLTs for GPON, aggregation routers, and safety controls, connecting networks to Fiber Distribution Hubs.



Fiber Distribution Hub

The Fiber Distribution Hub is a passive enclosure where feeder and distribution cables intersect, with splitter enclosures, cable management trays, and an IP 55+ environmental rating.

04 Submarine to Home Journey

Optical Network Terminal

Optical network terminal connects a fiber optic network to the end-user's premises, converting optical signals to electrical signals.

Network Router

A network router forwards data between networks by analyzing the best path for data packets to reach their destination efficiently.

End Devices

Devices such as computers, phones, or printers that connect to a network to send or receive data.

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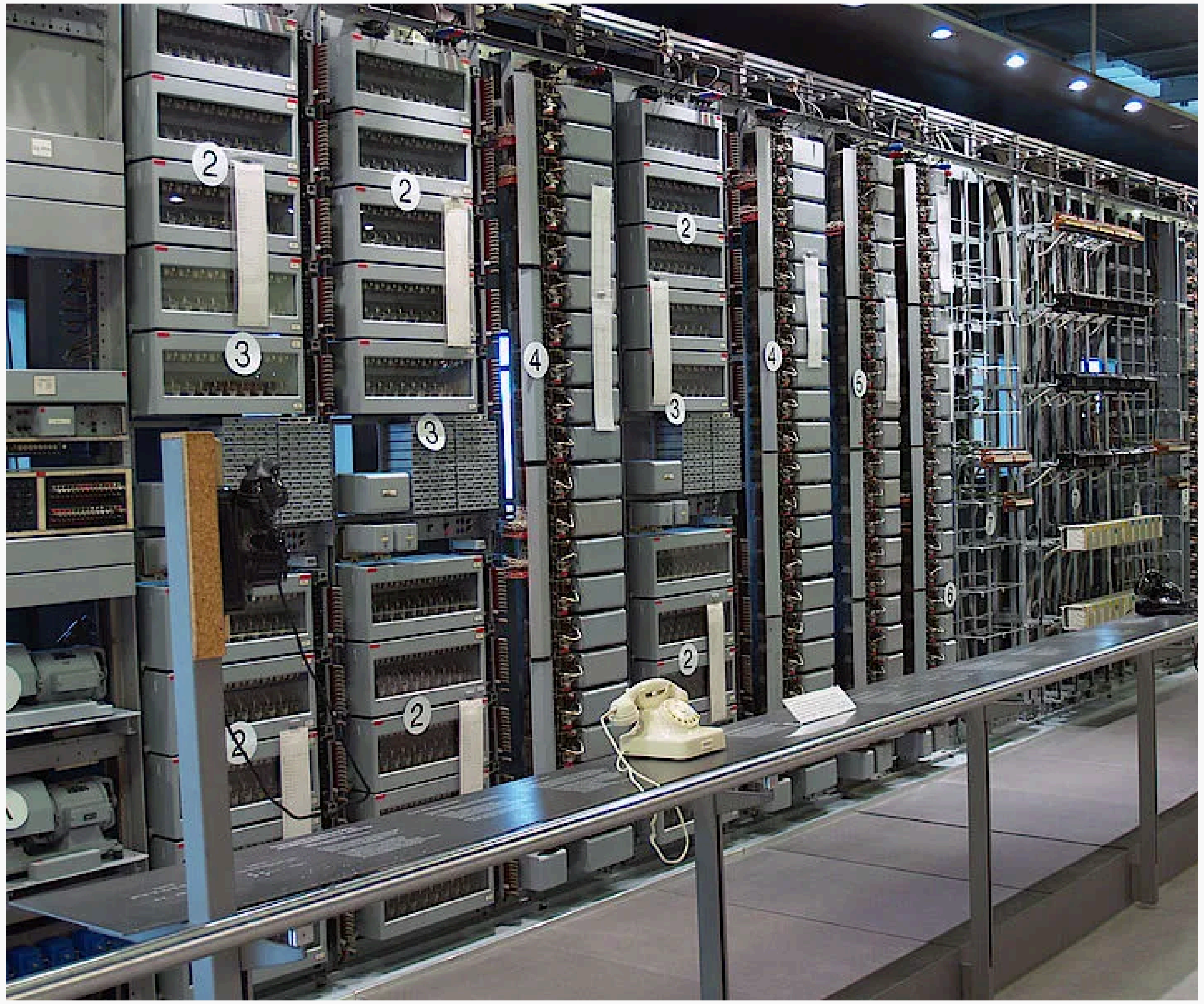
Central Office (CO)

A Central Office is a facility that connects end-users to the broader telecommunications network, housing essential equipment like OLTs and routers for signal distribution.



Key Functionalities

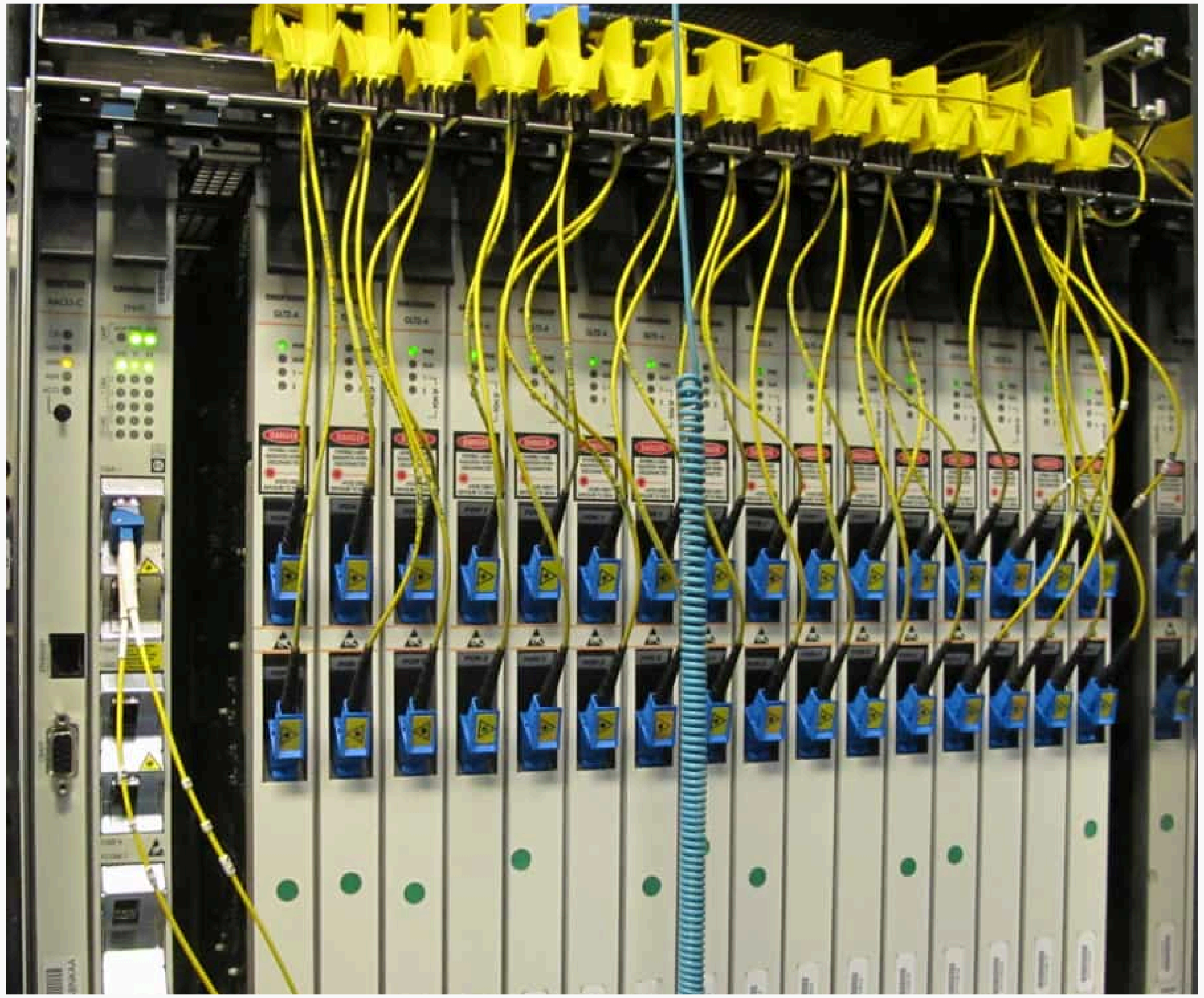
OLT Hosting: Central Office hosts Optical Line Terminals (OLTs) that convert electrical signals to optical signals for fiber distribution.

Routing and Switching: Core routers and switches manage traffic aggregation, QoS, and VLAN segmentation.

Passive Distribution Frame (PDF): Provides cross-connects between OLT ports and OSP fiber feeders for efficient fiber management.

02 Optical Line Terminal (OLT)

Optical Line Terminal (OLT) is the key device in an ISP's central office that converts electrical signals to optical ones for data distribution over a Passive Optical Network (PON).



Key Functionalities

Signal Conversion: Converts electrical signals to optical signals for downstream and vice versa for upstream.

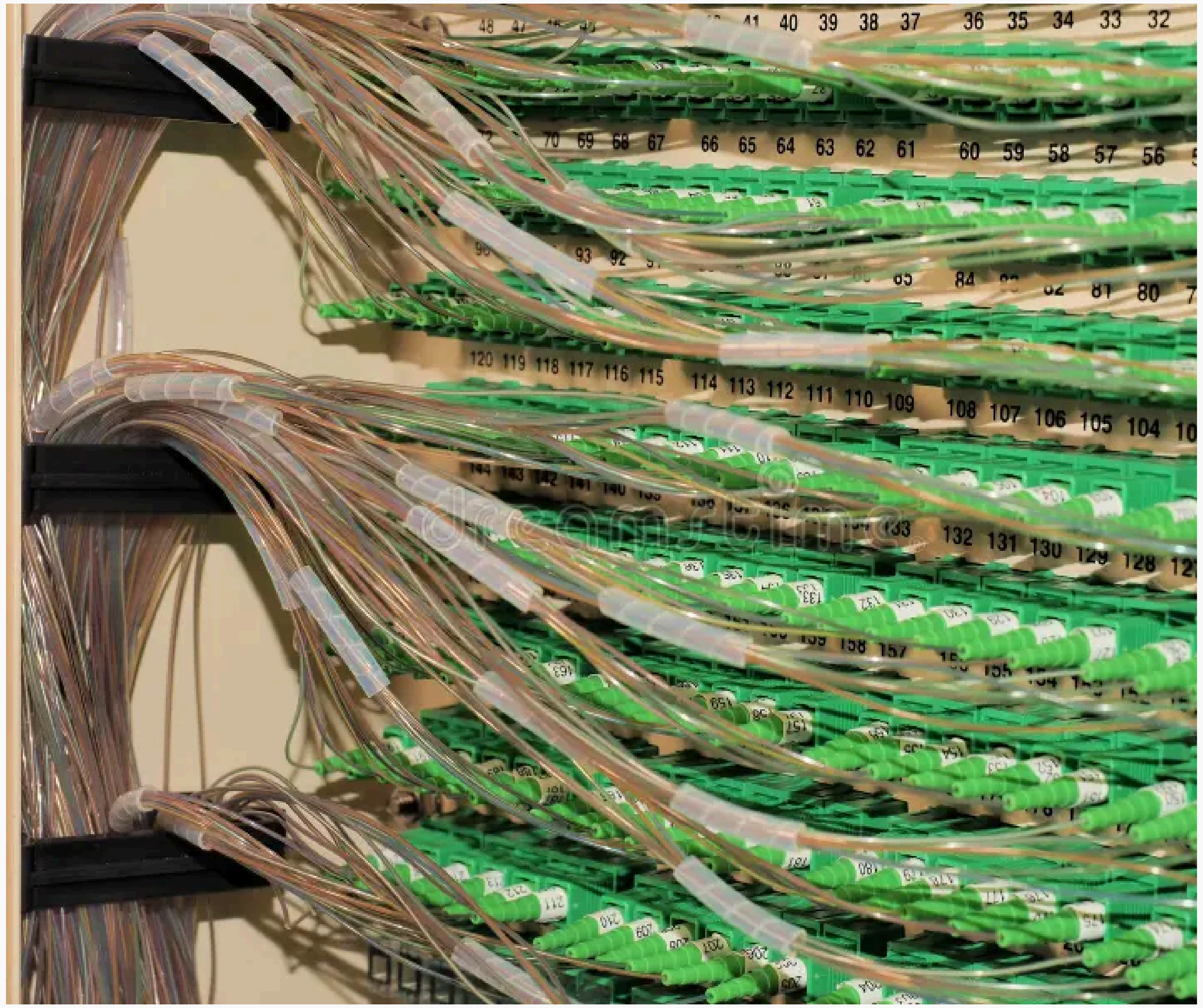
Central Control: Acts as the main control unit of the fiber access network, managing all ONUs/ONTs.

Data Management: Handles large-scale, simultaneous data transmission and reception.

Service Delivery: Provides internet, IPTV, and VoIP services.

03 Fiber Distribution Hub (FDH)

A Fiber Distribution Hub (FDH) is an outdoor enclosure that houses optical splitters and connects feeder and distribution fibers in a Passive Optical Network (PON).



Key Functionalities

Signal Branching: Connects high-fiber-count feeder cables (F1) to lower-count distribution cables (F2)**.**

Integration: Interfaces between Central Office (OLT) and customer drop points, ensuring seamless signal transmission.

Optical Splitting: Uses PLC splitters (1:32 or 1:64) to distribute signals to multiple end users.

04 Multi-Splice Terminal (MST)

Multi-Splice Terminal (MST) is a fiber optic terminal serving as the final distribution point before customer drop cables, commonly used in fiber optic networks.

Key Functionalities

Final Distribution Point: Distributes fiber to customer drop cables before the ONT.

Fiber Distribution: Receives and distributes pre-terminated feeder fibers to drop cables.

Flexible Deployment: Supports multiple mounting options (pole, pedestal, wall, below-grade).

Scalable Ports: 4, 6, 8, or 12 hardened SC/APC adapter ports for flexible subscriber density.

05 Optical Network Terminal (ONT)

An Optical Network Terminal (ONT) converts optical signals from a fiber network into electrical signals for devices like routers and phones, and vice versa for upstream traffic.

Key Functionalities

Signal Conversion: Converts incoming optical signals into electrical signals for customer equipment.

Customer Interfaces: Provides Ethernet (RJ-45) and telephone (RJ-11) ports for data and voice services.

Network Management: Supports in-band and out-of-band management through OMCI (ONT Management and Control Interface).

06

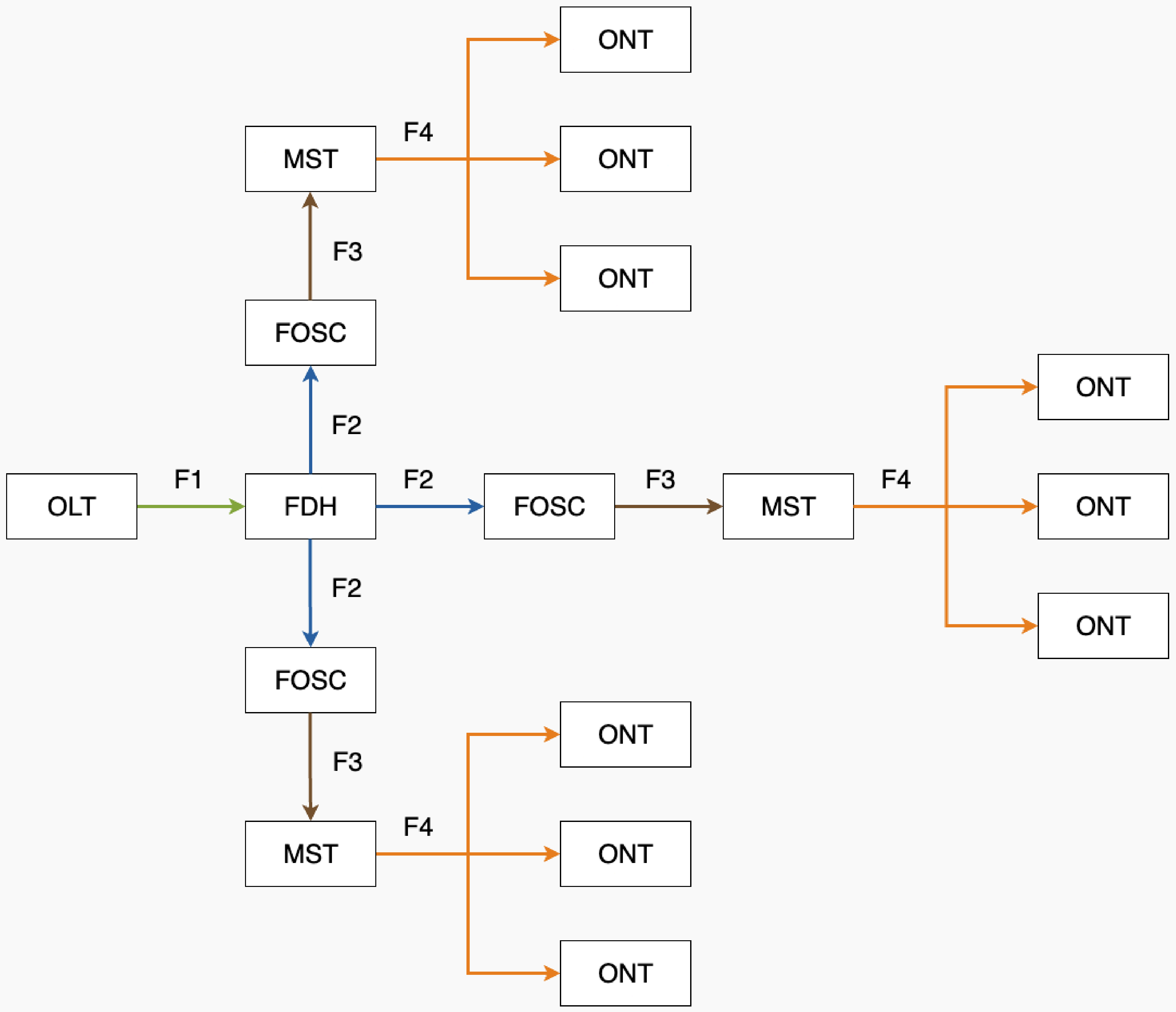
Fiber Optic Network Hierarchy

F1 (Feeder Fiber): Connects the Central Office or OLT to the FDH, serving as the main backbone of the network. It typically uses high-count cables (144–288 fibers).

F2 (Distribution Fiber): Connects the FDH to FOSCs, forming the main distribution route through the network. It carries fibers that are later spliced to serve multiple MSTs.

F3 (Pigtail): Connects the FOSCs to MSTs. These fibers extend the network from the splice closure to the service terminals.

F4 (Drop): Connects the MSTs to ONTs, providing the final fiber link that delivers service directly to each customer premises.



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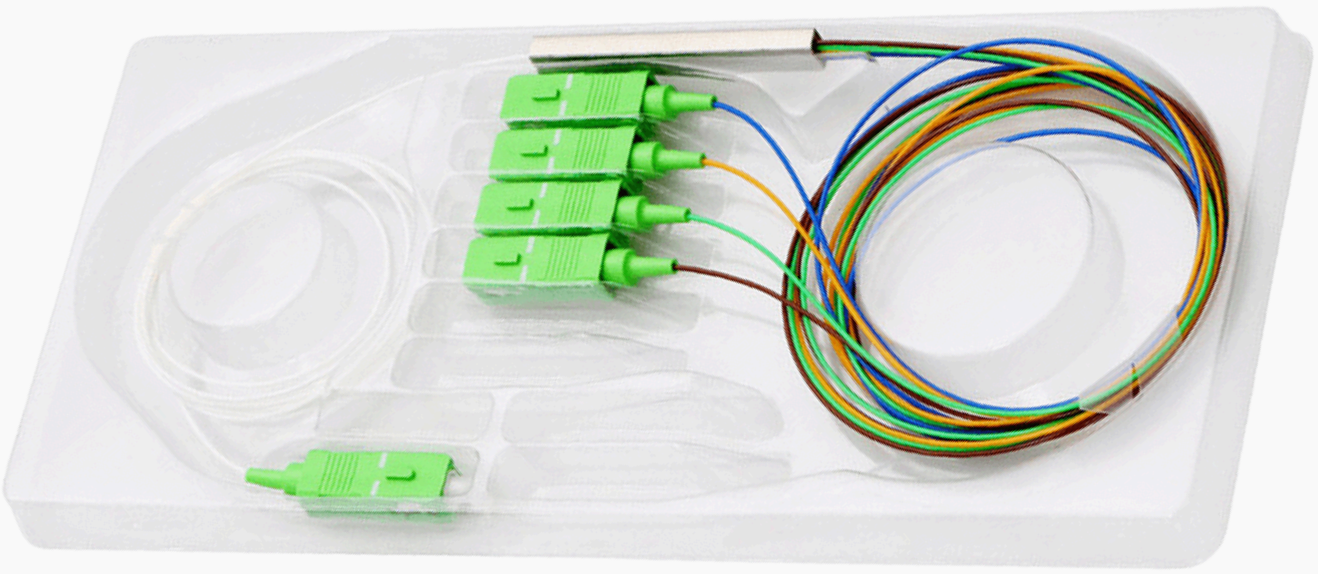
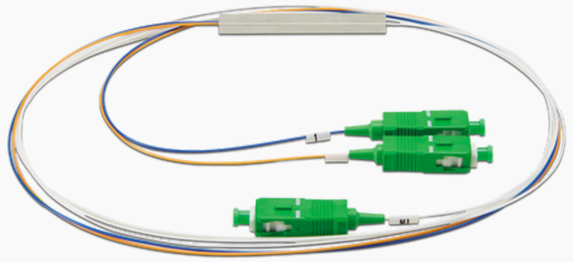
02

Splitters

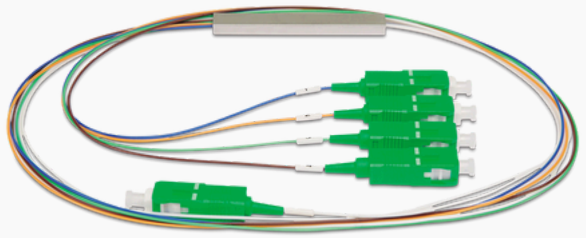
A splitter is a passive optical device that divides one input fiber into N output fibers. Ratios are denoted 1×N (e.g., 1:32).

Common splitter ratios include
1:2, 1:4, 1:8, 1:16, 1:32, 1:64

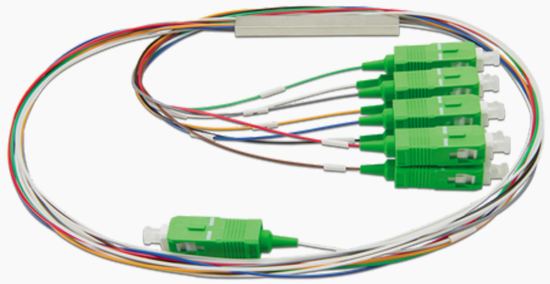




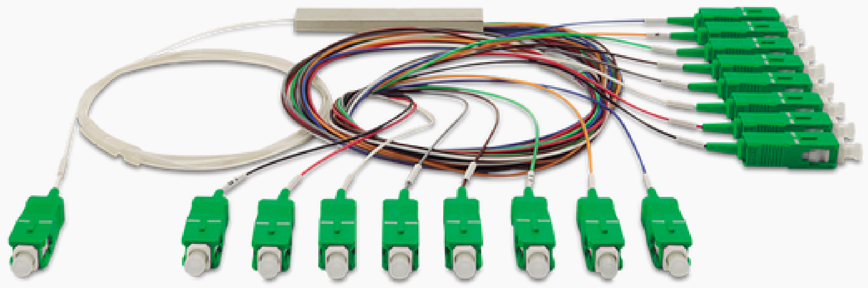
1:2 Splitter



1:4 Splitter



1:8 Splitter



1:16 Splitter

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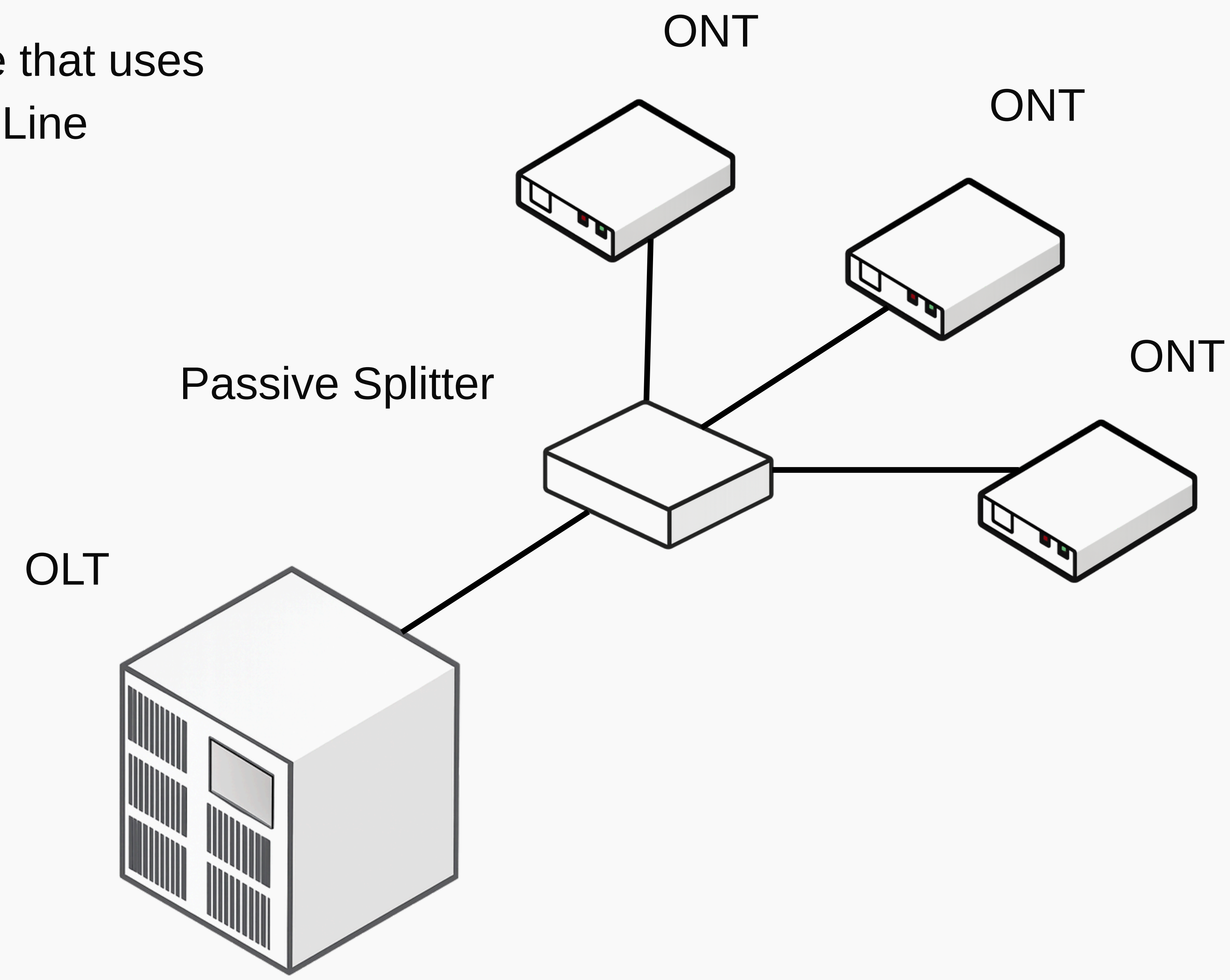
01 Passive Optical Network (PON) Basics

A Passive Optical Network (PON) is a network architecture that uses unpowered splitters to let one central fiber from an Optical Line Terminal (OLT) serve many customers (ONT).

How It Works

Downstream (to users): The OLT sends light (1490 nm for internet, 1550 nm for video). The splitter divides the signal equally for all ONTs (ratios like 1:32 or 1:64).

Upstream (from users): All ONTs share one wavelength (1310 nm). They take turns sending data using TDMA (Time Division Multiple Access) so signals don’t collide



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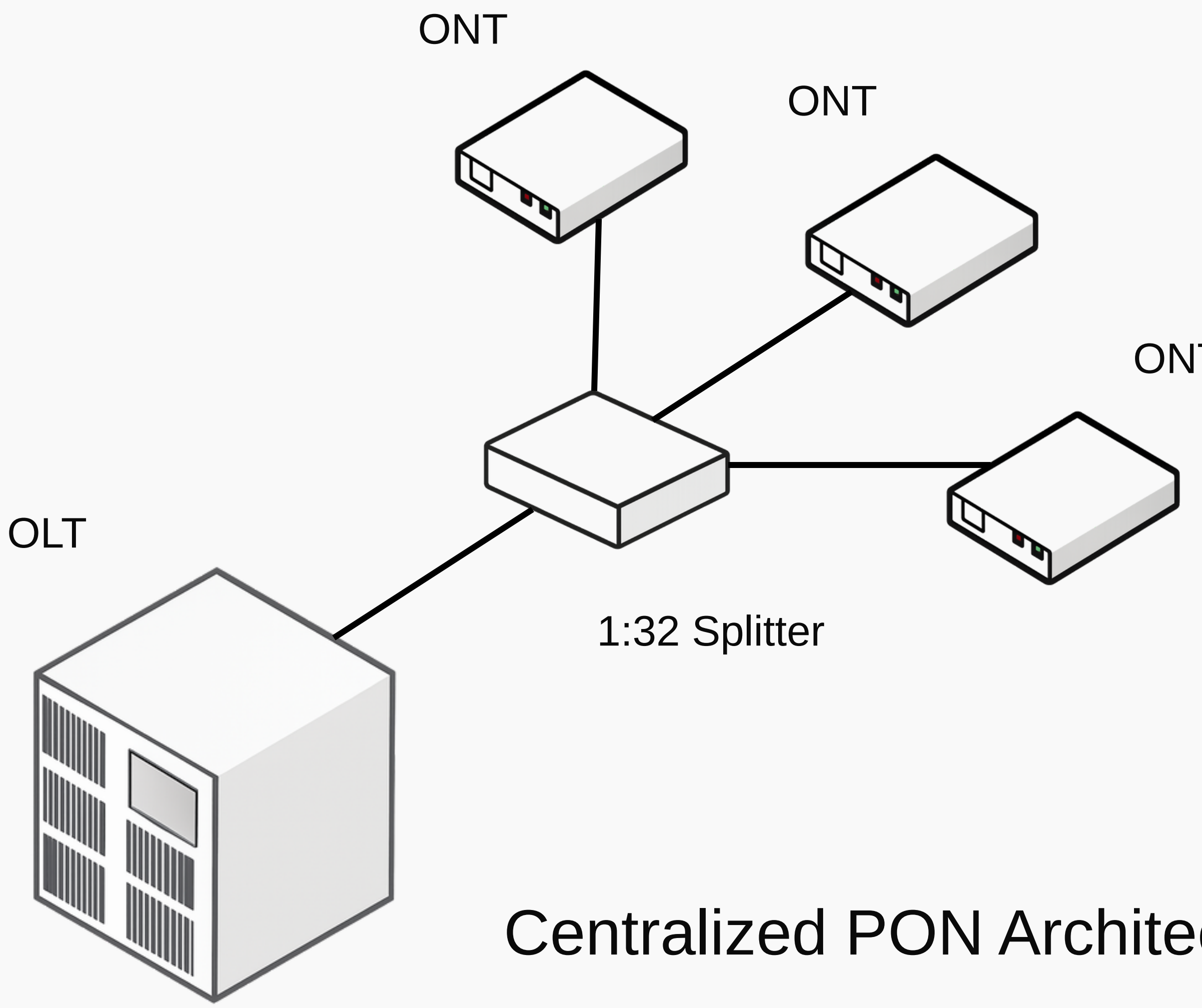
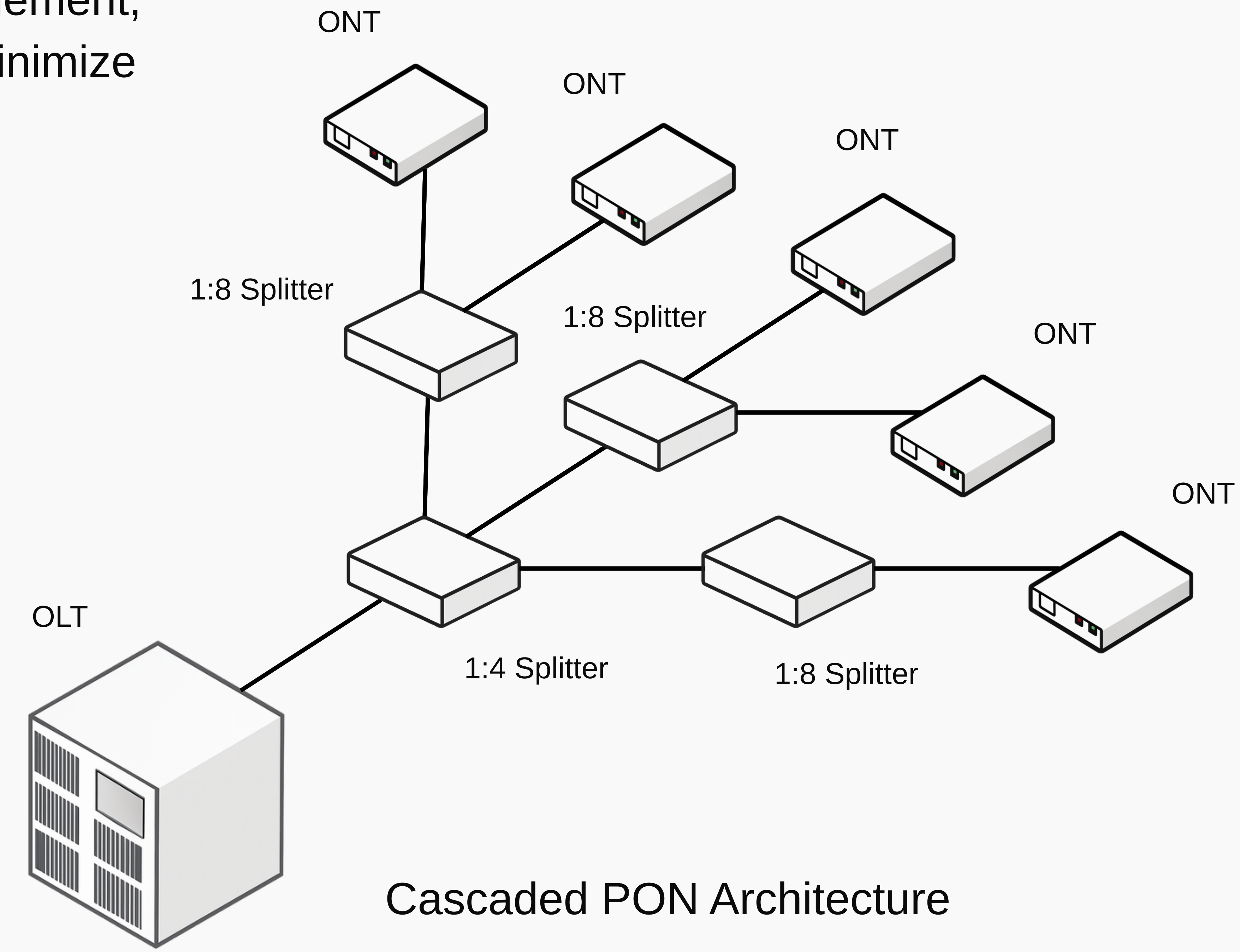
04 Centralized & Cascaded PON Architecture

Centralized architecture uses one splitter for easier management, while cascaded architecture deploys multiple splitters to minimize fiber use



Centralized PON Architecture



Cascaded PON Architecture

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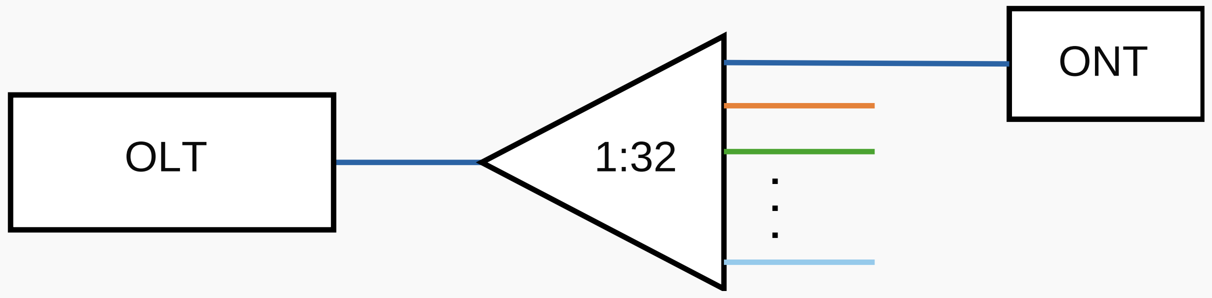
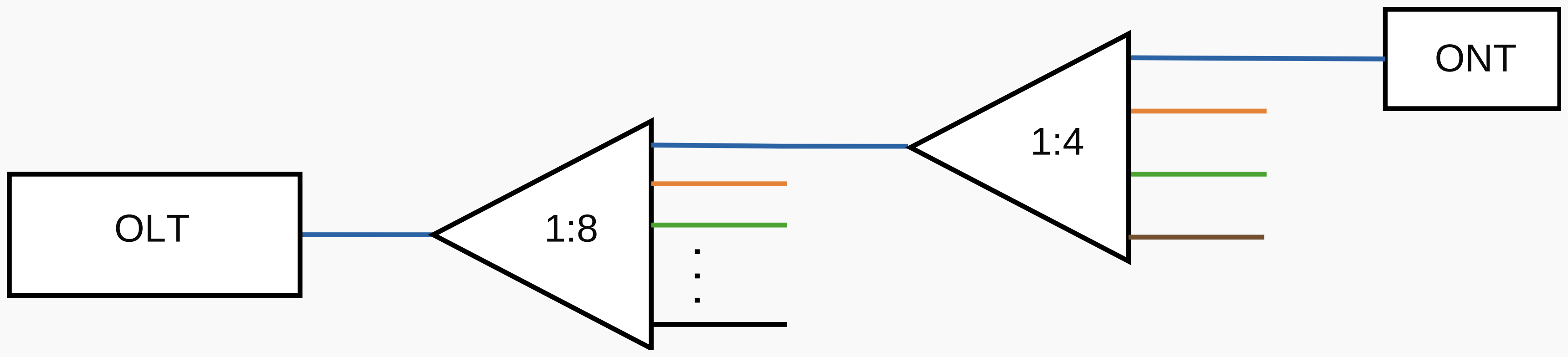
05 Centralized vs Cascaded PON Architecture





Centralized Architecture

A single high-ratio splitter (e.g., 1x32) placed in a central Fiber Distribution Hub (FDH)

Simpler deployment and easier management due to consolidated splitter location

Best suited for high-density urban and suburban areas

Cascaded Architecture

Multiple splitters deployed in stages (e.g., 1x4 splitter to 1x8 splitter)

More complex installation and management due to distributed splitters

Best suited for low-density, rural areas where fiber cabling costs need to be minimized

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01 Fiber Construction

Fiber optics is a technology that transmits information using light pulses through thin, transparent fibers, typically made of glass or plastic.

Ultra-High Speeds

Fiber supports speeds up to 10 Gbps and beyond, ideal for streaming, gaming, and cloud computing

Durability

Resistant to temperature, water, and corrosion, lasting 20–40 years with minimal maintenance

Long-Distance Transmission

Can transmit data over long distances without needing complicated amplification devices as used for copper cables

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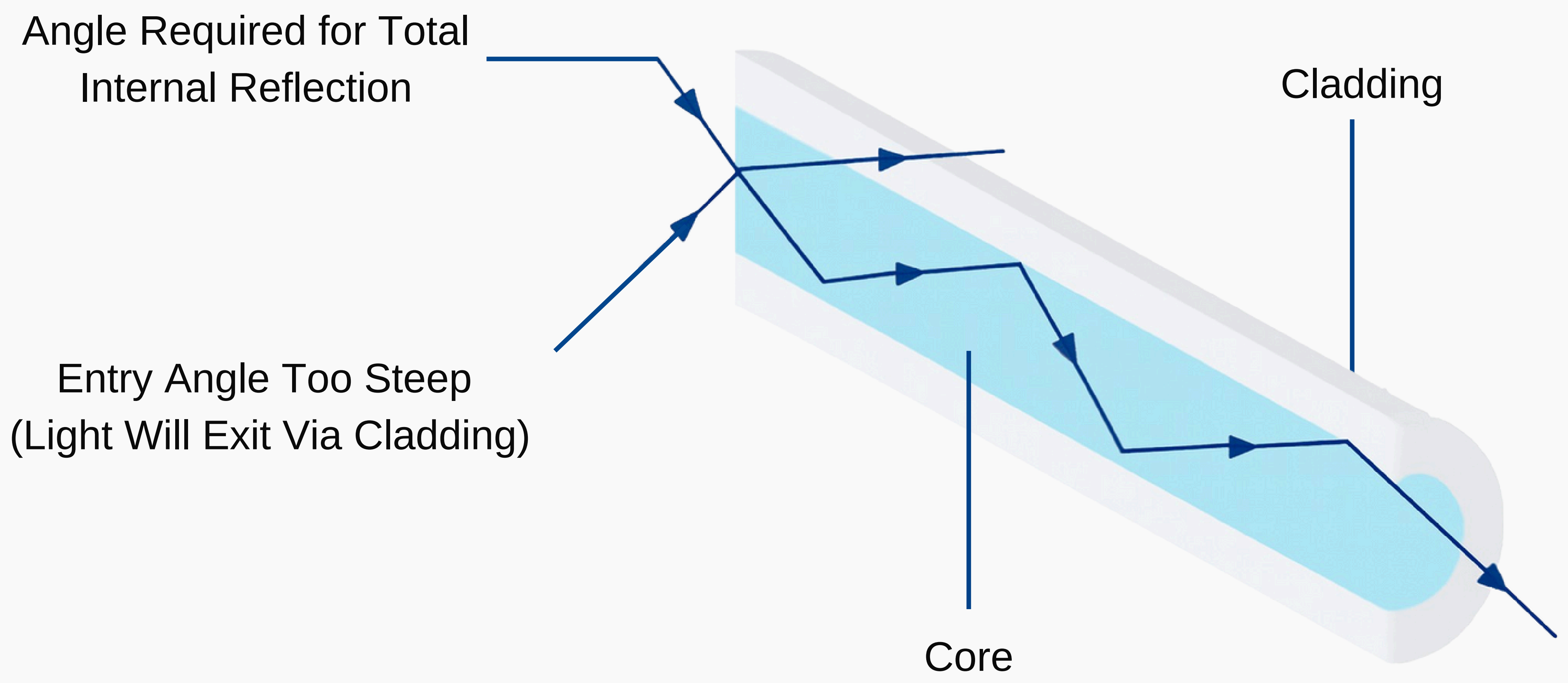
02 Light Transmission Physics

When light travels through one material into another (like glass to air), it bends. This is called refraction.

But if the angle is shallow enough, the light bounces back inward instead of escaping. This is called total internal reflection.

Fiber optics are designed so light entering at one end keeps bouncing along the core, staying trapped and traveling long distances with very minimal signal loss.



03 Fiber Anatomy

Outer Jacket: Protective outer layer.

Water Blocking Gel: Prevents water from entering the cable.

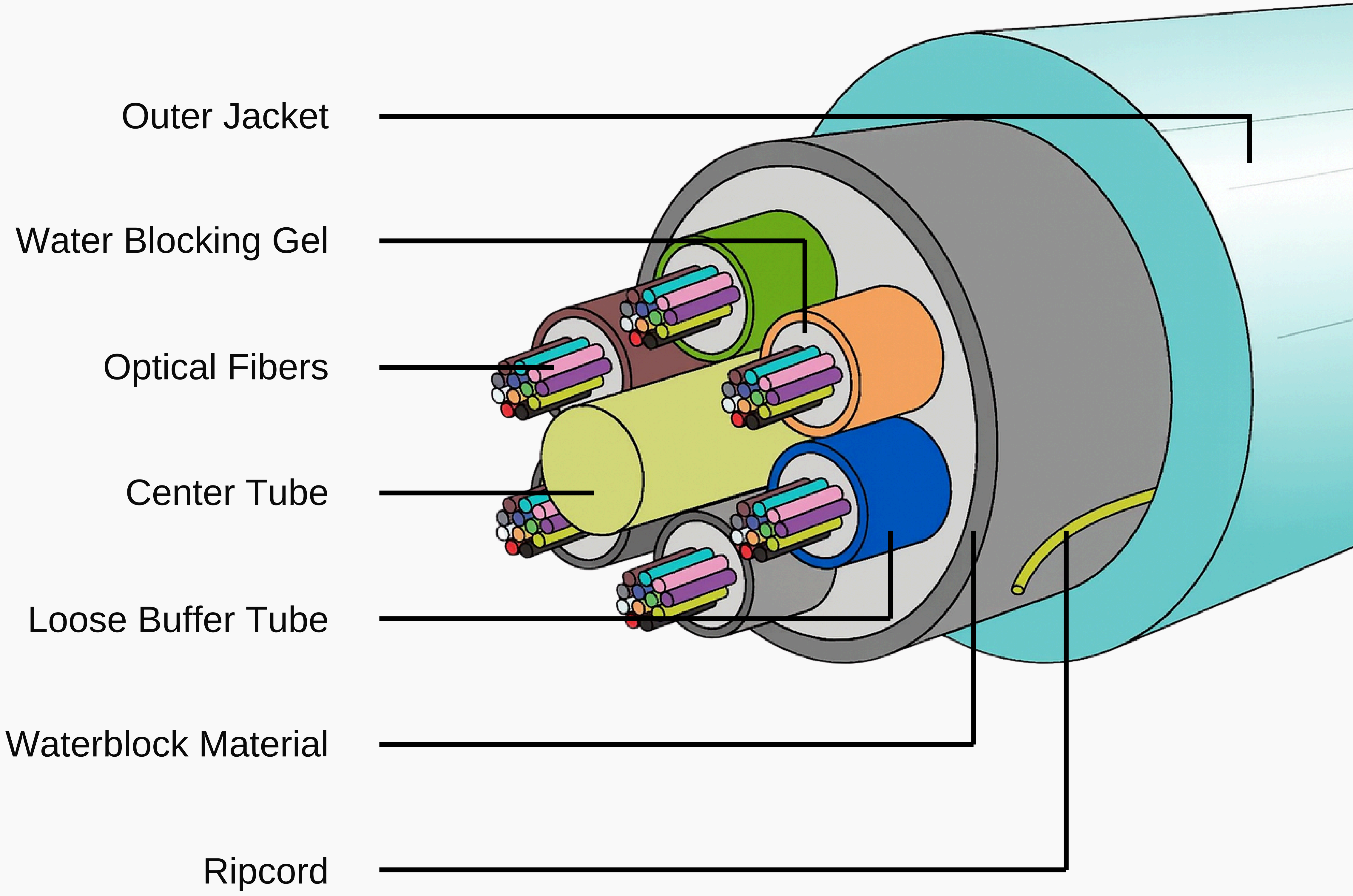
Optical Fibers: Transmit light signals for data.

Center Tube: Holds and protects the fibers.

Loose Buffer Tube: Provides extra protection and flexibility to the fibers.

Waterblock Material: Swells to block water from reaching the fibers.

Ripcord: Used for removing the outer jacket during installation.



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06

Fiber Color Codes

Fiber optic cables are color-coded to make identification, splicing, and maintenance easier.

Fiber Count Range: From 12 to 432 fibers per cable.

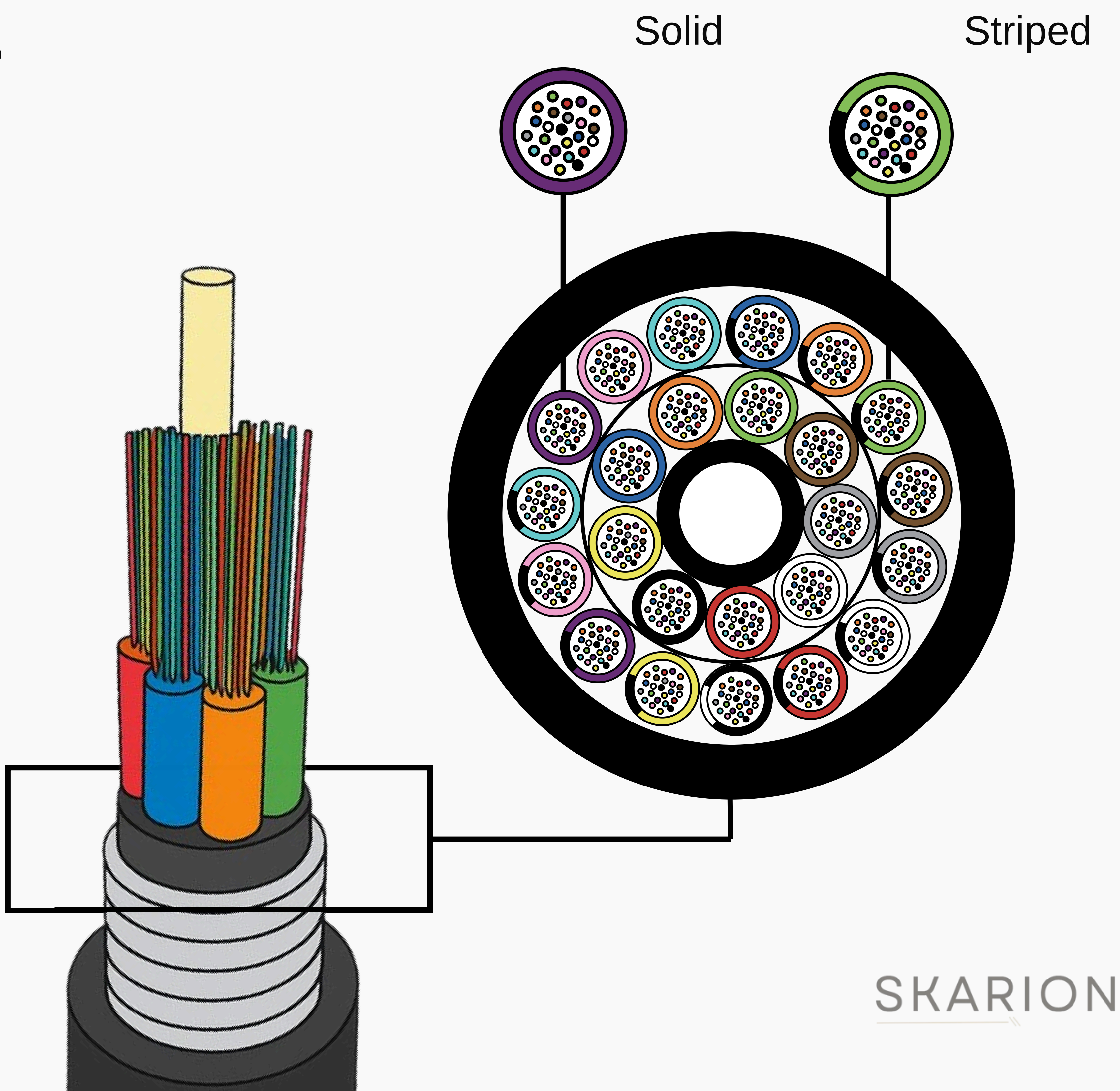
Grouping: Fibers are color-coded in groups of 24 (TIA-598-C standard).

Fiber Color-Coding in 24-Strand Cables

A 24-strand fiber optic cable typically includes two tubes, each containing 12 fiber strands.

Tube 1 fibers: Solid colors (e.g., Blue, Orange, Green).

Tube 2 fibers: Stripes added to the base color (e.g., Blue with Black Stripe, Orange with Black Stripe).



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Colour	blue	orange	green	brown	slate	white	red	black	yellow	violet	rose	aqua	d-blue	d-orange	d-green	d-brown	d-slate	d-white	d-red	d-black	d-yellow	d-violet	d-rose	d-aqua
blue	1	25	49	73	97	121	145	169	193	217	241	265	289	313	337	361	385	409	433	457	481	505	529	553
orange	2	26	50	74	98	122	146	170	194	218	242	266	290	314	338	362	386	410	434	458	482	506	530	554
green	3	27	51	75	99	123	147	171	195	219	243	267	291	315	339	363	387	411	435	459	483	507	531	555
brown	4	28	52	76	100	124	148	172	196	220	244	268	292	316	340	364	388	412	436	460	484	508	532	556
slate	5	29	53	77	101	125	149	173	197	221	245	269	293	317	341	365	389	413	437	461	485	509	533	557
white	6	30	54	78	102	126	150	174	198	222	246	270	294	318	342	366	390	414	438	462	486	510	534	558
red	7	31	55	79	103	127	151	175	199	223	247	271	295	319	343	367	391	415	439	463	487	511	535	559
black	8	32	56	80	104	128	152	176	200	224	248	272	296	320	344	368	392	416	440	464	488	512	536	560
yellow	9	33	57	81	105	129	153	177	201	225	249	273	297	321	345	369	393	417	441	465	489	513	537	561
violet	10	34	58	82	106	130	154	178	202	226	250	274	298	322	346	370	394	418	442	466	490	514	538	562
rose	11	35	59	83	107	131	155	179	203	227	251	275	299	323	347	371	395	419	443	467	491	515	539	563
aqua	12	36	60	84	108	132	156	180	204	228	252	276	300	324	348	372	396	420	444	468	492	516	540	564
d-blue	13	37	61	85	109	133	157	181	205	229	253	277	301	325	349	373	397	421	445	469	493	517	541	565
d-orange	14	38	62	86	110	134	158	182	206	230	254	278	302	326	350	374	398	422	446	470	494	518	542	566
d-green	15	39	63	87	111	135	159	183	207	231	255	279	303	327	351	375	399	423	447	471	495	519	543	567
d-brown	16	40	64	88	112	136	160	184	208	232	256	280	304	328	352	376	400	424	448	472	496	520	544	568
d-slate	17	41	65	89	113	137	161	185	209	233	257	281	305	329	353	377	401	425	449	473	497	521	545	569
d-white	18	42	66	90	114	138	162	186	210	234	258	282	306	330	354	378	402	426	450	474	498	522	546	570
d-red	19	43	67	91	115	139	163	187	211	235	259	283	307	331	355	379	403	427	451	475	499	523	547	571
d-black	20	44	68	92	116	140	164	188	212	236	260	284	308	332	356	380	404	428	452	476	500	524	548	572
d-yellow	21	45	69	93	117	141	165	189	213	237	261	285	309	333	357	381	405	429	453	477	501	525	549	573
d-violet	22	46	70	94	118	142	166	190	214	238	262	286	310	334	358	382	406	430	454	478	502	526	550	574
d-rose	23	47	71	95	119	143	167	191	215	239	263	287	311	335	359	383	407	431	455	479	503	527	551	575
d-aqua	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576

01 Fusion Splicing Process

Fusion splicing permanently joins two optical fibers by melting their glass ends with an electric arc

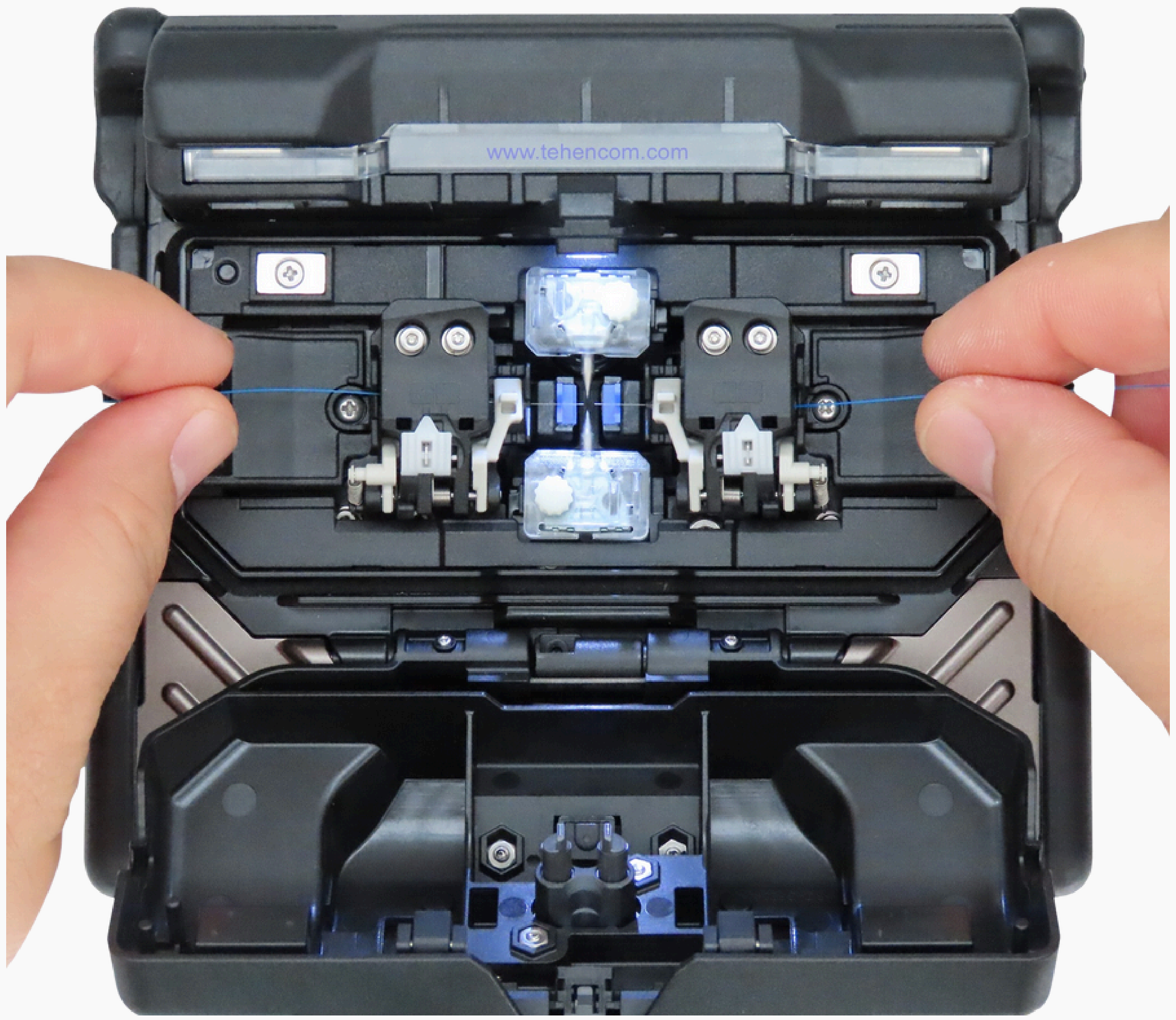
Stripping & Cleaning: Remove polymer coating and clean with isopropyl alcohol to eliminate dust and oils.

Cleaving: Use a high-precision cleaver to achieve a flat fiber end face.

Alignment: Alignment is achieved using either V-Groove (passive) or Core-Alignment (active) methods, with precise adjustments to ensure optimal fiber core matching.

Arc Fusion: A high-voltage discharge is applied to melt the fiber ends and fuse them under controlled tension.

Protection & Testing: The splice is protected with a heat shrink sleeve or gel, and loss is tested using an Optical Time-Domain Reflectometer (OTDR).



02

Mass Fusion Splicing

Mass fusion splicing joins entire ribbons of fibers simultaneously, greatly reducing labor time compared to single-fiber splicing

Preparation: Strip the outer sheath of the ribbon cable, remove the buffer and coating, and clean the fibers with isopropyl alcohol.

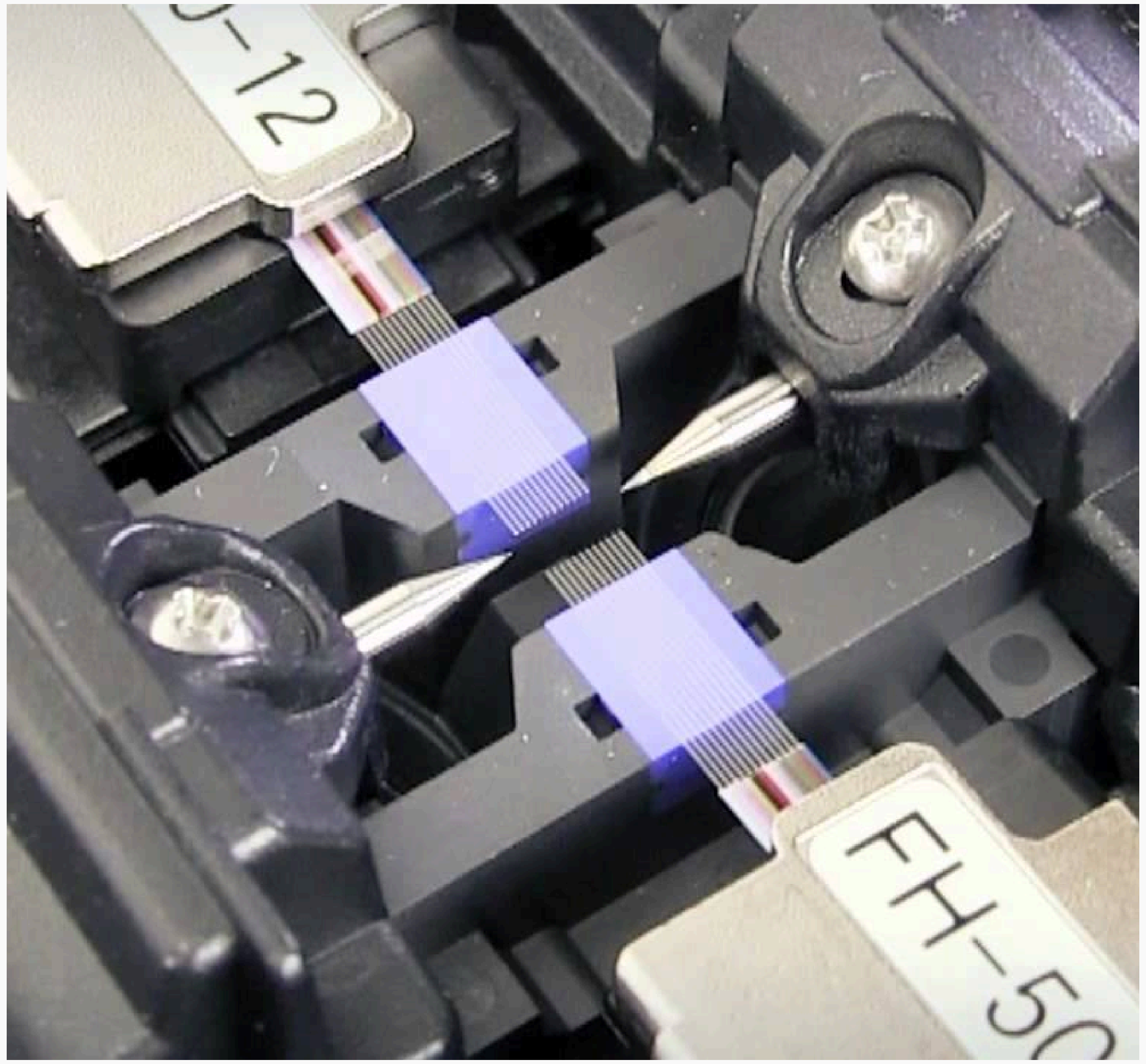
Cleaving: Use a ribbon-specific cleaver to ensure end-face angles of ≤ 1° for the fibers.

Splice Alignment: Insert ribbon ends into the V-groove fixture of the fusion splicer and the splicer automatically adjusts the arc.

Fusion: The splicer fuses all 12 fibers in 2–3 seconds, with splice loss of 0.05–0.10 dB.

Protection: Apply heat-shrink protector and heat using a hot-plate or oven.

Documentation: Record splice loss and map fiber positions in the closure diagram.



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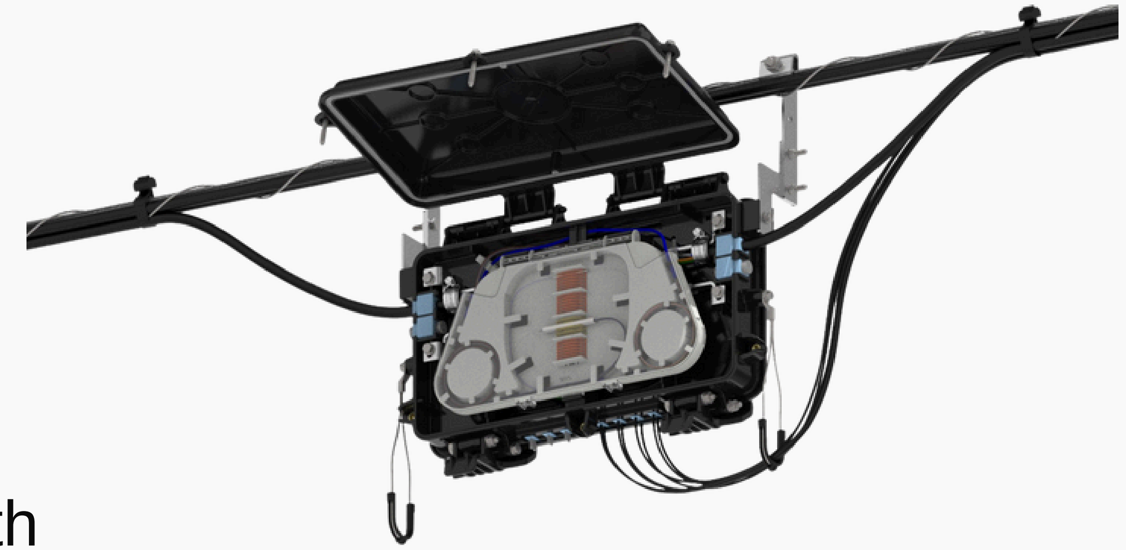
03 Splice Closure Types

Inline Closures



Elongated capsule shape for in-line cable routing

Designed for applications with minimal footprint (e.g., roadside vaults)

Two primary ports for through-cables, optional drop ports

Fiber capacity ranges from 6 to 144 fibers

Gel or rubber seals for moisture protection

Compact and space-efficient

Dome Closures

Cylindrical shape with a domed lid secured by clamps or bolts

Used for high splice counts (12–288 fibers)

Typically installed in manholes or handholes

Features multiple cable ports and vertical splice trays

Elastomeric seals rated for IP68 for moisture protection

Ideal for high-density splicing and easy maintenance access

04

Splice Closure Types Contd.

Aerial Closures

Available in dome or inline variants

Designed for mounting to aerial messenger wires or poles

UV-resistant housing and seals to protect against wind-blown dust and rain (NEMA 4X)

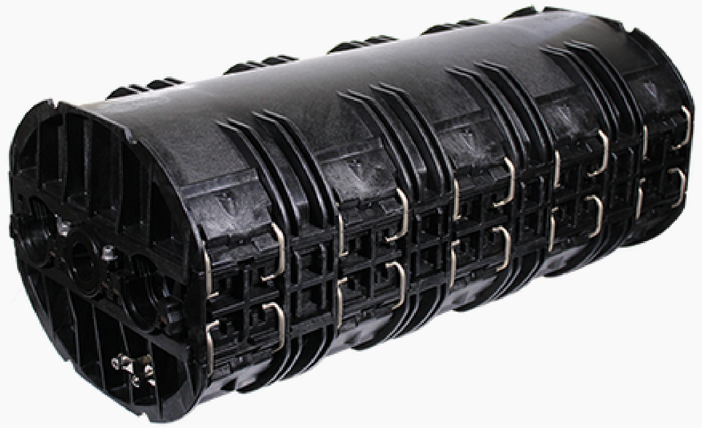
Used for aerial installations and drop connections to subscriber premises

Secured using brackets or clamps

Underground Closures

Two main variants: pedestal closures (mounted above ground) and vault closures (installed below ground)

Typically installed in manholes or handholes



Features bolt-down bases and venting valves for pressure equalization

Water-blocking cable seals for moisture protection

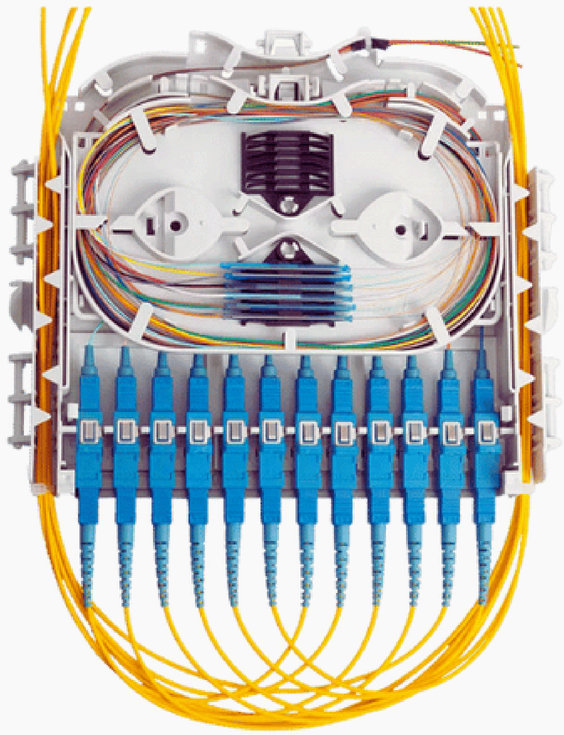
Suitable for underground installations in vaults, handholes, or manholes

05 Splice Point Planning

A splice point is where two fiber optic cables are permanently joined. Closures are typically placed every 1,200–1,500 ft (365–460 m), at branch points and service transitions.

Slack Loops

Provide ≥ 20 feet (6 m) of spare fiber per cable entry to enable re-splicing and future expansions



Splice Tray Capacity

Select closures supporting the projected fiber count plus ≥ 20% growth

08

Field Splicing Workflow

1

Strip the Fiber

Use a fiber stripper to remove the outer jacket and buffer coating

Cleaving

3

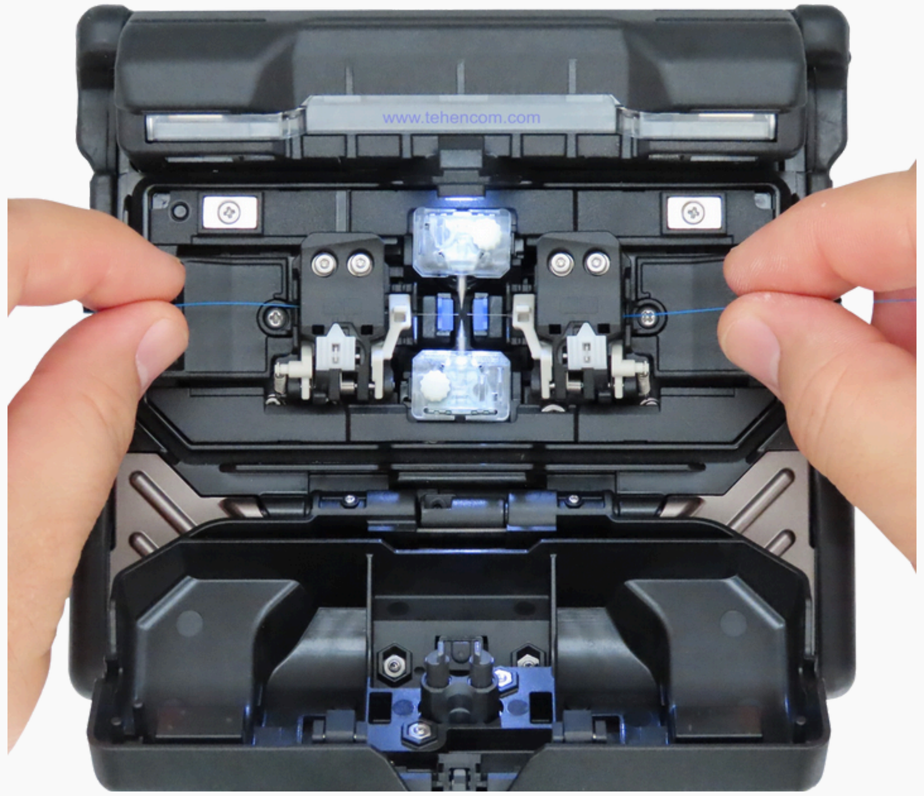
Use a precision fiber cleaver to cut the fiber at a right angle

2

Clean the Fiber

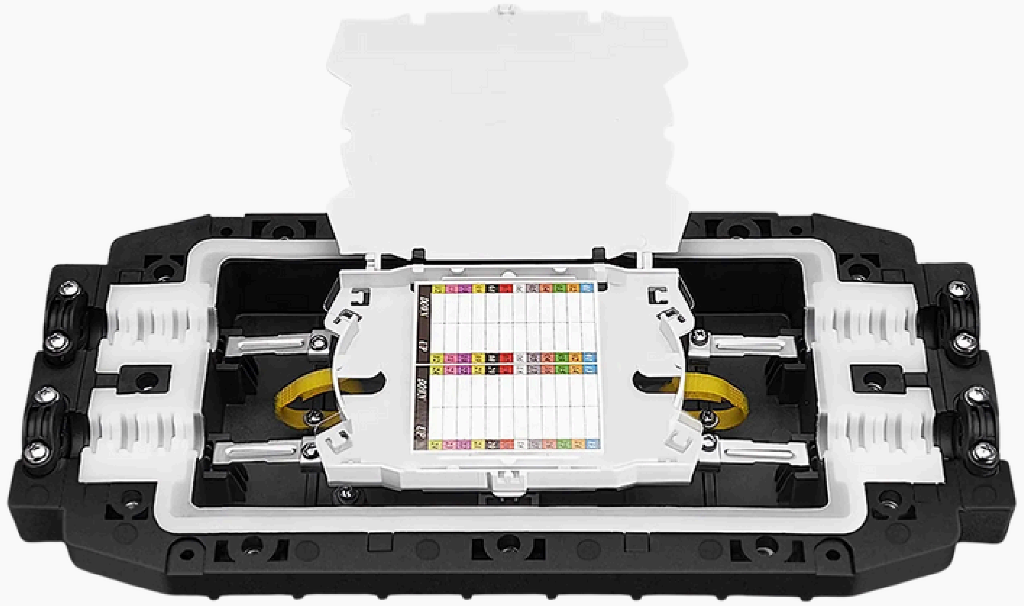
Clean the exposed fiber with alcohol wipe or cleaning solution

Field Splicing Workflow Contd.



4 Align and Insert Into Splicer

Place the cleaved fiber into the splice connector



Protect the Splice 6

Shield the splice with a splice protection sleeve or splice closure

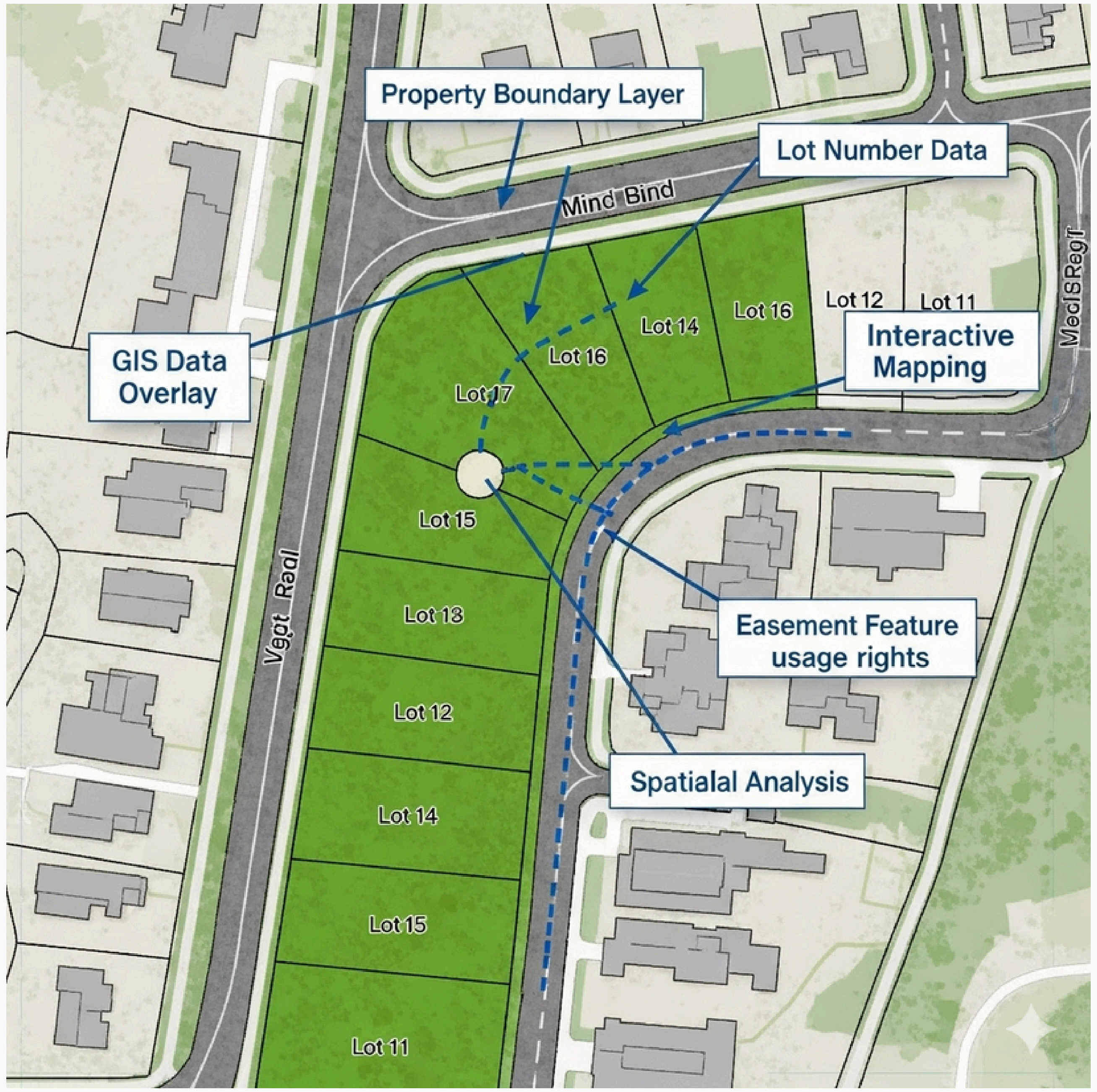
5 Test the Splice

Check the splice with a visual fault locator or power meter

01 Plat Maps GIS website

What is a County GIS Website and Plat Map?

- A County GIS (Geographic Information System) website provides interactive maps displaying land data such as parcels, zoning, roads, and property boundaries.
- County GIS websites typically integrate Plat Maps, providing a digital version that's easier to navigate and update.
- Plat Maps are detailed land surveys used to define property boundaries, easements, and access points.
- GIS platforms and Plat Maps are essential in real estate, urban planning, and OSP design to manage land data effectively.

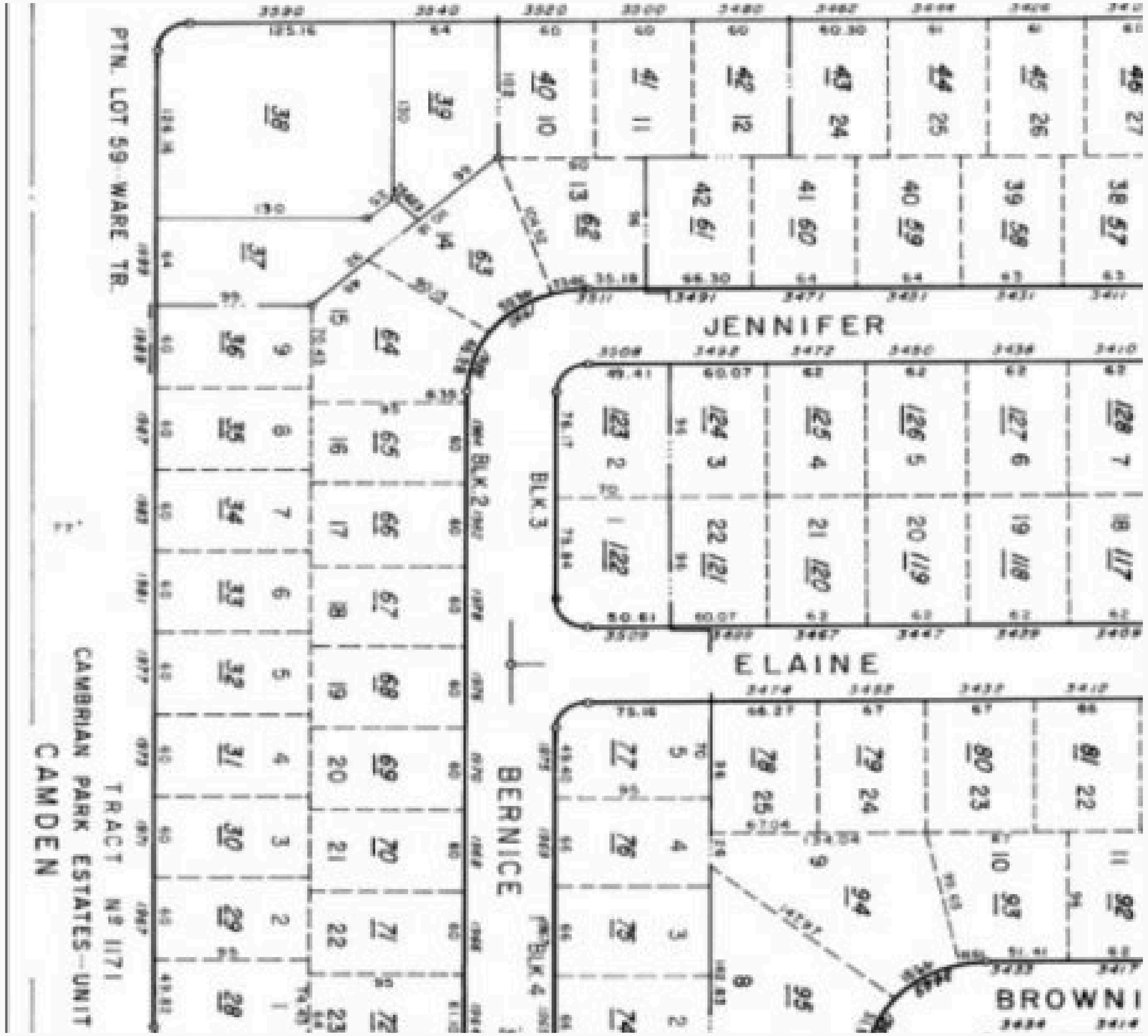


02 Plat Maps

A plat map is the official survey drawing approved by city or county authorities. Which shows exact measurements for roads, easements, property boundaries, and public access paths.

This is the document engineers and surveyors rely on, it is the official legal reference for land layout.
Why It’s Important in OSP Design

In OSP fiber design, the plat map is like the holy bible, you must refer to it to measure ROW width, easement locations, and property limits accurately. Every distance, alignment, and boundary you draw in AutoCAD should match the plat.



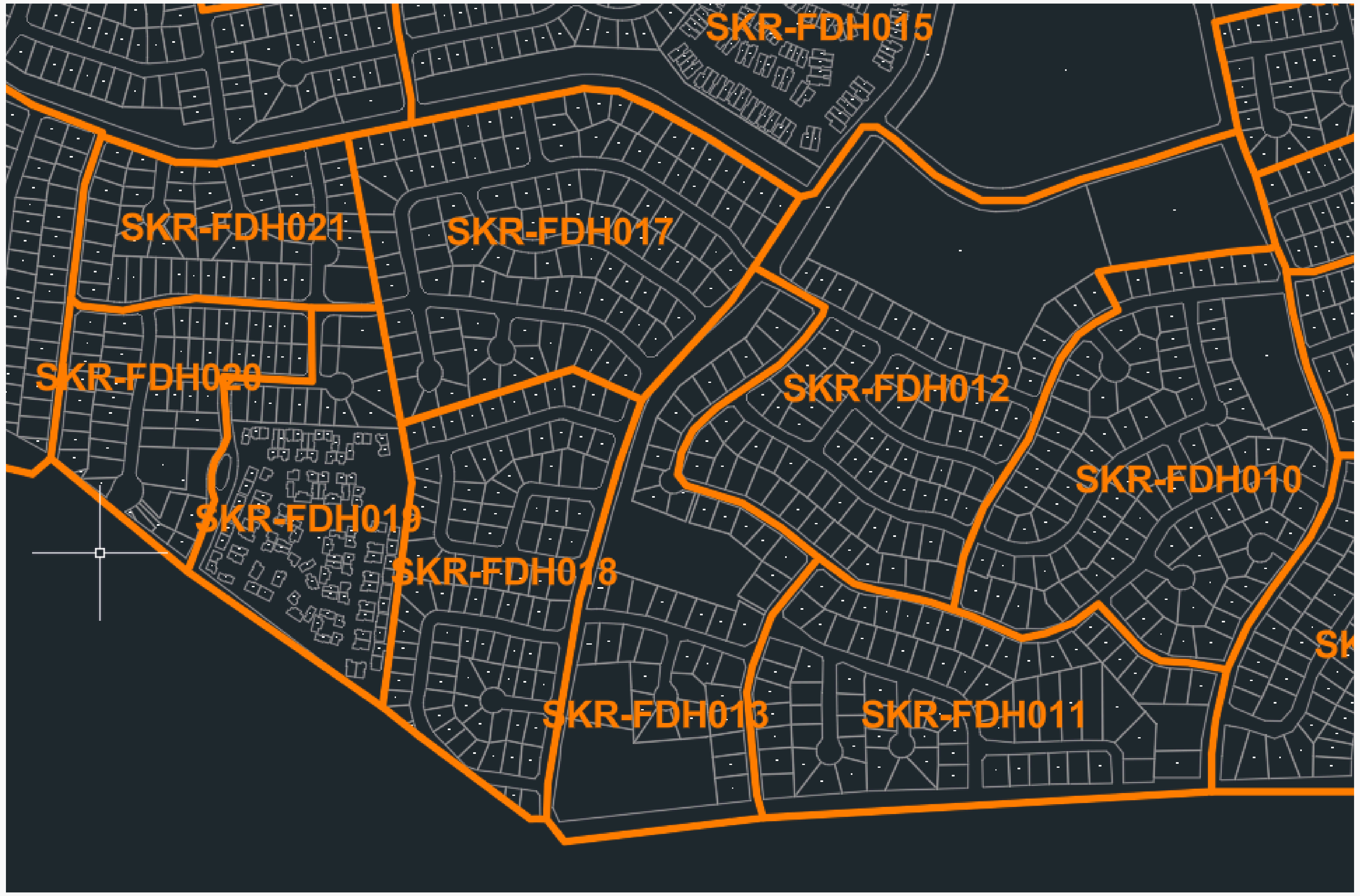
03 Parcel Map

A parcel map is the GIS or digital version of land information derived from plat data. It shows approximate property outlines and helps drafters quickly identify groups of homes or plots. However, parcel maps are not 100% precise they are meant for reference and planning only.

Why It's Important in OSP Design

- Parcel maps help us visualize the coverage area quickly and decide where the fiber route will pass.
- We use it to estimate ROW space, identify potential access paths, and group homes under MSTs.

But before confirming measurements or alignment, we always verify with the plat map.



Each of the bordered areas are parcels