ODN

Optical Distribution Network

FTTH Description and Overview

1. FTTH Introduction
2. Planning the Network
3. Building the Network

What is FTTH Networks (Broadband Network)

- FTTH Network = End-users are connected to a Central Point using only optical fiber cabling.
- Central Office (CO) = Center Point = Point of Presence (PoP) – transmission equipment to deliver applications and services
- End users = located in residences. “Fourth Utility” (Electric, Water, Gas, Fiber)

What do FTTH access networks connects?

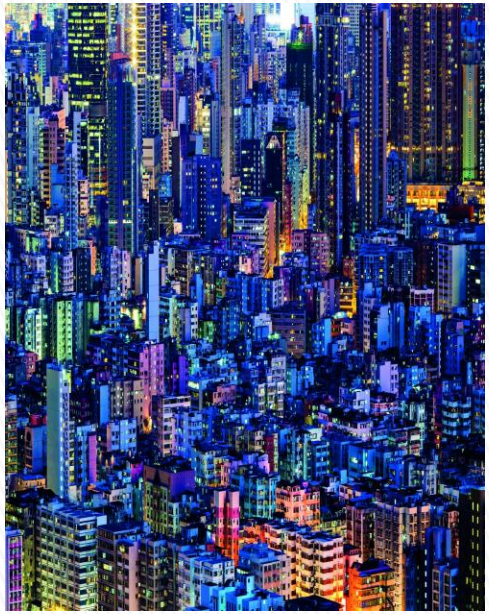
- Fixed Wireless Network (Wi-Fi, WiMAX).
- Mobile Base Stations (3G, 4G, 5G).
- SDU (Single Dwelling Units), MDU (Multi-Dwelling Units).
- Campus Network (schools, hospital and businesses).
- Security and monitoring (CCTV, alarms, control devices…).

What are the key attributes of a FTTH Network?

- High-bandwidth Services (100Mbps, …. 1Gbps)
- Direct Fiber Connection
- Future Service demands (IoT, AI … etc.)
- Future Network Upgrade and Expansion
- Minimum Disruption during Network Deployment

Influences on FTTH deployment

- Site Type – (Dense-urban, Urban, or Ruban).
- Network Size (256…4096 subscribers).
- CAPEX (USD 120 per Subscriber).
- OPEX (USD 1 per Month).
- Restrictions (Local, Authority).



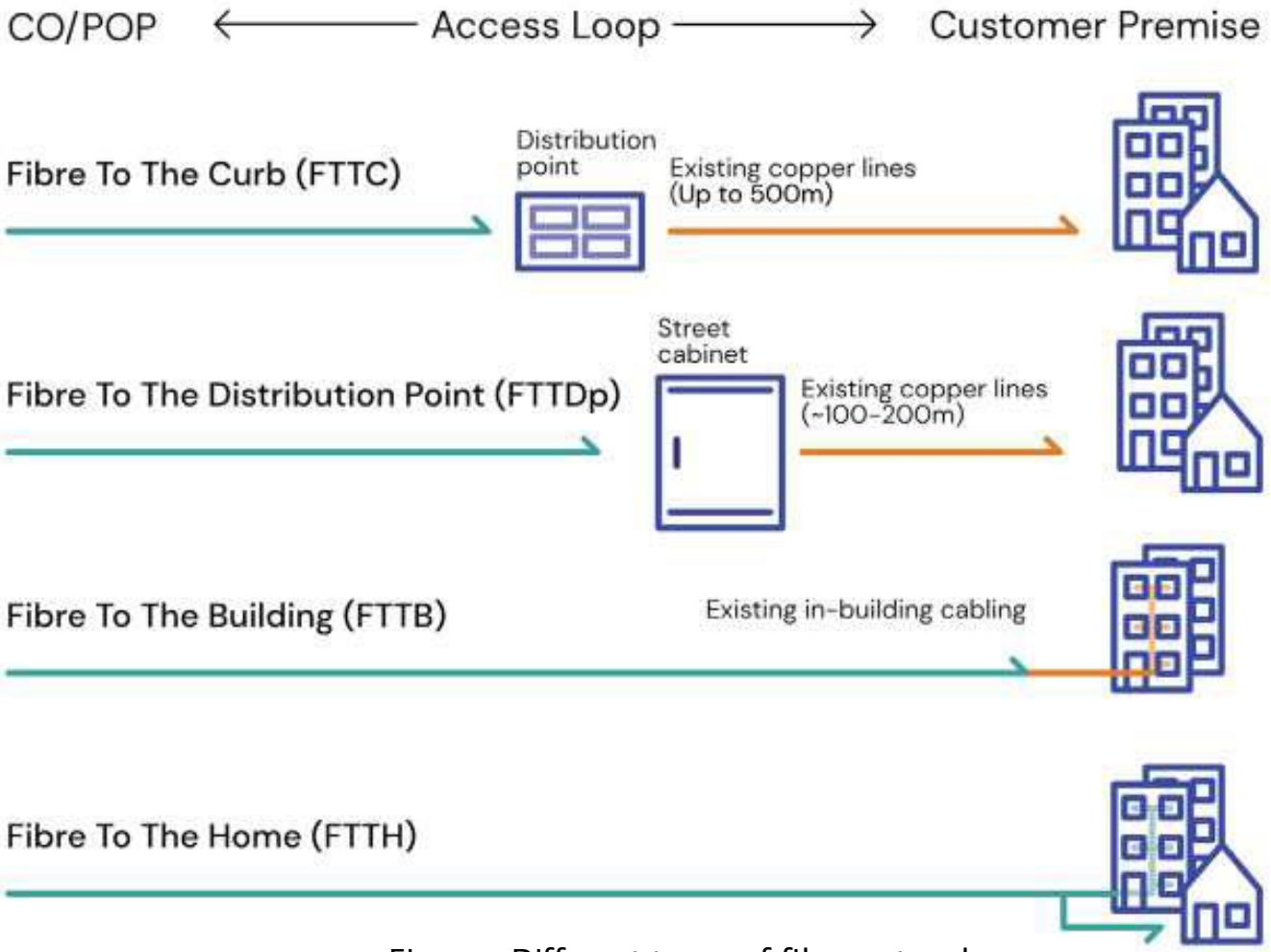
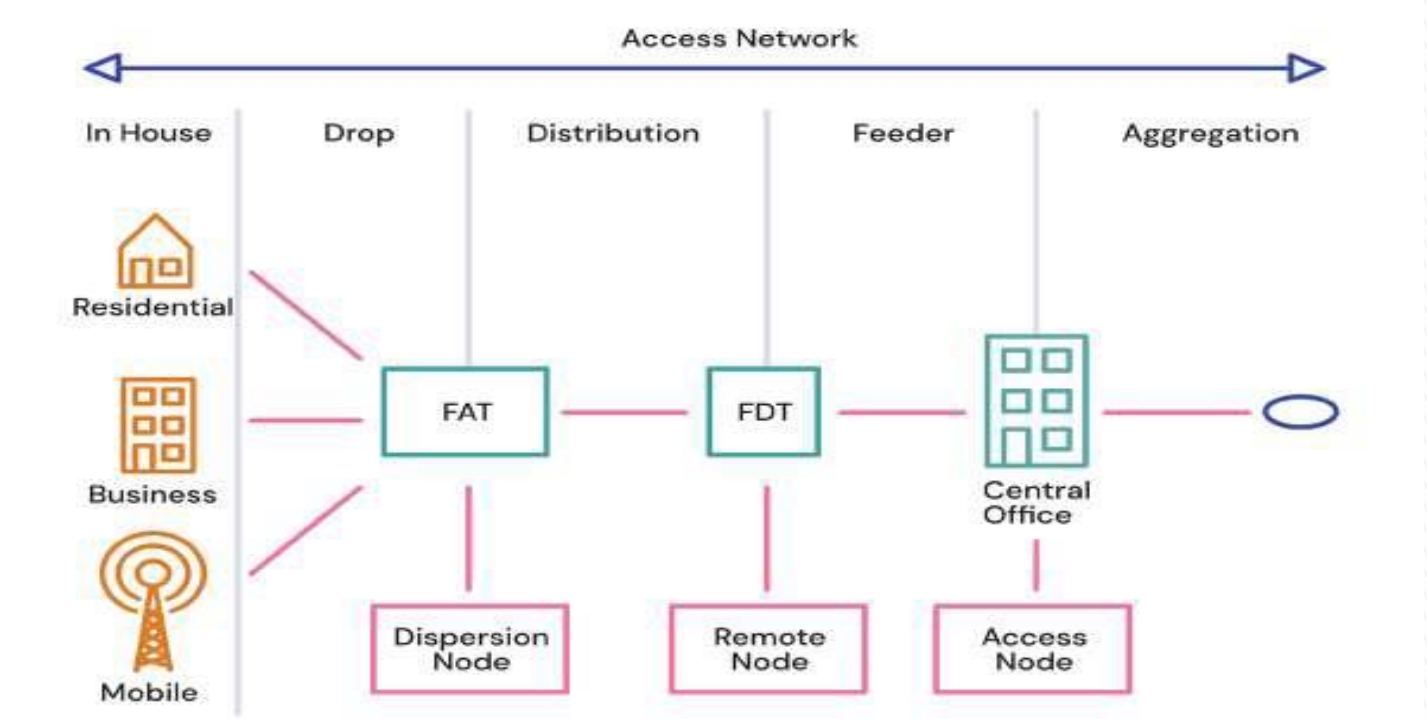


Figure . Different types of fiber networks

PLANNING THE NETWORK

Key Architecture Decisions

The access network is essentially the connection of end users to an aggregation node. It connects active equipment, such as OLT, to the end customer via different passive elements.

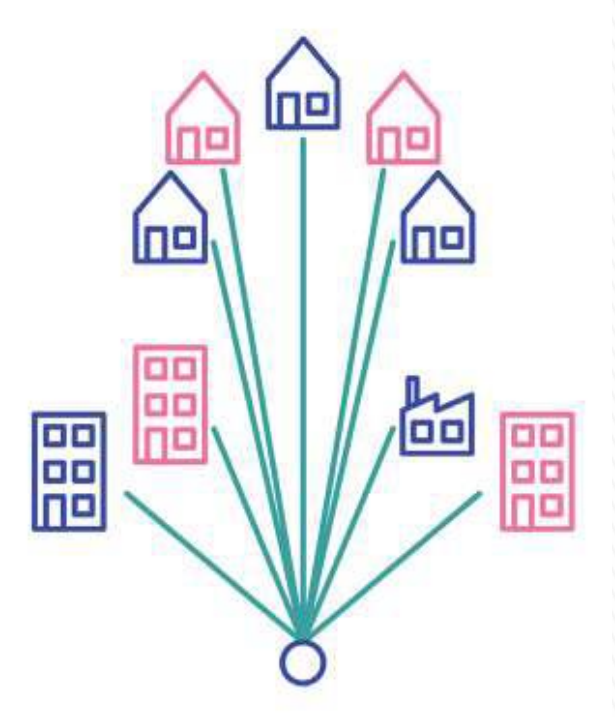


Network Environments

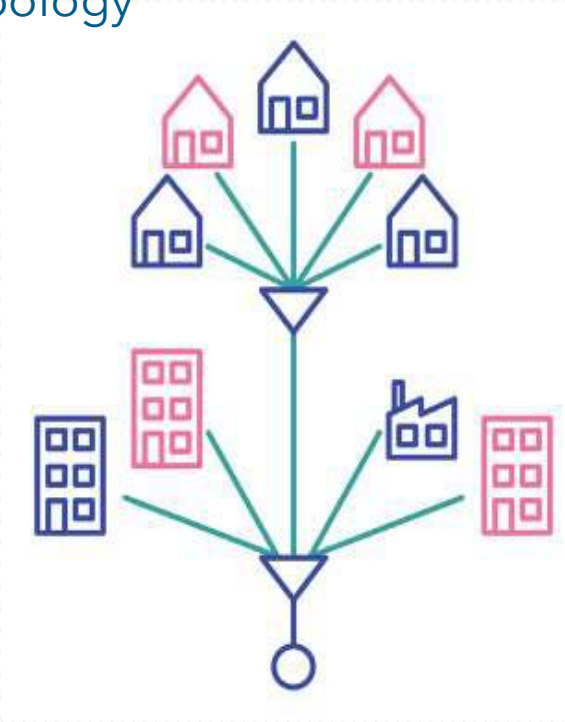
- Ruban and Urban – favorable space.
- Dense-urban - limited space.
- Brownfield deployment - Favorable with existing infra
- Greenfield development – build the entire network
- A fiber network is a long-term investment (25 years or more).
- The active equipment is several upgrade (5 Years each).
- Non-telecom operators (Utilities, Municipalities, and Real estate)
- FTTH plus SDU, MDU
- FTTH plus 4G, 5G

FTTH Topologies

Point to Point (P2P) Topology



Point to Multipoint (P2MP) Topology



Feeder Cable	Distribution Cable	Drop Cable
Underground Installation	Overhead Installation	Overhead Installation
Between OLT to 1st Splitter	Between 1st Splitter and FAT	Between FAT and ONT
The higher the count (48 to 288 fibers), the broader the FTTH footprint	12 to 24 Cores	1 to 4 Cores

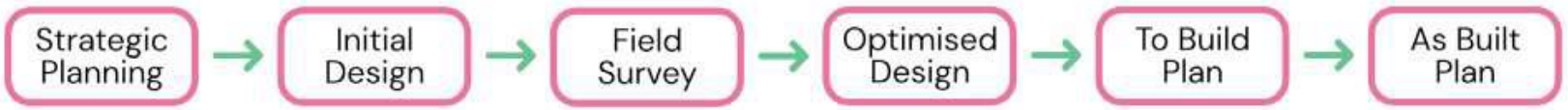
BUILD THE NETWORK

1. Network Design
2. Installation Techniques
3. FTTH Test Guidelines

Detail Network Design - Survey

Type of survey :

1. Desktop survey (with Google Map – Road, Tree)
2. Field survey (after that LLD)



Detail Network Design (High Level Design)

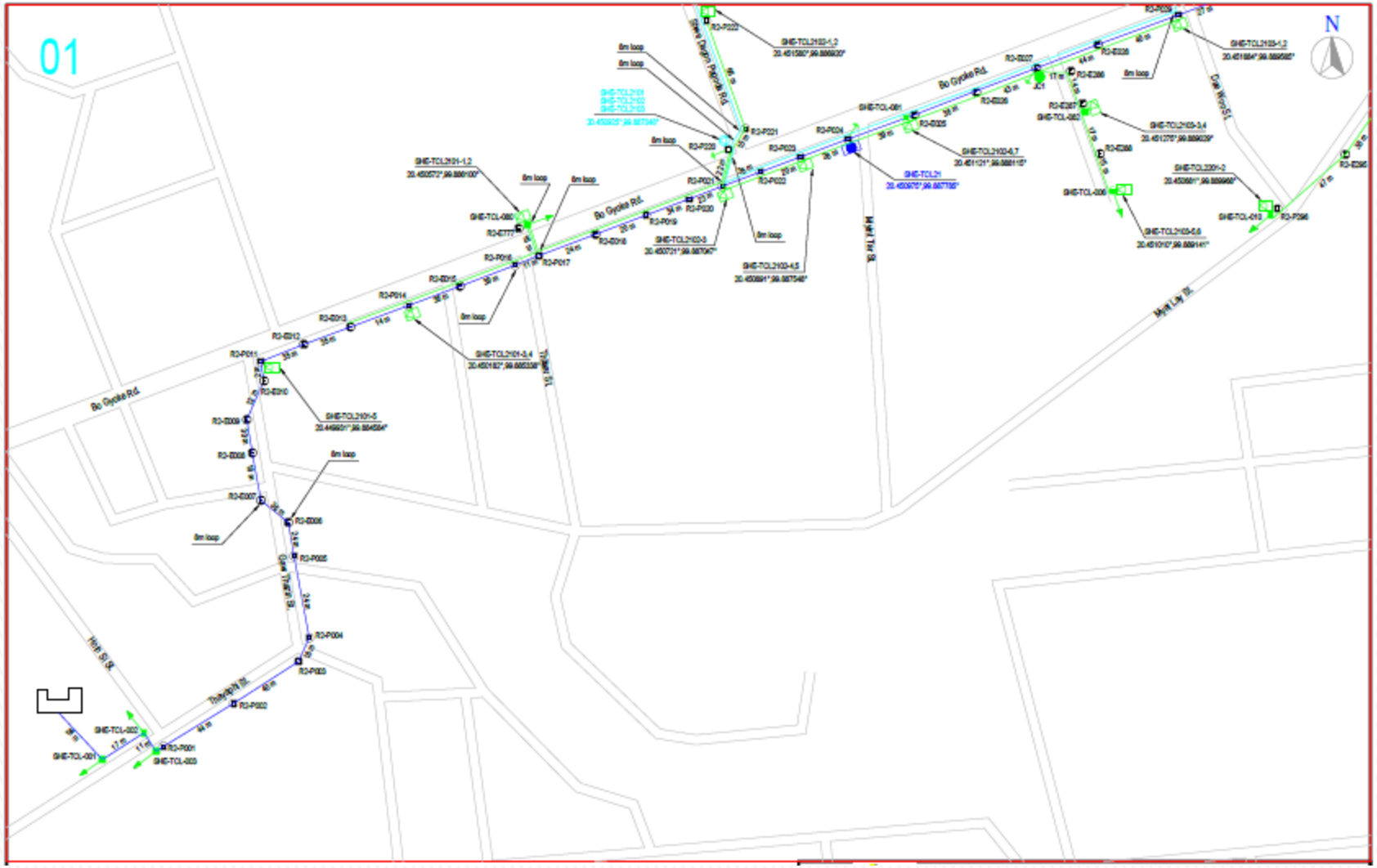
1. HLD based on Google Earth
2. Field Survey (Cable Route, ODF Location, Pole Location, Stay Wire Requirement)
3. TSSR (Photos, Coordinate, Existing Pole Status, Road Crossing, Electric Pole, Bridge Crossing, Pole ID)
4. Survey BoQ

Detail Network Design (High Level Design)

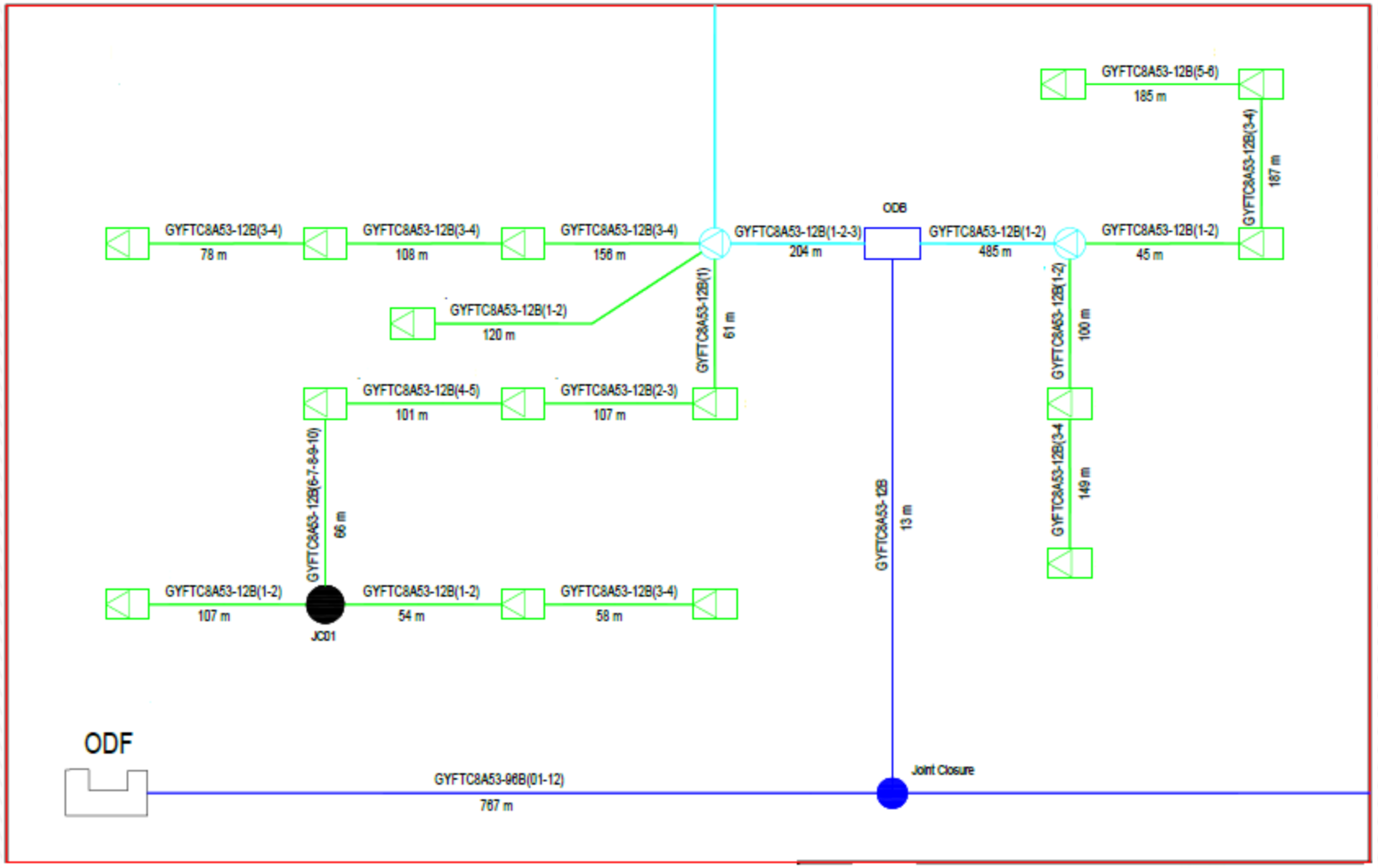
Detail Network Design - Low Level Design

1. LLD (Existing Pole Location, Cable Route, Detail Aerial Installation Method, Pole distance, Grounding, Stay Wire Requirement, New Pole Requirement, Equipment on Pole and Labelling)
2. Auto CAD Drawing
3. Network Topology
4. Core Assignment Plan
5. BOQ calculation based on LLD (in the drawing)

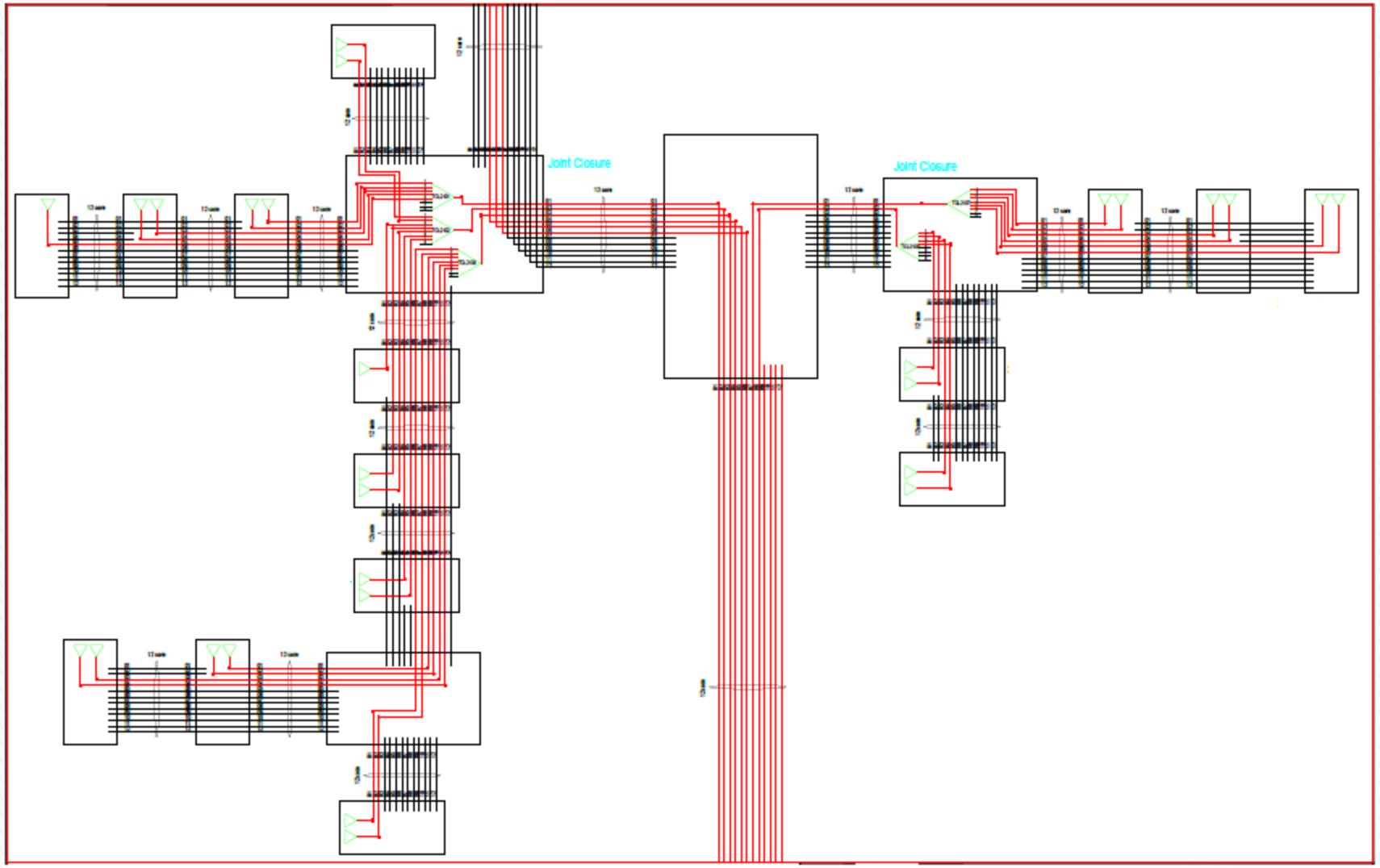
Sample Route Map (Low Level Design)



Sample Topology (Low Level Design)



Sample Core Plan (Low Level Design)



Sample BOQ (Low Level Design)

Item	Description	Unit	Qty
1	Reserved cable rack	kit	396
2	U shaped Galvanized hoop R75mm*12mm	pcs	396
4	Pole provision(aerial, 7m concrete pole)	Pcs	86
5	Pole provision(aerial, 8m concrete pole)	Pcs	10
6	Stay wire provision(7 / 2.2 single strand stay wire)	Pcs	64
7	Stay wire warning pipe	pcs	64
8	Warning marker pipe(2m in length)	pcs	88
9	Power line cross protection device (50m one coil)	m	80
10	Φ16mm,L=2000mm copper bonded steel rod	PCS	37
11	general copper earthing clamp	KIT	37
12	H07V-K&RV Yellow-green 1×35mm2 Wire	m	222
13	U-pvc pipe Φ20mm	m	148
14	Stainless Steel Clamp for fixing 8-figure Fiber Cable	pcs	687
15	Stainless Steel Tape	m	1260
16	Stainless Steel Tape Locking Seal	pcs	2100
17	U-shaped steel card Φ8 mm	pcs	1716
18	Hoop of stay wire	pcs	286
19	Stay wire backing ring (3#)	pcs	572
20	Cable marker	pcs	328
22	Equipment Label	pcs	166
23	spiral marker	m	267

Installation Techniques

1. Fiber Deployment
2. Underground Installation
3. Aerial Installation
4. Micro Duct Installation

Fiber Deployment

Large drums handling.

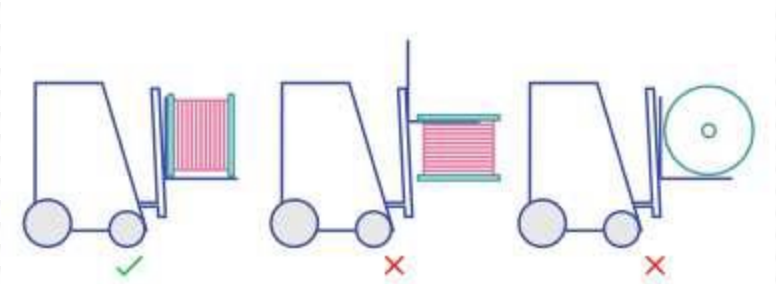


Figure - Safely moving drums with a forklift

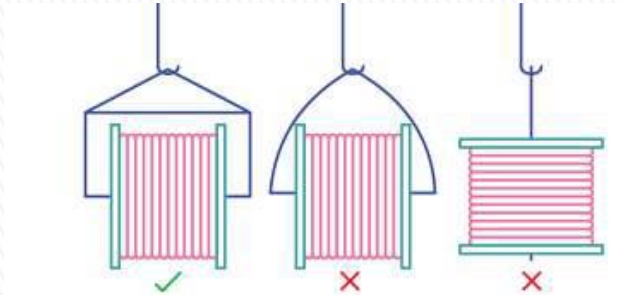


Figure – Safely moving drums with an electric hoist

Never drop or roll from a higher step

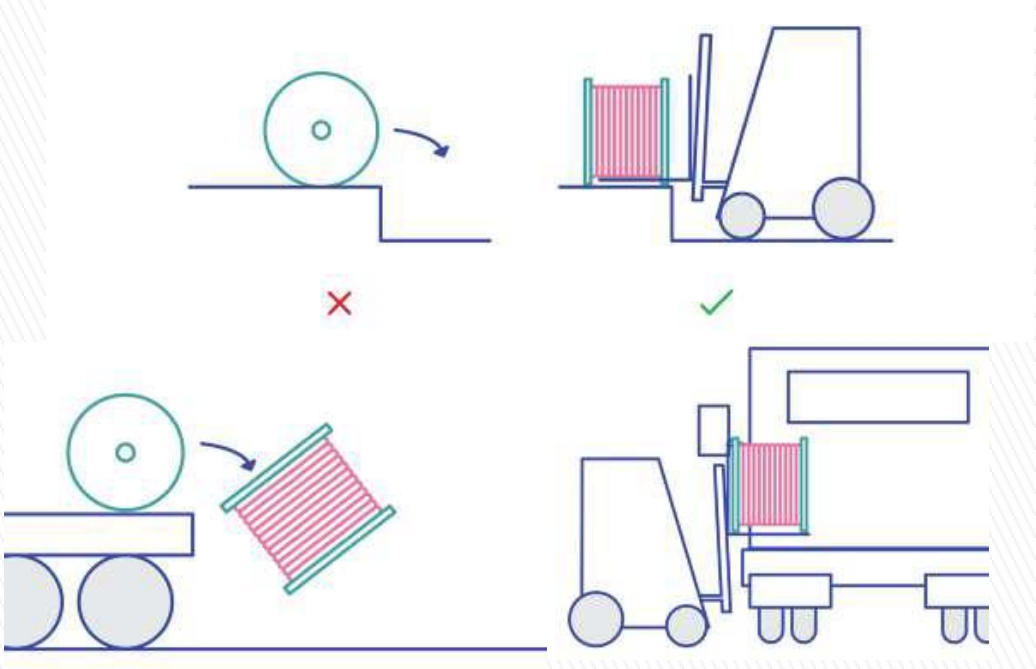


Figure – Never roll the drum from a high step or the back of truck

Drum Rolling Direction

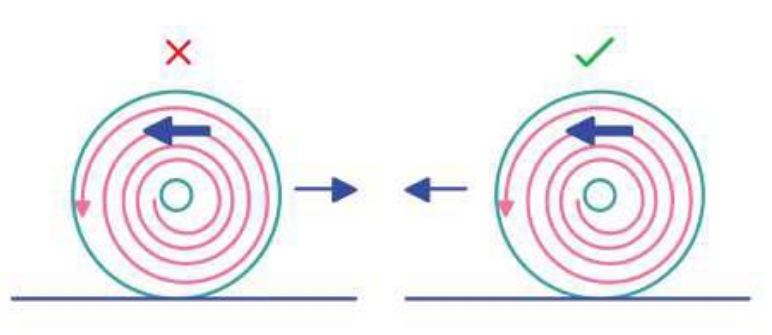


Figure – Drum rolling direction

Drum Vertical Positioning

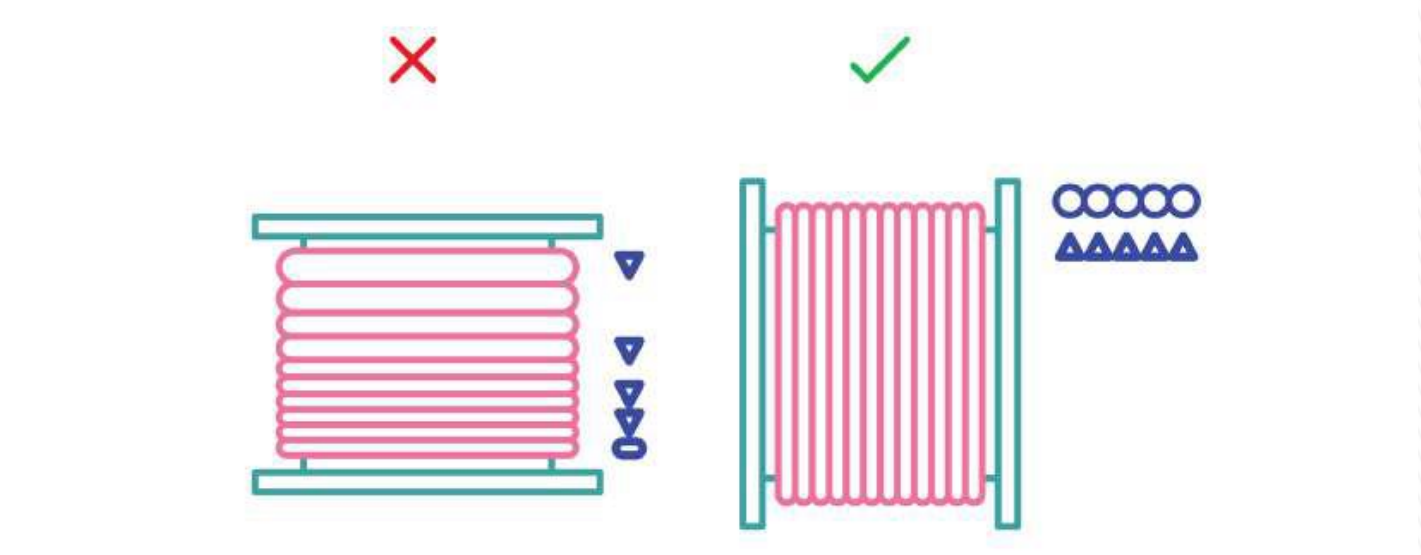


Figure – Vertical positioning

Avoid resting the drum on the cable

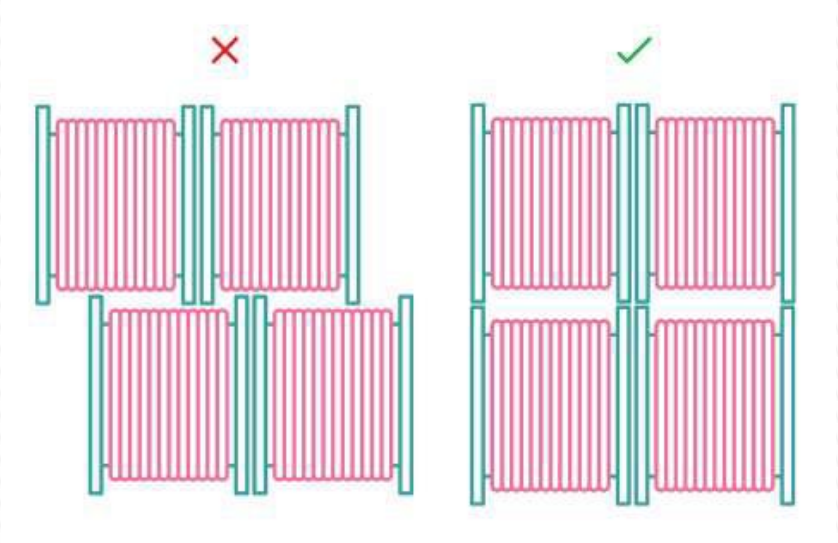


Figure – Avoid resting the drum on the cable

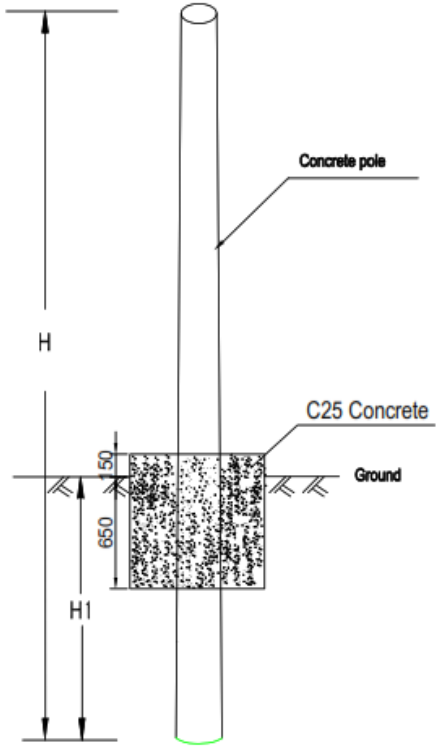
Aerial Fiber Cabling Process Steps

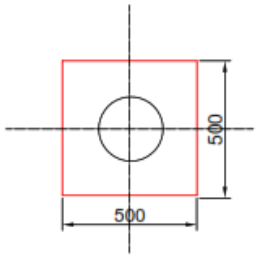
1. Pole Construction
    1. Stay Wire
2. Fiber Laying
    1. Fixing Fiber on the Pole
    2. Cable Tensioning
    3. Reserve Cable Rack Installation
    4. Cable Marking
    5. Warning Pipe
    6. Fiber Optic Cable Labeling
    7. Grounding
3. ODF Installation
4. Joint Closure Installation
5. FAT Installation
6. Drop Cable Installation

Tools

Shovels 	Sledgehammers 	Earth Auger 	Measurement Tape 
Water Level 	Plumb-Bob 	Theodolite 	Steel Wire Cutter 
Wrench Set 	Diagonal Plier 	Ladder Fixing Strap Stabilizer 	Ladder 

Pole Excavation



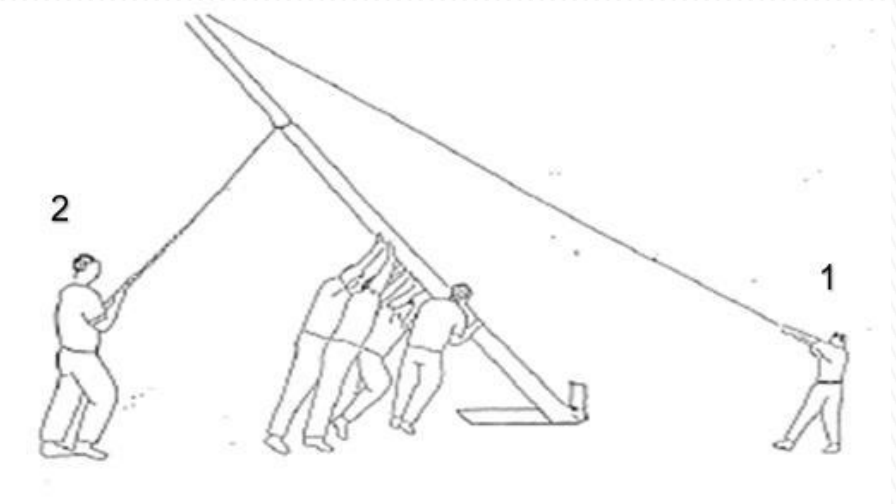


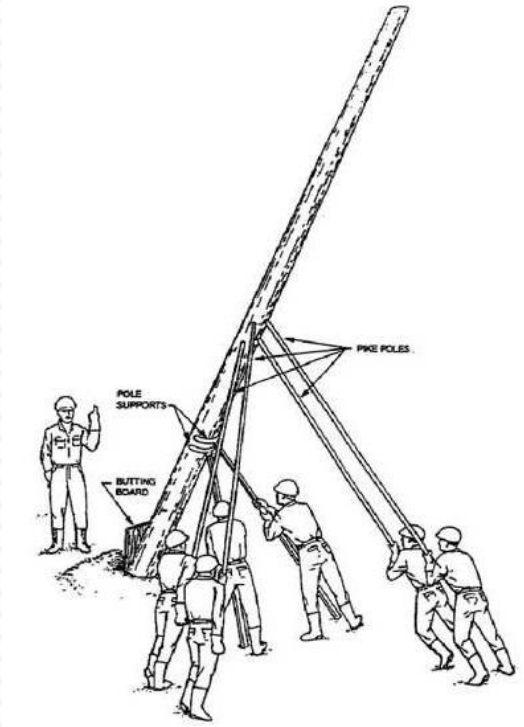
Scetion 1-1

Buried Depth of Concrete pole(Unite:m)

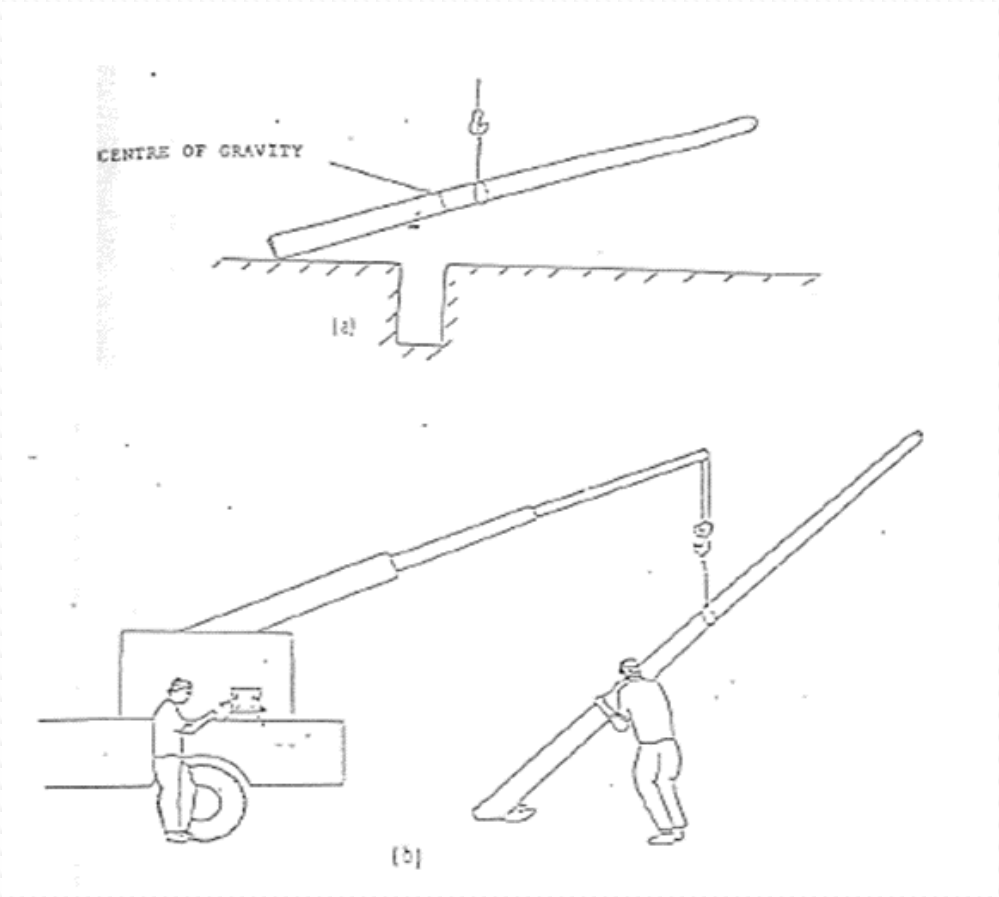
Soil / H1 / H	Normal soil	Hard soil	Gravel soil
7m	1.4	1.2	1.0
8m	1.5	1.4	1.2

Manual Pole Erection



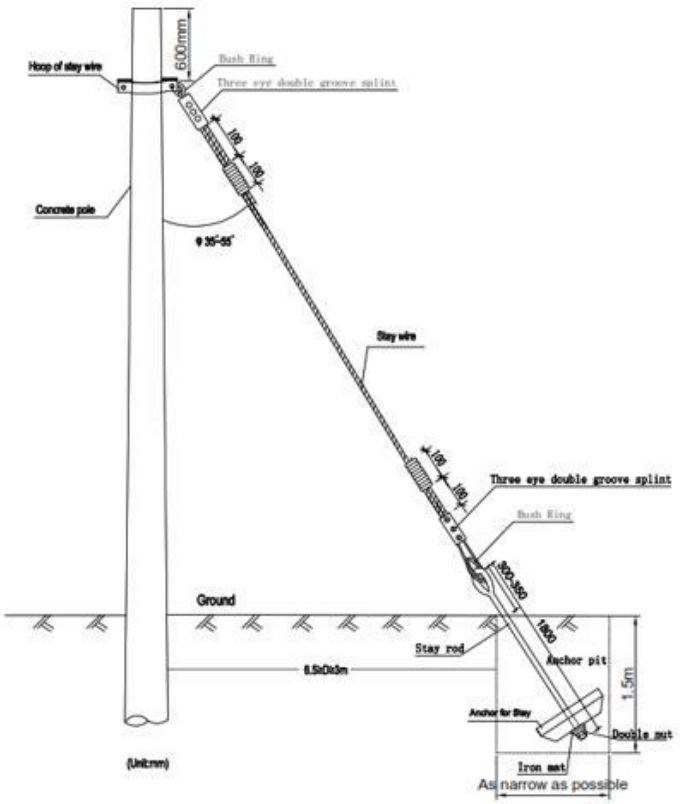


Pole Erection by Machine

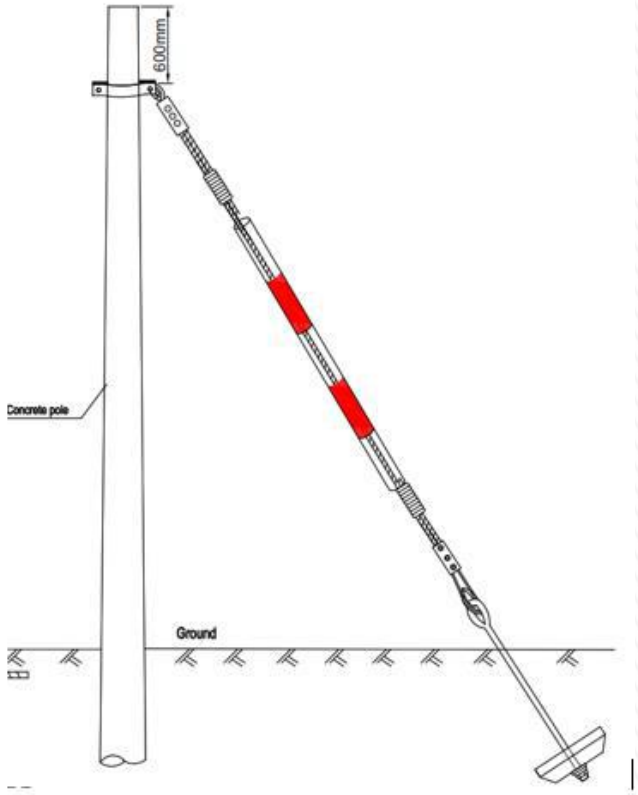


Sample Pole Erection Photos

Stay Wire Installation



Stay wire installation details



Stay Wire Warning Pipe

Aerial Installation

The Pull-back method of cable deployment

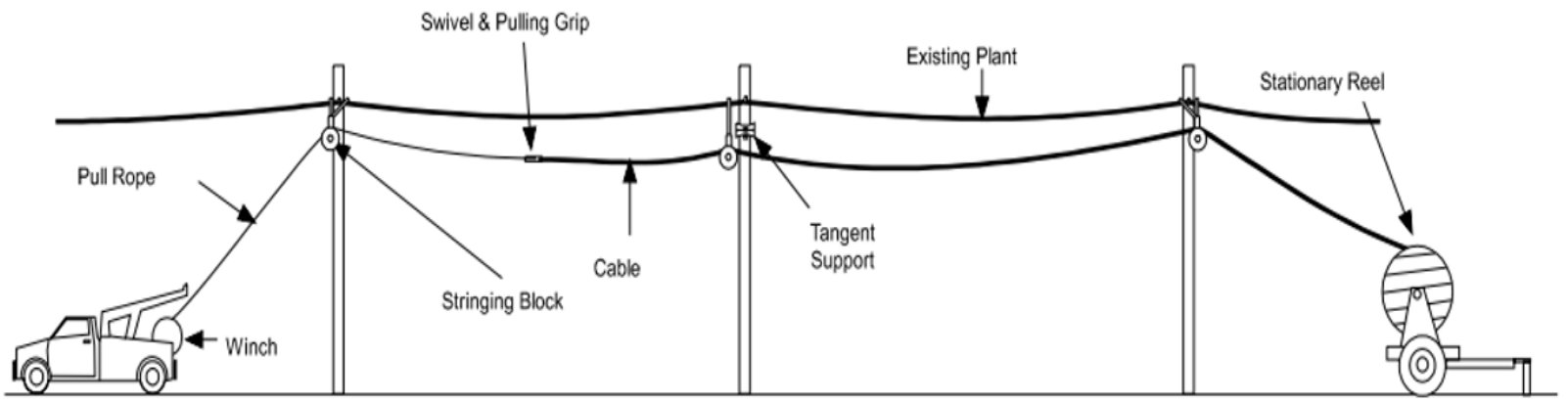


Figure – The pull-back method of cable deployment

Pre-Installation Cable Checking

1. Check the cable spec including cable type, no. of fiber, cable length
2. Inspect the cable reel for sign of excessive damage.
3. Do not accept the delivery of an optical fiber cable if the reel is visibly damaged.
4. Reel on site, must be on chocked to prevent them from moving and rolling
5. All optical fiber cables must be tested while on the reel, prior to deployment.
6. OTDR testing shall be done on fibers in one direction at 1550 nm
7. OTDR trace must be stored and electronic copy must be submitted to authorized person

Aerial Installation (Cont.)

1. Bend Radius: The cable should not be pulled over a bend radius smaller than 20 times the cable diameter
2. Pulling Tension: the maximum allowable pulling tension for a particular cable can be found on the cable spec sheet.
3. To eliminate possible cable contact with the ground, play the cable off from the top of the drum.
4. Aerial pulley should be used on the poles for smooth cable pulling.
5. The pulling team must pull the cable.
6. The drum team must feed the cable off the drum at the same speed at which the cable is being pulled.
7. There must be no strain on the cable between the drum and the first pulley.

Fiber Cable Laying Sample Photo

To eliminate possible cable contact with the ground

Take care maximum Pulling Tension

Direct Buried Cable Installation Method

Trenching

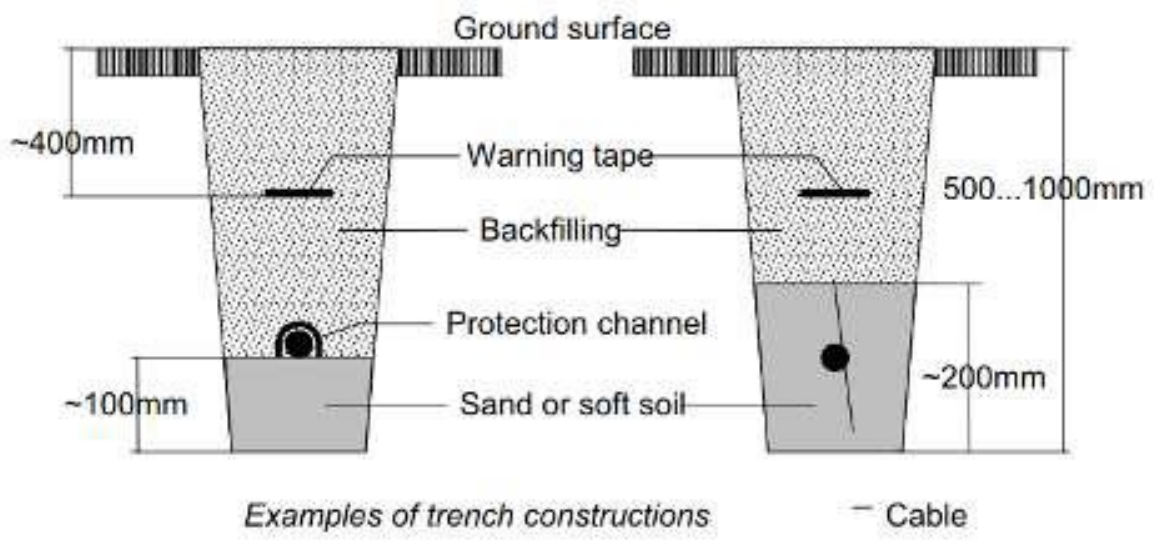


Figure – Direct Buried method

Underground Cable Installation in Ducts

Cable Pulling

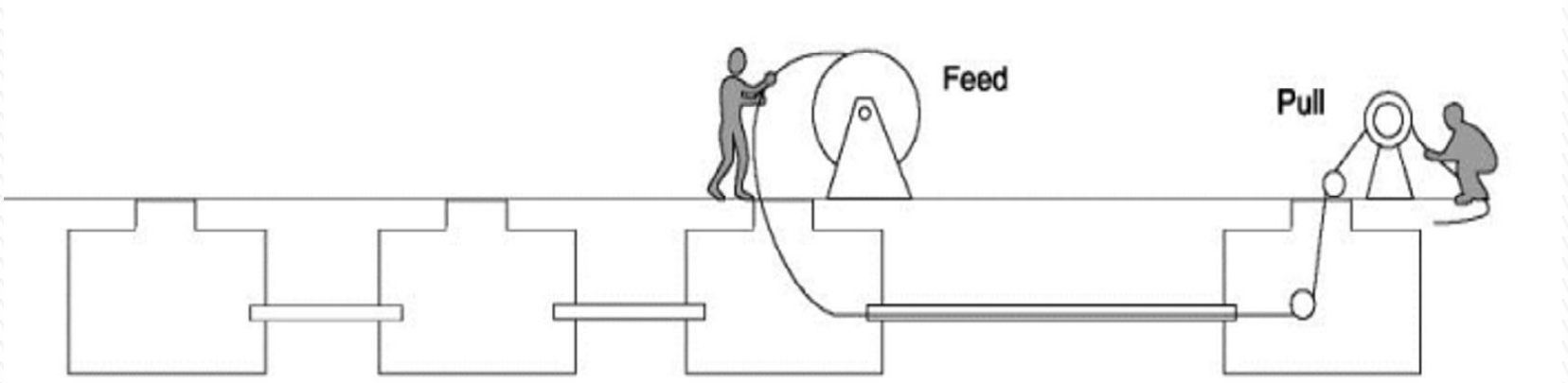


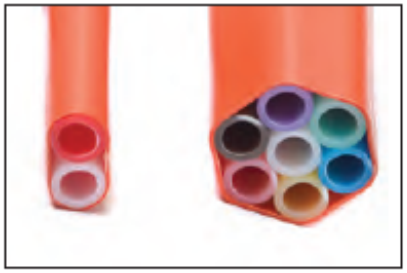
Figure – Underground Cabling Installation by pulling method

Micro Duct System

Micro Duct System Tube Bundle

Direct Bury metal free (DBmf) - Thickwall

DBmf Heavy-Wall Microduct Bundles



All these bundles have simplicity and strength. They have exceptional toughness and crush resistance and can be directly buried without the need for additional protective closures at branch-off points, or inline connections. The individual microducts are so strong that the outer sheath does not need to be protective in design, but simply holds the bundle together. The individual tubes can be joined by Protected and Directly Buried rated connectors (page 66-68). This solution is easy to use, quick to install and will reduce the Total Cost of Ownership long term.
The 1, 2 and 3 way bundles are also suitable for slot cut installations.

Example configuration

Underground installation

Micro-trenching

Figure – Micro trenching deployment technique

Underground installation

Duct and Microduct Installation

Figure – Protected microduct laid in open trenches

Underground installation

Air blowing

Figure – Air blowing of microducts

Optical cable handling during installation

Figure – Splice closure and slack storage

Figure – Optical fiber splicing

Optical cable handling during installation

Commissioning

- Record all steps and test results.
- An initial visual inspection - damaged during transport and manipulation.
- test with OTDR
- Test with OPM

Optical cable handling during installation

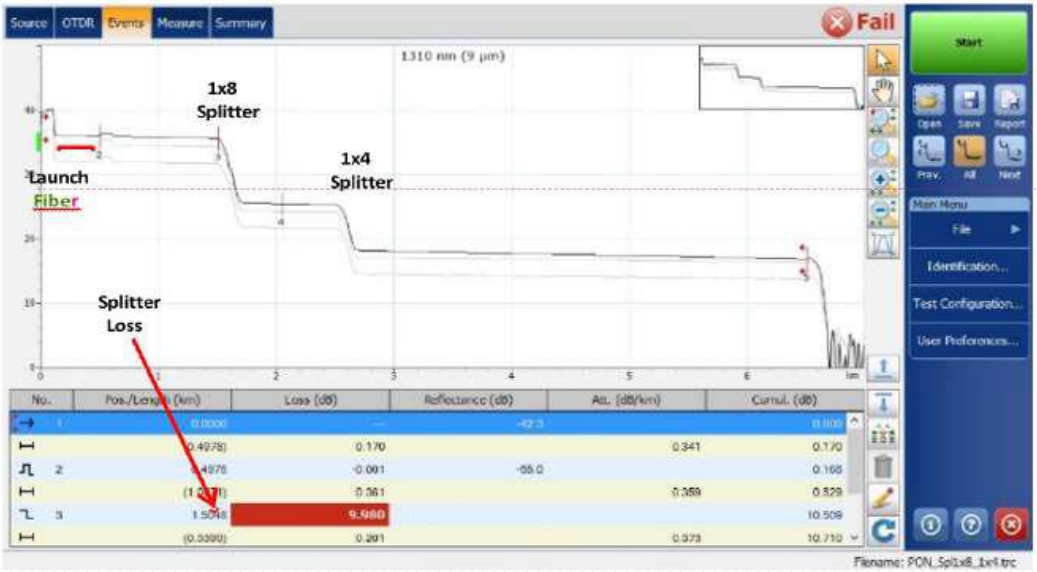


Figure – Sample OTDR Trace

Figure – OPM Measurement

FTTH Test Guidelines

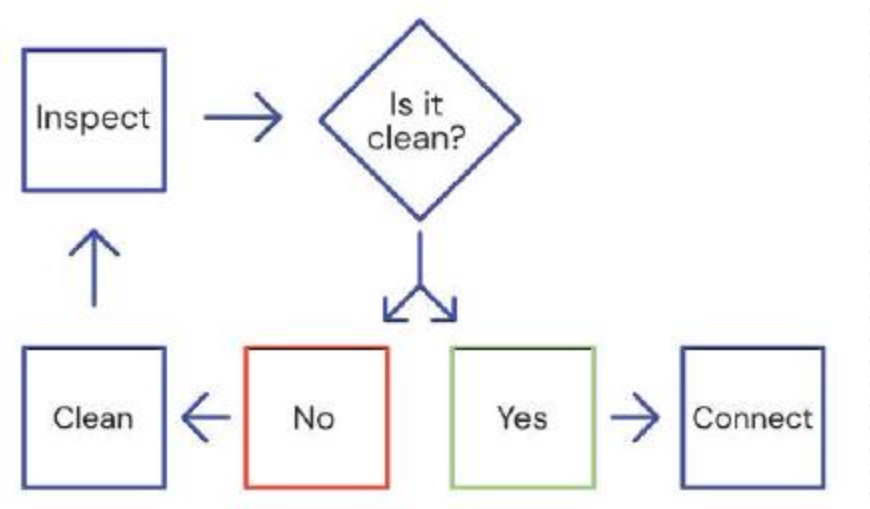


Figure – Connector mating decision tree.

FTTH Test Guidelines

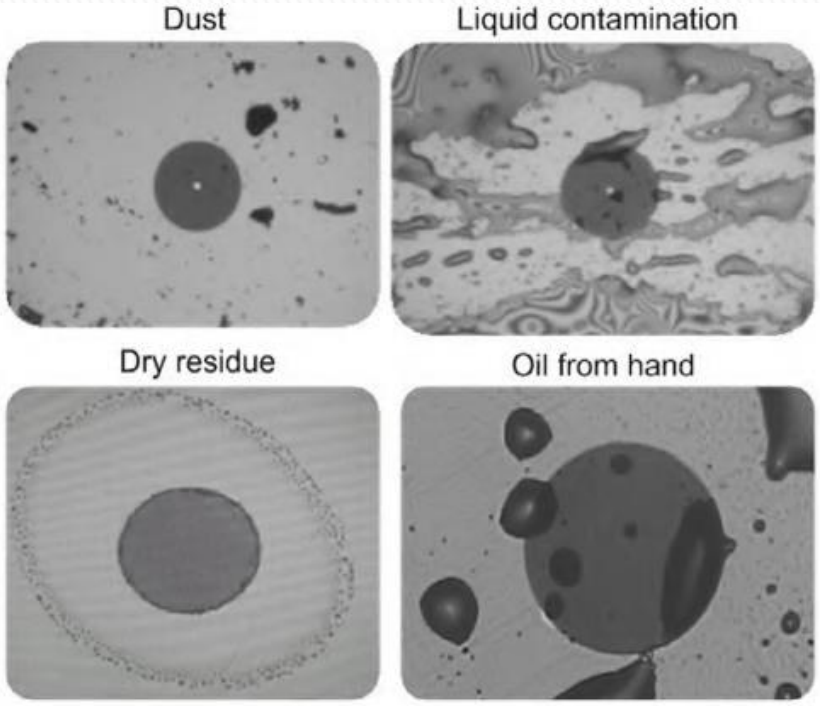


Figure – Appearance of various contaminants on a connector end face.

Sample Power Meter Test Results

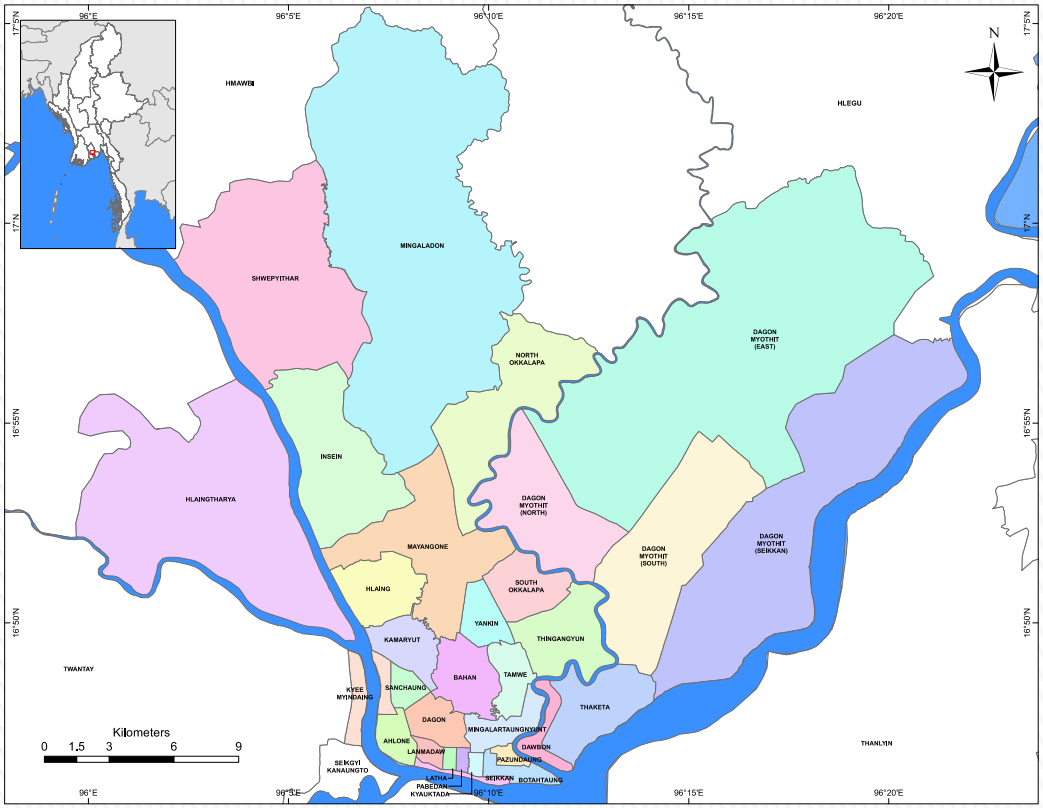

APNIC
FOUNDATION


MMIX
Myanmar Internet Exchange


isif asia

AERIAL FIBER OPTIMIZATION

RESOLVE AERIAL FIBRE OPTIC CABLE & Right of Way (RoW) Issues In YANGON

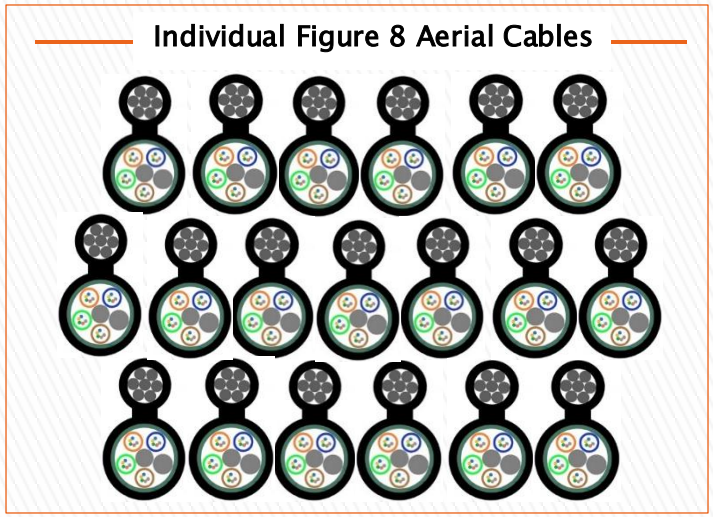


Credit : OpenAI

Problem of Uncontrolled Aerial Fibre

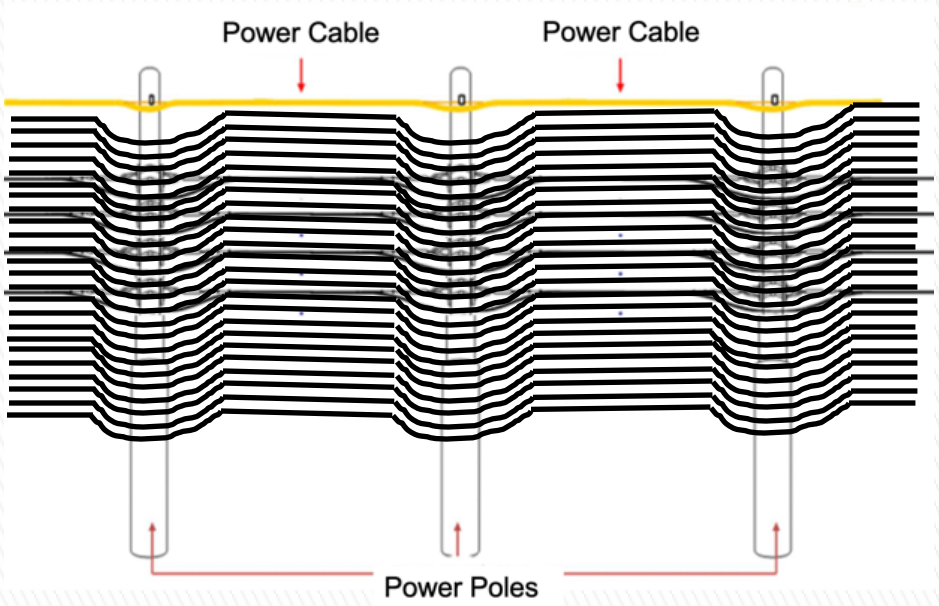
(1)Lack of Standards,
(2) Professional Discipline and Cable Management

without Standards
'very messy' installations.



Solution
- Need _Cable Management
for Multiple RoW Concession Holders

Multiple Figure-8 Aerial Fibre Cables Pole Mounted

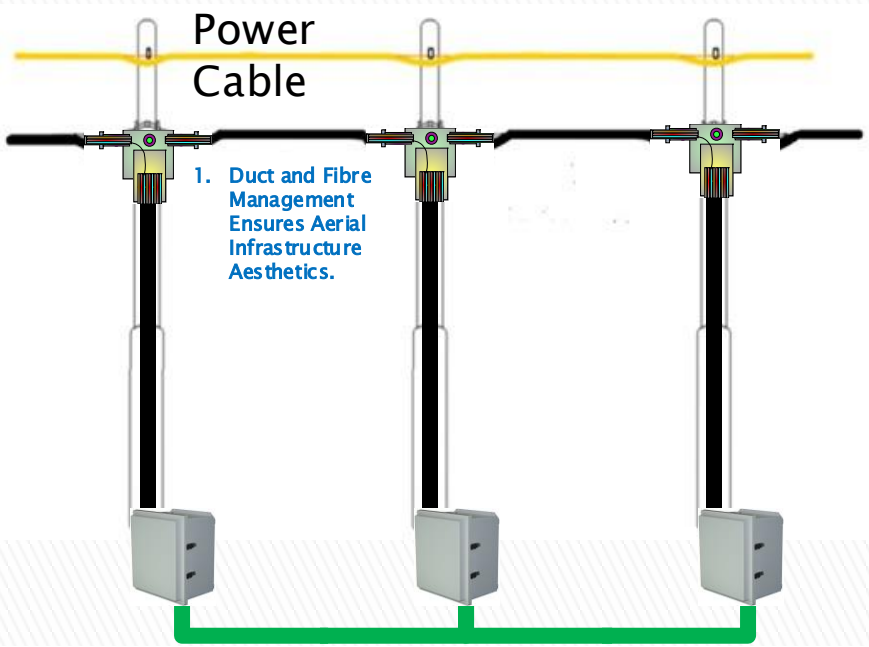


misconception : N x Aerial ROW holders = N x Aerial Cables !

Main Issues

- Cable Management Issue.
- Untidy Cables,
- Increasing Cable
- Poles stressed & misaligned .
- Safety issues
- Manpower intensive
- Expensive due to overbuild

MicroDuct & MicroFibre Solution



2. Correct Termination Cabinets (or Manhole) Positioning aids future Migration to UG Duct.

MicroDuct

Aerial ADSS Duct Blown Microfibre Innovation

ADSS= All Dielectric Self Supporting

National Development Objectives

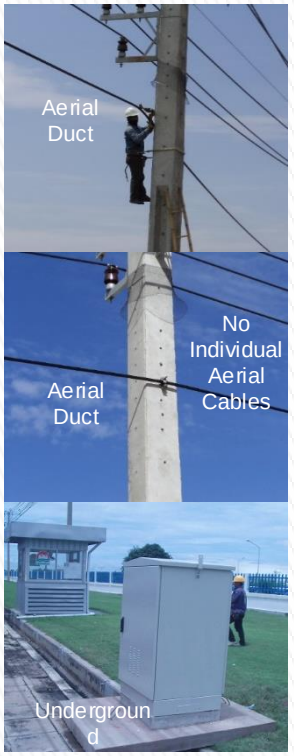
- Multiple ROW – fast Broadband Services Deployments
- Fair Market Collaboration
- Future Proof Network.
- Aerial Fibre deployment 'Discipline' without the mess seen
- Reuses existing Aerial Fibre for Rural Broadband

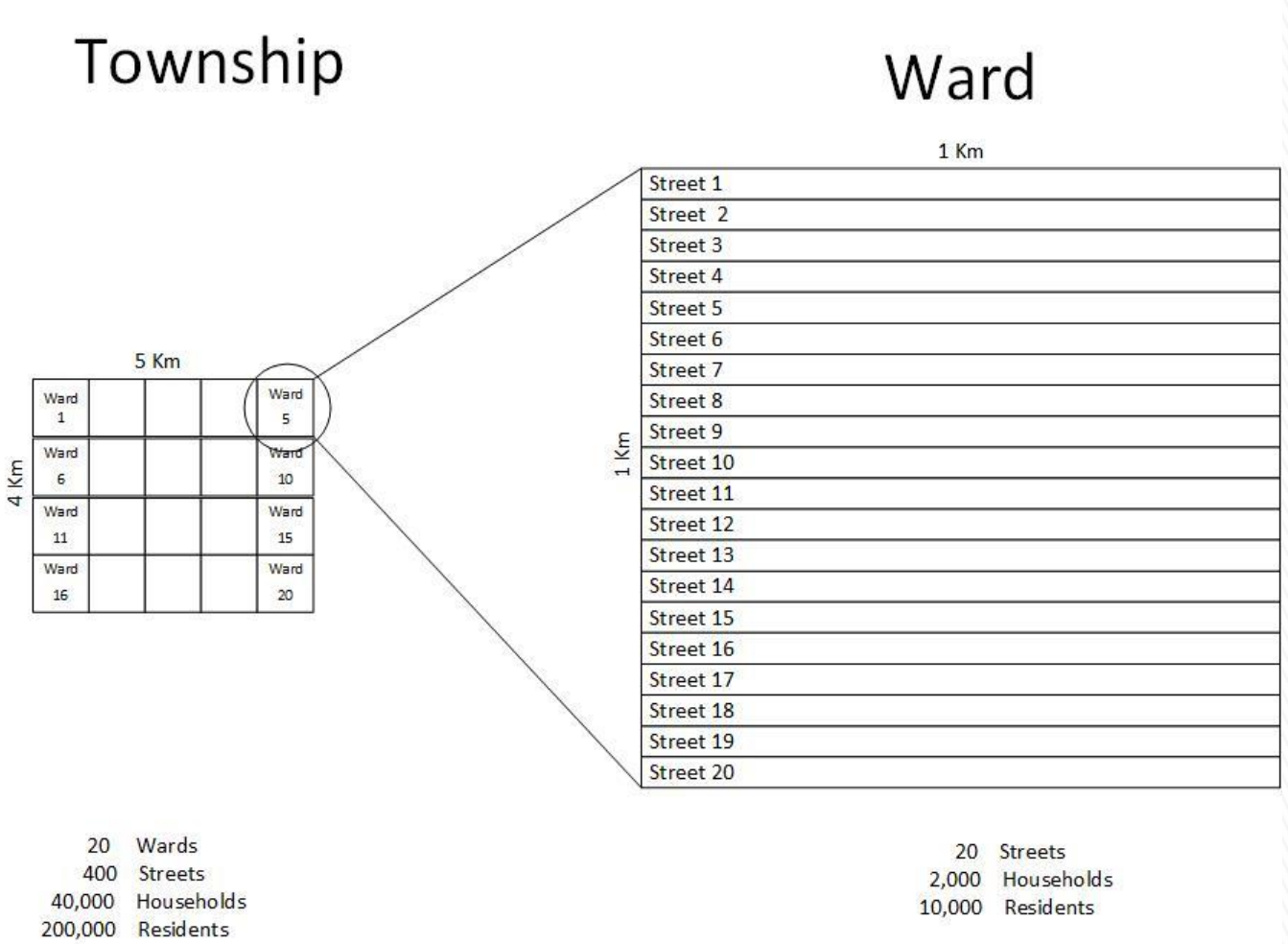
Faster, Cheaper, Lighter, Smaller

- One time Cost for aerial duct
- Future Low cost cables added by blowing
- Cost saving and time.
- Good cable management,
- Less Wind Loading
- Easy Branch out
- Easy expansion
- Old Telecom Poles –reuse in Rural,
- Better visual impact on the city.

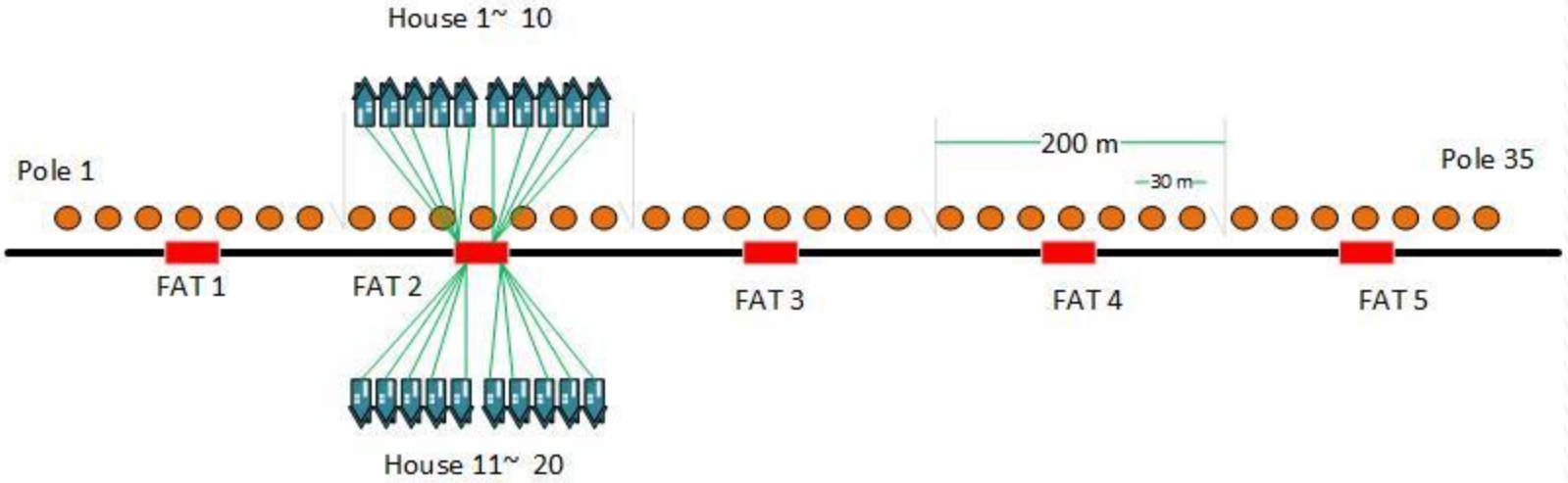
Shared Infrastructure & ROW Concept

1. Share Investments.
2. Build, Operate, Transfer (BOT) Model with Authorities.
3. 7-way sub-duct of an Aerial
4. Single 30 Year ROW.
5. Authorities Benefits
    1. a Sub-Duct and Fibre Cable - Free of Charge.
    2. a monthly ROW Fee per km per Sub-Duct



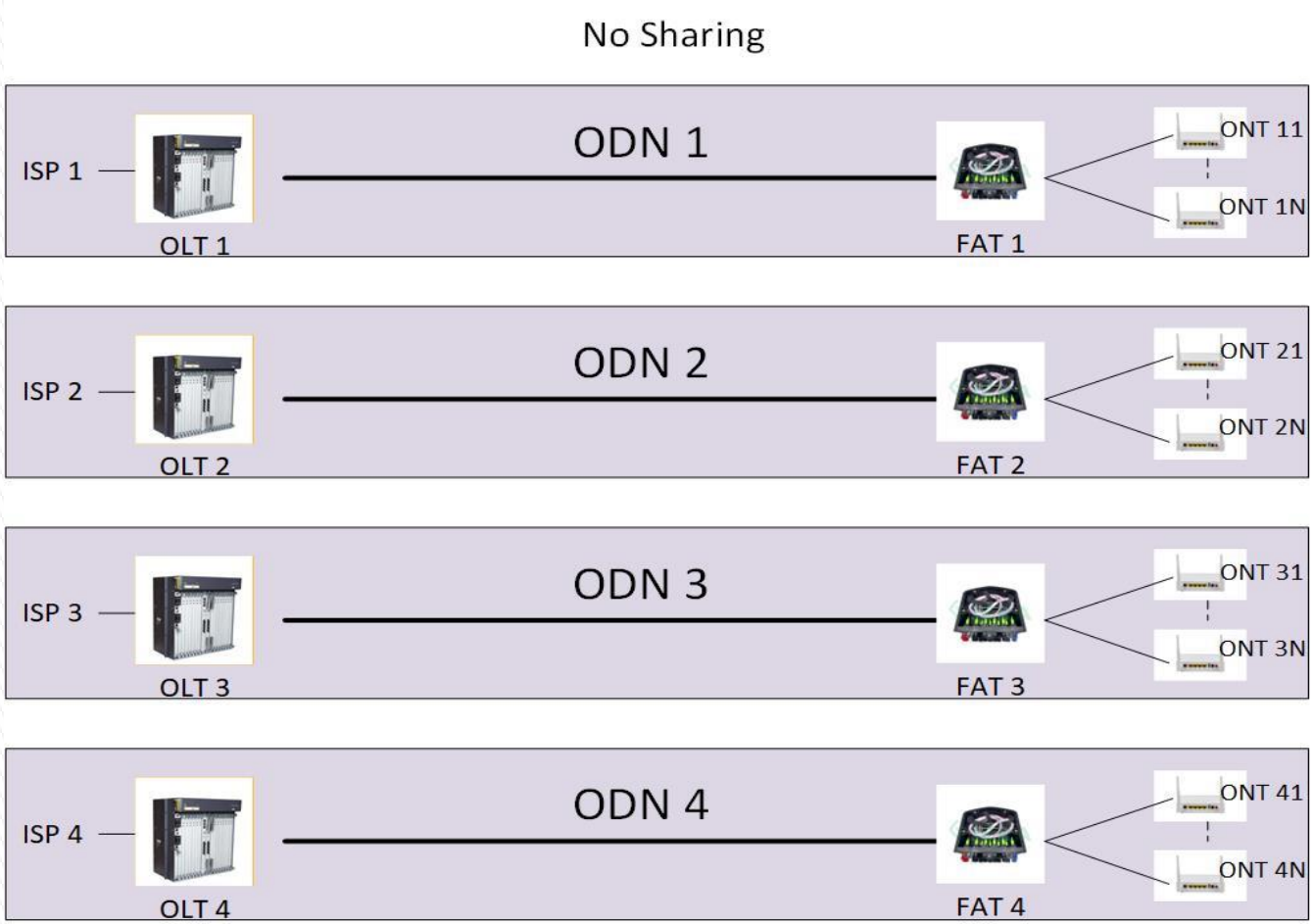

Township
5 Km
4 Km
Ward 1
Ward 5
Ward 6
Ward 10
Ward 11
Ward 15
Ward 16
Ward 20
20 Wards
400 Streets
40,000 Households
200,000 Residents
Ward
1 Km
1 Km
Street 1
Street 2
Street 3
Street 4
Street 5
Street 6
Street 7
Street 8
Street 9
Street 10
Street 11
Street 12
Street 13
Street 14
Street 15
Street 16
Street 17
Street 18
Street 19
Street 20
20 Streets
2,000 Households
10,000 Residents

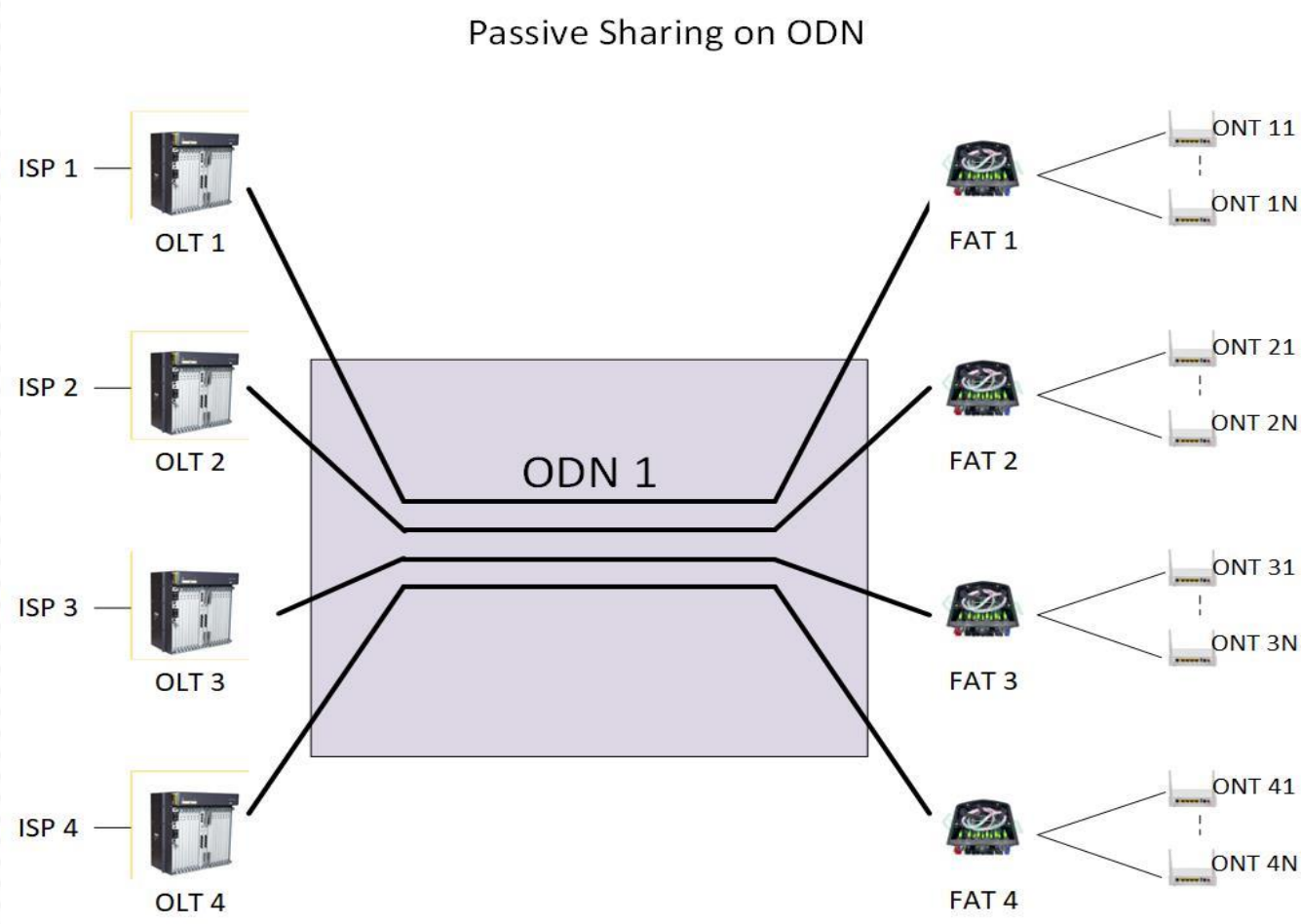
Street

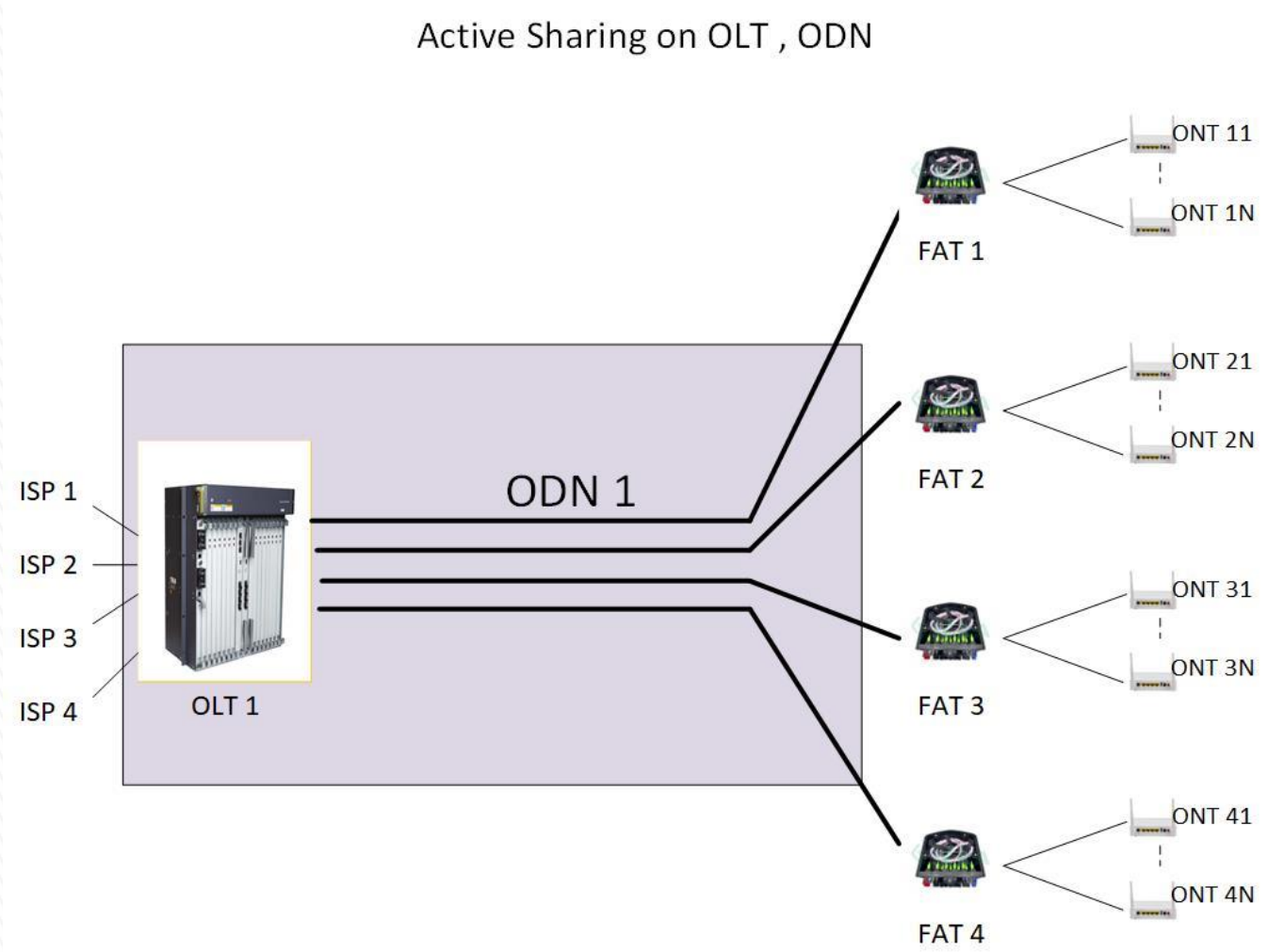


100 Households
500 Residents
5 FATs (1:N splitters)
35 Poles

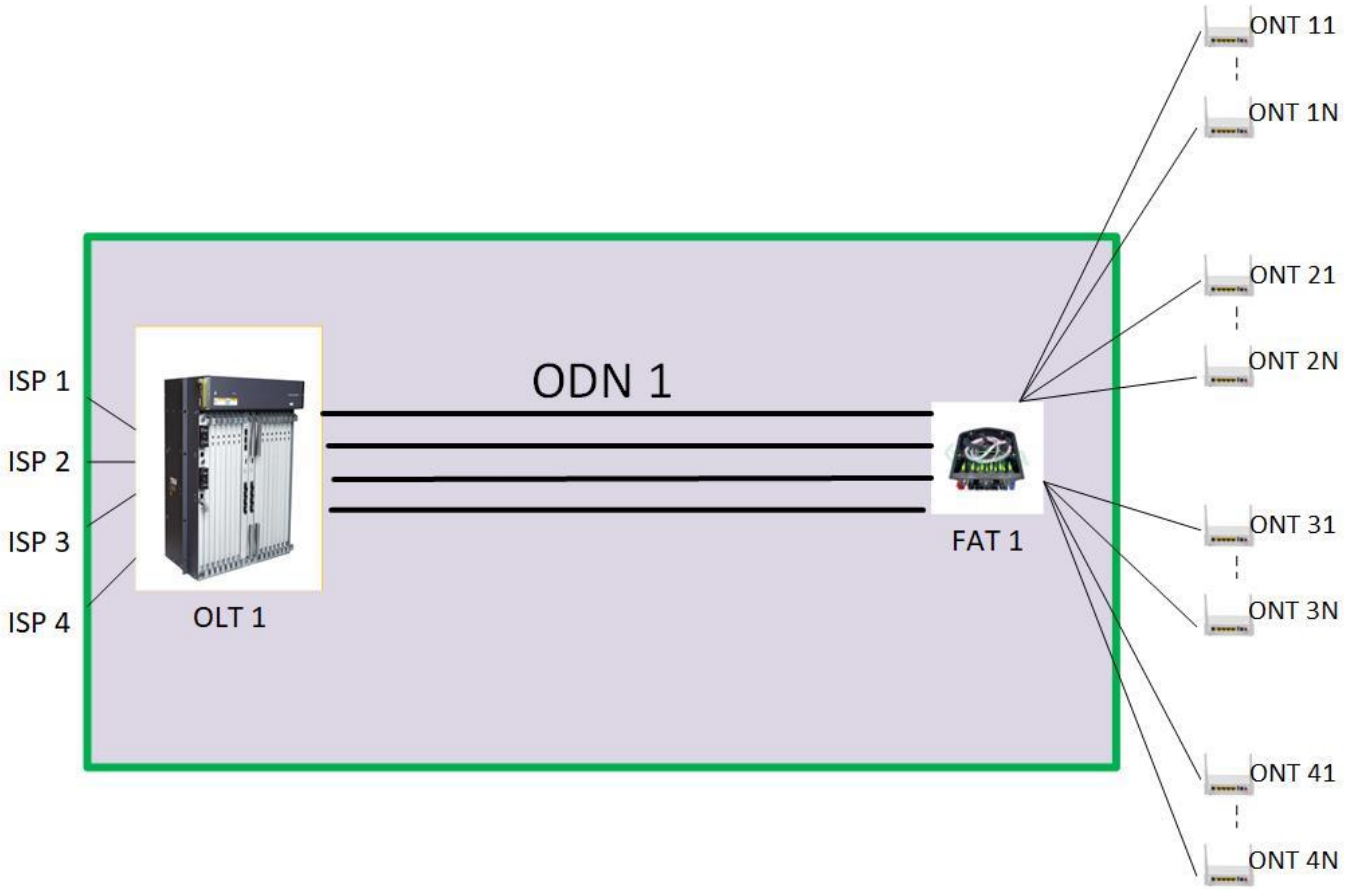
1000 m


No Sharing
ISP 1
OLT 1
ODN 1
FAT 1
ONT 11
ONT 1N
ISP 2
OLT 2
ODN 2
FAT 2
ONT 21
ONT 2N
ISP 3
OLT 3
ODN 3
FAT 3
ONT 31
ONT 3N
ISP 4
OLT 4
ODN 4
FAT 4
ONT 41
ONT 4N


Passive Sharing on ODN
ISP 1
OLT 1
ISP 2
OLT 2
ISP 3
OLT 3
ISP 4
OLT 4
ODN 1
FAT 1
FAT 2
FAT 3
FAT 4
ONT 11
ONT 1N
ONT 21
ONT 2N
ONT 31
ONT 3N
ONT 41
ONT 4N


Active Sharing on OLT , ODN
ISP 1
ISP 2
ISP 3
ISP 4
OLT 1
ODN 1
FAT 1
FAT 2
FAT 3
FAT 4
ONT 11
ONT 1N
ONT 21
ONT 2N
ONT 31
ONT 3N
ONT 41
ONT 4N

Active Sharing on OLT , ODN , FAT

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MMIX
Myanmar Internet Exchange


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THANK YOU!

Questions

1. What are access network components of FTTH system?

2. What is the fourth utility services in our long-term economic and social future?

3. In brown field deployment, the fiber network is built from the scratch.

4. What are two type of survey?

5. Fiber Core assignment should be put in (Low Level Design).

Answers

1 Feeder, Distribution, and Drop

2. Fiber Networks

3. False

4. Desktop survey and field survey

5. Low Level Design