STL | CII

stl.tech

Optical Fibre
Enabling 5G and FTTx

Sudipta Bhaumik
Head – Applications and Standards Engineering
STL - Sterlite Technologies Limited

Agenda

1. **Data and OF/C Consumption Trends**
2. Next Gen networks – Both 5G and FTTH will play a role in that space
3. Next Gen – One Fibre Network and High-Density Cables

Data Consumption Trends

26%
IP traffic growth rate (2017-22)

46%
Mobile Data traffic growth rate (2017-22)

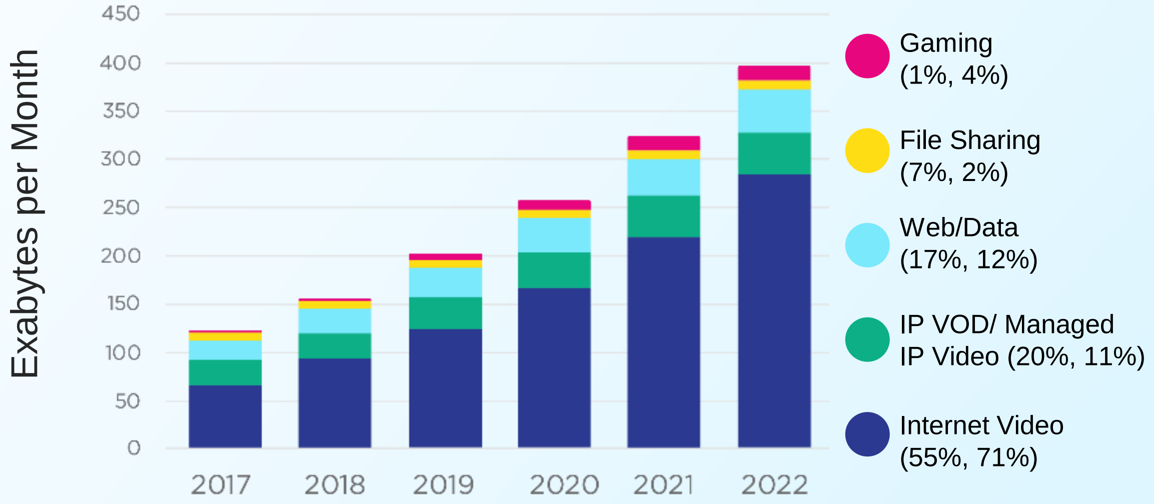
NETFLIX prime video YouTube

82%
Internet traffic will be in form of Video

29%
IP Video traffic growth rate

Key Digital Transformers By 2022

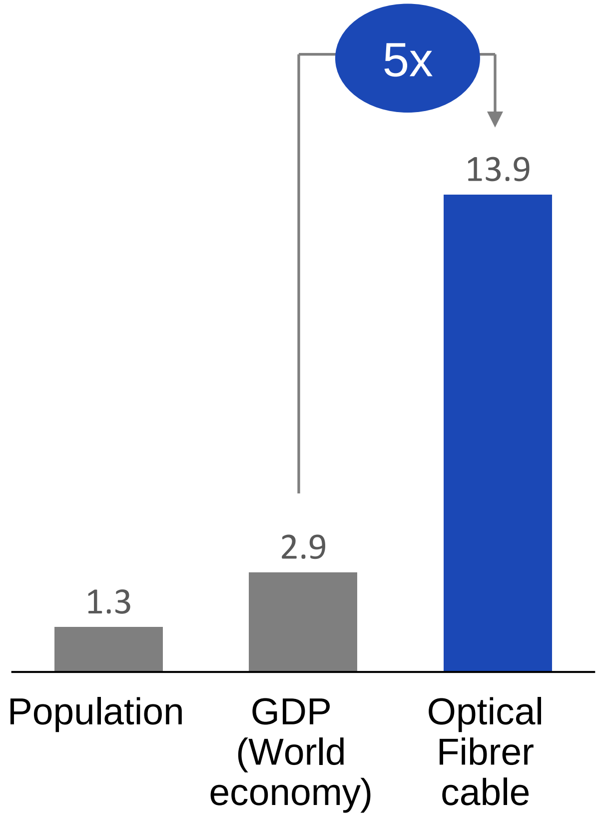
	More **Internet Users**	More **Devices & Connections**	Faster **Broadband Speeds**	Faster **Video Viewing**
2017	3.4 Billion	18.0 Billion	39 Mbps	75% of Traffic
2022	**4.8 Billion**	**28.5 Billion**	**75.4 Mbps**	**82% of Traffic**



Source: Cisco Visual Networking Index

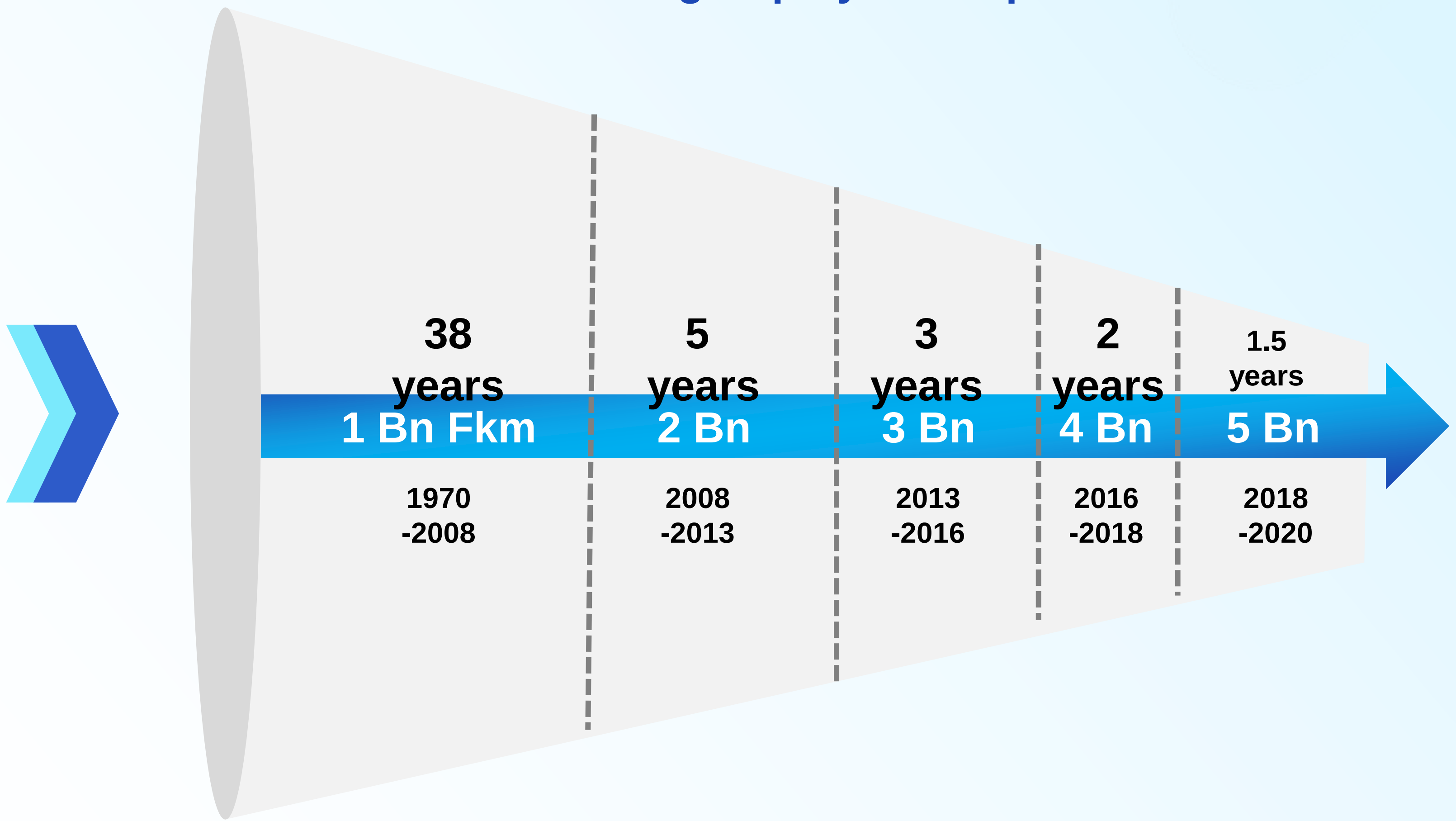
Unabated Growth in Demand of Optical Fiber

Optical fibre cable deployment has outpaced the growth of world economy by **~5x**



20 years CAGR: 1997 to 2017

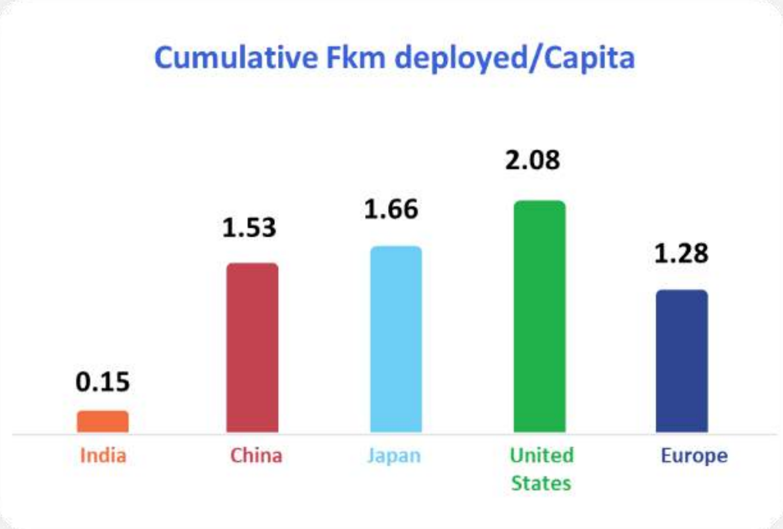
Increasing Deployment Speed

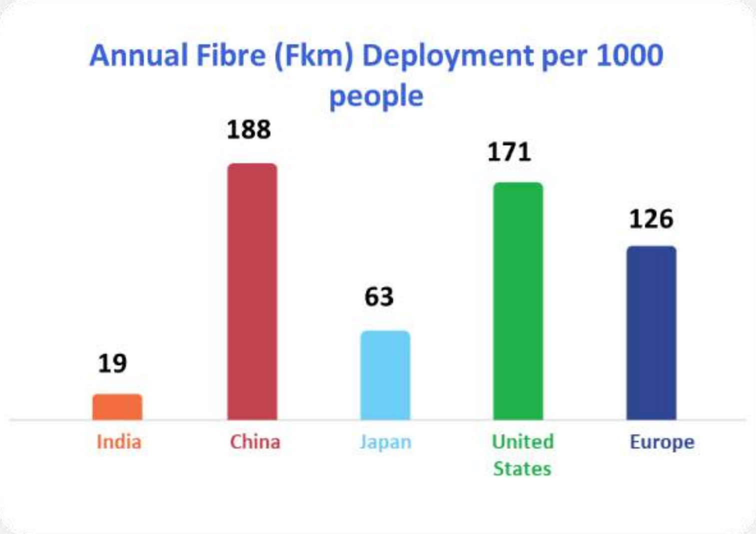


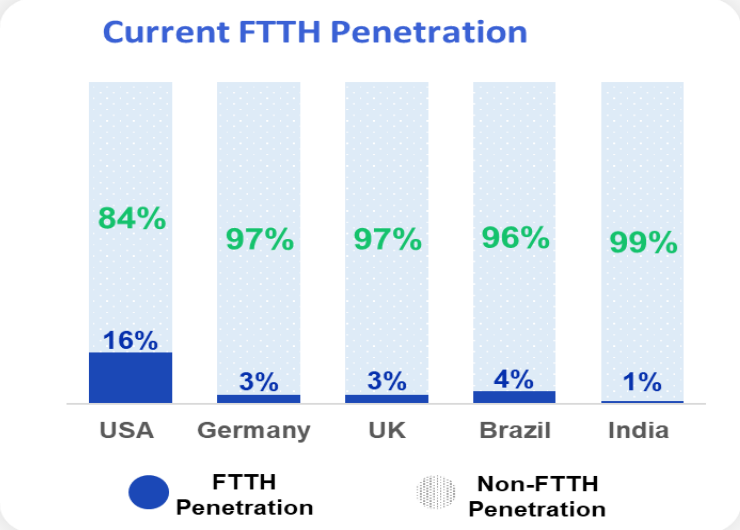
World's rate of deployment of **1Bn fkm cable** has shrunk drastically from **38 years to less than 2 years**

Source : CRU

Fiberization in India

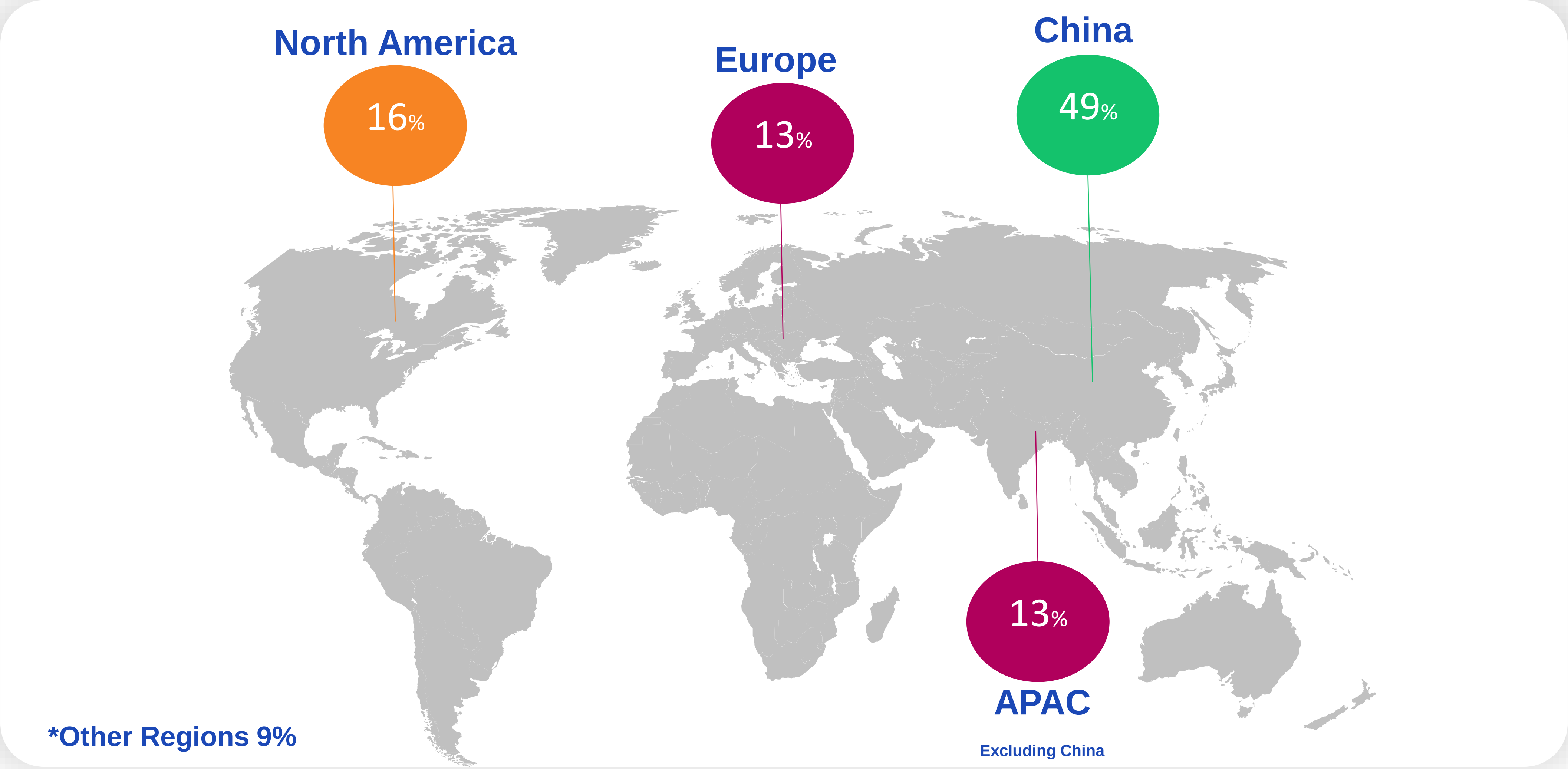






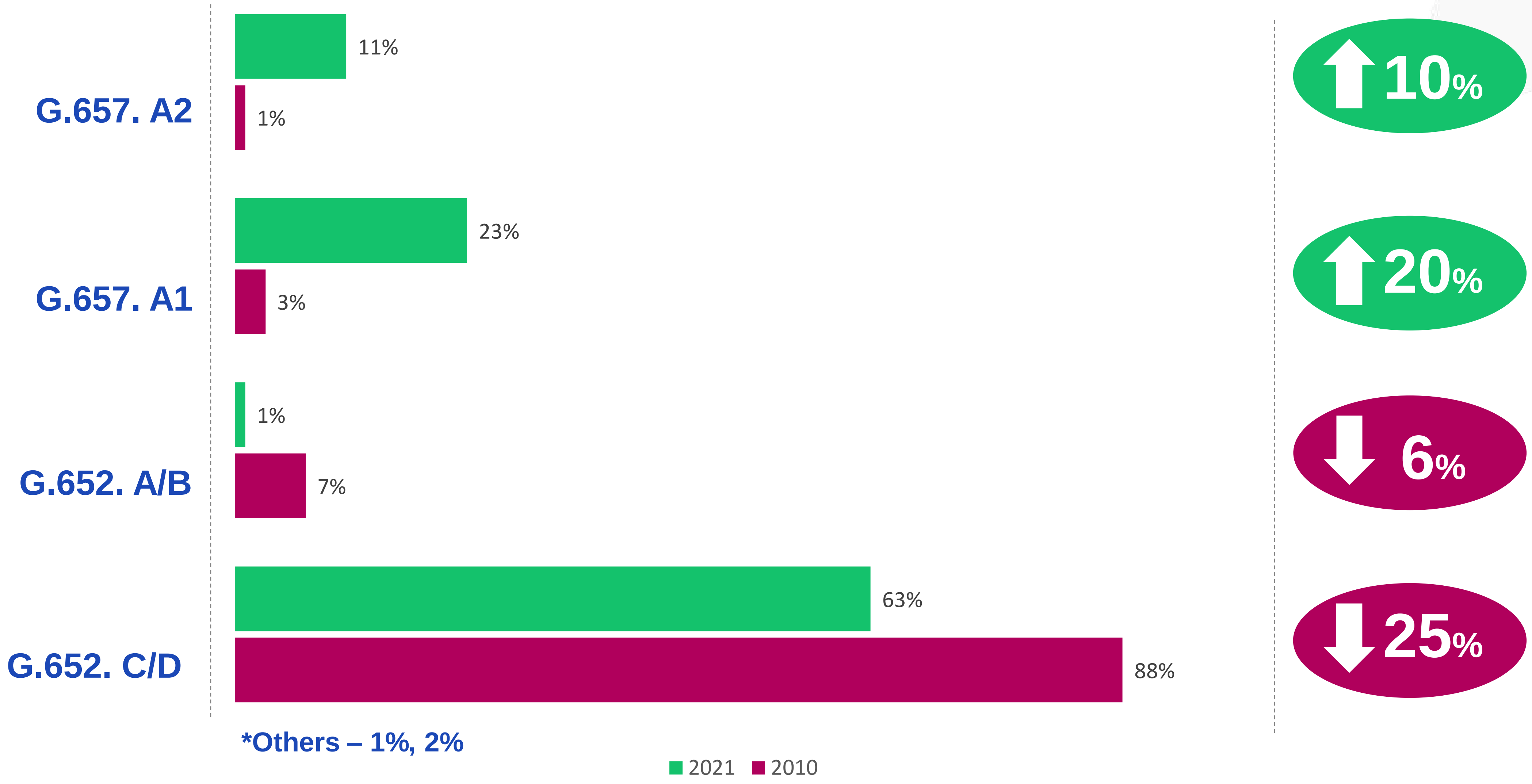
- Around 1500 Mkm fibre need to be deployed to reach 1.3 fibre/Capita
- Deployment rate in India should reach 150 MFkm/year within next 5 years to achieve 1.3 Fkm/Capita by 2035

OFC Installation in 2021



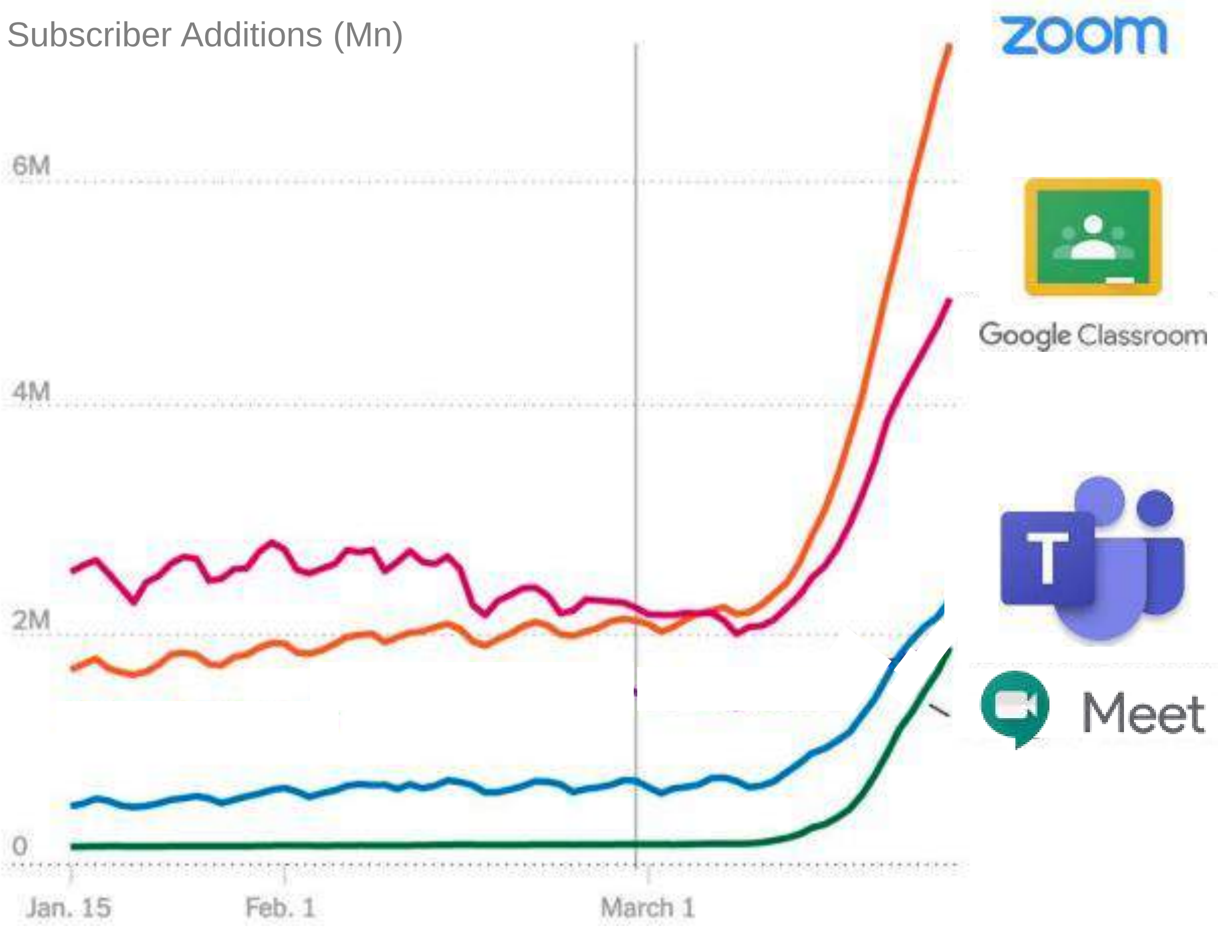
Region wise share of optical fibre cable installed in 2021

Single Mode Fibre (SMF) Mix



Covid has Significantly Accelerated this Journey

Study and Work from Home have become second nature



5G

12% of the Global mobile Traffic will be on 5G by 2022, which would generate **21 GB traffic/month per connection**

FTTH

By 2022, global fixed broadband speeds will reach **75.4 Mbps,** up from 39 Mbps in 2017.

5G and FTTH would play a pivotal role to sustain the increased speed and data consumption requirement

Source: Apptopia, IDC, Statista

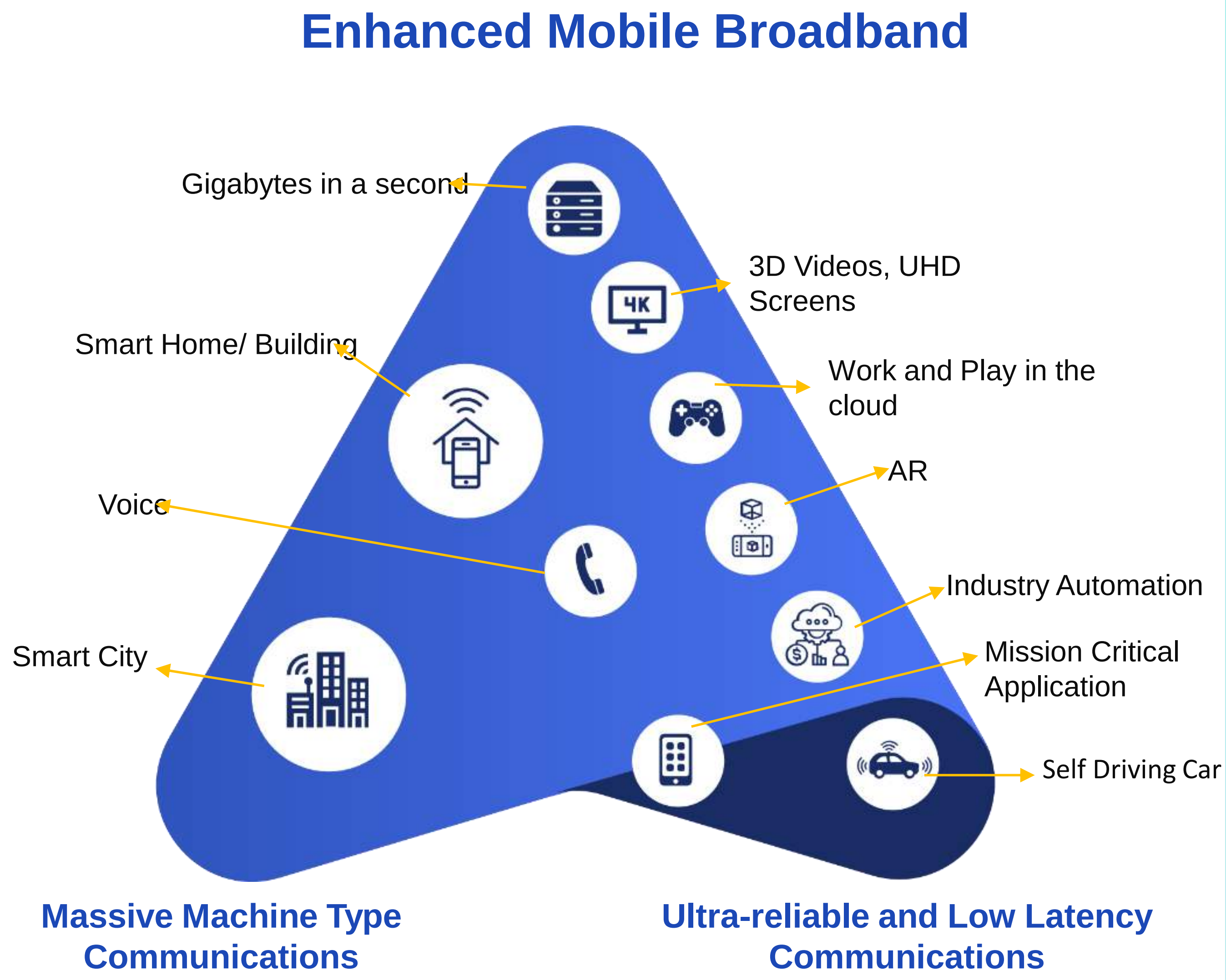
Agenda

1 Data and OF/C Consumption Trends

2 **Next Gen Networks- Both 5G and FTTH will play a role in that space**

3 Next Gen – One Fibre Network and High-Density Cables

ITU-R Triangle And 4G vs 5G



Parameters	4G	5G	Enhancement
Latency	10 ms	1 ms	10 x
Peak Data Rate	1 Gbps	20 Gbps	20 x
User Experienced Data Rate	10 Mbps	100 Mbps	10 x
Connection Density	10^5 devices / km^2	10^6 devices / km^2	10 x
Mobility	350 km / hr	500 km / hr	43%
Area Traffic Capacity	0.1 Mbps/m^2	10 Mbps/m^2	100 x

5G Frequency Bands

LOW BAND	MID BAND	HIGH BAND	mmW	Unlicensed
700-2100 MHz	2600-3800 MHz	3800-7000 MHz	26 GHz	60 GHz

3G, 4G and 5G Re-farmed

“Real” 5G mobile (3.6GHz) and Fixed Wireless

Backhaul/ Residential BB

Macro Sites

Macro and Small Cell/Micro Sites

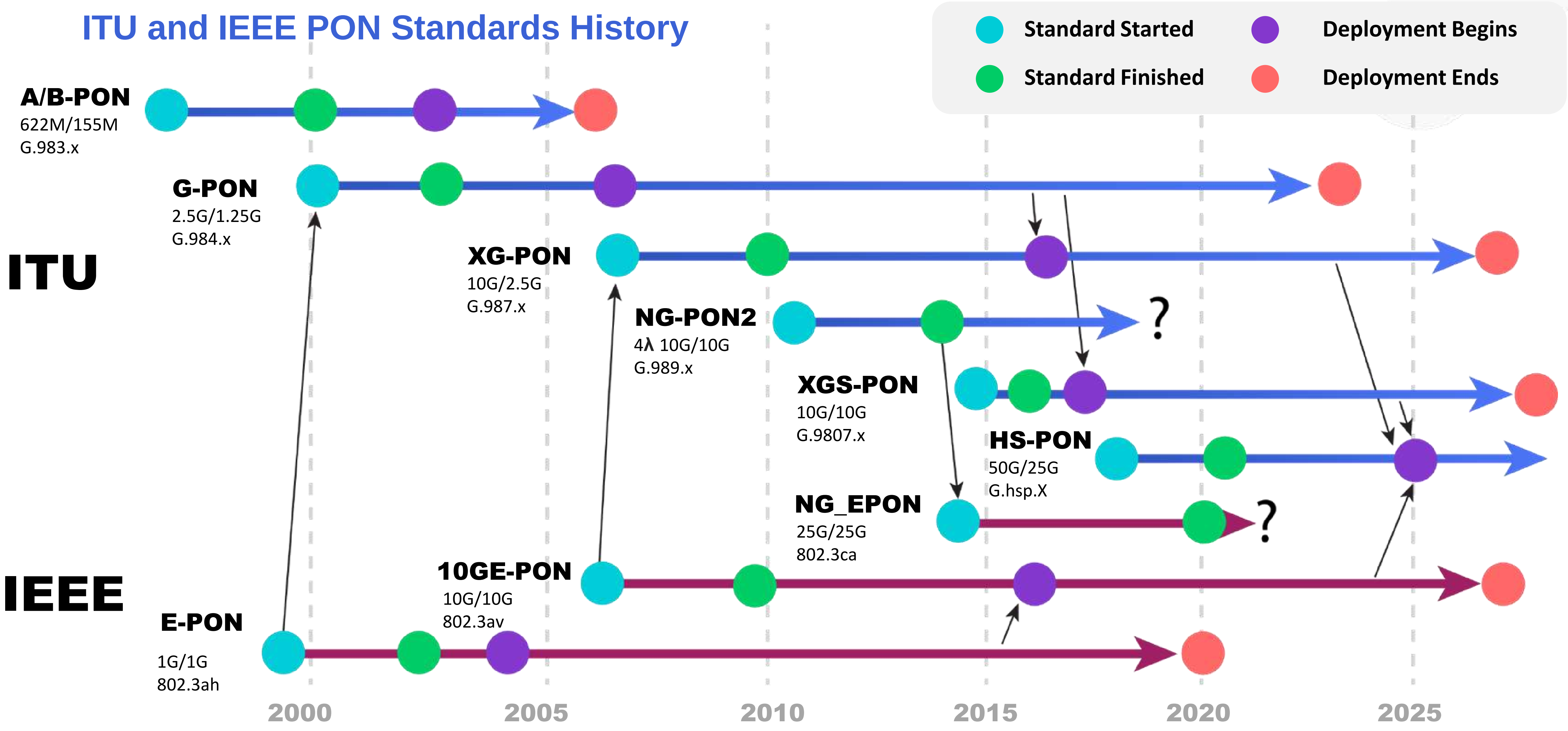
Mainly Small Cell / Micro Sites

Fixed / Wireless

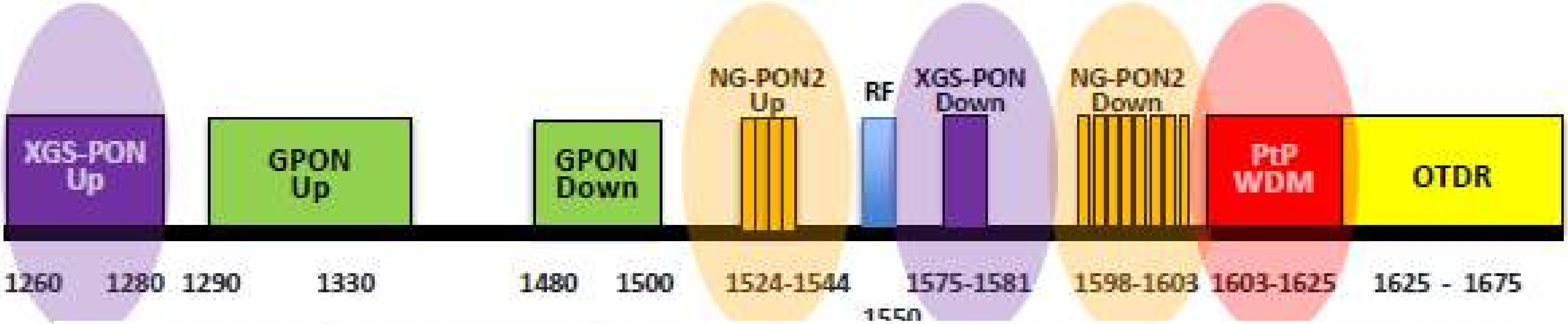
Low Bandwidth / Longer Reach / Good Penetration

High Bandwidh / Shorter Reach / Bad Penetration

Evolution Of PON Standards



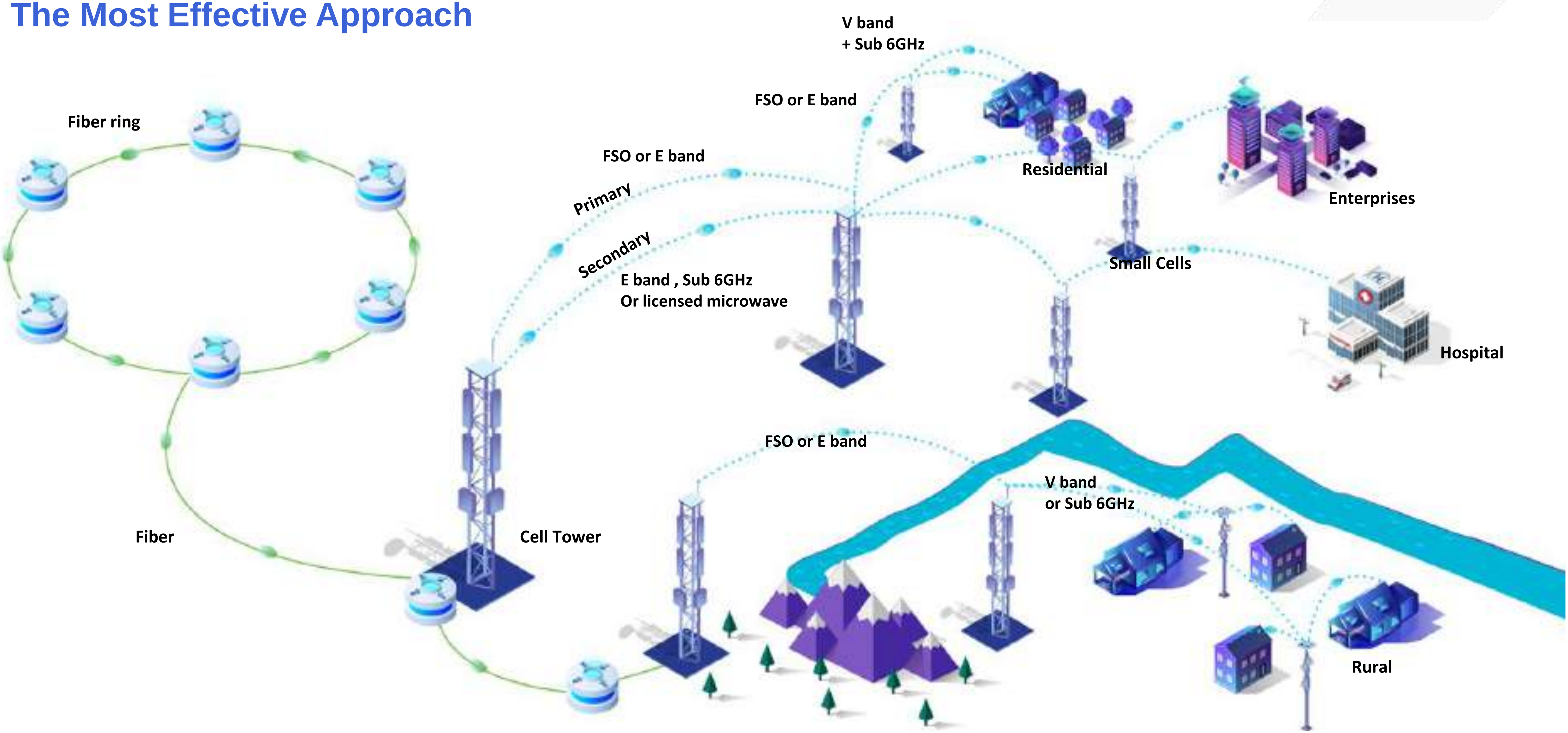
PON Spectrum: Wavelength Evaluation



Standard	Nomenclature	Bandwidth	Wavelengths	Primary Focus
25G/50G-EPON **(IEEE 802.3ca)**	High Speed EPON	2 x 25G Down 2 x 10G Up 2 x 25G Up	High O-band Down Low O-Band Up	Business services/MDU 5G Transport
ITU G.9807.3 (Super-PON)	Long Reach (50km) – Large Split (1024)	16 x 10G Down 16 x 2.5G/10G Up	L-Band Down C-Band Up (like NG-PON2)	Suited for Greenfield Residential/5G Transport
WDM-PON*	Point to Point WDM	16* x 10G/25G PtP Down/Up Symmetrical	?	5G Fronthaul (eCPRI)

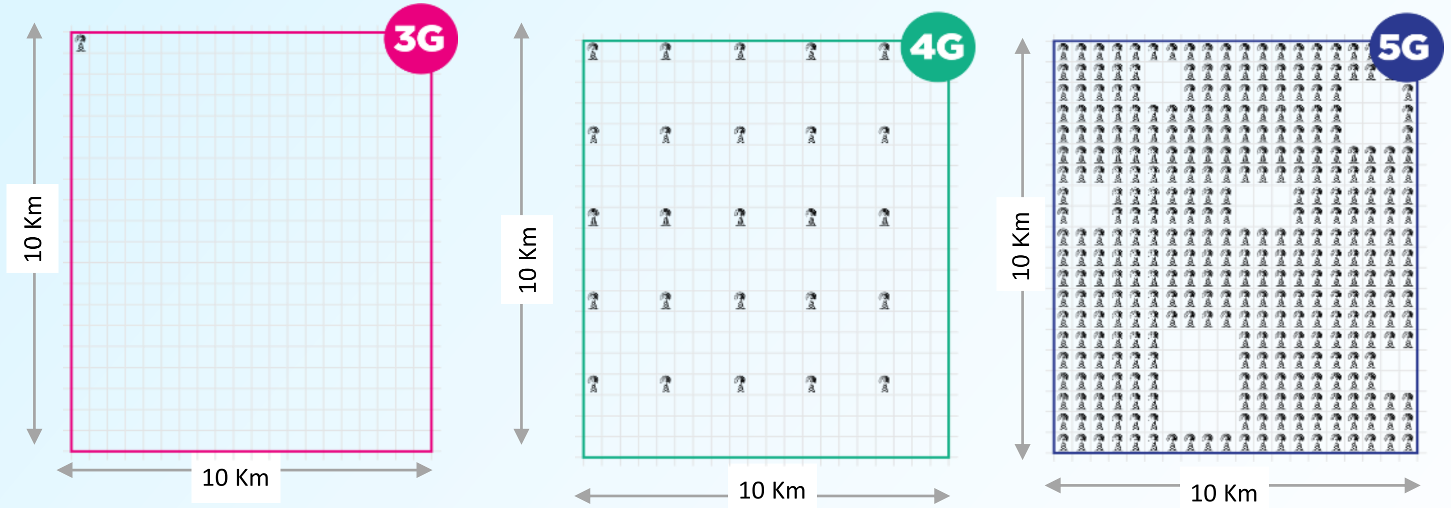
A Converged Topology for FTT-5G

The Most Effective Approach



Shorter Range Of 5G- More Cells and More Fibres

Small Cell Requirements For Full 5G Commitment



1 Site
Every 10 KM

CELL DENSITY (Cell/ 100 Sq.Km.)
1 Cell

25x

1 Site
Every 2 KM

CELL DENSITY (Cell/ 100 Sq.Km.)
5x5= 25 CELLS

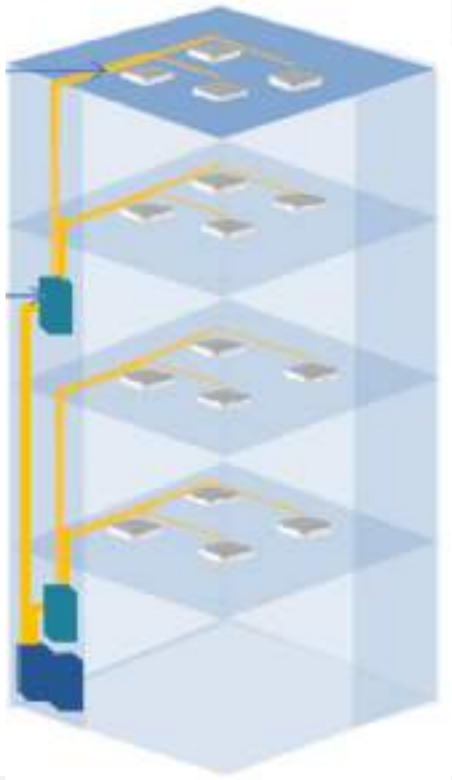
10x

1 Site
Every 0.5 KM

CELL DENSITY (Cell/ 100 Sq.Km.)
~250 CELLS

3G To 4G = At Least 25x Fibres
4G To 5G = At Least 10x Fibres

Indoor Fibre Infra For Large Building



Full Fibre Infrastructure
Fibre To The Ceiling (FTTC)

Example Of Converged Physical Layer

825 Fibre strands (incl. 20% extra for maintenance and future uncertainties)

EXAMPLE: Suburban area with 20,000 population per sq. km. density

Home	
No. of Persons in a Household	4
No. of Households	5000
Households that can afford	75 %
Market Share of an operator	30 %

2 Gbps (Peak) → **P2MP** (XGPON,SGXPON, NGPON2)

141 Strands

1125 Homes / 8 Homes/GPON Port

+

Enterprises	
Number of Enterprises	20
Market Share of an operator	50 %

Scalable Bandwidth & High SLA Ultra Low Latency - < 1 ms → **P2P** (MPLS,MEN,OTN)

20 Strands

10 Enterprises * 1 Pair of Fiber/Enterprise

+

Small Cells	
Street Length (km)	9
Distance between Poles (km)	0.1

Differentiated Services For Mobility & Smart City → **MIMO/ mmwave**

540 Strands

90 Poles * 3 Pairs of Fiber/Pole

Source: Sterlite Estimates

Agenda

1 Data and OF/C Consumption Trends

2 Next Gen Networks- Both 5G and FTTH will paly a role in that space

3 **Next Gen – One Fibre Network and High-Density Cables**

The Fiberization Challenges

A

Attenuation

Signal Decay

+

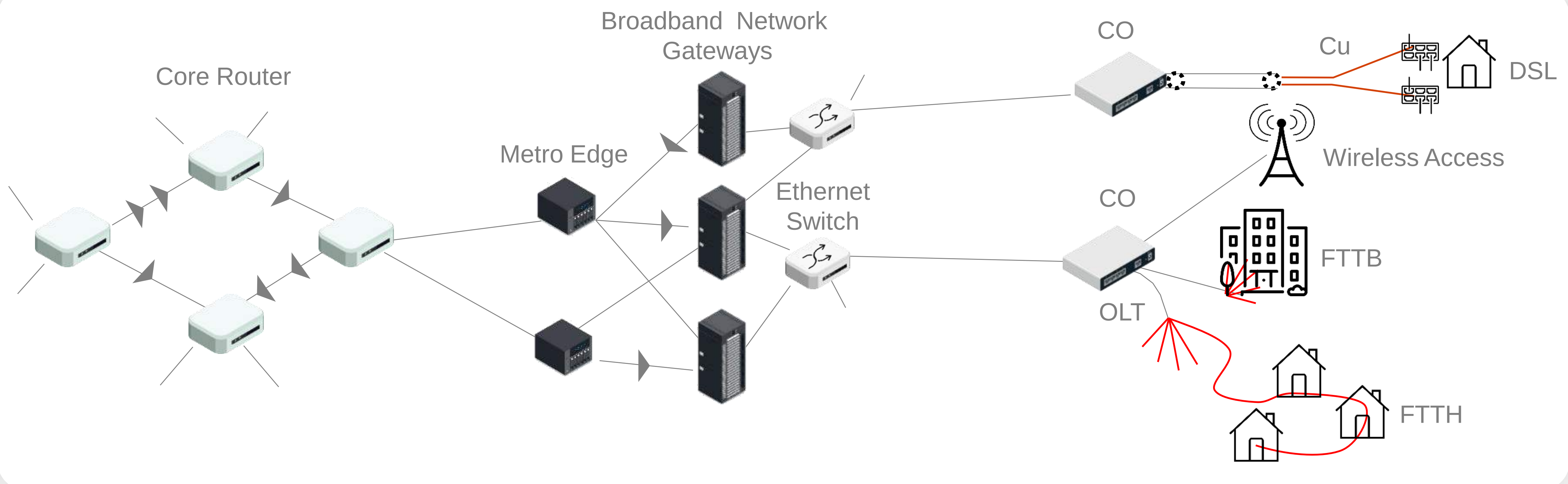
B

Bend Sensitivity

Signal Leakage

Source: GSMA, Canalys, Company & Industry Estimates

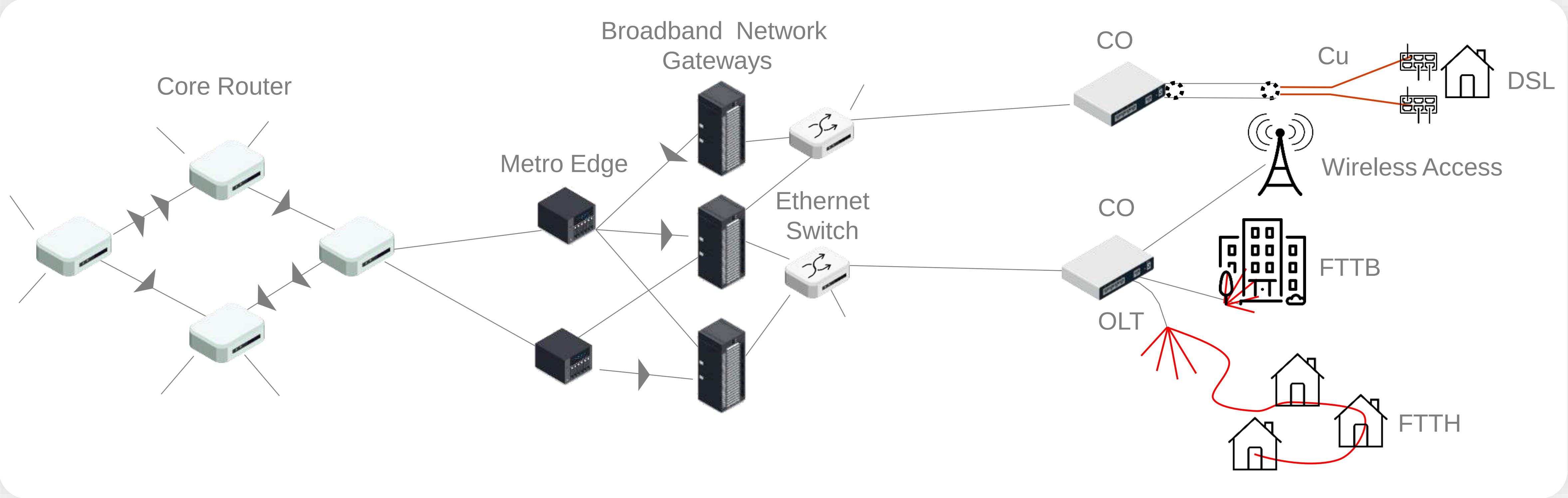
“Recommended” Fibre Type in a Typical Network



Core Network	Metro Network	Access Network
G.652.D G.655	G.652.D G.655/ 656	G.652.D G.657.A1/A2/B2/B3

ITU-T G.652.D is the “Standard” fibre type today!

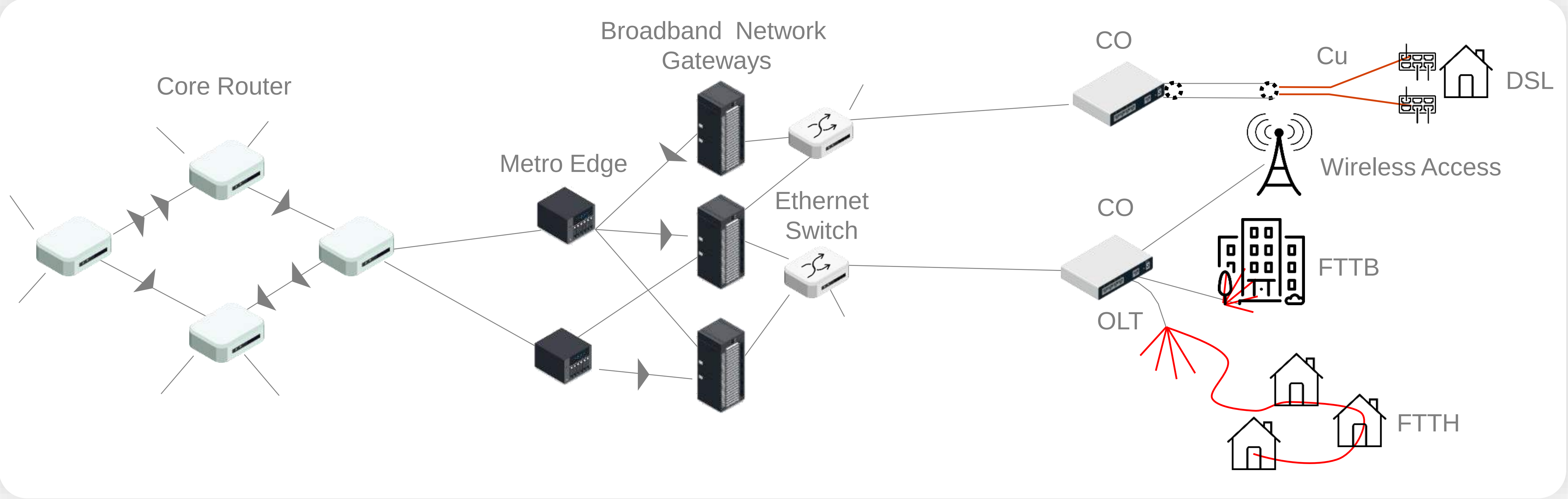
Common Fibre type across all network sections TODAY : ITU-T G.652.D compliant



Core Network	Metro Network	Access Network
G.652.D	G.652.D	G.652.D
G.655	G.655/ 656	G.657.A1/A2/B2/B3

Bend Insensitive Fibre (BIF) is the Future

Common Fibre type across all network sections IN FUTURE : ITU-T G.657.A2 compliant



Core Network	Metro Network	Access Network
~~G.652.D~~ G.657.A1/A2	~~G.652.D~~ G.657.A2	~~G.652.D~~ G.657.A2/B3
G.655	G.655/ 656	G.657.A1/A2/B2/B3

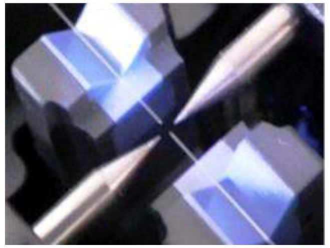
Optical Loss Management

Beginning of Life (BOL) Loss =

Optical Fibre Cable Drum Attenuation

\+

Fiber Splice Loss



\+

Connector Loss

\+

Bend Loss

\+

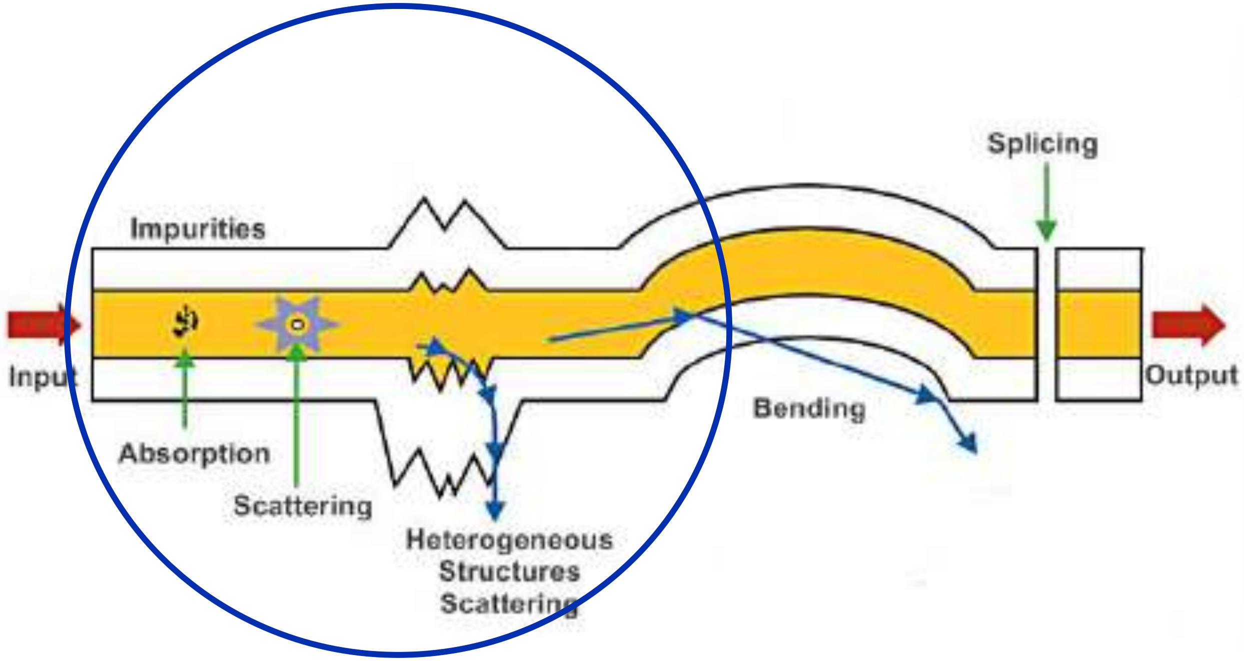
Incidental Losses

Why link loss increases from BOL value?

BOL Optical Link Loss + Fiber Aging, Water Ingress + Accidental/ Unplanned Fiber /Cable Cut

- Fiber Splice Loss
- Bend Loss
- Incidental Losses

What is Attenuation

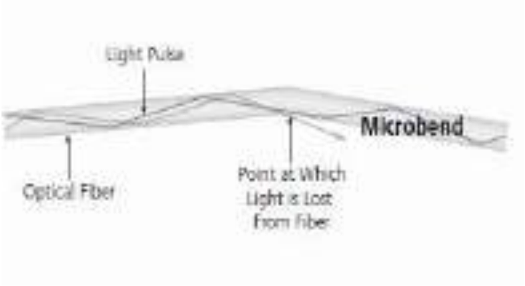


Attenuation refers to signal loss along the length of the fibre.

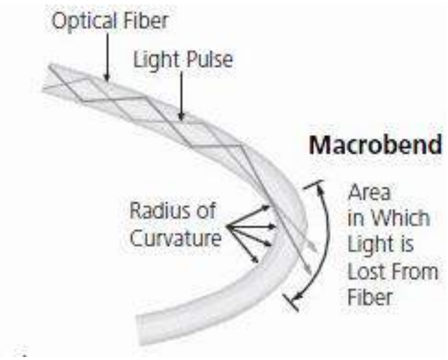
Attenuation happens due to absorption and scattering of light signal inside the core

What is Bend Sensitivity

Bend Insensitive Fibre provide more than **10x reduced Macro Bend Loss**



Microbend



Macrobends

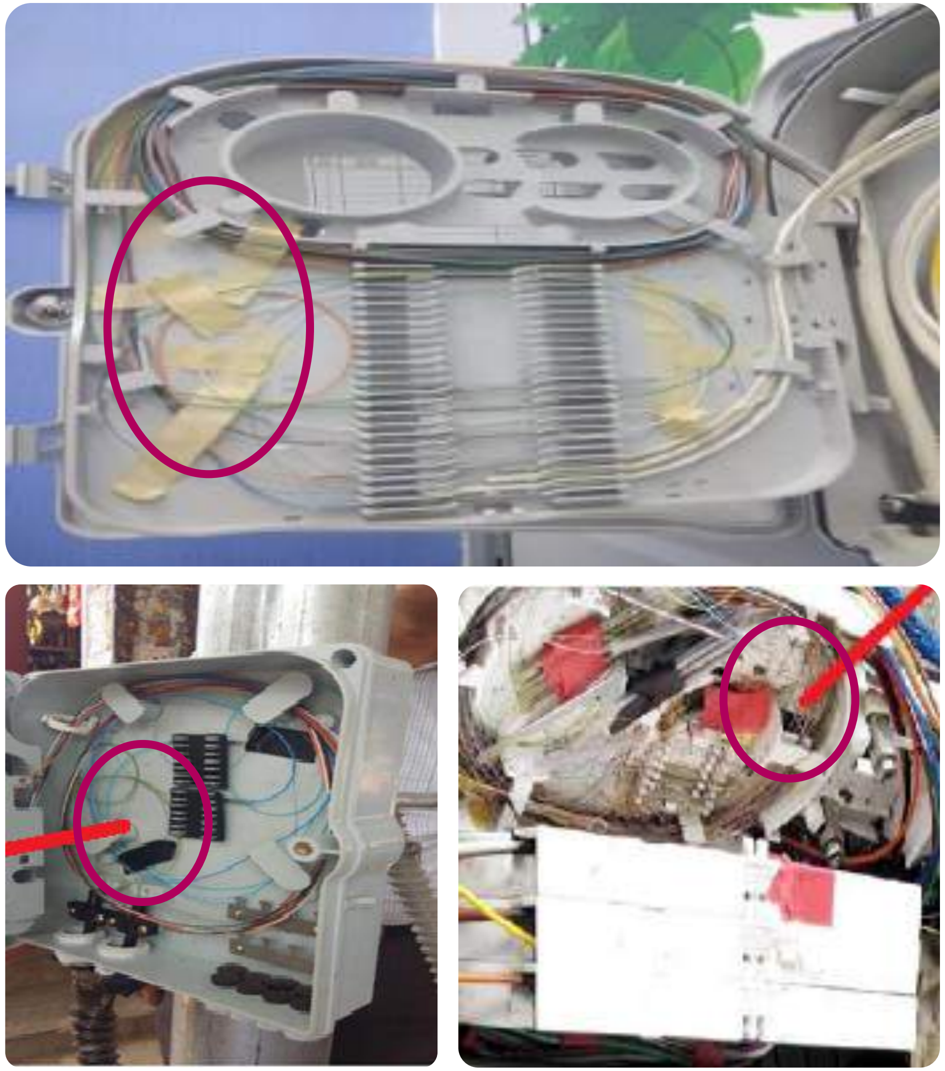
Bend Performance G652.D vs G.657.A2

Unsafe to use Under extreme

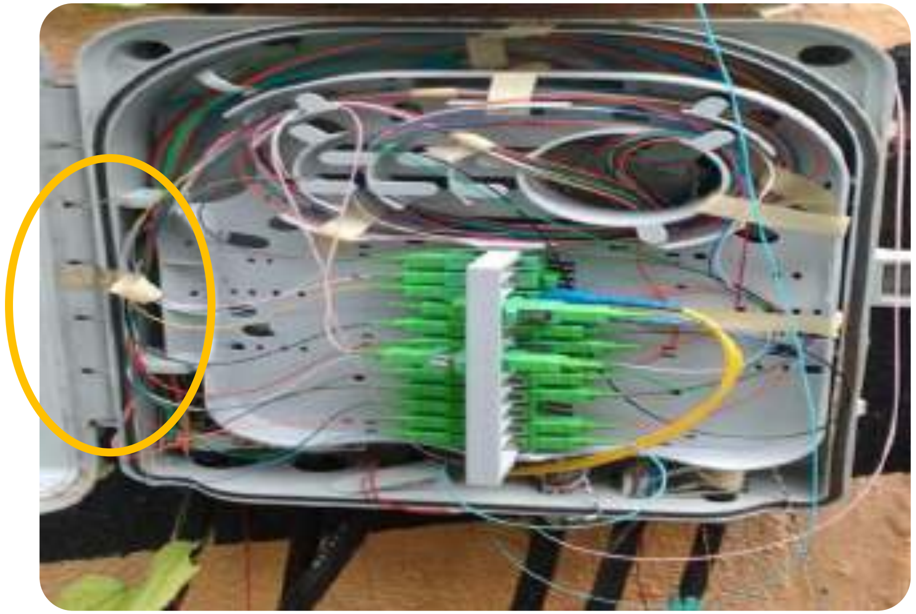
Source: Sterlite Tech calculations

Accidental Bends in Real Life Scenarios

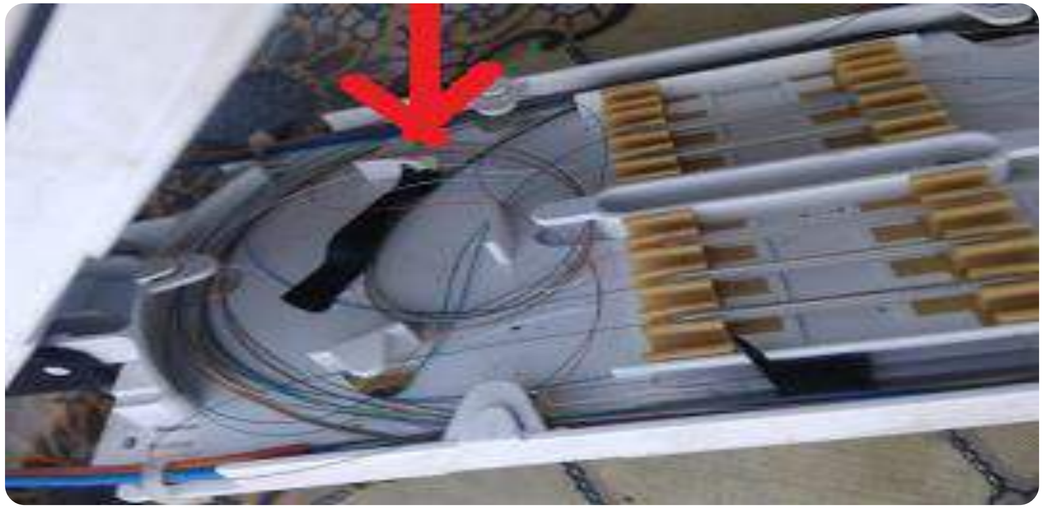
Abuse In Optical Fibre

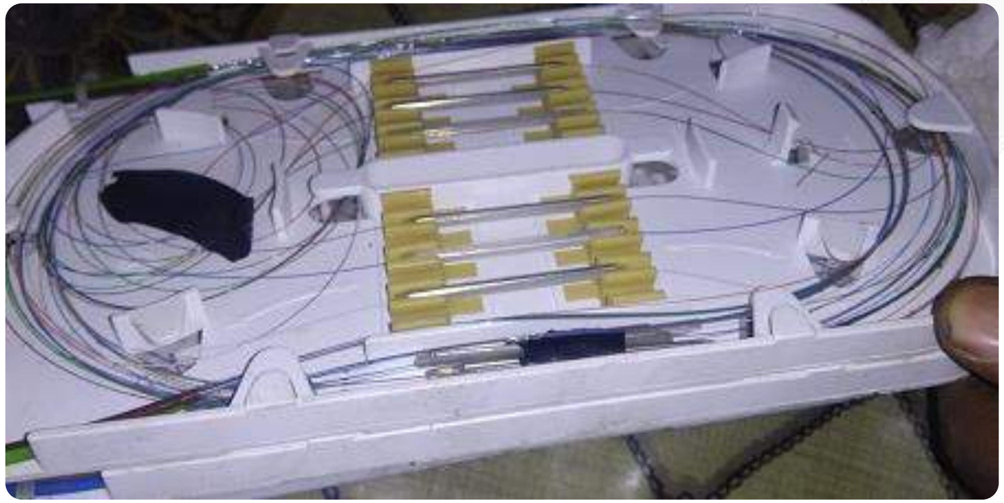


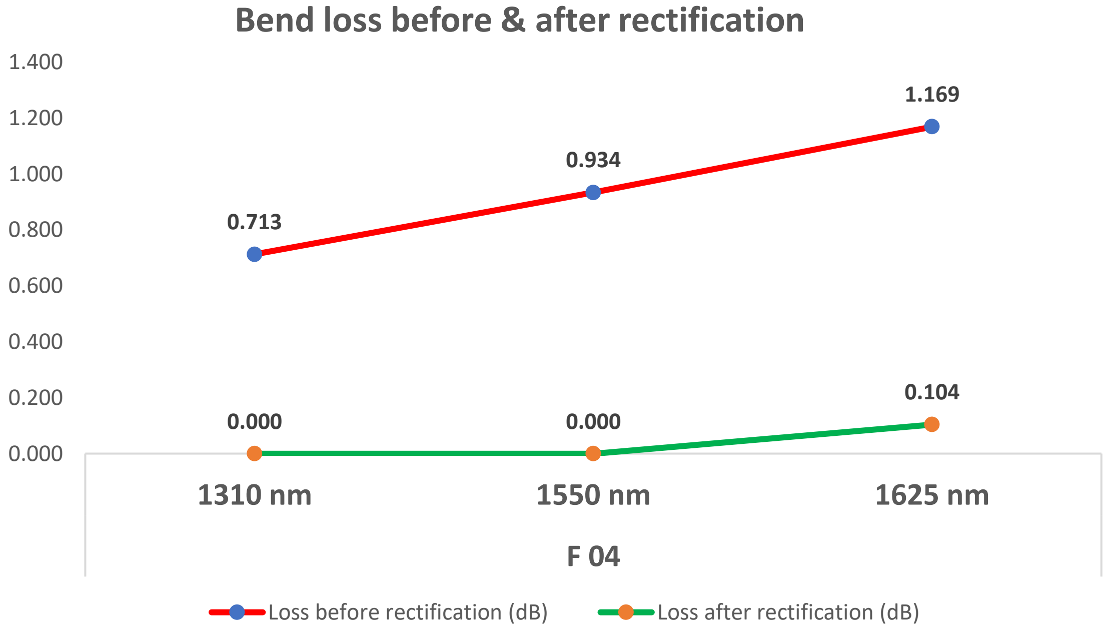
Ideal Condition

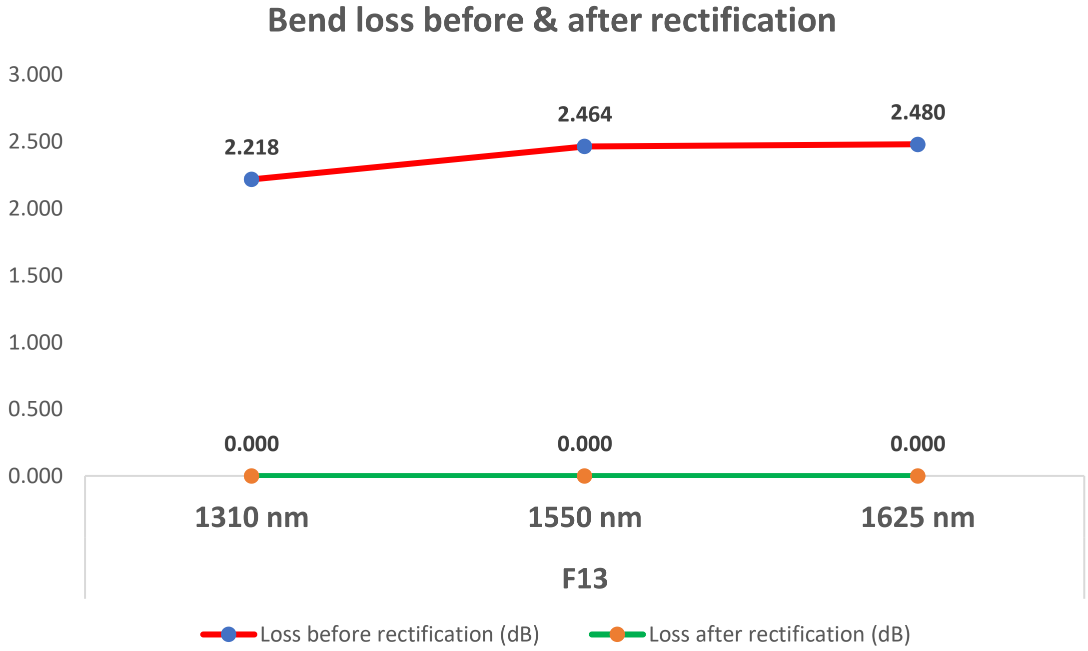


Most Common Origin Of Optical Loss





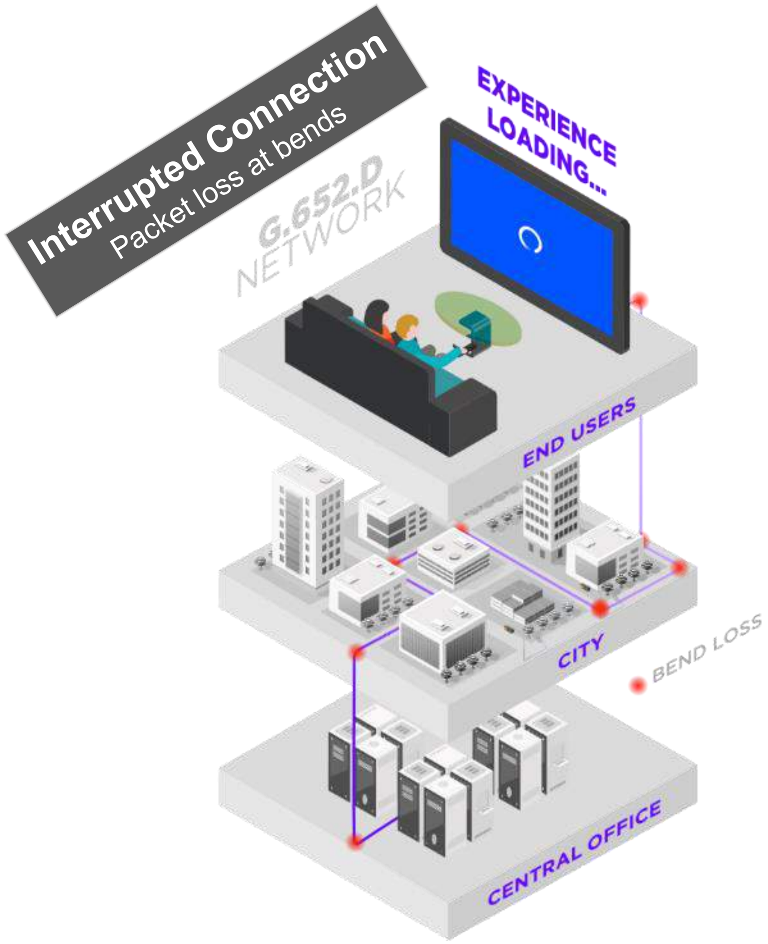




Impact on Reach and New Technology Adoption

Increasing geographical spread

More no. of tight bends & turns



Newer Technology & Next Gen PONs

Exposure to higher wavelengths

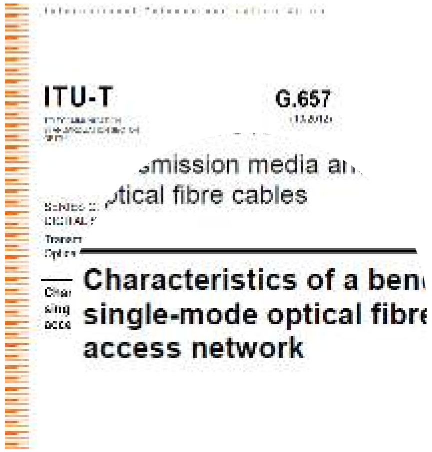
Applications	DOCSIS & HFC		Metro & Long Haul		Fibre to the X			
Macro Bend Loss increase	2x		2.5x		3x		4x	
Technology upgradation	RF-Video Downstream	RFoG Upstream	C-Band DWDM/CWDM	L-Band DWDM/CWDM	G-PON Downstream	10G-PON	G-PON Downstream	40G-PON
	1550 nm	**1610 nm**	1560 nm	**1625 nm**	1490 nm	**1577 nm**	1490 nm	**1603 nm**
Wavelength increase	60 nm		65 nm		87 nm		113 nm	

ITU-T G.657.A2 Bend-insensitive Fibre

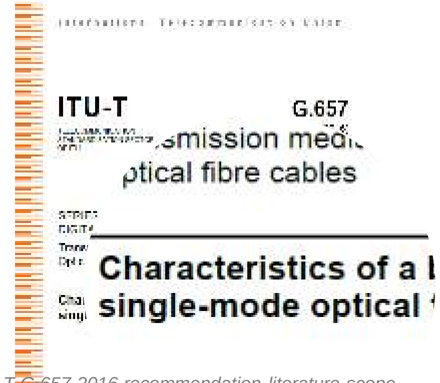
STL

ITU-T removed the mention of "Access Network" for bend insensitive fibre…

2012



2016



"ITU-T **G.657.A1/A2** fibre can be used **for all networks** where ITU-T **G.652.D fibre is specified**"

…and revised attribute specifications for compliance with legacy G.652.D fibre

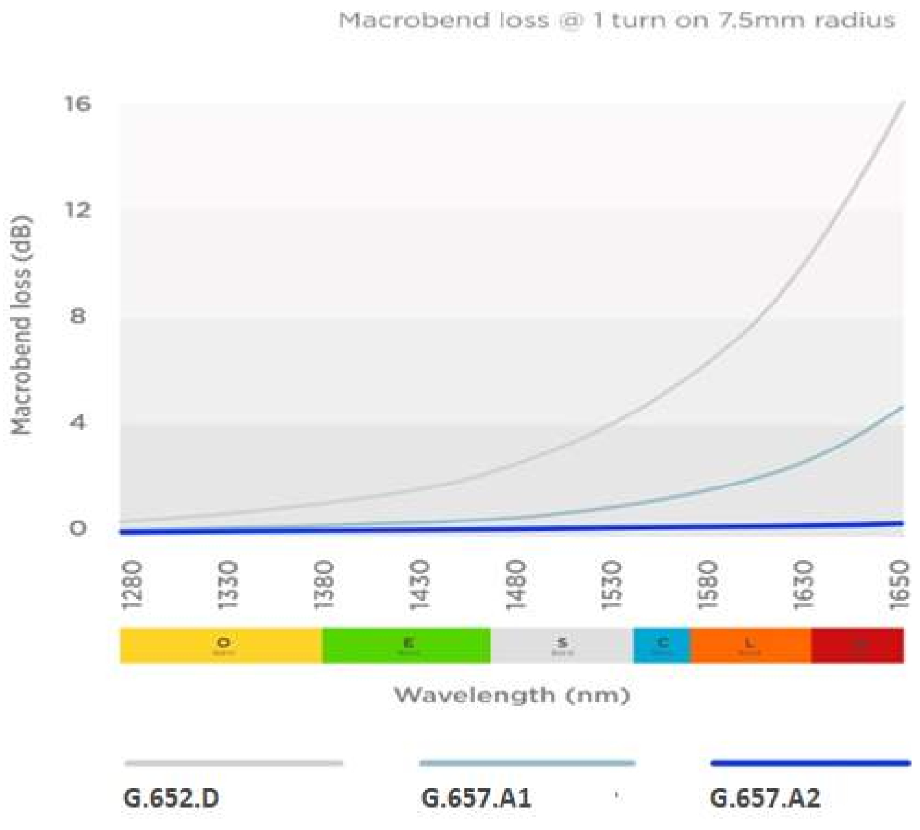
Attribute	ITU-T G.652.D	ITU-T G.657.A2
Maximum Attenuation at 1310nm	0.40 dB/km	0.40 dB/km
Maximum Attenuation at 1550nm	0.30 dB/km	0.30 dB/km
Maximum Attenuation at 1625nm	0.40 dB/km	0.40 dB/km
Maximum Attenuation at 1383 nm ±3 nm	0.40 dB/km	0.40 dB/km
Mode field diameter at 1310nm	8.6-9.2 (± 0.4) µm	8.6-9.2 (± 0.4) µm
Cladding diameter	125±0.7 µm	125±0.7 µm
Maximum Core Clad concentricity error	0.6 µm	0.5 µm
Maximum Cladding non circularity	1%	1%
Zero Dispersion Wavelength	1300 – 1324 nm	1300 – 1324 nm
Maximum Zero Dispersion Slope	0.073 to 0.092 $ps/nm^2.km$	0.073 to 0.092 $ps/nm^2.km$
Cable Cutoff Wavelength	≤1260nm	≤1260nm
Minimum Proof test	0.69 GPa	0.69 GPa
Macrobend loss, 100 turns,30mm radius, 1625 nm	≤0.1 dB	Not specified
Macrobend loss, 10 turns, 15 mm radius, 1550 nm	Not specified	≤0.03 dB
Macrobend loss, 10 turns, 15 mm radius, 1625 nm	Not specified	≤0.1 dB
Macrobend loss, 1 turn, 10 mm radius, 1550 nm	Not specified	≤0.1 dB
Macrobend loss, 1 turn, 10 mm radius, 1625 nm	Not specified	≤0.2 dB
Macrobend loss, 1 turn, 7.5 mm radius, 1550 nm	Not specified	≤0.5 dB
Macrobend loss, 1 turn, 7.5 mm radius, 1625 nm	Not specified	≤1.0 dB
Maximum PMD_Q	0.20 ps/ √km	0.20 ps/ √km

Source: pg. 7, ITU-T G.657 2016 recommendation literature scope

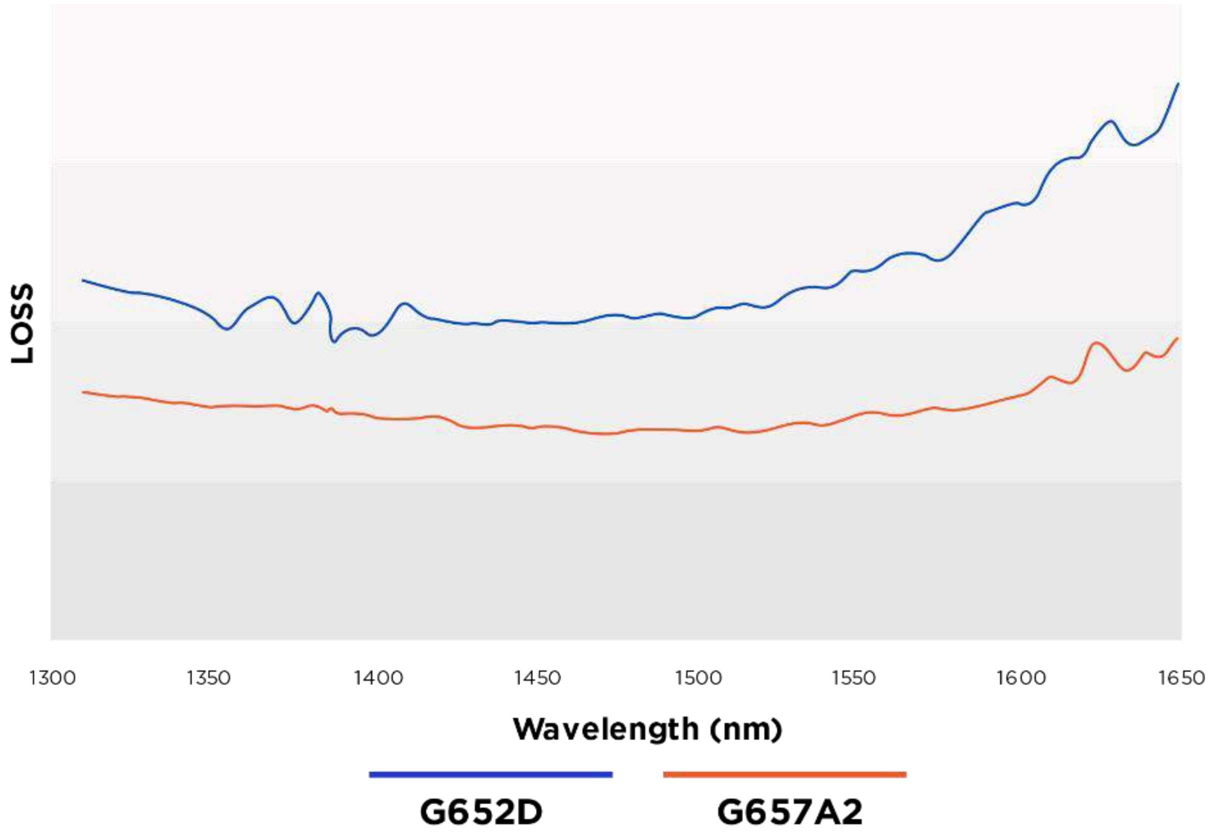
Source: ITU-T literature on G.657 fibre

The Cascading Effect Of Low Bend Loss

Reduced losses at higher wavelength
For a future proof network



Microbend Loss Test
(IEC TR 62221, method B, Fixed drum method)



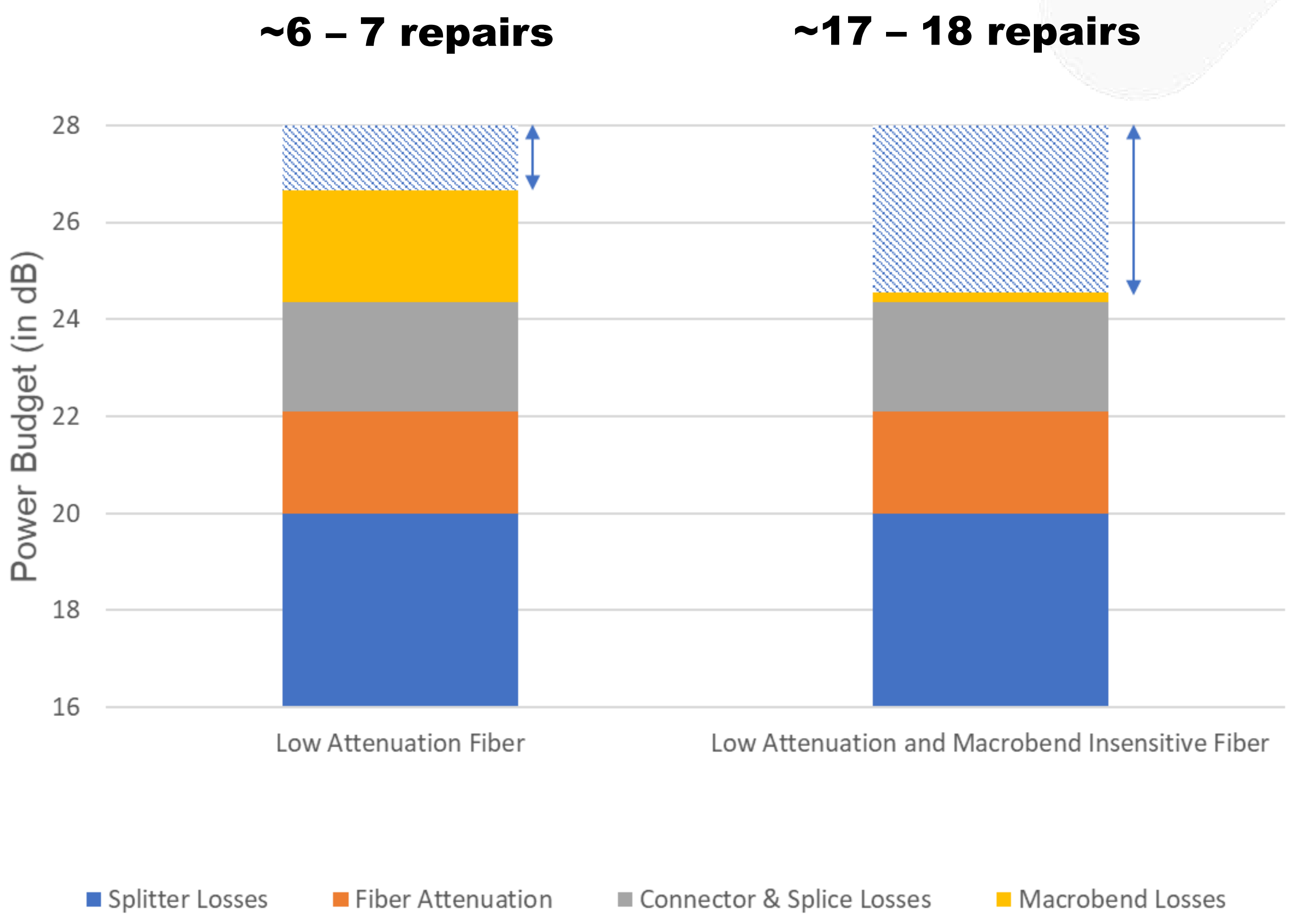
Source: ITU-T literature on G.657 fibre

Reduced Operational Expense With Bend Insensitive Fibre

10+ years

increased network life*

Lower loss increases repair resilience enhancing overall network life

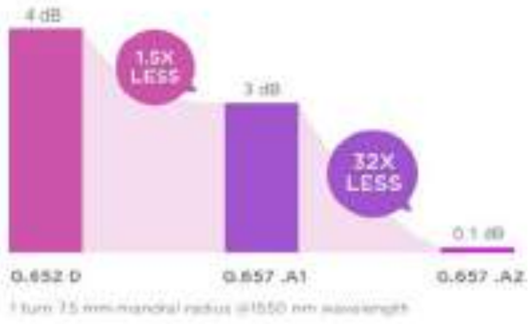


Assumptions:

- *Accidental 15mm bend at time of repair*
- *Average link length : 14kms, 1000 links per sim and 51 sims in total*
- *Splice loss: 0.1 dB (G.652.D vs G.657.A2)*
- *Cuts/1000km/month: 10*
- *BOL drum attenuation: 0.20/0.21/0.22/0.23 dB/km*

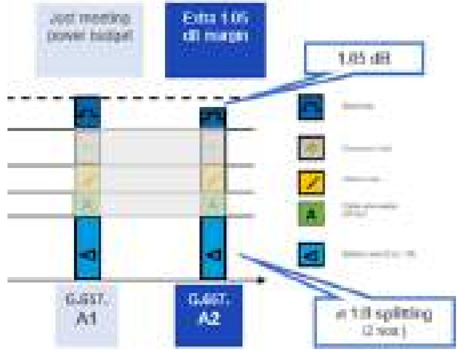
ITU-T G.657.A2 fibre- The New Standard

1. Reduced Bend Loss

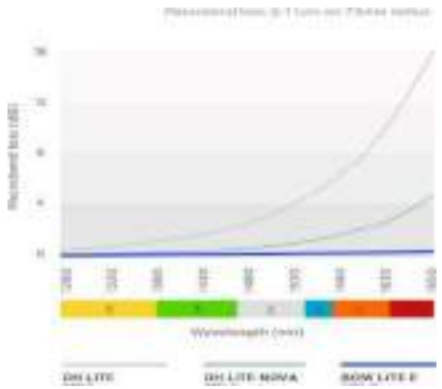


2. Enhanced Network Reach

3. Higher Splitting Ratio

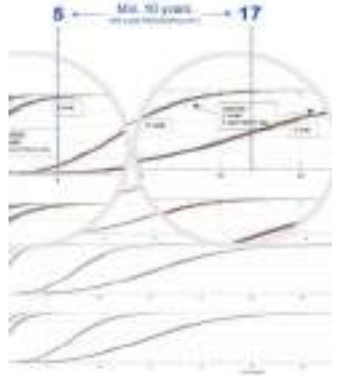


4. For a Futureproof Network



5. Splice Compatible With Legacy Fibre

6. Network Lifetime Increment



The Fiberization Challenges

A

Attenuation

Signal Decay

+

B

Bend Sensitivity

Signal Leakage

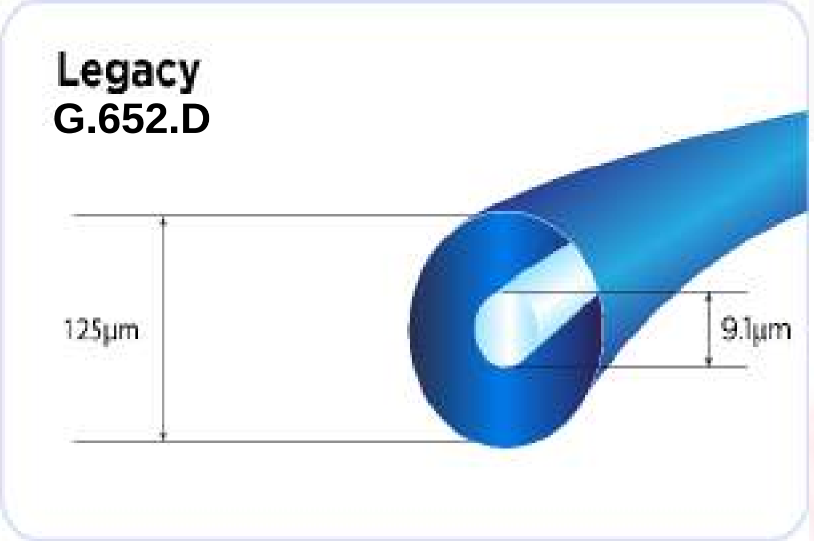
C

Compatibility

Legacy and Future Technology

Source: GSMA, Canalys, Company & Industry Estimates

Compatibility with Legacy Network and Future Technology



MFD of Typical G.657. A2: **8.6 micron**

MFD of Legacy G.652. D: **9.1 micron**

MFD Mismatch

Actual Splice Loss
0.005dB

A2 to D Apparent Loss **0.12dB**

D to A2 Apparent Loss: -**0.22dB**

Legacy Fibre Compatible G.657.A2 Fibre

stellar™

The Installer's Fibre

World's 1st G.657.A2 fibre which is compatible with legacy networks built on G.657.A1 and G.652.D

Minimal Splice Loss

9.1 MFD ensures seamless splicing

Increased Network Life

Low bend loss - Provision for more splices

Cost Saving

Bend Insensitive – Compact Splice Box and Manholes

Future Ready

Superior Macro Bend performance at higher wavelength

The Fiberization Challenges

A

Attenuation

Signal Decay

B

Bend Sensitivity

Signal Leakage

C

Compatibility

Legacy and Future Technology

D

Duct Space

Optimize Limited Space

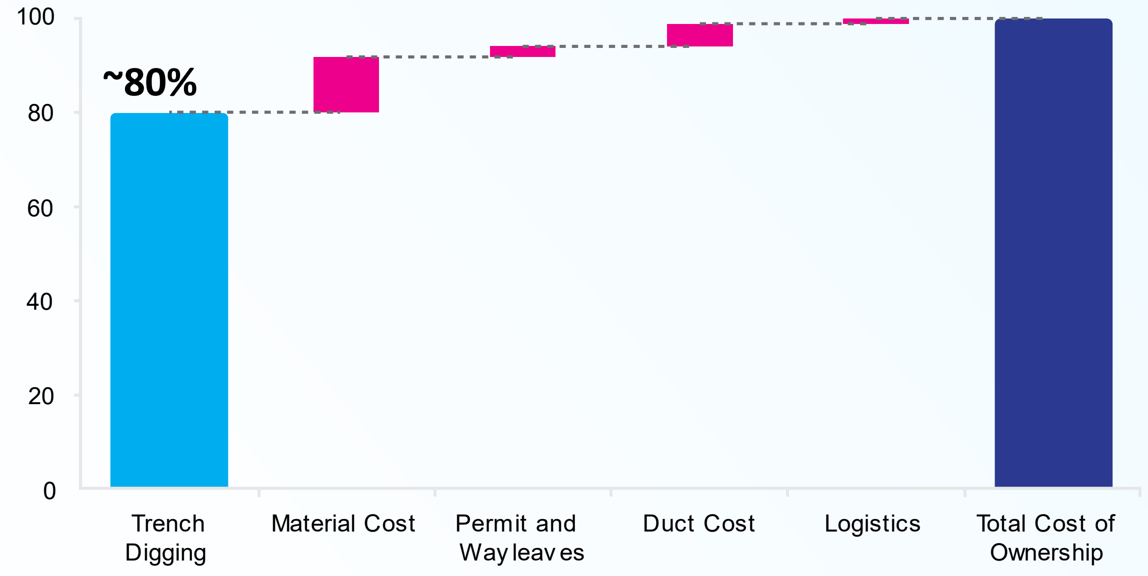
Source: GSMA, Canalys, Company & Industry Estimates

Limited Duct Space

80% **Cost share of civil work in a Cable Deployment Project**

Rest 20% constitutes Cables, Ducts and supplementary products

TCO - Cable Deployment Project



To meet this exponential growth

Need 10X Fibre

In the same available duct space

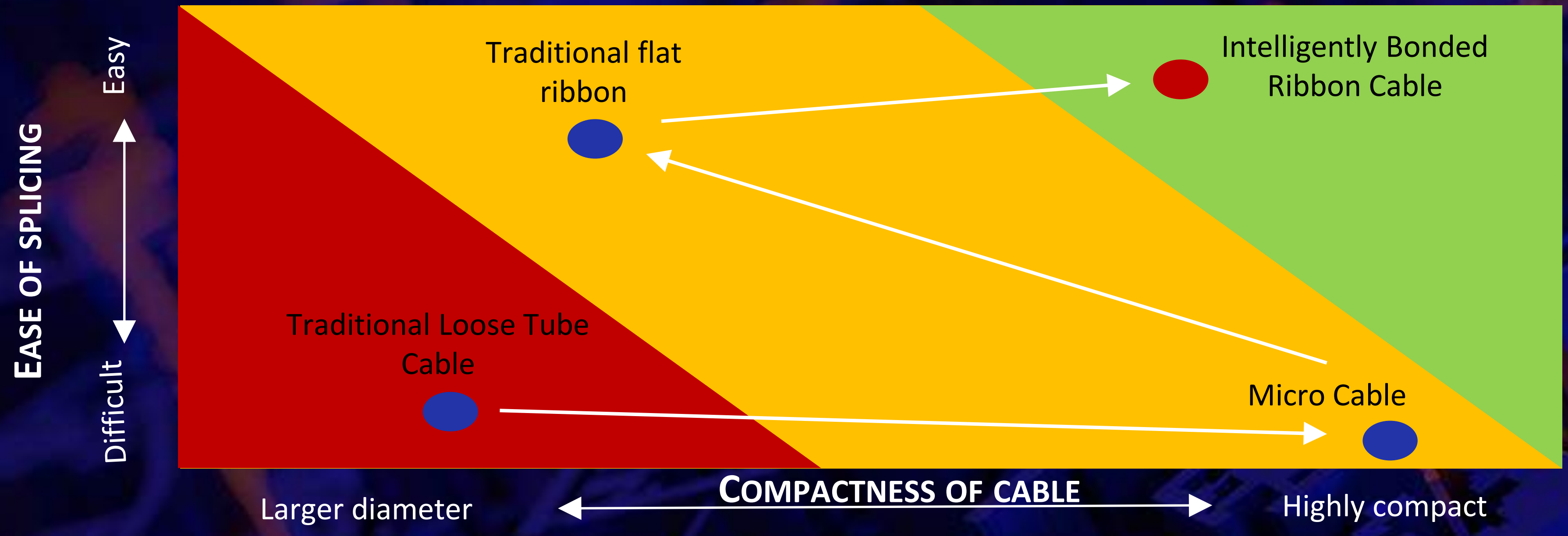
Minimize the size of Cable as per requirement and provision for future requirement

Maximize Fibre Count on the basis of forecasted future demand

Next Generation Ribbon Technology

Modern networks require more fiber per cable and Minimize new duct installation and construction

Better TCO from one-time deployment with compact cables in choked ducts



Traditional Loose Tube Cable

Splicing is difficult and time consuming in high fiber count cables

Micro Cable

- *Slimmer Jacket & 200um fibre reduces cable diameter*
- *Splicing is still time consuming*

Traditional Flat Ribbon Cable

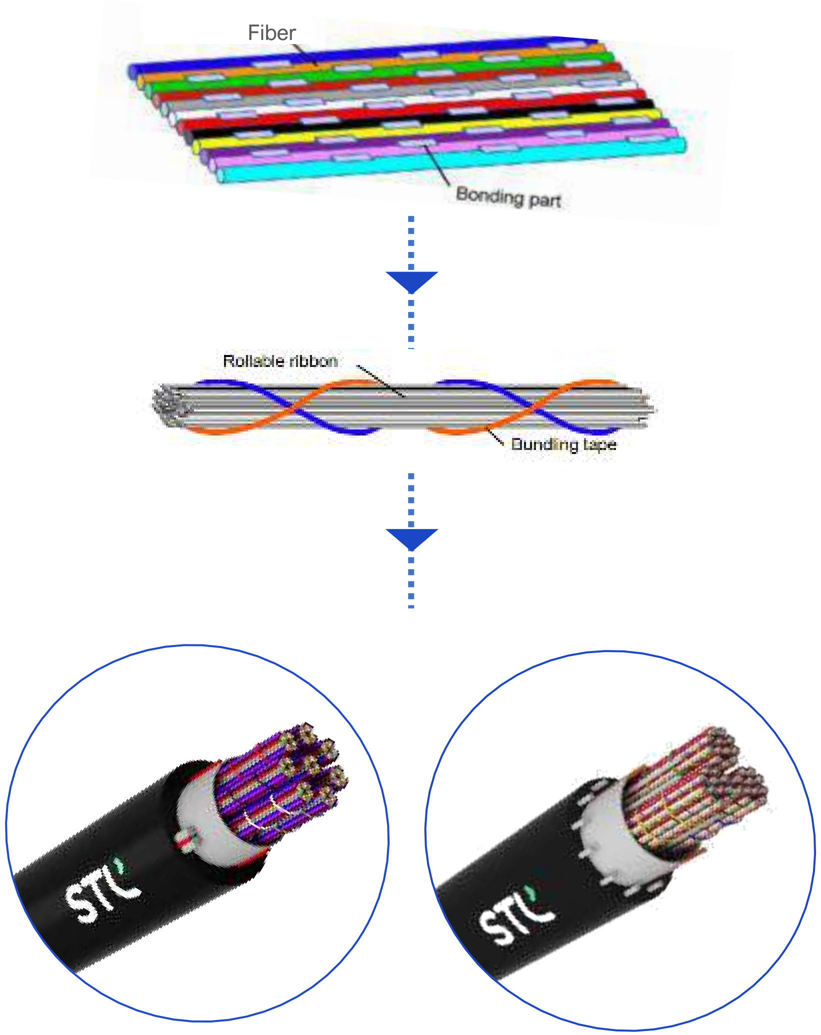
- *Ribbon, bundle of Fibres expedites splicing process*
- *Unoptimized cable space with flat ribbons in a round cable*

Intelligently Bonded Ribbon Cable

- *Improved form factor due to bond design*
- *Collapsible ribbon transforms into flat ribbon for fast splicing*

Celesta – Intelligently Bonded Ribbon Cable

Intermittent Bonded Ribbon



..upto **6912F**

Industry's lowest attenuation in Ribbon Cables

- Made using G.657.A2 bend insensitive optical fibre

Splice fast and easy

- mass splice with new and existing ribbon solutions
- Single fiber splice compatible – safe and fast ribbon separation into 12 loose fibers

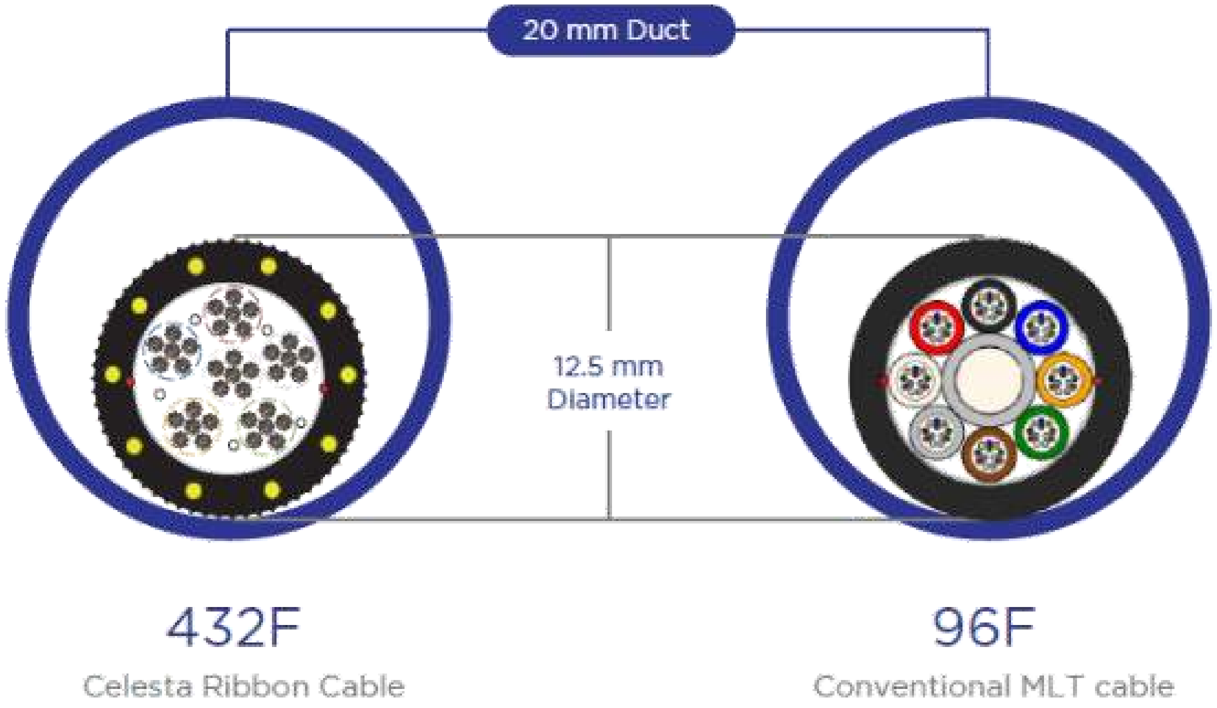
Easy to install

- blow optimized micro ribbon cable, but at same time robust enough for pull installation
- easy ribbon routing/handling in splice tray – zero preferential ribbon bend,

Saves installation cost

- Saves duct cost - IBR roll up and fill the space inside of a cable efficiently allowing for the highest fiber counts
- Accessories miniaturization - Micro ribbon cables and ultra ribbon cables bend tightly

Celesta - Maximise Duct Space Utilization



4.5x
More Fibre*
* As compared with MTL cable

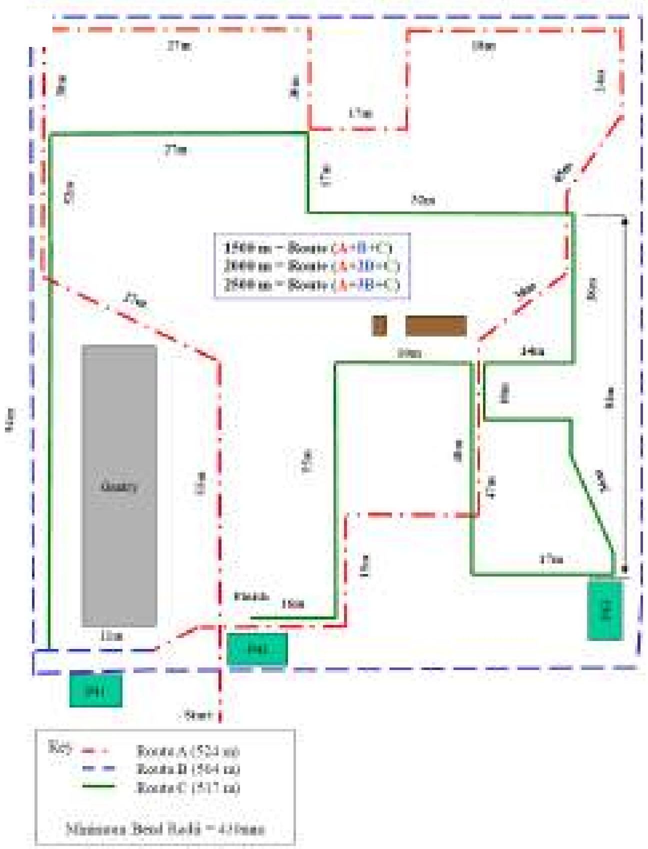
2x
Faster Blow Installation

32%
Overall Cost Savings

Easy install - Innovative Blow Optimised Ribbon Cable Design

432F G657.A2 STL IBR

AIR BLOWN INSTALLATION CABLE
TEST ROUTE



2000m
Single shot blow in super tough the UK Telco test track < 35 mins UK Telco approved

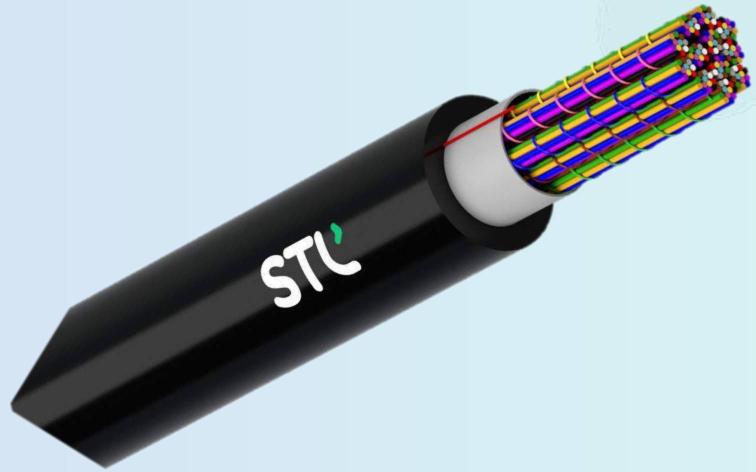
Global innovations for Indian deployment scenarios

STL

Enabling Future Readiness at Lowest Total Cost of Ownership

Backward Compatible
G657A2 Fibre

+



High Density Ribbon Cable
Intelligently Bonded Ribbon (72F - 6912F)

Faster deployment of future proof bend resilient network

opticonn

Optical Connectivity

Global leader in E2E optical physical layer solutions

Higher density network - 100% existing duct capacity augmentation

Q&A

Let us know your thoughts

#STLWebinar

LinkedIn

twitter

beyond tomorrow