

Fusion SOC Deployment for Reliable FTTH Network

By

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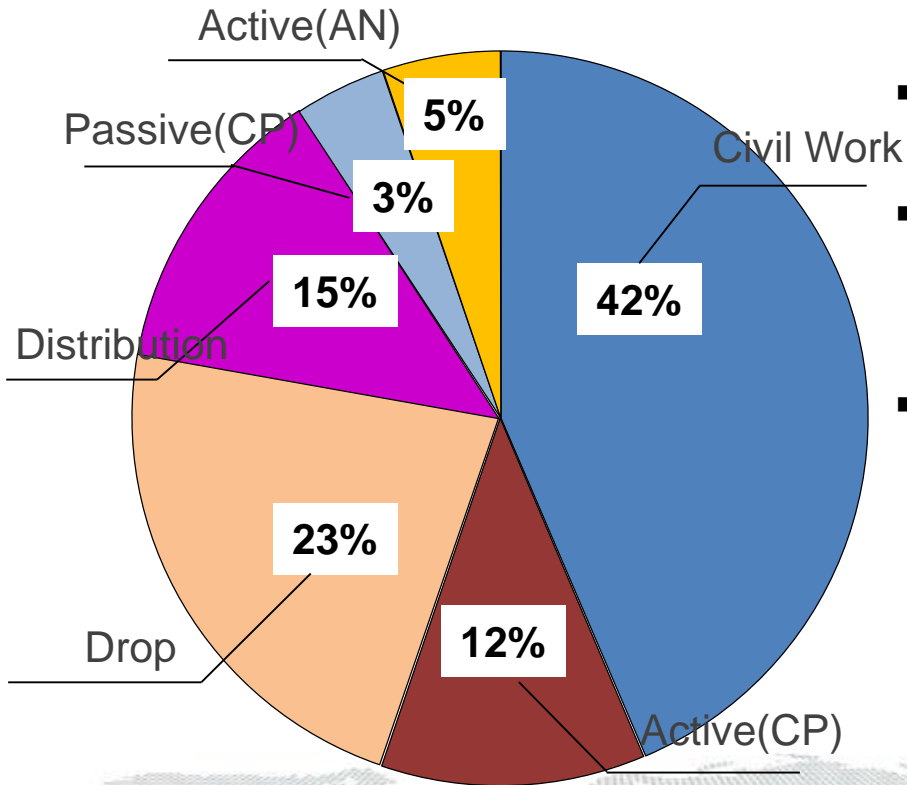
Il sintech Trading India Pvt Ltd

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1. *Consideration Prior to FTTH Deployment*
2. *Mechanical Field Instable Connector Analysis*
3. *Pre-Connectorized Drop Cable Analysis*
4. *Fusion Splice On Connector as Countermeasure*
5. *Case Study FTTH Asia Pacific*
6. *Fusion SOC Application at Data Center*
7. *FTTH Portfolio*
8. *Wrap Up*
9. *Fusion Splicer Line Up*

Successful FTTH deployments can deliver an attractive return on investment if the first cost and life-cycle cost of the network is minimized



[FTTH Deployment Cost Break down]

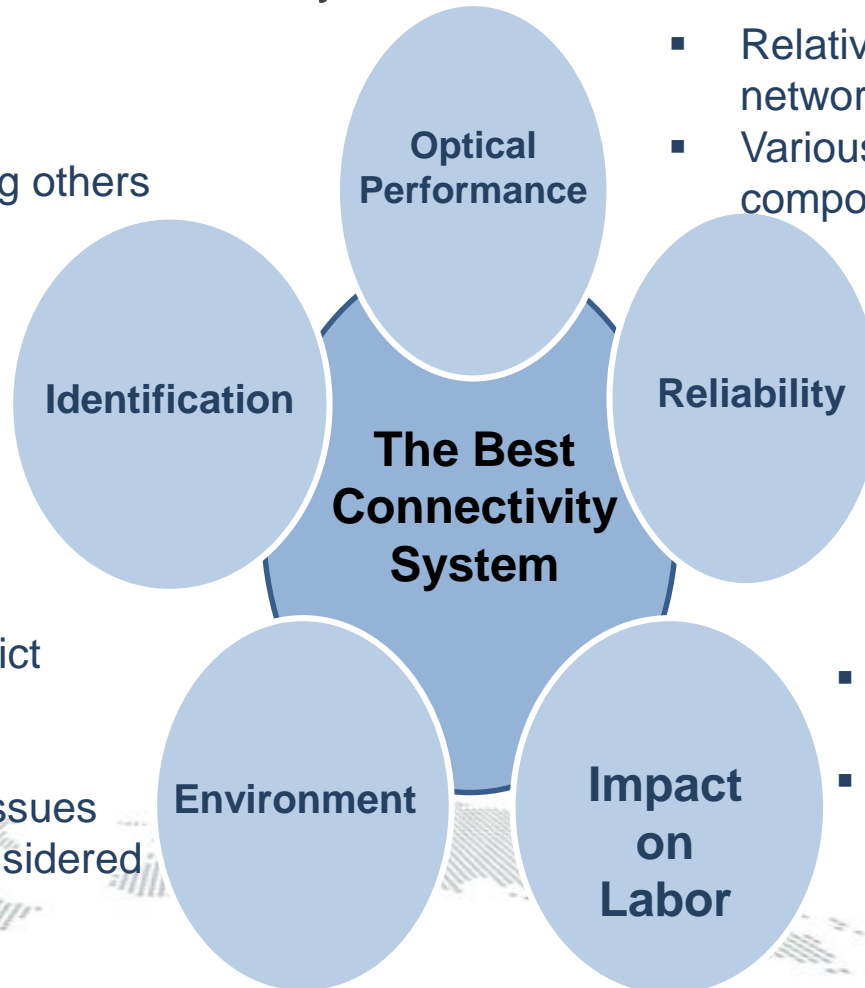
- **Intelligence about network elements**
- **How to place these elements in the field for maximum economy**
- **Understanding the relationship between network element costs**



Optimized and Reliable Products will Reduce OPEX and the unexpected cost

Connectivity characteristics need to be considered when selecting the appropriate connectivity method for the **FTTH access points**.

- Easy access to individual line without disturbing others
- Compactness
- Relatively complicated network
- Various Passive components are applied
- Trouble Shooting & Repairs are all unplanned activity
- Expose to strict weather Condition
- Mechanical issues should be considered like vibration
- Minimize Craft induced Error
- Objective to reduce OPEX to a minimum



Big Challenge to choose proper connectivity for subscriber at that moment because no one guarantee long term reliability of connection method

Deployment with M/C on 2007

- ✓ Experience 25% failure in the initial installation
- ✓ Another 25% failure occur within 1~2 years

- ✓ Unexpected Maintenance Cost
- ✓ 25,000 A/S labor force
- ✓ Migrate to Pre-Conn. & FSOC

- ✓ Adopted FSOC, reduce the labor force about 5,000

1.1 Which Connectivity is the Best Choice?

FTTH SOLUTION

Through the field experience, Connectivity technology migrate to new solution to avoid trouble shooting & maintenance cost

M/C
In a year, Fusion SOC will be adopted.

M/C => Pigtails, Pre-terminated drop cable
In a year, Fusion SOC will be used.

Fusion SOC, Pre-terminated drop cable, small portion of M/C

M/C
In a year, Fusion SOC will be adopted.

Many ISP have struggled with Mechanical SOC's drawbacks and cost for repair or replacement then **take into account the migration to new connectivity**

Statistics of FTTH Failure ("Broadband China/OptiNet City" project)

	Cause	Freq.	Share
1	Power down at central office	329	7.6%
2	Feeder or distribution cable failure	179	4.1%
3	Splitter failure	93	2.2%
4	Drop cable failure	425	9.8%
5	Pigtail or connector failure	193	4.5%
6	Project cutover	153	3.5%
7	Termination failure at subscriber end	2180	50.4%
8	ONU failure	473	10.9%
9	Power down at user terminal	54	1.2%
10	Others	251	5.8%
	Total	4330	100%

■ **Problems with last mile termination at the subscriber account for more than half of total malfunction**

Termination Method share in Jiangsu, China

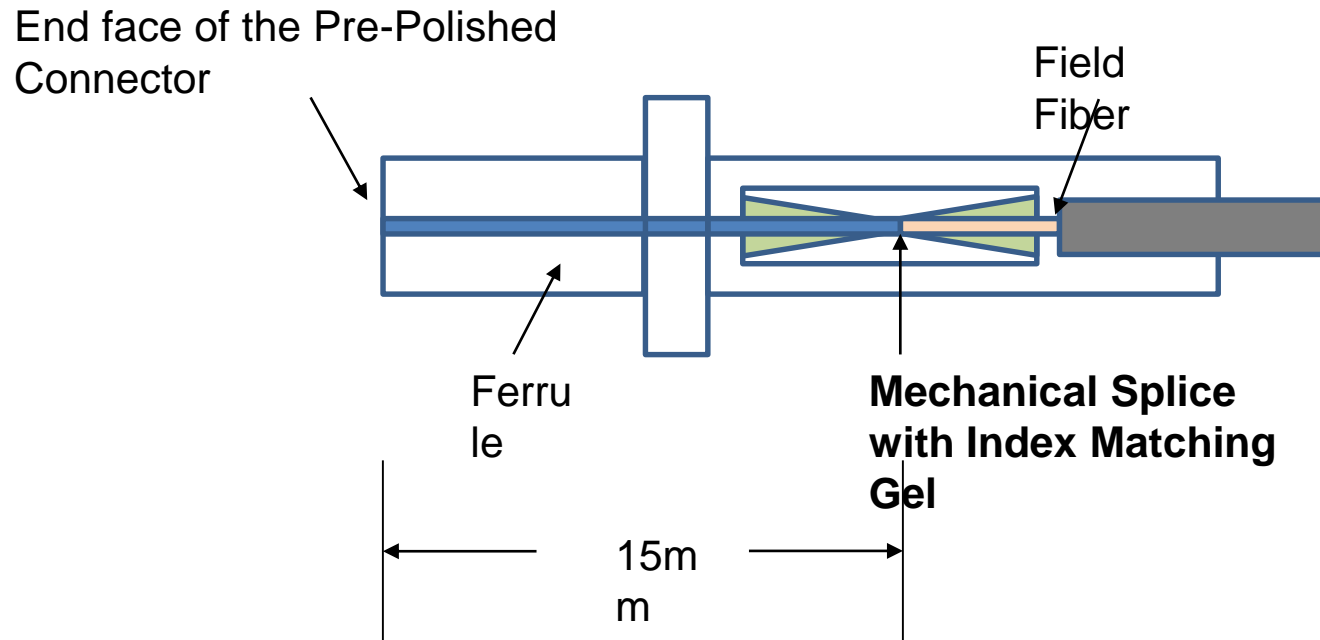
improved mechanic splicer	54.09%
Pre-termination	40.24%
Fusion Splicing	5.67%

(Source :Jiangsu Posts & Telecommunications)

[Statistics of FTTH malfunction in Jiangsu, China, Dec.2010]



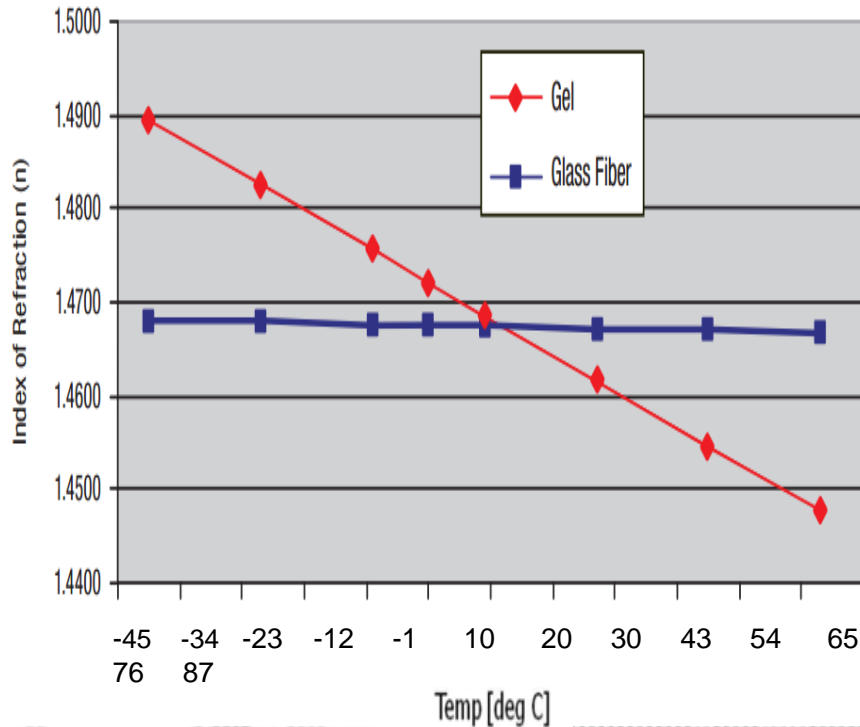
Built-in fiber end face **contains refractive index matching gel** whose refractive index is the almost same as glass and **physically contacted** with drop cable fiber



[Cross Section of Typical Mechanical Connector]

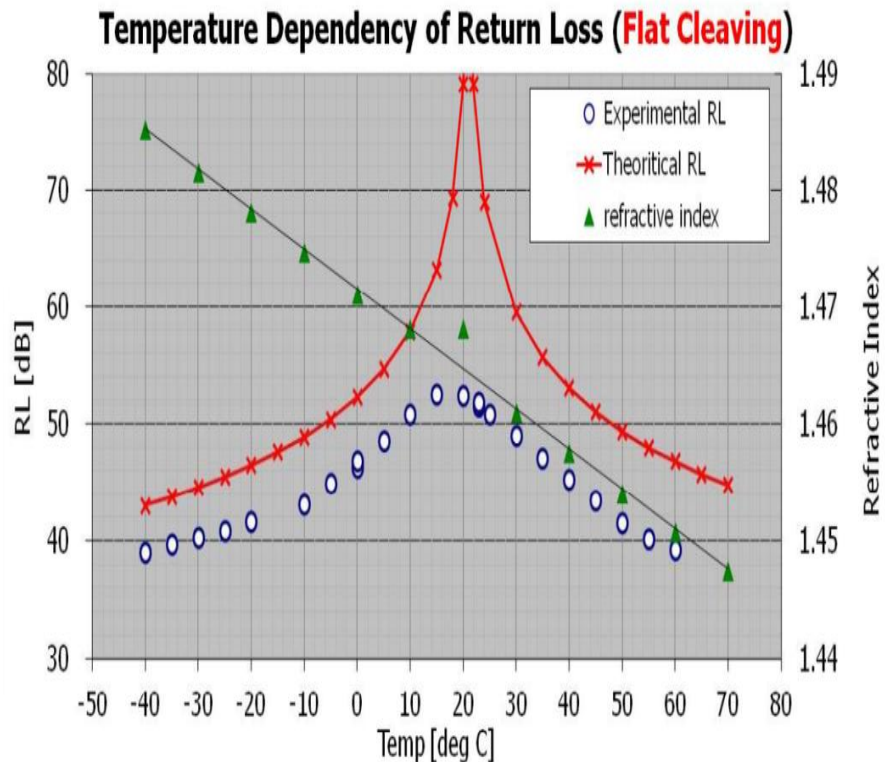
However, the lifespan of the gel and the robustness of the mechanical splice have often been questionable.

Index of Refraction vs. Temperature



- *It is engineered to produce an optimum index match with optical fibers **at room temperature***
- *However, the gel's index of refractive **changes with high or low temperature differently than glass fiber index of refraction***

However, the lifespan of the gel and the robustness of the mechanical splice have often been questionable.



- **At 40°C, the RL has decreased by about 10% from its room temperature value.**
- **Temperatures down to -30°C below or rises above +50°C decreased to less than 40dB return loss.**
- **In case of *analog(Video) transmission*, more than 55dB return loss required.**

FSOC has great return loss, more than 55dB

Unexpected faults occurring during and after installation of these fiber connections might detrimentally affect performance, **it is called 'Blind Splice'**.

Some of vendor designed visible check window with VFL(Visual Fault Locator) for **Checking air gap, it does not express exact loss(dB)**

❖ Glass Fragmentation

Improper operation like overexertion when inserting the fiber into the mechanical splice connector might break the fiber optic and produce glass fragmentation.



Pre-polished
ferrule



Installed Fiber

Bicsi[®]

3. Pre-Connectorized Drop Cable

FTTH SOLUTION

Pre-Connectorized Drop cable, well-known connectivity method, is manufactured at factory with various type of connector and These length requested by customer. **but it shows some drawback in the field and structure problem issue**



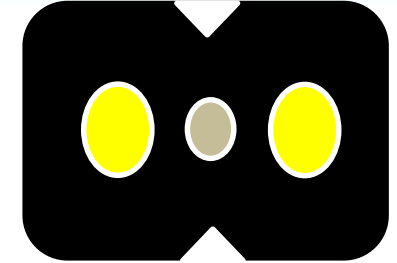
- Loss of **Left Over Drop cables about 15~20%**
- **Longer cable length, Higher connector cost (Handling Cost)**
- **Increasing Inventory cost for each length**



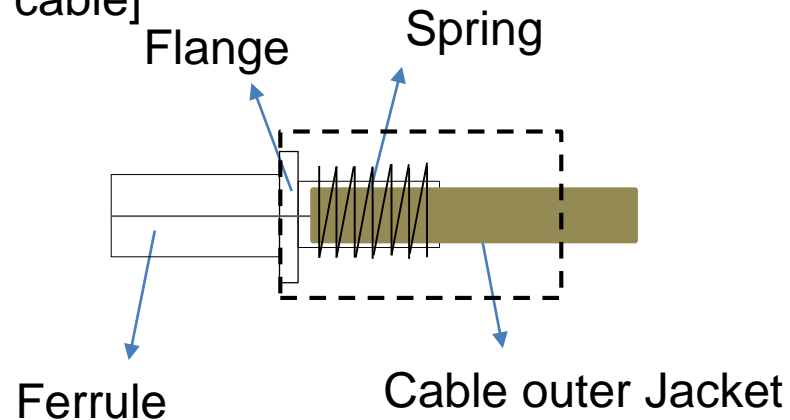
Direct purchase drop cable and FSOC

- . **No excess slack**
- . **Cost down cable and Reduce Stockpiling Cost**
- . **No complain by subscriber about excess slack**

Pre-Connectorized solution with Rectangular Type Drop Cable has serious problems at field application **due to not suitable type for assembly with connector**



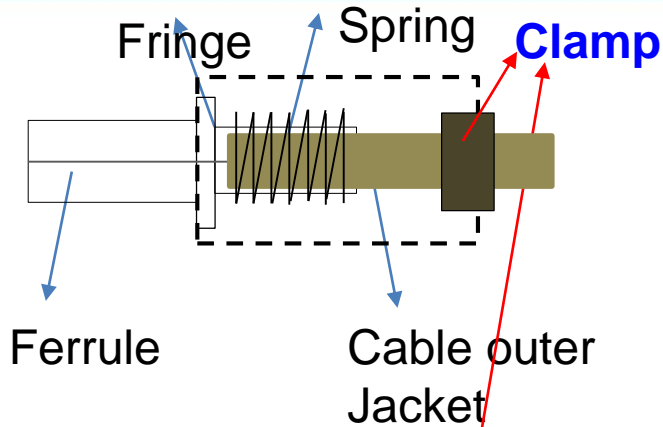
[Structure connector with cable]



- Insert cable outer jacket into the ferrule fringe directly because it is very difficult to assemble bare fiber with ferrule at the connector fabrication process

3. Pre-Connectorized Drop Cable

FTTH SOLUTION

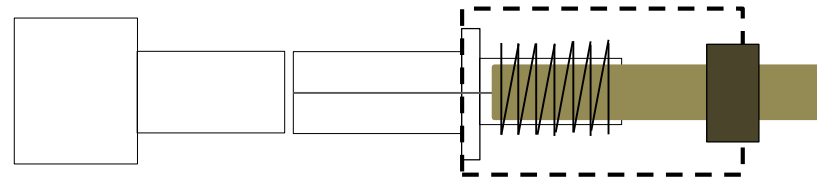


[Structure connector with cable]

The problems in case of tensile load applied, some of **products adopt the “Clamp” under the boot to hold tightly the cable.** But at the ONT site, it has below significant problem

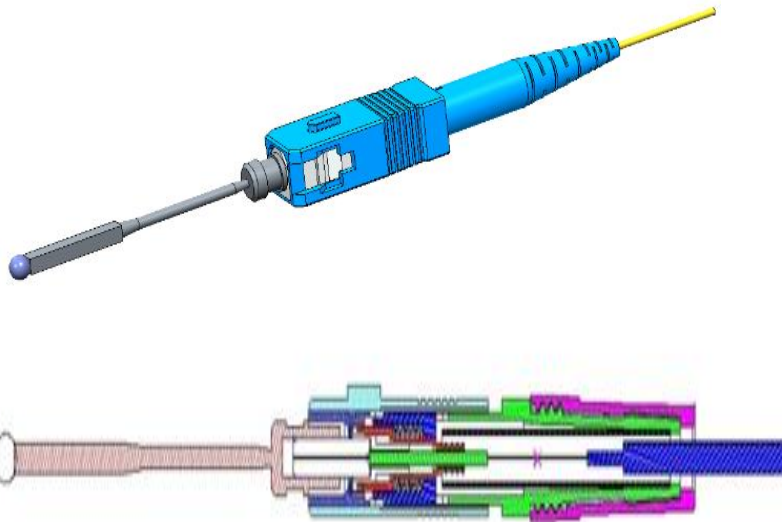
ONT Transceiver
Fiber Stub

Pre-Connectorized
Drop Cable

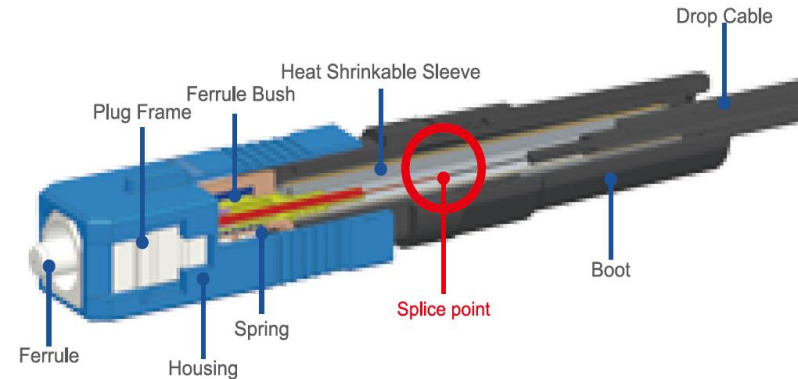


- Fiber stub of ONT transceiver **is fixed**, without ferrule moving, and ferrule of connector **can not move backward due to the clamp as well.**
- It can make ONT damage from the transceiver, and it may cause a fatal problem for the Internet connection.

The next generation connectivity should meet all the requirements for **speed, real-time monitoring, performance, reliability and quick time to restoration** of today and future's optical network.



FSOC dramatically reduces attenuation and reflectance, and mitigates craft-induced error by introducing an automated alignment process.



[Optical & Mech. Performance Mechanical vs FSO

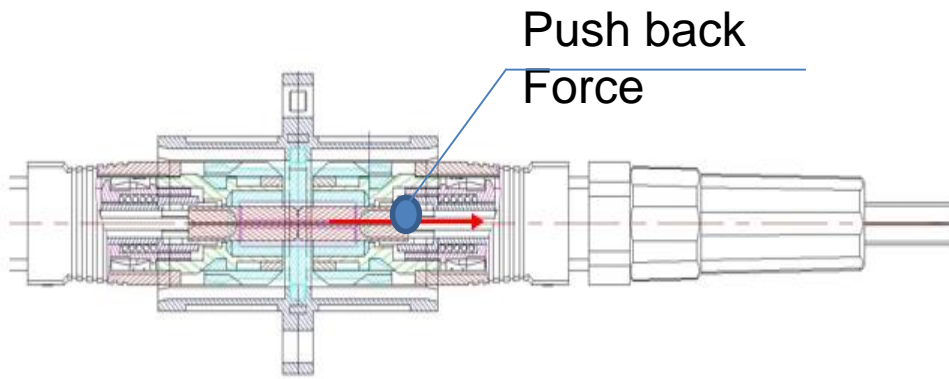
Parameter	unit		Mechanical	Fusion SOC
Insertion Loss	dB	Typ.	0.3	0.15
	dB	Max	0.5	0.3
Return Loss	dB	min	40	55
Tensile Proof	N		3	60

Factory-quality connection in a field-installable format

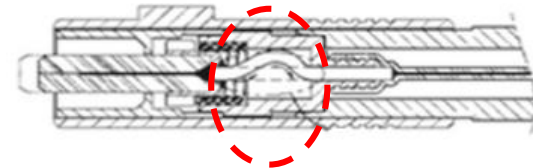
- Complies with Telcordia GR-326-CORE, GR-1081-CORE, and IEC 61300.



FSOC has a patent to prevent fiber bending from pulling back force when mating with other connector in the adapter



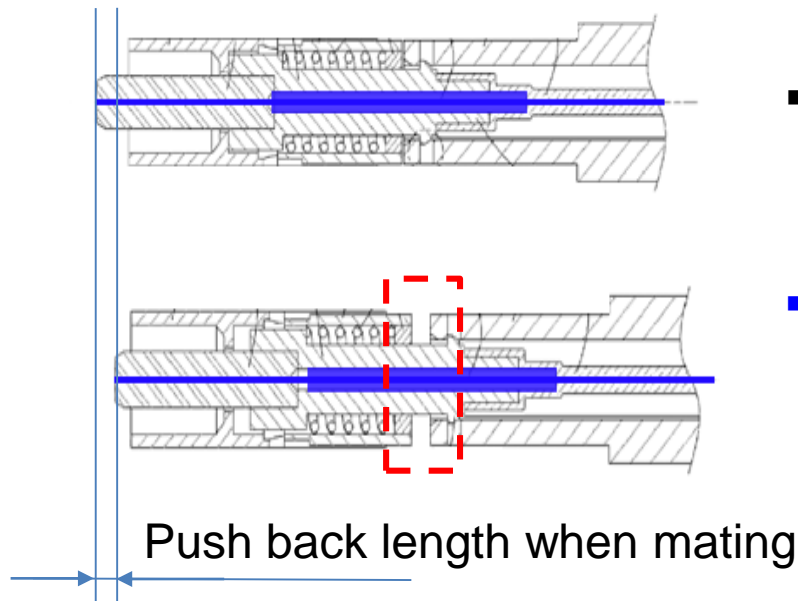
- **No Space for fiber at connector so induce the fiber bent**



[Cross section mating Connectors in Adapter]

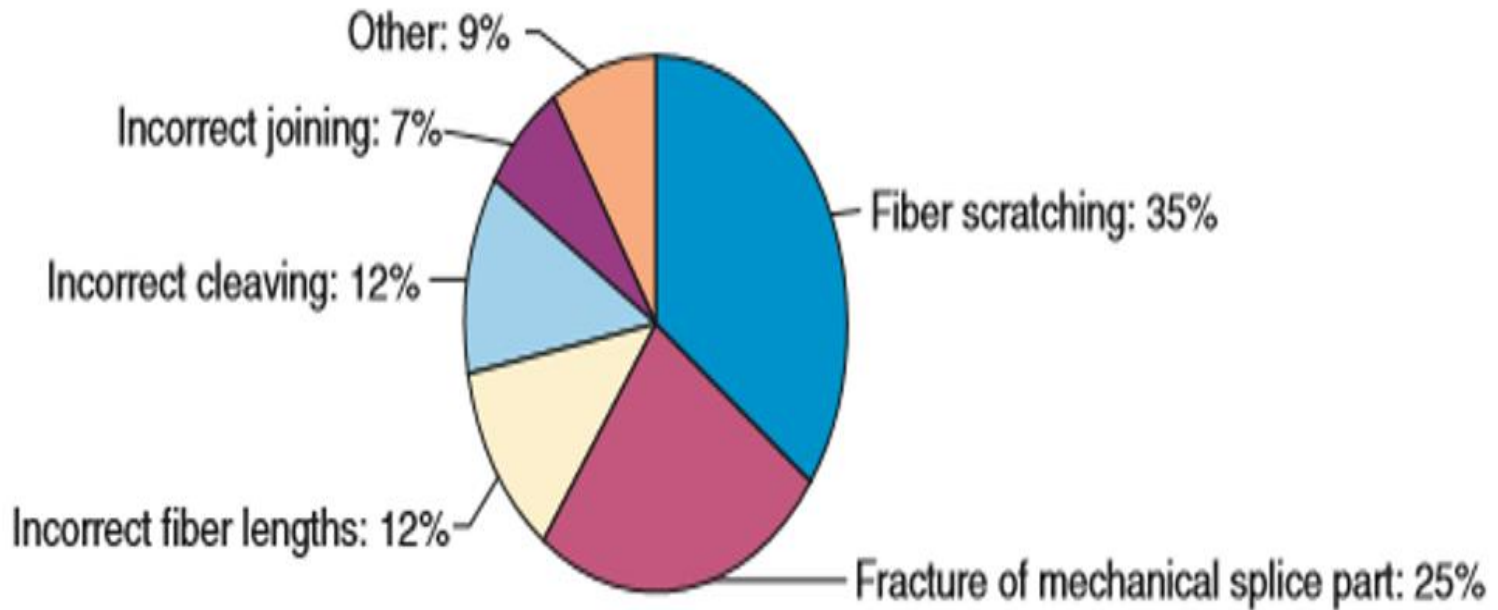
- **Despite OK just after assembly, it has potential damage of crack or cutting on fiber**

FSOC designed **“Sliding Back” mechanism** to figure out the **conventional Connector’s draw back** with providing enough space against fiber bending issue



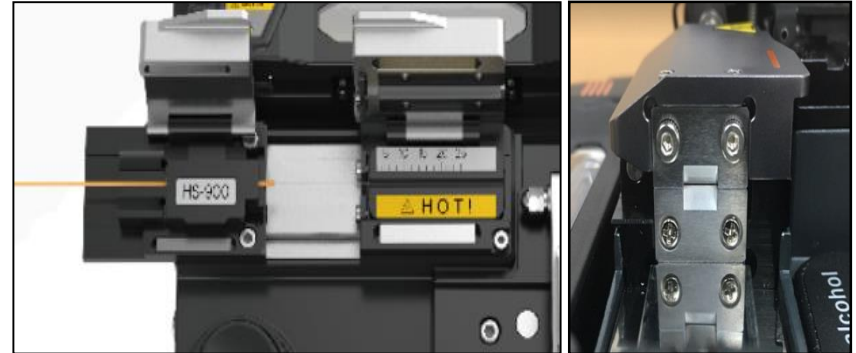
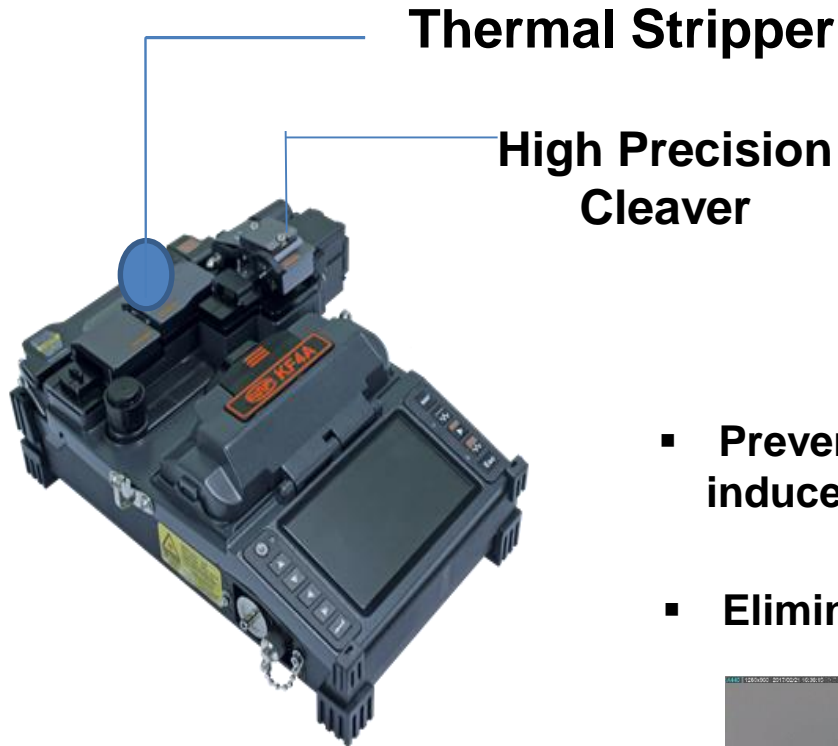
- *When mating with ferrules in adapter each ferrule influenced push back force*
- *“Sliding Back” Design provide the space for fiber to prevent fiber bent*

It is very important to detect and investigate **the causes of faults** and to apply **correct countermeasures**. Imperfect physical contact cause serious environmental problem

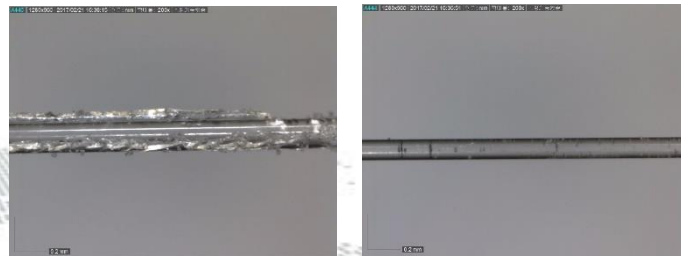


[Mechanical SOC fault analysis by NTT]

Compatible with Fusion Splice-On Connector and figure out Mechanical Splicing drawbacks



- Prevent the damage on the fiber induced by manual stripper
- Eliminating fiber chipping and scratch

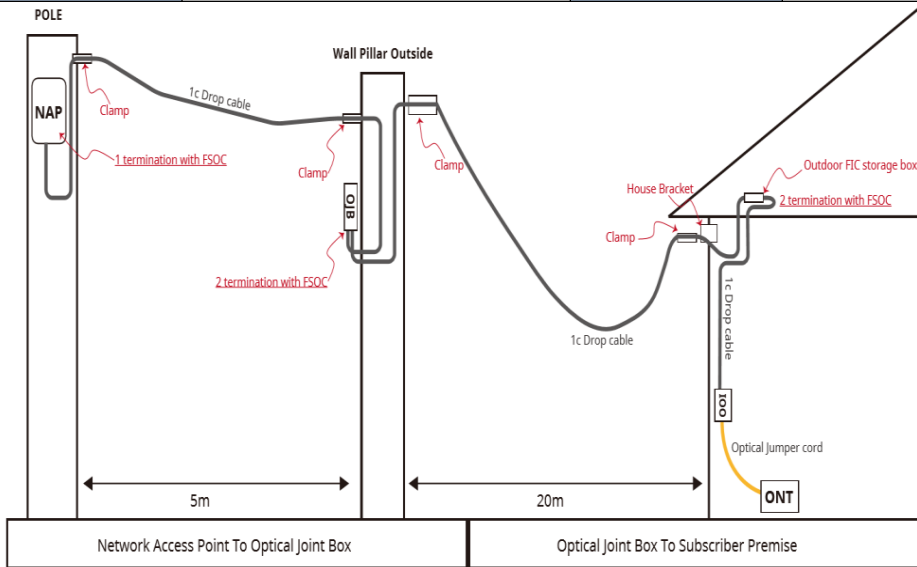


Deteriorate to the fiber broken

5. FTTH Case Study in Asia Pacific

FTTH SOLUTION

Purpose	FTTH Trial Service	ISP	PLDT	Field Condition	From NAP To ONT 6 FSOC Termination
Technology	G-PON	Region	Philippines		
Subscribers	Trials for 2 subscribers	Date	Jan 11 ~ 15, 2016		



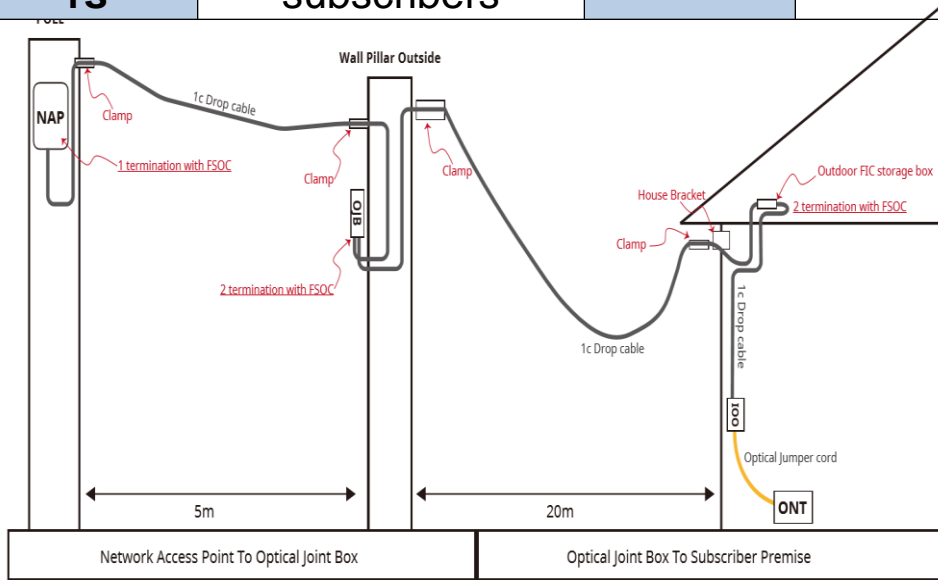
- **The output result at the IOO as ready by the F1+OPM is -18.5dBm. Average Insertion Loss per connector as this trial was 0.17dB**



5. FTTH Case Study in Asia Pacific

FTTH SOLUTION

Purpose	FTTH Trial Service	ISP	PLDT	Field Condition	From NAP To ONT 2 FSOC Termination
Technology	G-PON	Region	Philippines		
Subscribers	Trials for 2 subscribers	Date	Jan 11 ~ 15, 2016		



- **Pre-installed with Mechanical SOC(TE, -24.1dBm from ONT) showing higher link budget(Fail), then replaced with FSOC**
- **After one end replacement, it shows -23.01dBm(Pass) then opposite side replacement, it shows -16.9dBm(Pass)**

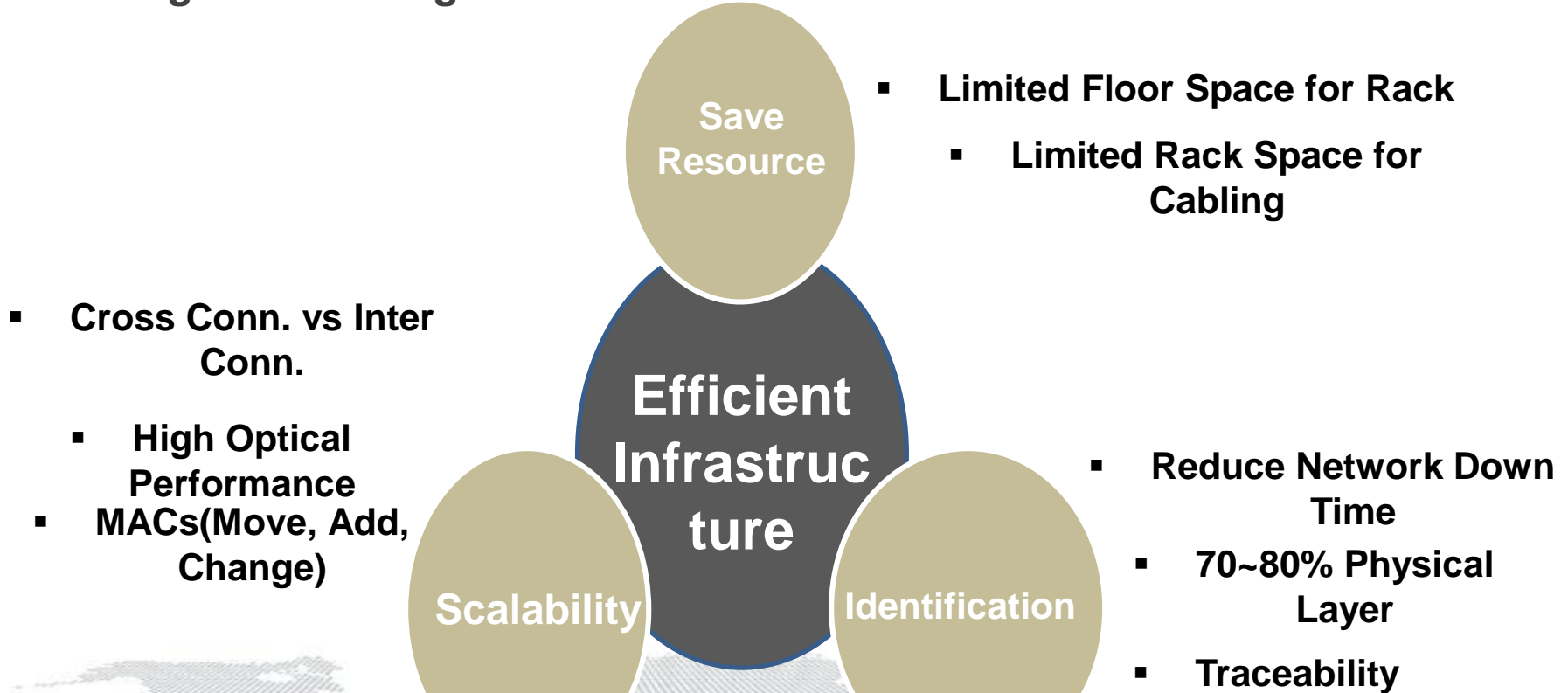


Summary of FSOC as countermeasure for NEXT CONNECTIVITY

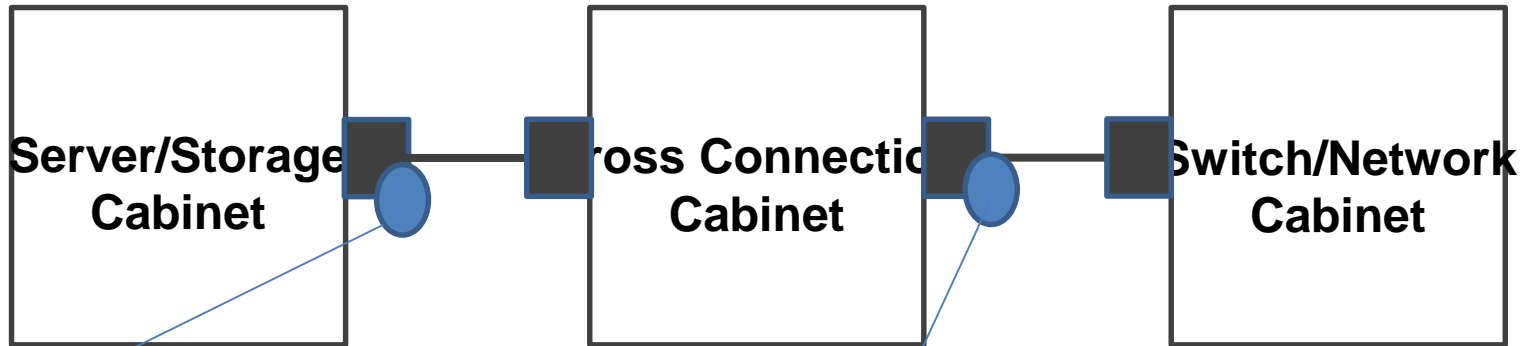
Conventional Option	Technical Issues		Cost Issues	
	Draw Back	FSOC Solution	Draw Back	FSOC Solution
Mechanical SOC	Fiber Bent Issue	Sliding Back Mechanism	Very high failure rate Re-Installation cost (within 1~2 years, 70% within 5 years almost 100%)	Proven Technology of Fusion Splicing
	Blind Splice	All-In-One Splicer		
Pre-Connectorized Drop Cable	Fiber Bent Issue	Sliding Back Mechanism	Leftover 15~20%	Exact Length Calculation
	Tensile Load Issue		Longer length, Higher Connector Cost	
	Stuck by Clamping		Inventory Cost	



Data center require physical cabling with an increasing demand for higher performance and flexibility, all of which require a **reliable, scalable and manageable cabling infrastructure**



Fiber optic cable infrastructure block diagram with Optical Solution



❖ Conventional Connectivity Method



- Fiber Count : up to 12C
- Fiber Type : SM, OM1, OM2, OM3, OM4
- Jacket : Riser, Plenum, LSZH
- **Less than 20meter length**

❖ MPO Splice-On Connector



- Elimination Extra Cable Slack
- Save limited space in the Rack
- Save Inventory Cost
- Easy to handle with Ribbonizing holder
- Splicing Loss include Connector's Insertion Loss

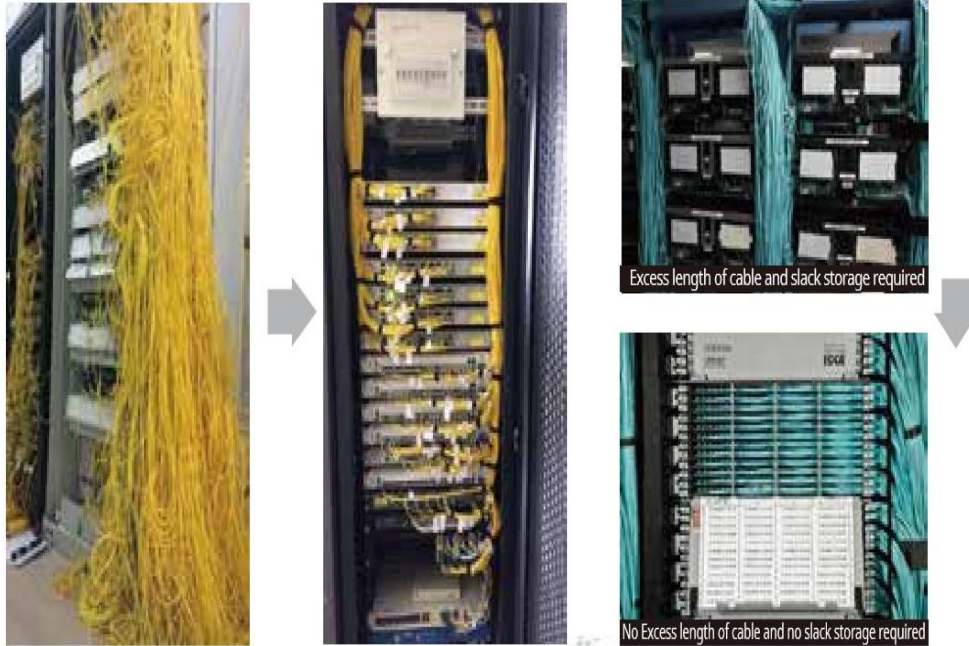


- **More than 20meter length application**
- **Splicing Loss(MM) is below 0.1dB**



Case Study with FSOC MPO & LC Connector

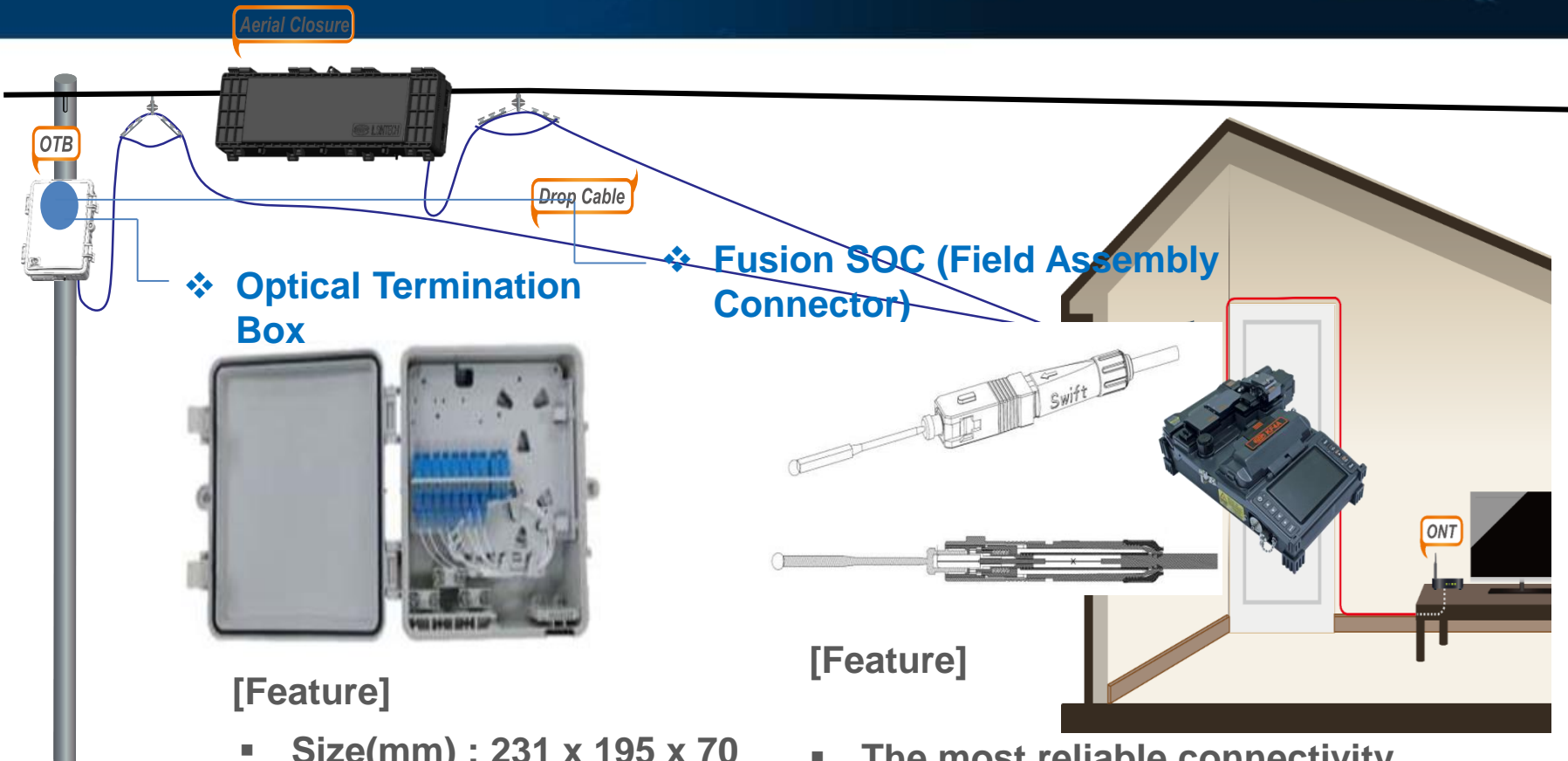
- *No need of splicing tray*
→ *Save the space in the Rack*



- *Most of Network failure caused by Connectivity*
→ *Fast to access to failure ports*
- *Perfect Length(Slack) management*
→ *Save the space in the Rack*

[Example of FSOC application before & After]





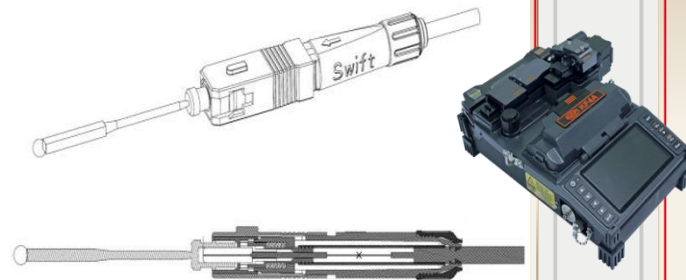
❖ **Optical Termination Box**



[Feature]

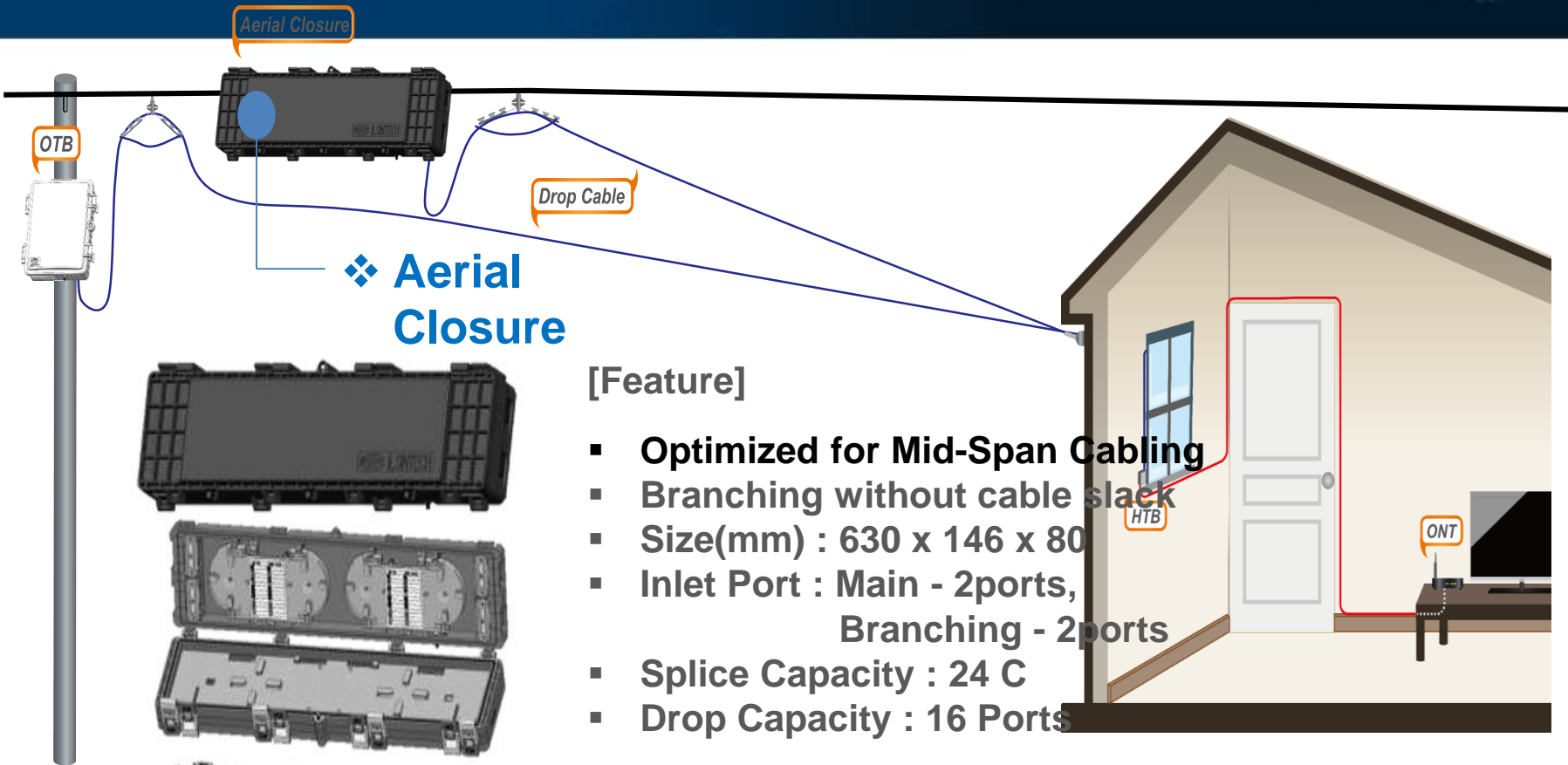
- Size(mm) : 231 x 195 x 70
- Inlet Port : Main - 2ports, Branching - 1port, Drop – 8ports
- Splice Capacity : 8C

❖ **Fusion SOC (Field Assembly Connector)**



[Feature]

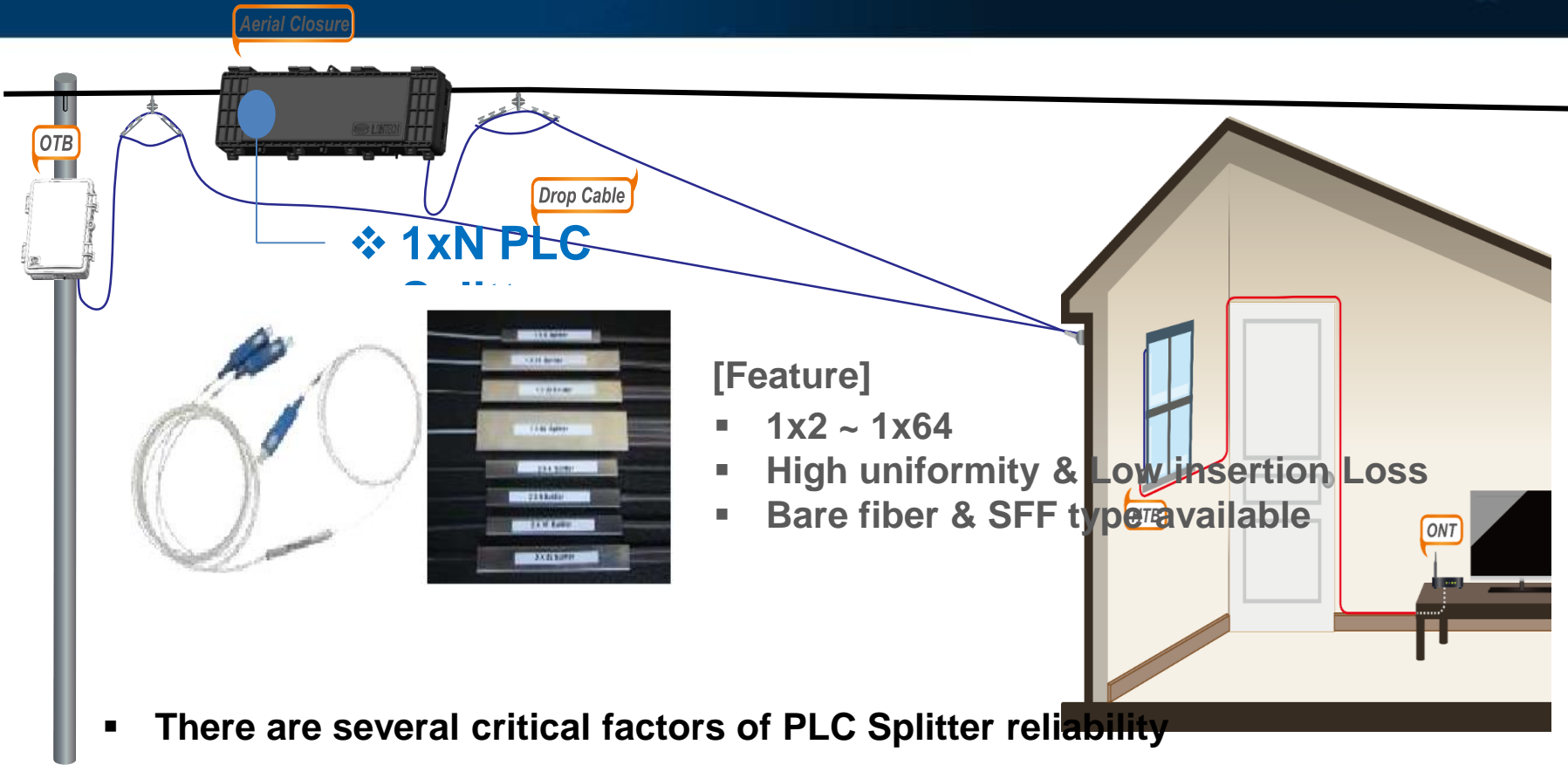
- The most reliable connectivity solution for Drop cable
- With ALLINONE splicer, eliminate human error.



❖ Aerial Closure

[Feature]

- Optimized for Mid-Span Cabling
- Branching without cable slack
- Size(mm) : 630 x 146 x 80
- Inlet Port : Main - 2ports, Branching - 2ports
- Splice Capacity : 24 C
- Drop Capacity : 16 Ports



Exact analyzing malfunction factors, then reinforce the In-Process Inspection.

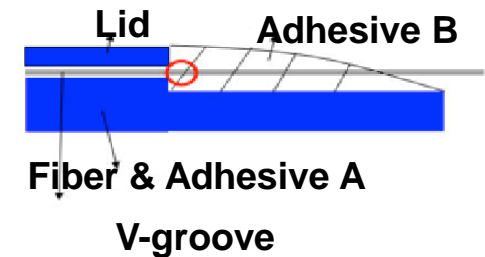
Damaged Waveguide

- Caused in waveguide mask process
- Increase light scattering effect



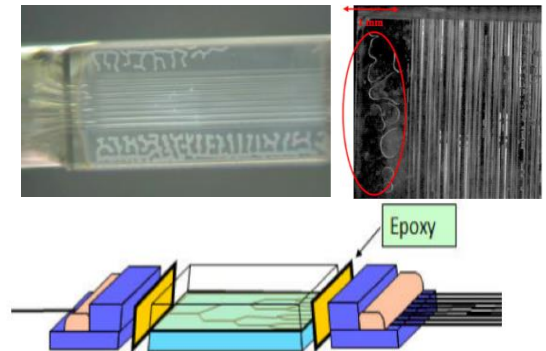
Broken fiber In Array

- Caused by imperfect fiber treatment, stripping, cleaving..
- Small Crack or Scratch will be stress point under temperature fluctuation and vibration

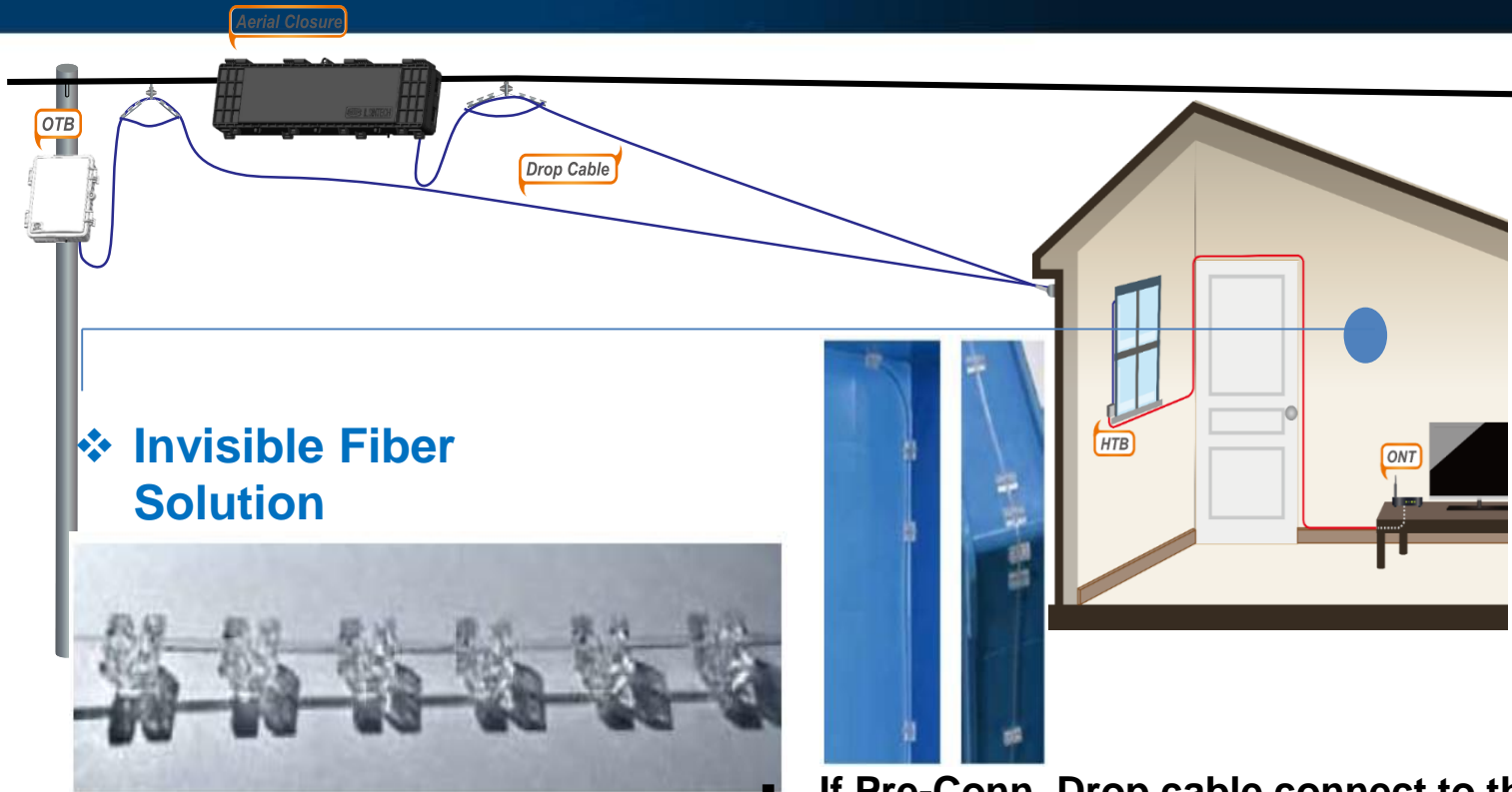


Delamination In Fiber Array

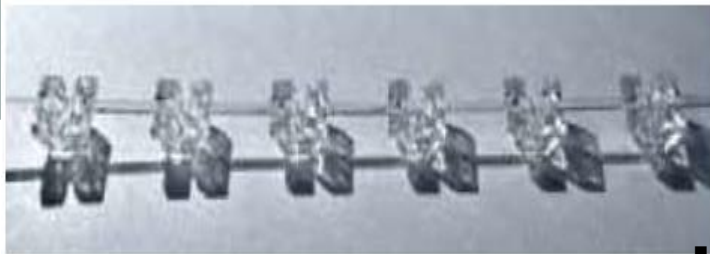
- Mismatch fiber, lid, V-groove with adhesive and poor pre-treatment process
- Cause the fibers to move out fiber array
- Low quality Epoxy and non-optical curing process
- Aligned position drift due to the mechanical and environmental stresses



Chip & FA Alignment



❖ Invisible Fiber Solution

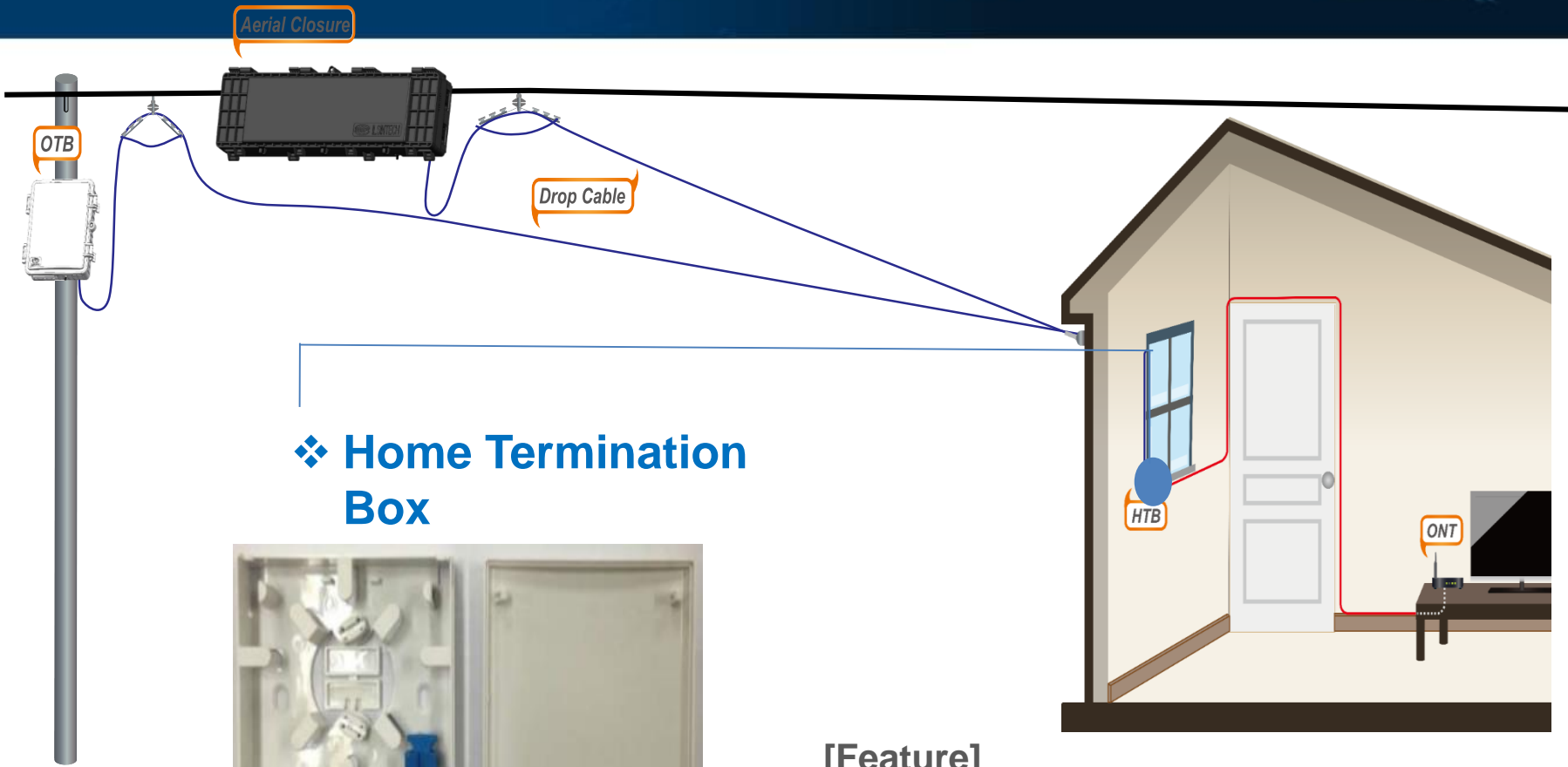


[Feature]

- 900um tight buffered invisible fiber,
- G.657.A1(2) and B3
- Color : Transparent

If Pre-Conn. Drop cable connect to the ONT directly,

- Extra slack should be piled somewhere in building
- It becomes cost increase factor
- **0.9mm transparent cable with FSOC will be perfect option in building**



❖ Home Termination Box



[Feature]

- Size(mm) : 86 x 86 x 27
- Port : Up to 2 SC Adapters
- Acceptable with FSOC
- Start point with invisible fiber

❖ FSOC vs Mechanical Splice On Connector

Technical Benefit

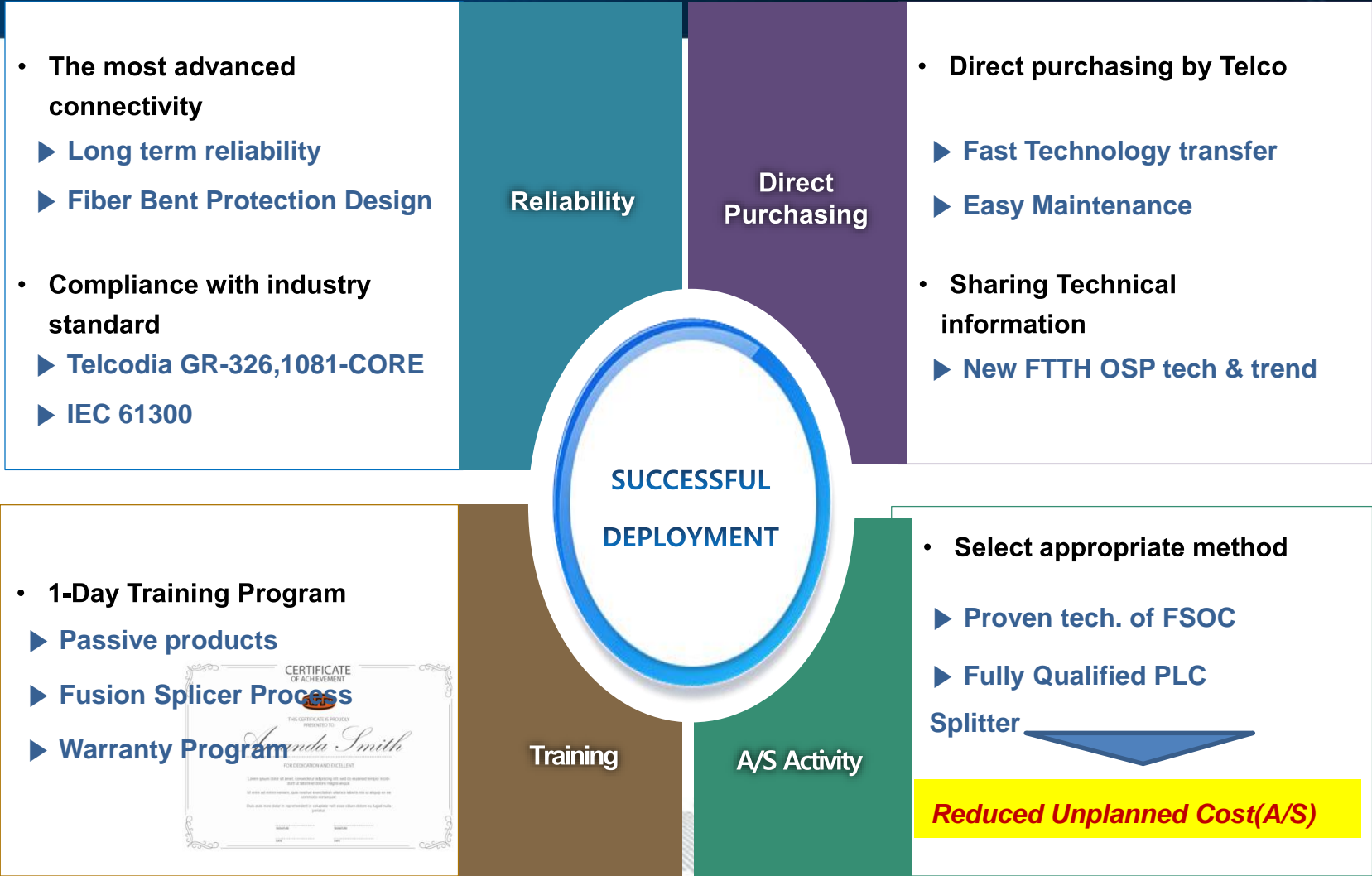
- Prevent Fiber Bending Structure
- Guarantee Long Term Reliability (No Matching Gel)
- Figure out failures induced by Craft (Human Error)

- Save cost for repair or maintenance (200%~)
- Eliminate potential malfunction rate
- After Break Even Point, Cost down dramatically

COST Benefit

8. Roll Out FSOC Business

FTTH SOLUTION



9. Fusion Splicer Line-Up

FTTH SOLUTION

✓ Clad

✓ Active Clad

✓ Core to Core

✓ Ribbon



2
Motor
s



4 Motors



6 Motors



2
Motor
s

Thank You

