CA-1C

FIBER OPTIC CABLE (INTERNAL)

Date: 09 May 2024

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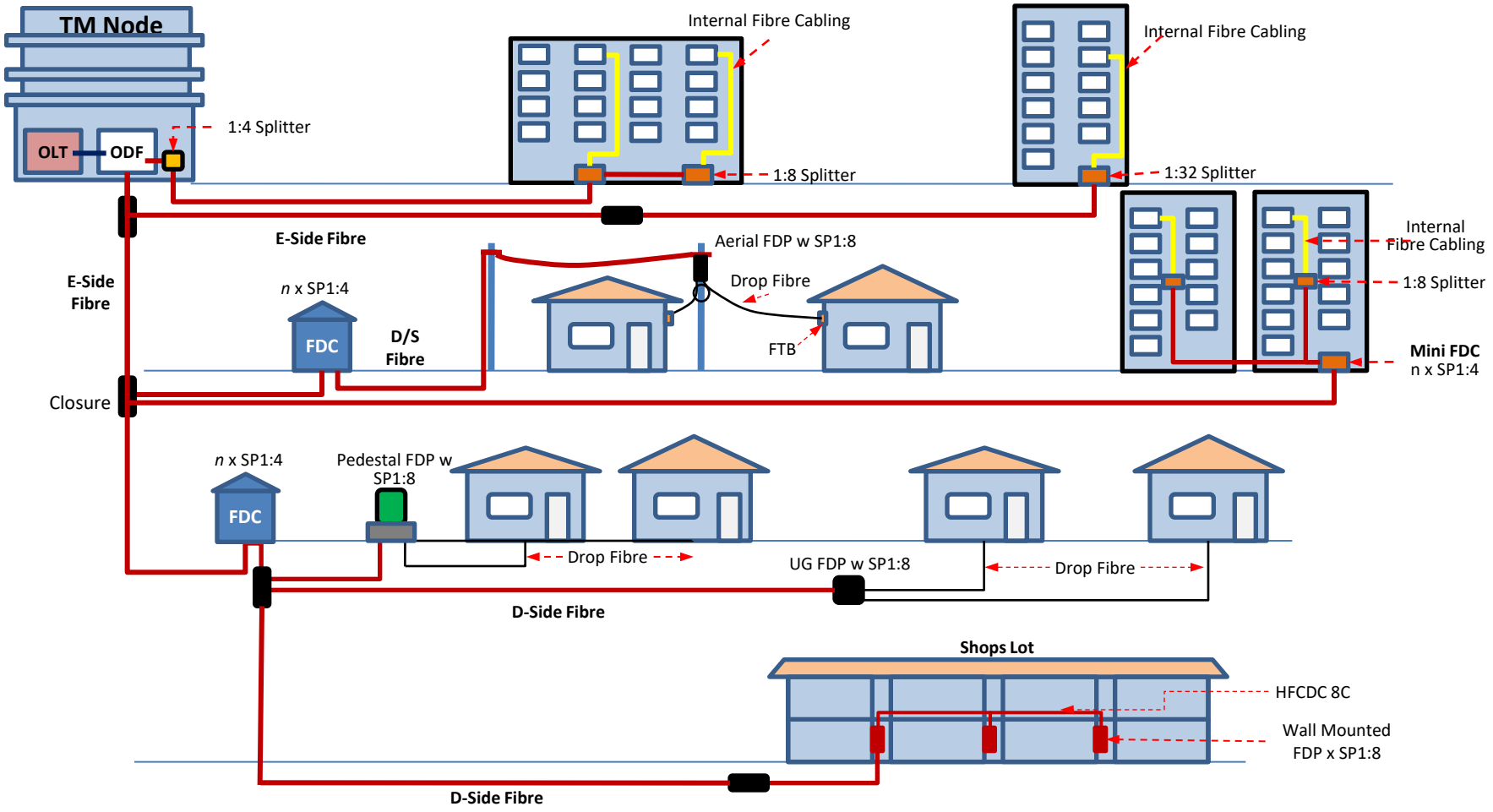
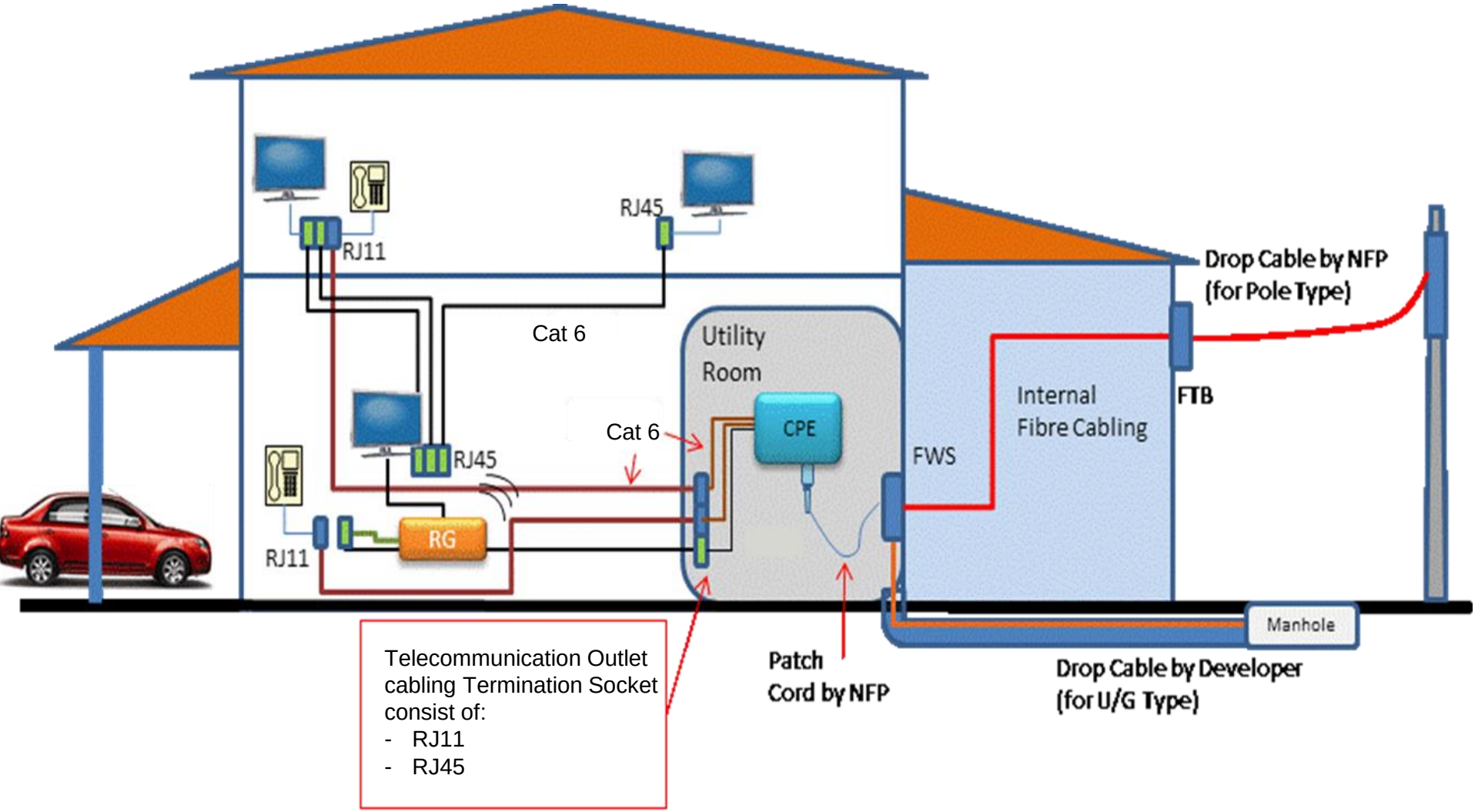
Introduction to Internal Cabling Network

FTTH Access Network



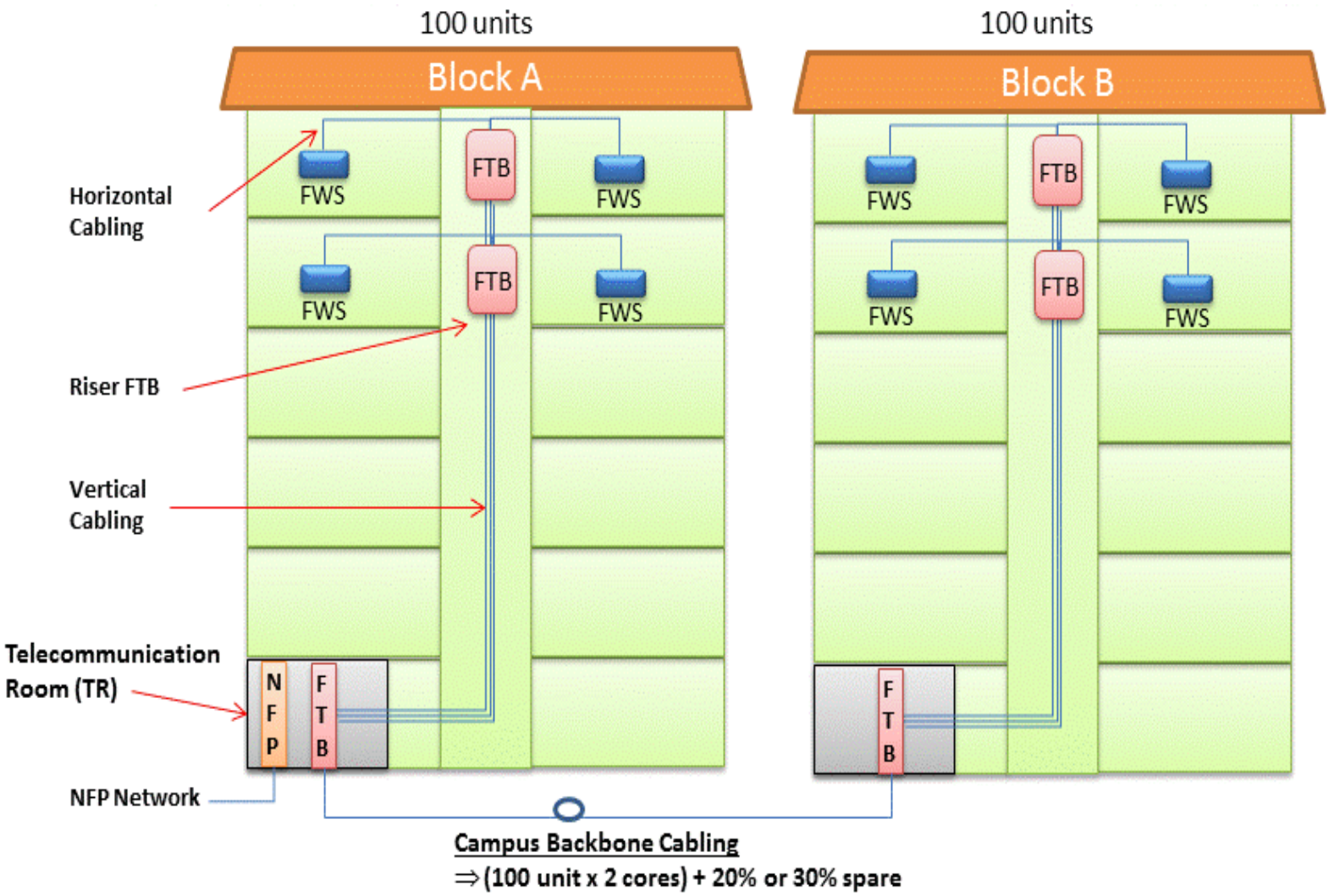
Internal Cabling for Landed House



Telecommunication Outlet cabling Termination Socket consist of:

- RJ11
- RJ45

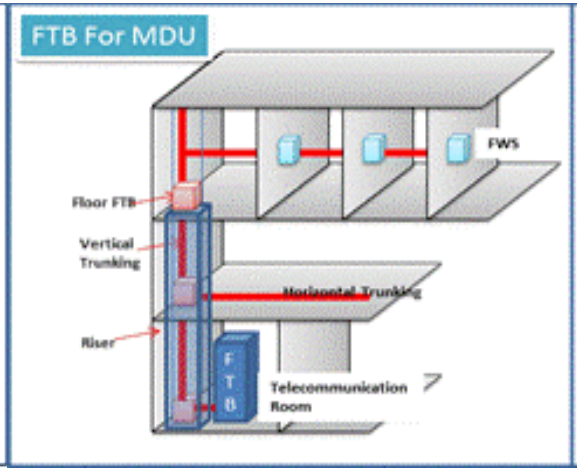
Internal Cabling for Highrise Building

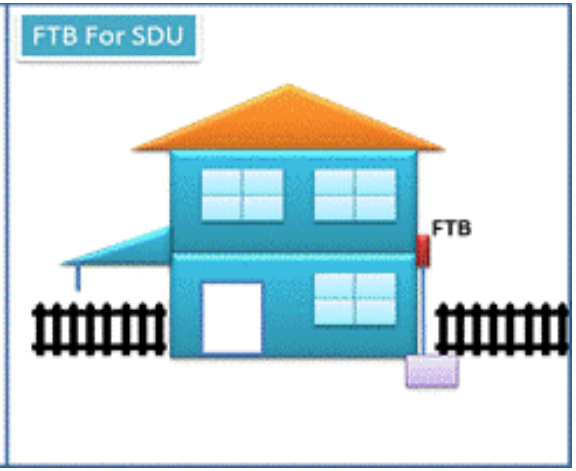


Fiber Termination Box (FTB)

FTB for MDU located in TR

FTB for MDU located in Riser Room

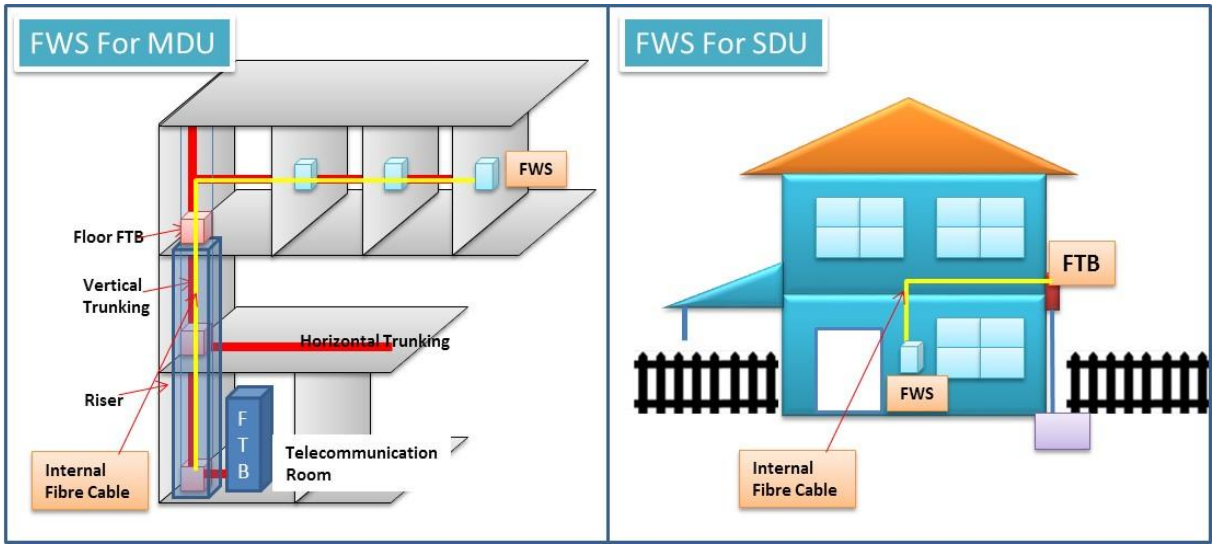




Features

- Large capacity ~ 1,000 termination – ODF type located at TR
- Medium capacity 12 – 96 termination – located in Floor Riser
- Small type 2-8 termination – Locator at individual premise
- SC/UPC adaptor type
- Interface point with NFP

Fiber Wall Socket (FWS)

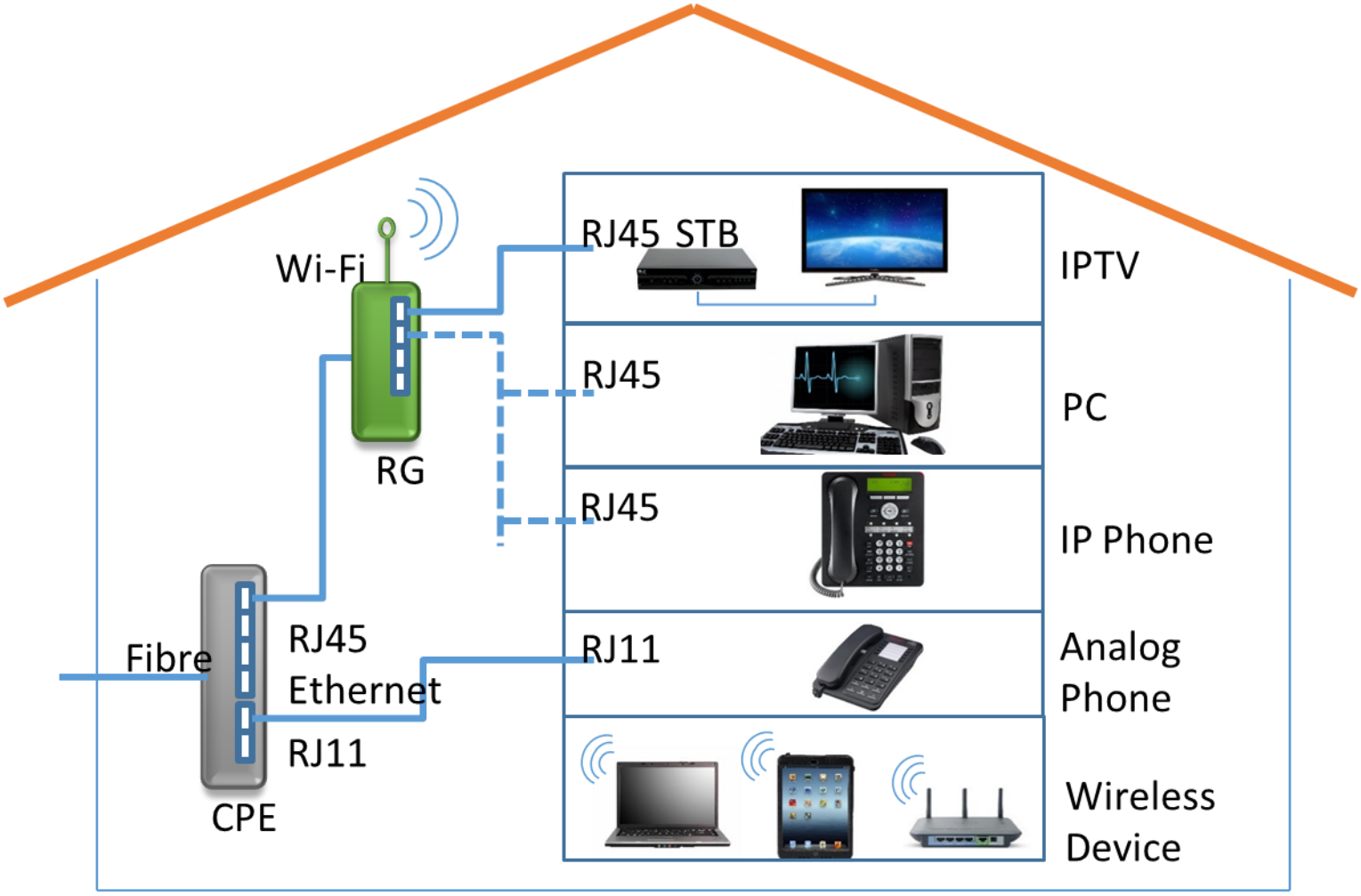


FWS

Features

- Ability to allow cables to enter from rear, bottom or of the unit.
- Proper routing, bend radius protection and strain relief of incoming cable
- Built-in auto shuttered SC adaptor as customer's required
- Drop cable terminated with Field Assembly or Fusion Splice with pigtail
- SC or duplex LC connector available
- Material is ABS/PC and Flame Retardant

Customer Premise Equipment (CPE) Setup for Triple Play Services



CPE: Customer Premise Equipment, RG: Residential Gateway, IPTV: Internet Protocol TV, STB: Setop Box

Service Content – Triple Play

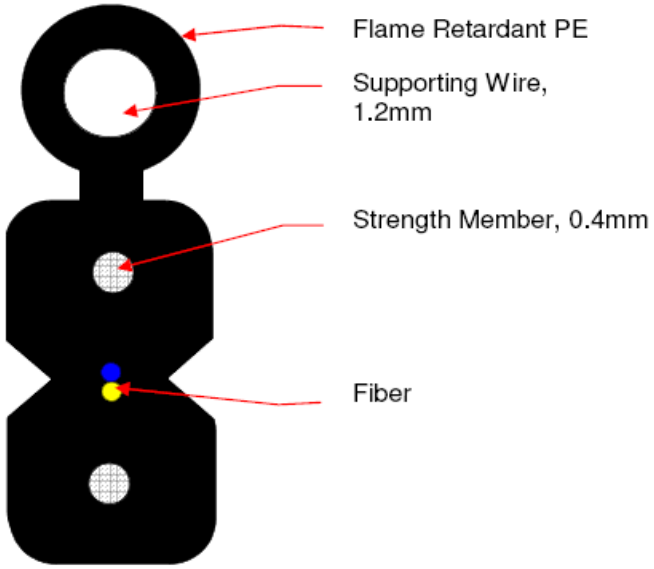
Triple play – Voice, Video and Data

- **Voice –** VoIP (Voice over IP) is used instead of conventional PSTN system. VoIP lowers telephony cost
- **Video –** IPTV over PON offers broadcast TV and also Video on Demand at SDTV and also HDTV quality
- **Data –** High Speed Broadband at 100Mbps and 2Gbps are currently available.

03

Outdoor Fiber Cable & Indoor Fiber Cable

Outdoor Drop Fiber Cable

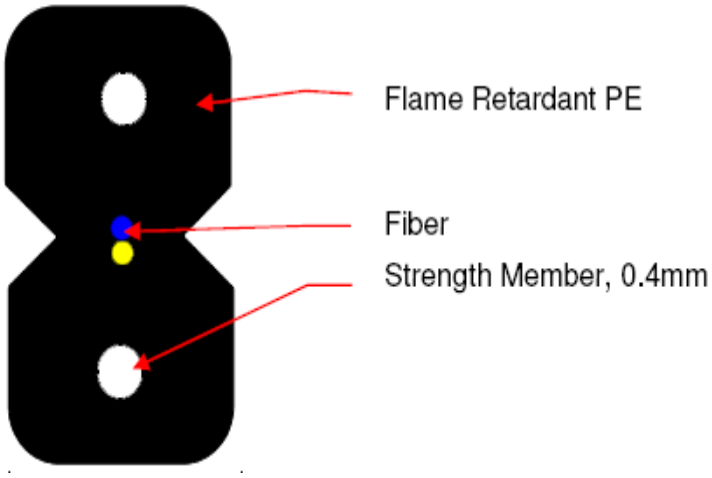


Cross sectional for Outdoor Fiber Cable

Features

- For outdoor installation – Drop Fiber Cable
- Used for connection between Fiber Distribution Point (FDP) and Fiber Termination Box (FTB)
- One or two fiber; ITU-T Rec G.657 (Bend Insensitive Fiber)
- Halogen Free Flame Retardant sheath
- Estimated Fiber Loss : 0.4 dB/km

Indoor Fiber Cable

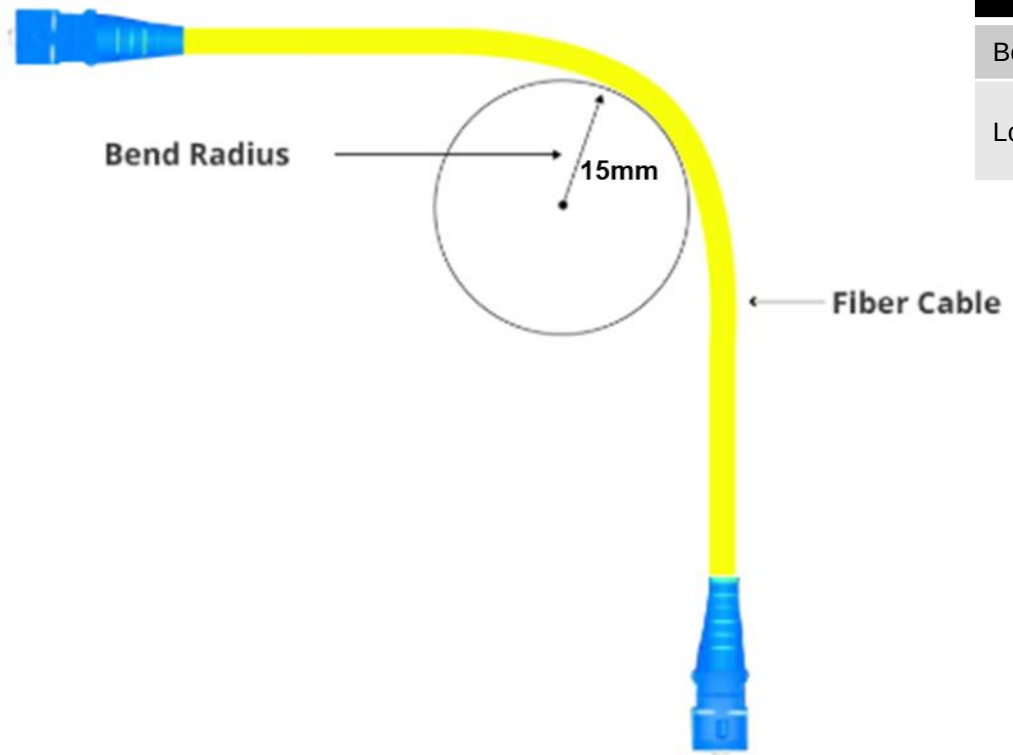


Cross sectional for Indoor Fiber Cable

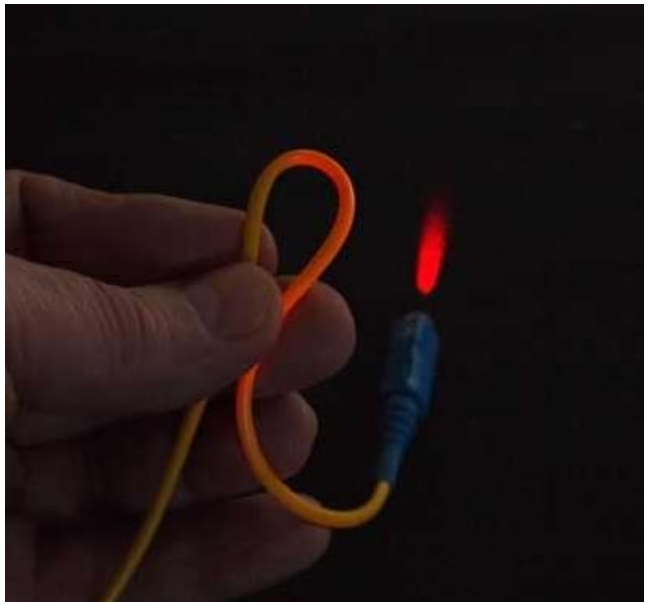
Features

- For indoor installation
- Used for connection between Fiber Termination Box (FTB) and Fiber Wall Socket (FWS)
- One or two fiber; ITU-T Rec G.657 (Bend Insensitive Fiber)
- Halogen Free Flame Retardant sheath
- Estimated Fiber Loss : 0.4 dB/km

Bending Radius for Outdoor and Indoor Fiber Cable



Fiber Type	G.652D	G.657A	G.657B
Bending radius	30mm	15mm	7.5mm
Location	OLT-ODF	FDP-FTB FTB-FWS	FWS-ONU



04

Type of Connectors and Adapters

Type of Connectors

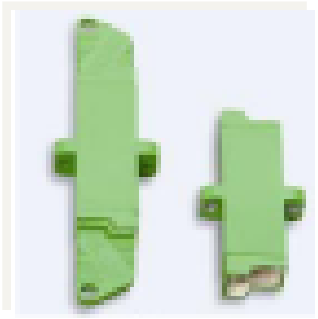
E2000

SC (Subscriber Connector)

FC (Ferrule Connector)

LC (Lucent Connector)

Type of Adapters



E2000 Adapter

SC Adapter

FC Adapter

LC Adapter

- To connect between two connectors
- Used at ODF, FDC, FDP, FTB and FWS

05
Tools and Test Gears

Power Meter

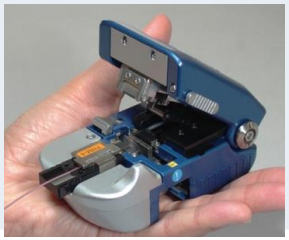
GPON Power Meter for testing FTTH optical network. It allows for the testing of passive optical networks (PONs) at the three main wavelengths (1310nm, 1490nm and 1550nm) used in FTTH.

Visual Fault Locator

1. **1mW 5KM** Visual Fault Locator Fiber Optic Cable Tester Meter

2. **10mW 10-12KM** Visual Fault Locator Fiber Optic Laser Cable Tester

Tools For Splicing

Splicing Machine		A splicing machine typically refers to equipment used in the telecommunications industry for joining optical fibers together
Cleaver		A fiber cleaver is a specialized tool used in the field of fiber optics to precisely cleave (cut) optical fibers cleanly and accurately.
Fiber Stripper		Stripping tools used for removing the protective polymer coating around optical fiber in preparation for fusion splicing.
Cable Sheath Stripper		Stripping tools used for removing the cable sheath for drop fiber cable

Tools For Splicing

Lint Free tissues / Dust free tissues		This type tissues used as wipers, its are soft, non-abrasive and safe for most delicate surfaces. Wipe clean, less fluff, and extractable. Easily wipe liquid and dust.
Alcohol		Alcohol is extremely effective cleaning chemical for communication fiber optic. It easily removes offending dirt and can resolve many issues with your fiber optic installation.
Protection sleeve		The protection sleeve fiber optic act as heat shrink tubes are tight and the metal support maintains its strength to prevent the fiber from breaking at the splice point.
Fiber Optic Disposal Unit		Fiber disposal container

Fiber Cleaning Kits

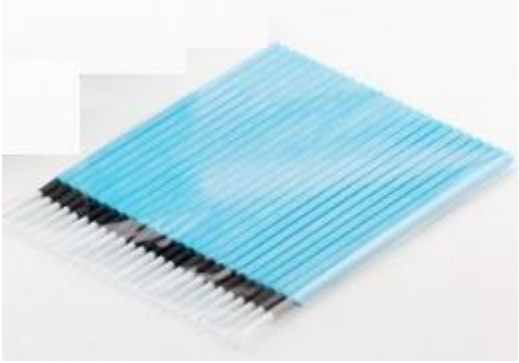
One Click Cleaner

Fiber Cassette Cleaner

99% Fiber Alcohol Wipes

Lint-free Tissues

99% Isopropyl Alcohol

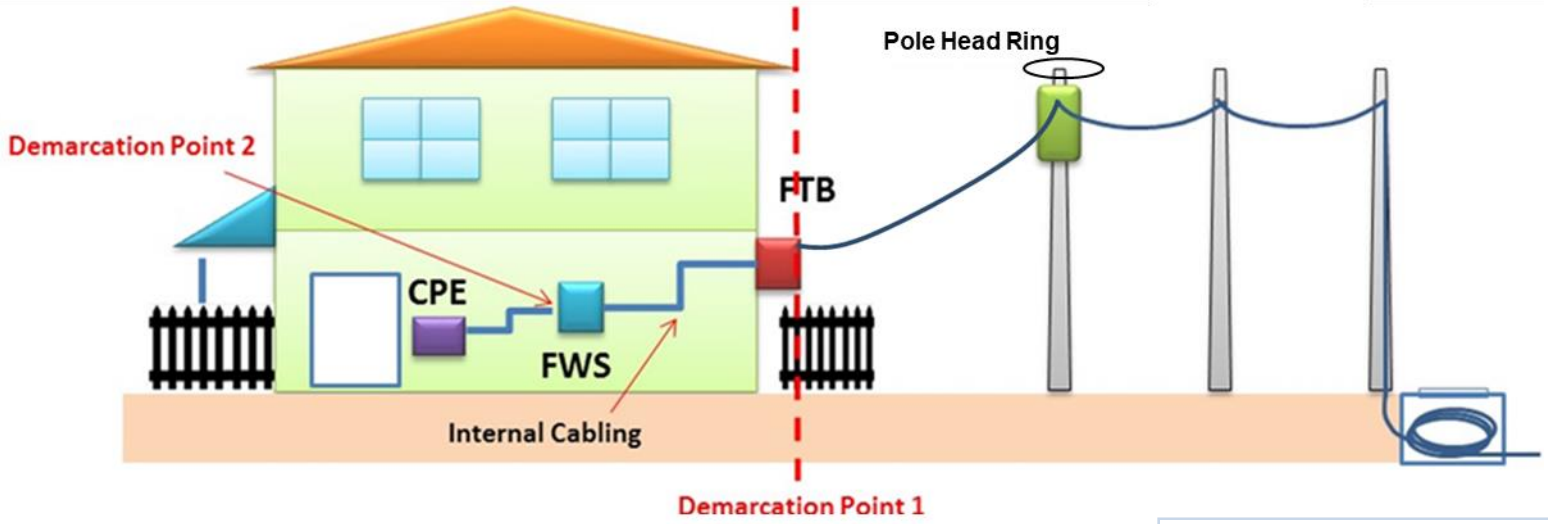


Lint-free Swab

06

Installation of Internal Cabling

FTTH Overhead Installation



Features

- Drop Fiber Cable will be pulled from on-Pole FDP to FTB.
- Termination IB Wire at Pole Head Ring and D-hook at Wall as shown in Figure 1 and Figure 2.
- FTB will be fixed onto customer premise wall.
- Demarcation 1 – between Outdoor Cabling and Internal Cabling.
- Demarcation 2 – between Internal Cabling and CPE Cabling.
- Microduct need to be install if the internal fiber install over the celling or underground to protect the cable from rodent.

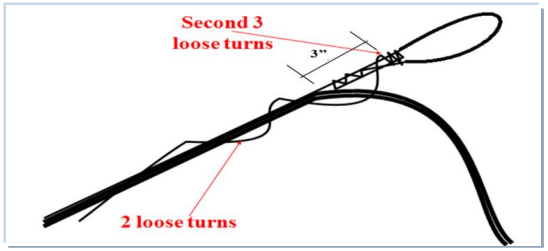


Figure 1

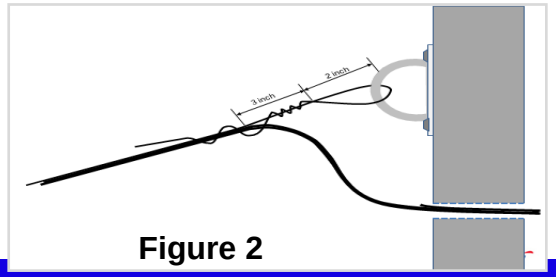


Figure 2

Drop Fiber Cable termination at Pole and Wall

- Good cable bearer installation shall minimize swinging impact to the connector.

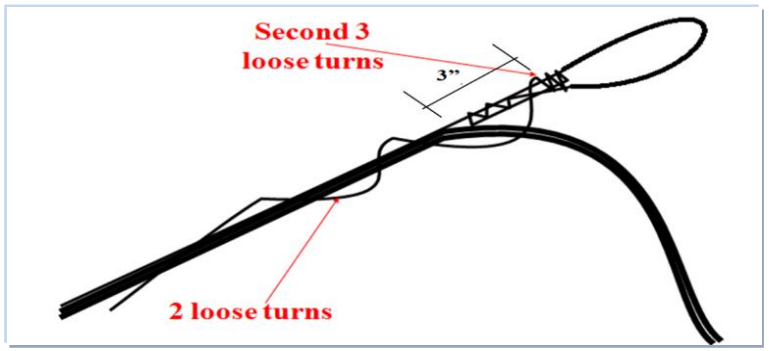


Figure 1

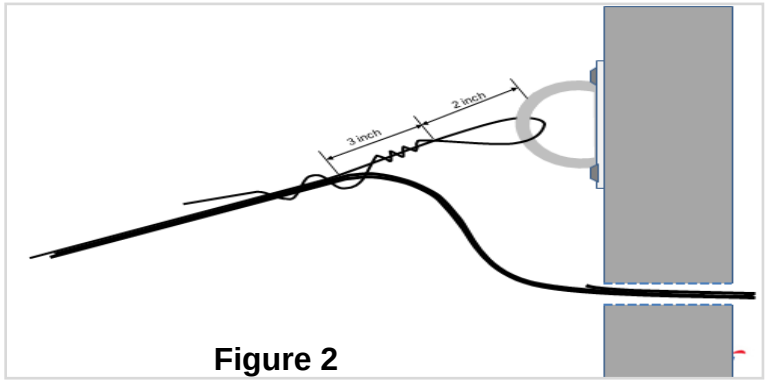
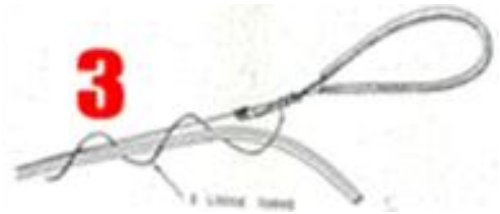


Figure 2

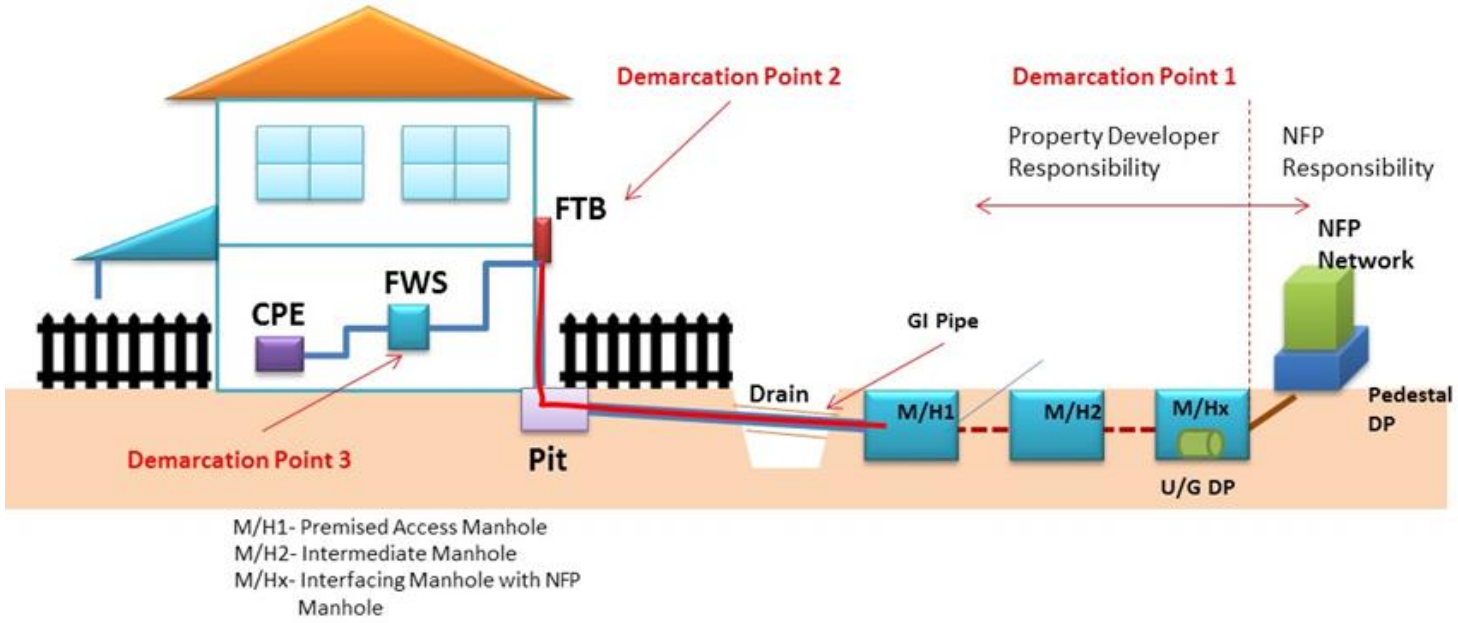
Penamatan drop fiber pada pole head ring di pintal sebanyak 3 kali

Pintalan seterusnya sebanyak 3 kali dilakukan di hujung berdekatan dengan pole head



Seterusnya sekurang-kurang 2 pintalan dilakukan pada drop fiber

FTTH Underground Installation



Features

- Drop Fiber Cable will be pulled from Pedestal or Underground FDP to FTB
- FTB will be fixed onto customer premise wall
- Demarcation 1 – between Telco Cabling and Outdoor Cabling (FDP to FTB)
- Demarcation 2 – between Outdoor Cabling and Internal Cabling (FTB to FWS)
- Demarcation 3 – between Internal Cabling and CPE Cabling (FWS to CPE)
- Microduct need to be install if the fiber cable installed over the celling or underground to protect the cable from rodent.

Installation of FTB and Drop Fiber

1. Installation of FTB will differ according to type of customer premise. Customer premise are defined as:
   - **SDU** – Single storey & double storey terraced, semi detached bungalow house and shop lot.
   - **MDU** – Condominiums, apartments and high-rise buildings.

2. Pull drop fiber with the FA-SC connector attached from FDP to the premise.

3. Attach one end of the drop fiber with the FA-SC connector to the FDP port.

4. Attach the other end of the drop fiber with the FA-SC connector to the FTB port.
   - Clean the connector ferrule before attaching to FWS.

Drilling Process for FTB Installation

1. Drilling must be from inside the house to the outside house
   - To make sure less breaking to the wall inside the house while drilling operation

2. Plaster filling must be applied after drilling operation
   - To rebuild the surface of wall that broken because of drilling

3. Use the metal detector to detect metal piping inside the wall
   - This action strictly must do to prevent from leakage from the water pipe in the wall

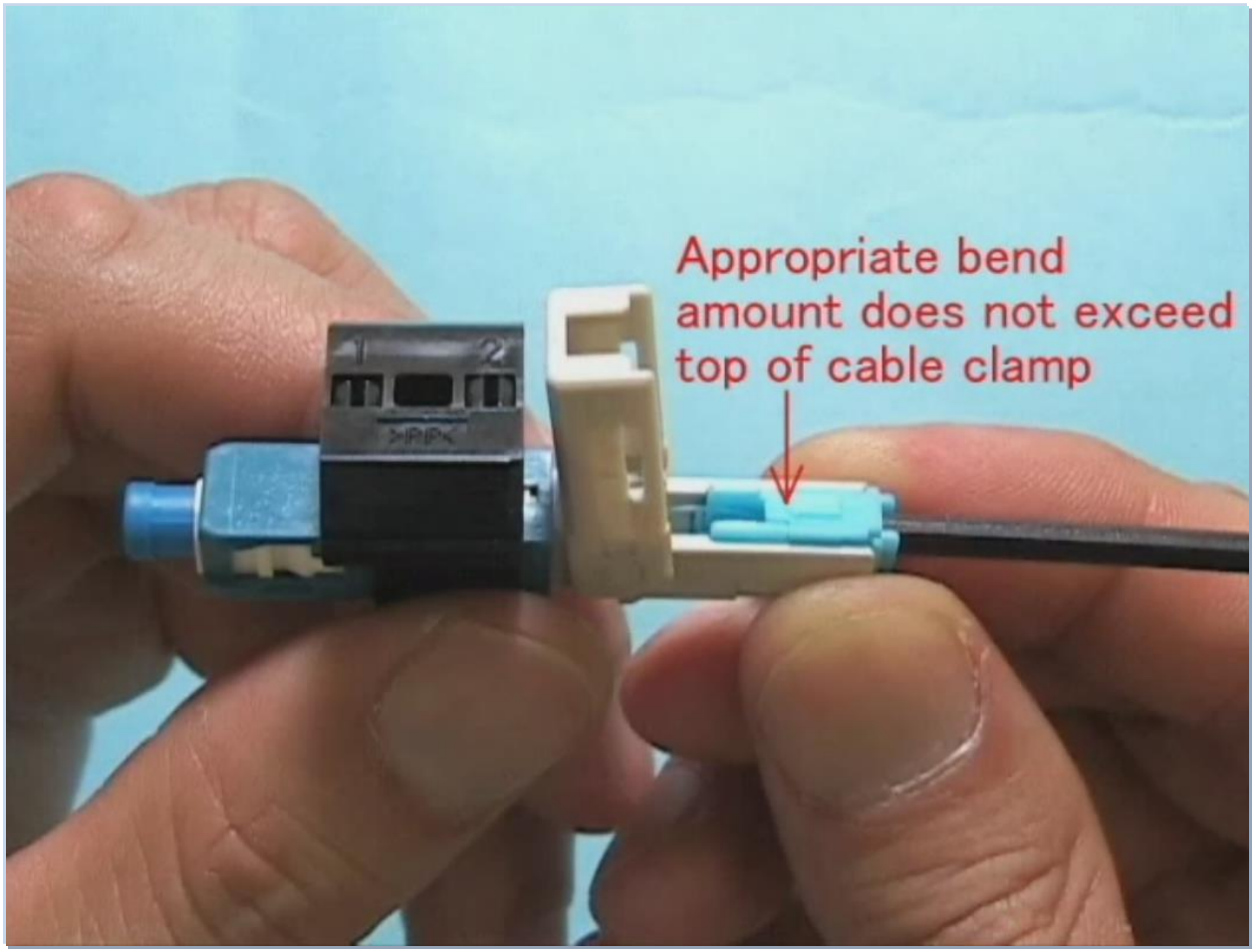
4. Observe the water tap location to determine the path of water pipe in order to avoid drilling the path of the water pipe

5. The determined the condition of the wall to be drilled (cement or plaster) to ensure that the drilling has a good grip
   - This is to ensure that FTB will hold

07

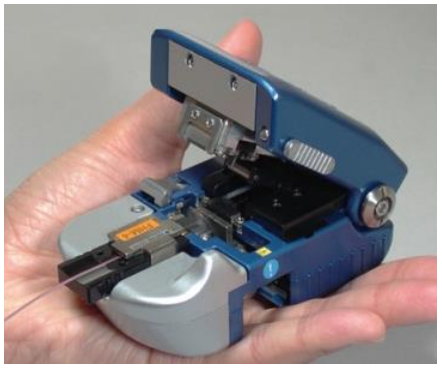
Installation of FASC Connector

Connector Assembly



- Places uses FASC connector:
  a. FDP
  b. FTB
  c. FWS

Tools for Connector Assembly



Cleaver

Fiber Stripper

Fiber Optic Disposal Unit

Lint-free Tissues

99% Isopropyl Alcohol

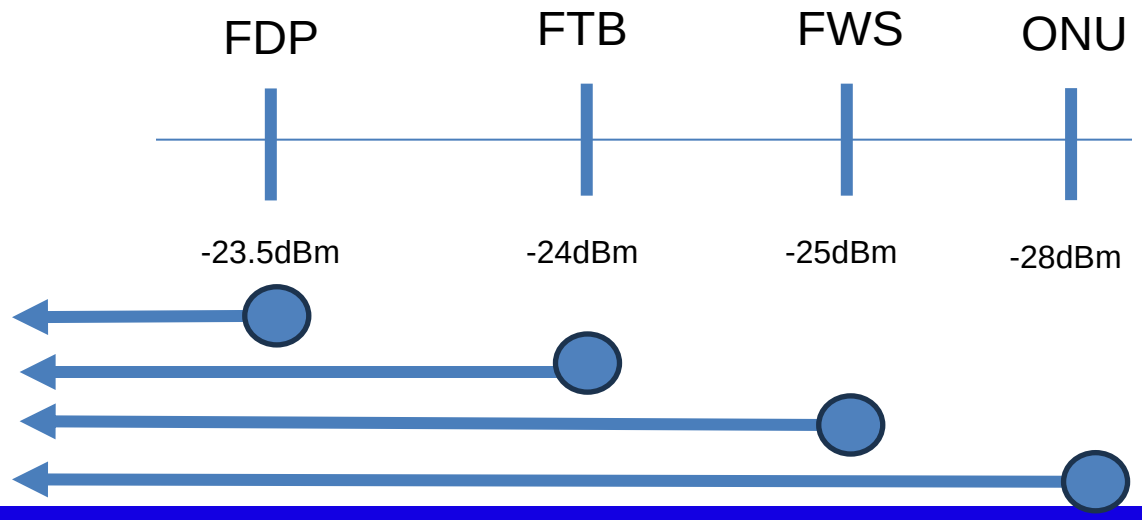
Cable Sheath Stripper

08

Installation of Customer Premise Equipment (CPE)

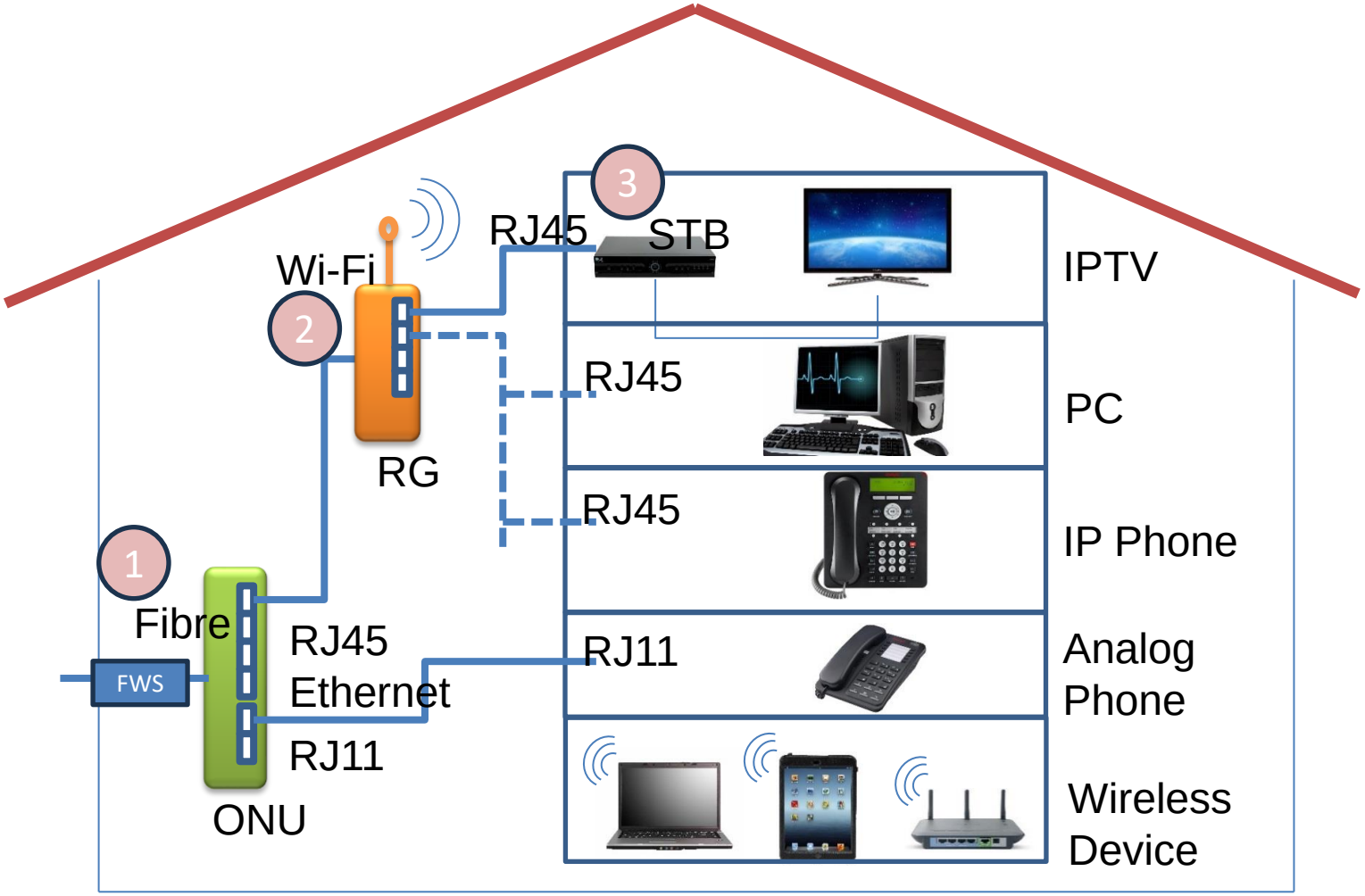
PREPARATION OF CPE INSTALLATION

1. Using a PON power meter, test the total link loss received at the FWS or end of connector at customer end.
2. Absolute power measurement should be more than -25 dBm. If the value is less than -25 dBm, clean the connector using alcohol and lint-free cloth.
   - Clean the connector with connector cleaner after and before the test.
3. Repeat measurement of absolute power level.
4. If the measurement is LESS than -25 dBm, test the loss measurement at every connection (FTB & FWS) to ensure it is within specification.
   - The reading should be 0.5dB or less at every termination



LETAK LEVEL

Layout of CPE in Customer Premise



ONU: Optical Network Unit, RG: Residential Gateway, IPTV: Internet Protocol TV, STB: Setop Box

Workspace cleanliness after the installation

1. Ensure all the packaging materials (including the instruction manuals) are properly put away and handed over to customer.
2. Ensure all the tools and test gears are stored back in the toolbox.
3. Ensure that the workspace inside and outside customer premise is clean.
4. It is recommended to use a vacuum cleaner to clean the working area.

09

Example of FTTH Installation method

Determining location of CPE

Location of CPE (including BTU, RG, STB) must be suitable i.e
- Near to power socket
- Good ventilation
- Near to Television

Don’t place CPE at the location below;
- Inside store room or inside closed cabinet
- Near electromagnetic device such as microwave
- High temperature area such as above other device that generate heat example owen

Quality of the Drilling works

3

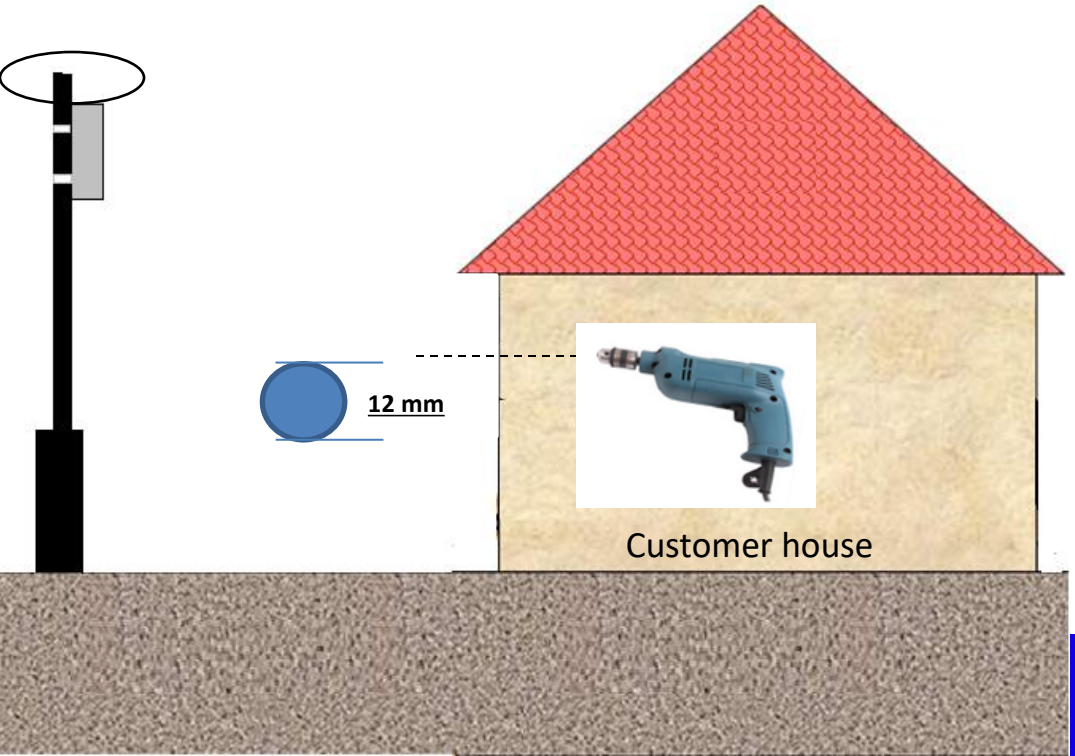
- Installer must be skilled in performing drilling works to avoid damage to customer's wall.

Drilling Operation

1. Drilling must be inside the house to the outside house
   - To make sure less breaking to the wall inside the house while drilling operation.

2. Plaster filling must be applied after drilling operation
   - To rebuild the surface of wall that broken because of drilling.

3. Use the metal detector to detect metal piping inside the wall



Peralatan keselamatan yang diperlukan oleh ‘Installer” sebelum melakukan kerja-kerja penggerudian ialah:
Goggle, sarung tangan, topi keledar keselamatan & penutup telinga

Blocked existing underground cable duct

4

- For certain customer premise with underground DP and cable duct, there are cases where the ducts are blocked.
- For blocked duct that cannot be recovered/rectified, new cable route need to be done. This would sometime involve hacking of concrete walls or floor tiling.

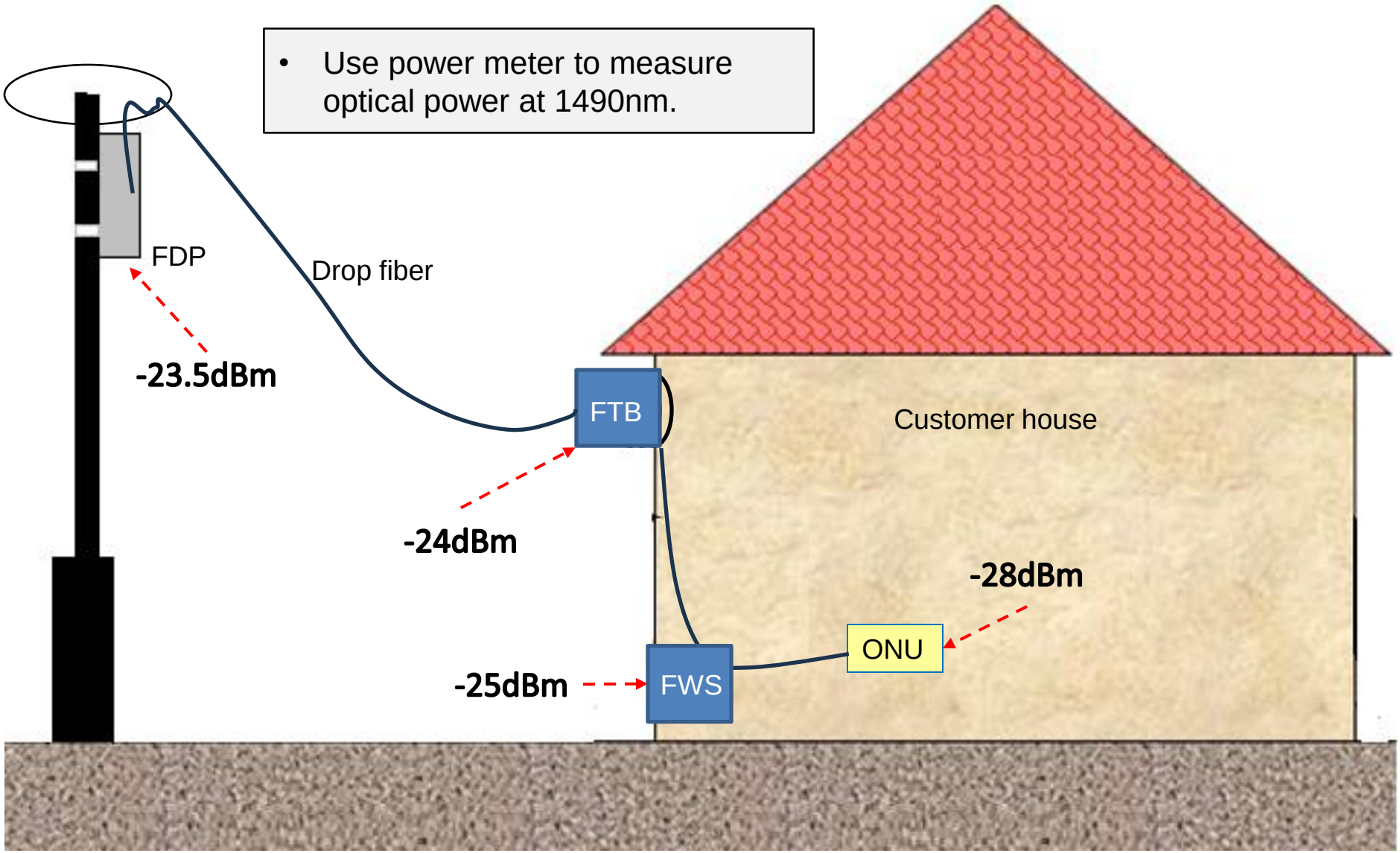
Example of Overhead Installation

Example of installation inside the house

10
Internal Cabling Testing

Check Power Level at FDP

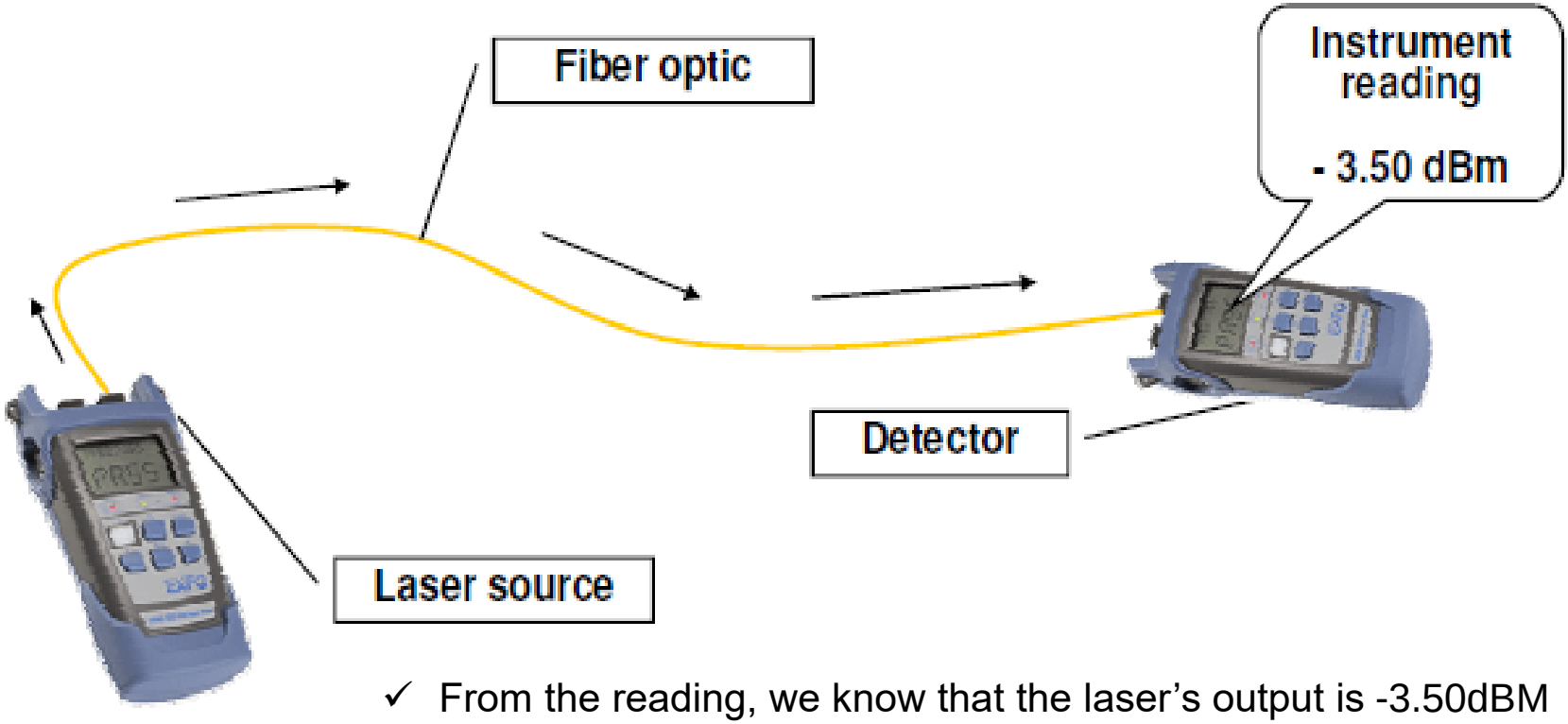
Minimum Optical Power for each point



Measurement Units of dBm

dBm

- **dBm** is refer to level of transmitting power, receiving power or instantaneous power in between.
- The dBm is used to measure the output power of the light source.

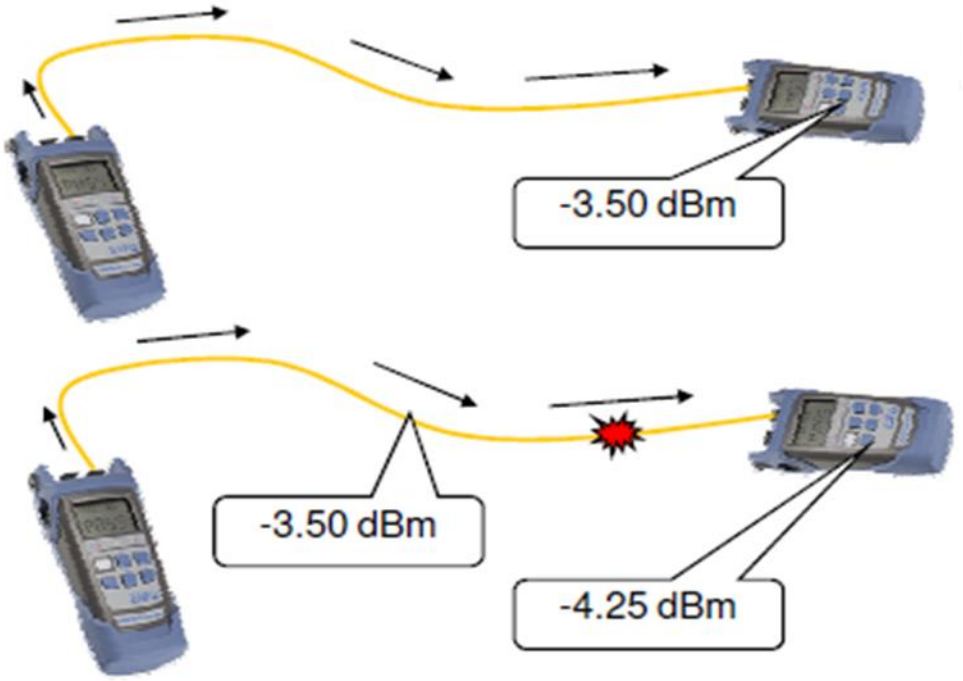


✓ From the reading, we know that the laser's output is -3.50dBM

Measurement Units of dB

dB

- **dB** is the different between 2 power measurements.
- We take the -3.50dBm laser's output shown previously….



Laser output = -3.50 dBm.

This is an event on the fiber and the detector reads -4.25 dBm.

To calculate this difference:

(-3.50 dBm) – (-4.25 dBm) = 0.75 dB

We have a loss of 0.75 dB.

So, the Insertion Loss is -0.75 dB.

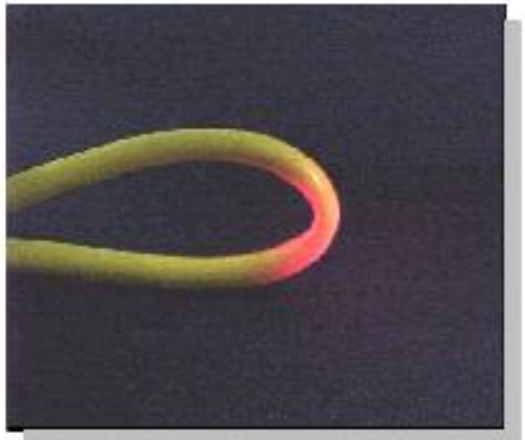
Measurement Units of ORL

Optical Return Loss (ORL) (dB)

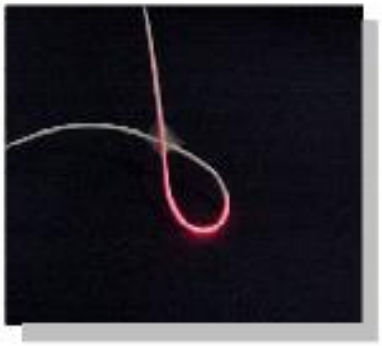
- Comes from the amount of energy lost within components and fiber due to back reflections.
- We use the term “ORL” when talking of the amount of energy returned by a section or an entire link.
- Expressed as a positive value.

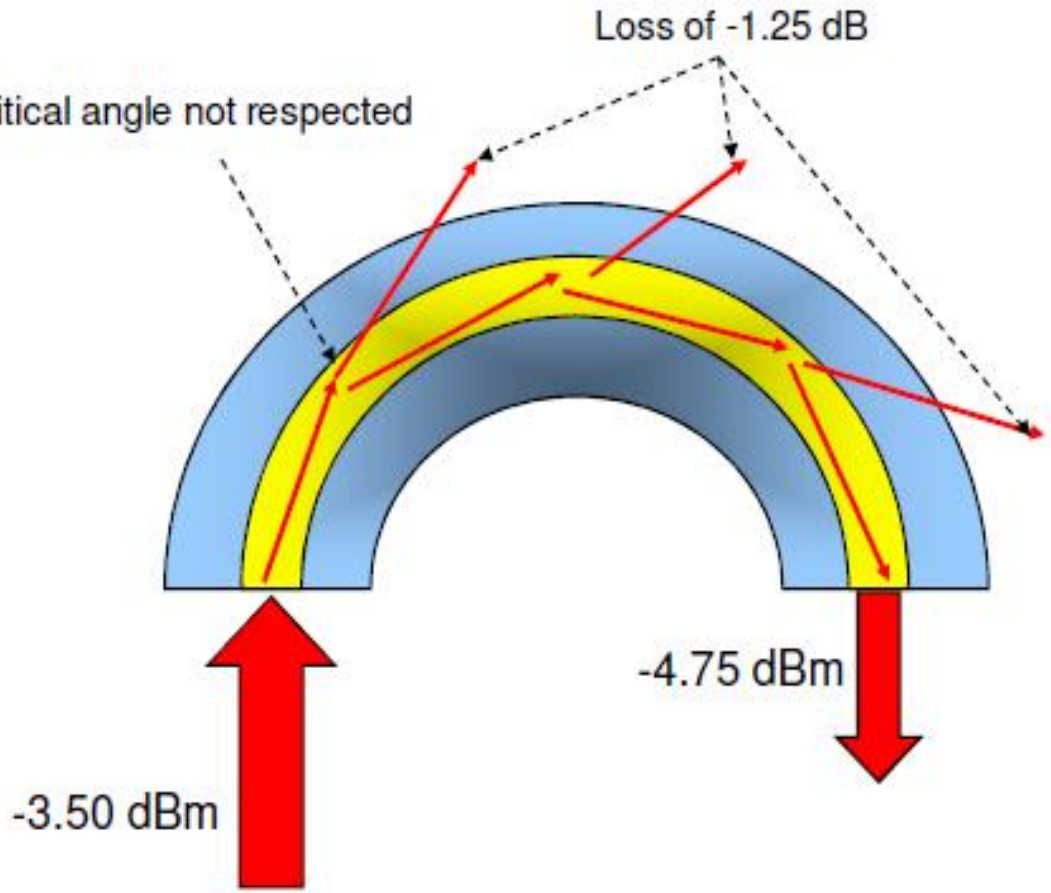
Type of Splitter FDC & FDP	ORL UP	ORL DWN
2:8 & 1:8	50dB	32dB
2:4 & 1:8	47dB	32dB

Macrobending

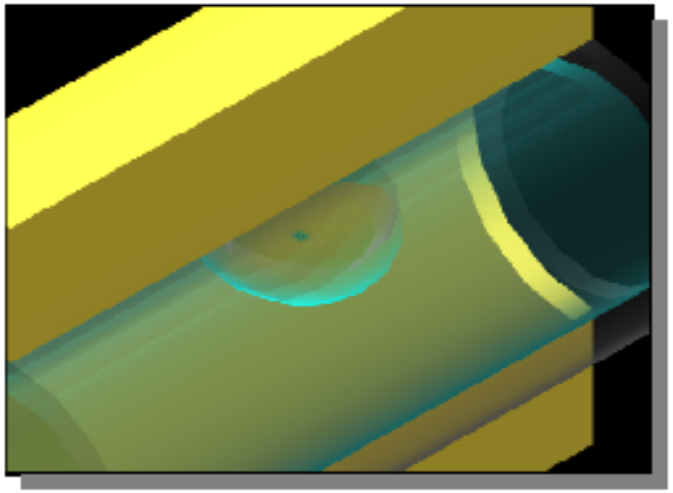


The minimal radius of curvature for Single Mode is 3 cm

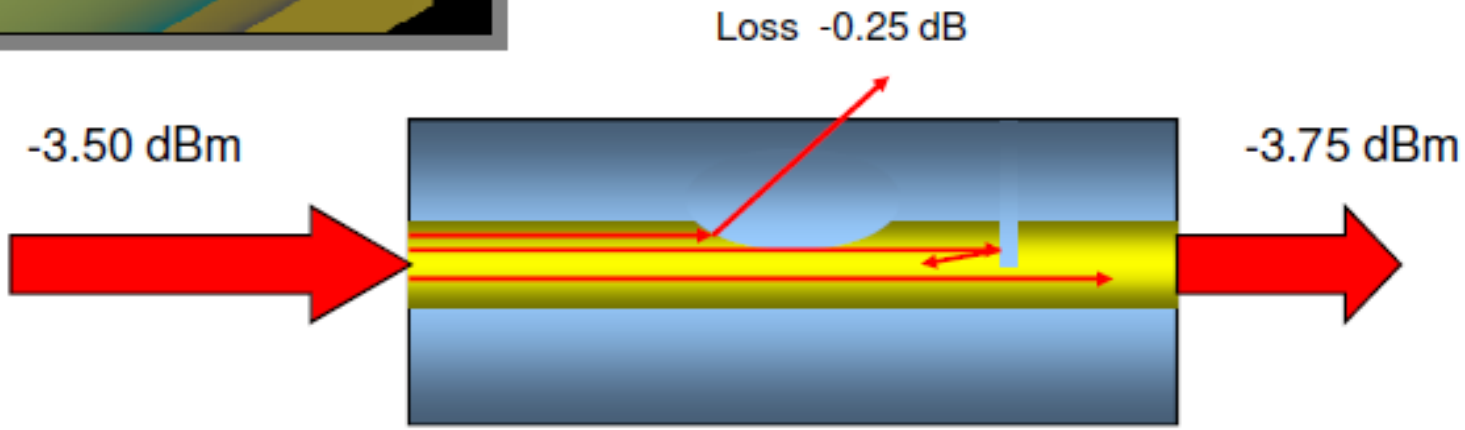




Microbending



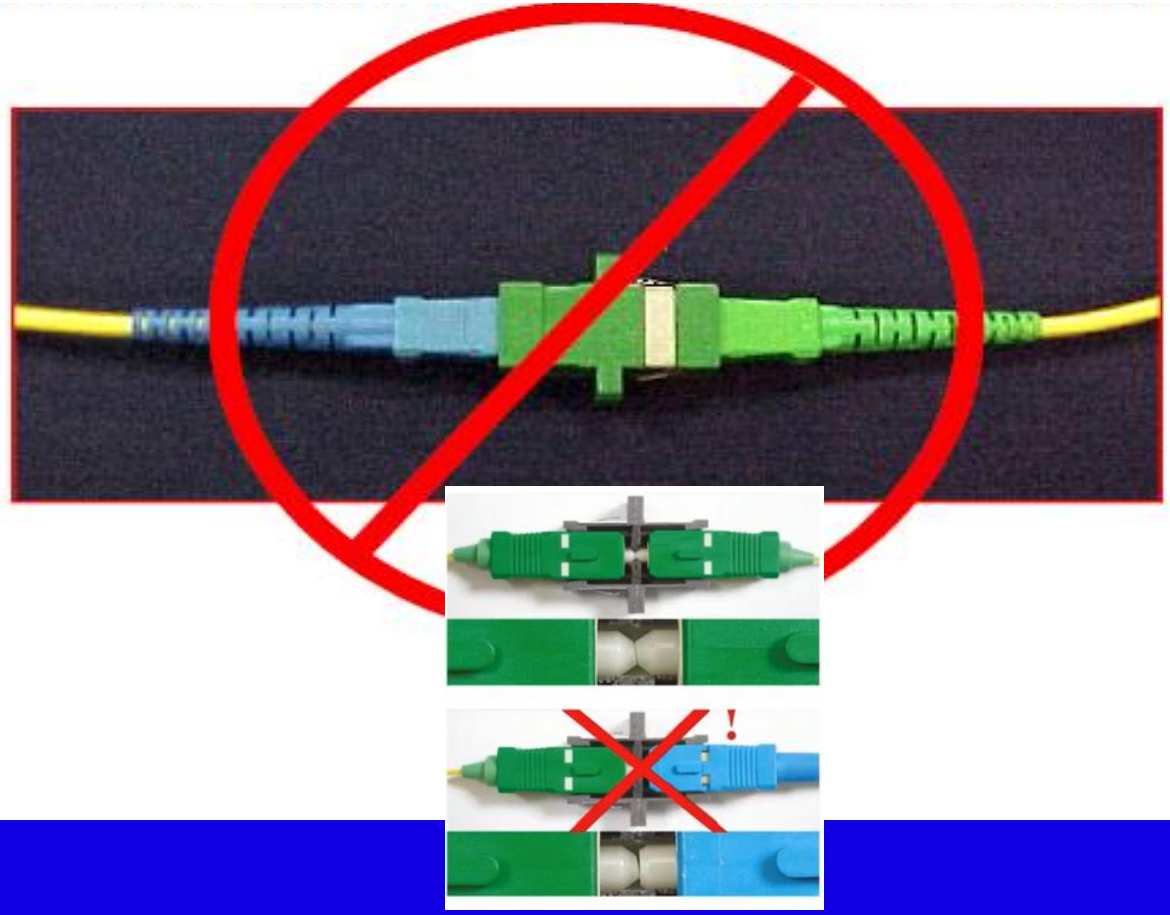
- Microbending are created during fabrication or due excessive bending.
- They create very minimal loss but can deteriorate the signal with time.



Connectors

WARNING !!!

- Angle Polished Connectors cannot be connected with Flat Polished Connectors.



Bad connectors handling

i. **Fiber connectors** are widely known as the ***WEAKEST AND MOST PROBLEMATIC*** points in the fiber network.

ii. **Fiber connectors** have extremely ***HIGH POSSIBILITY*** to create a high loss connection. To avoid this, they must be handled and connected properly.

iii. **Inspecting *BOTH SIDES*** of the connection are the ***ONLY WAY*** to ensure that it will be free of dirts and defects.

iv. It is recommended that **visual inspection** is done for fiber connectors at **every stage of handling *BEFORE*** connecting them.

v. Inspecting fiber connectors ***AFTER*** a problem is discovered, typically during troubleshooting, may caused connectors and other equipment have **suffered permanent damage**.

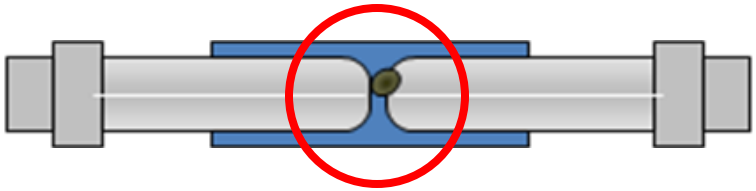
Fact 1 : Bad connectors contribute about **75% of network problems !**

Fact 2 : A **proper** and **convenience cleaning tool** is a must to everybody !!

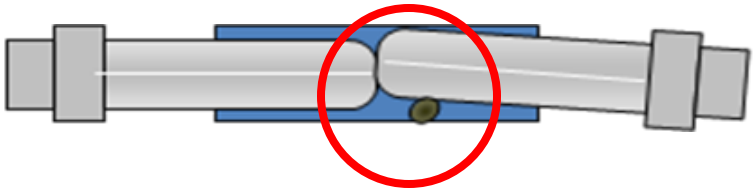
Fact 3 : Treat the **fiber inspection probe** as your best friend !!!

Bad connectors handling

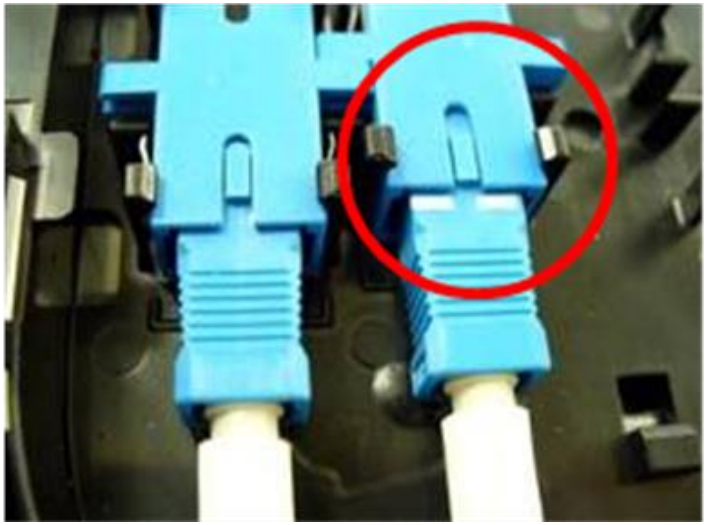
- Connector loss may happen if the connectors are not properly connected.



Contamination prevents connection



Contamination dislocates connection angle



Tools for cleaning the connectors

1. There are many different types of equipment available in the market to help cleaning the fiber connectors.
2. The most important tools required, but not limited to:

i. Pure alcohol and cleaning adapter

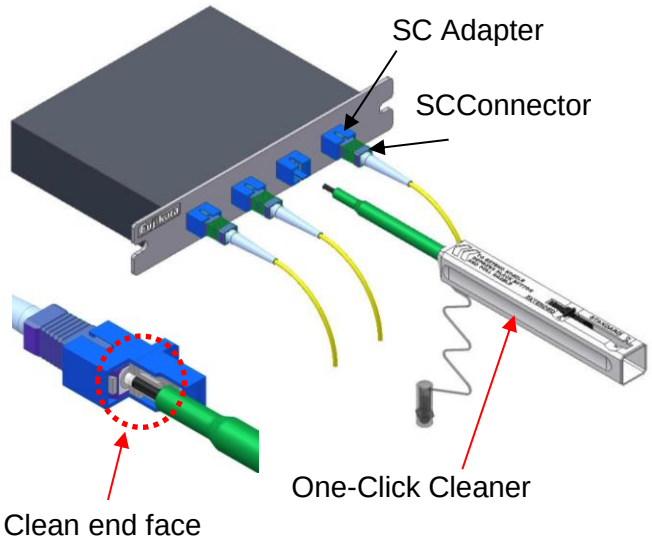
- To ensure the alcohol quality
- To ensure the paper quality

ii. Fiber optic inspection probe

- To ensure proper magnification to view fiber connector ends for cleanliness.

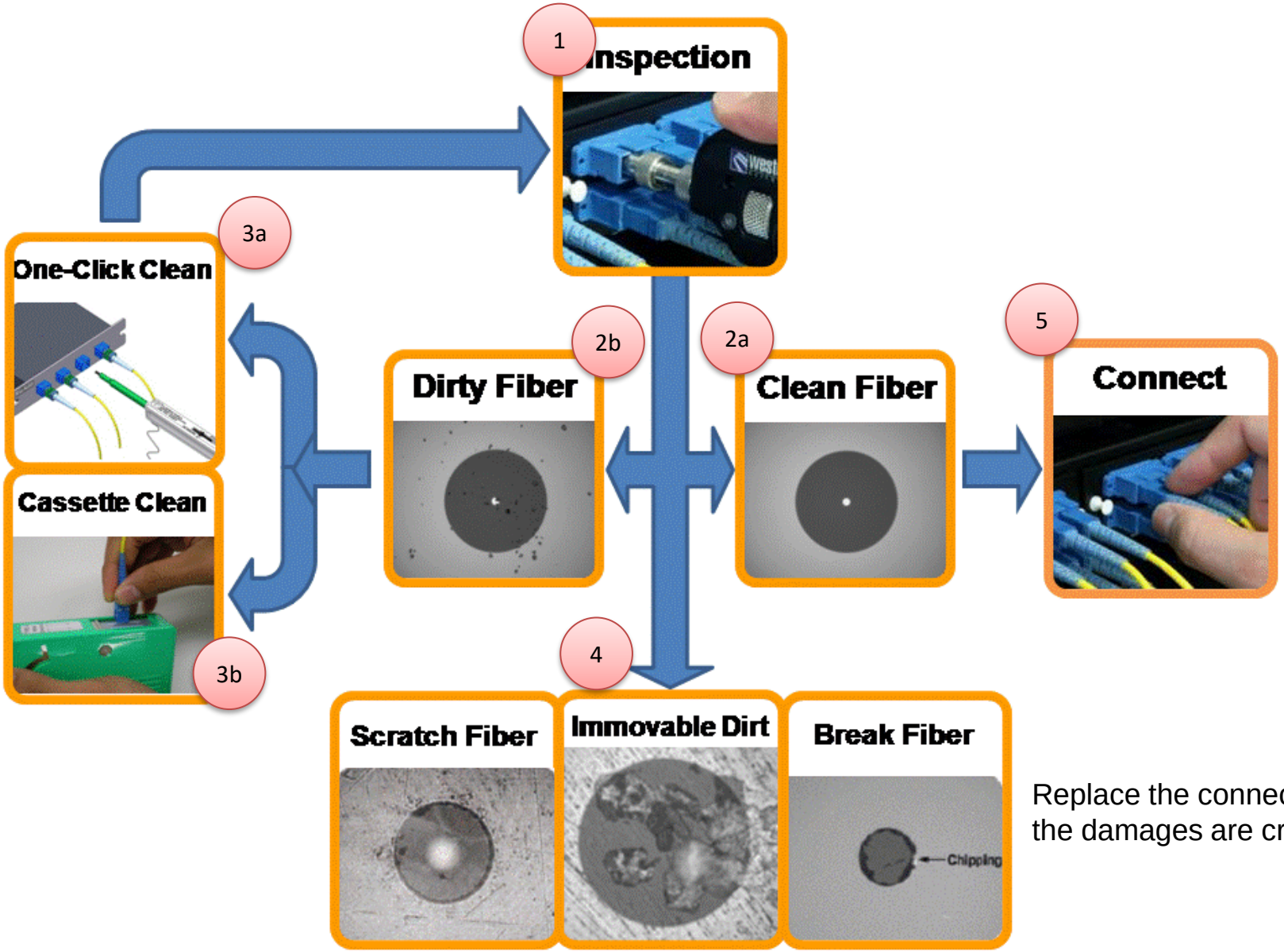
iii. Ferrule cleaner

- **One-click cleaner**
  - Convenience, fast and easily to clean the connectors as well as bulkheads which are installed in the patch panels.
- **Cassette cleaner**



Cassette Cleaner

Fiber Connector cleaning process



Replace the connector if the damages are critical

THANK YOU