Budgeting your link losses, still?

Innovations for enhanced network performance

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Tech ecosystem disrupting with new use cases

Consumer led use cases

Enterprise led use cases

Connected everything

+

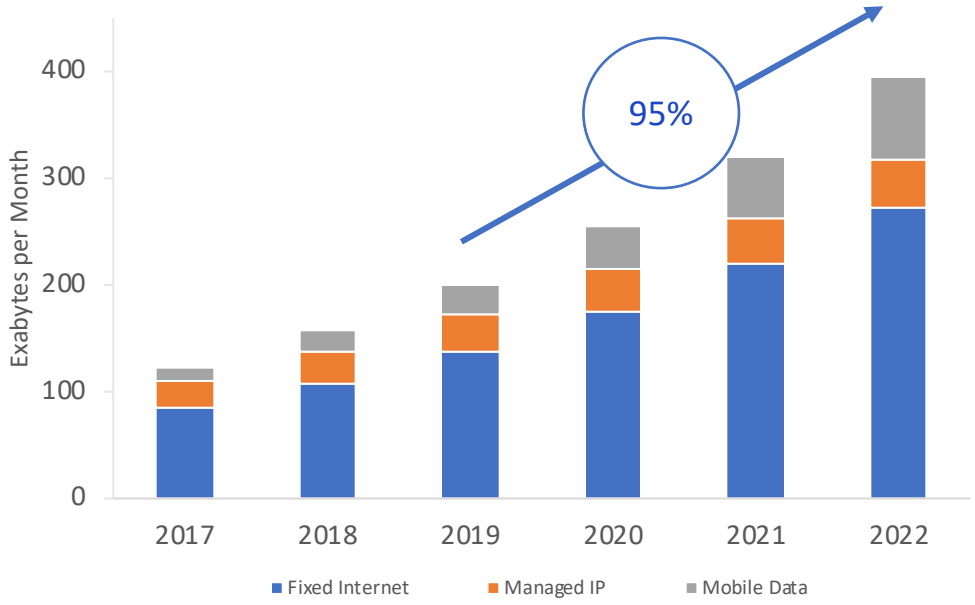
Contextual automated experience

Exponential Growth in data

Increasing data demand pushing for new network creation

2x increase in global data demand Fixed line

internet to be the major contributor



Source: Cisco VNI forecast

New networks would be different

Converged, fibre dense and deep fiberized

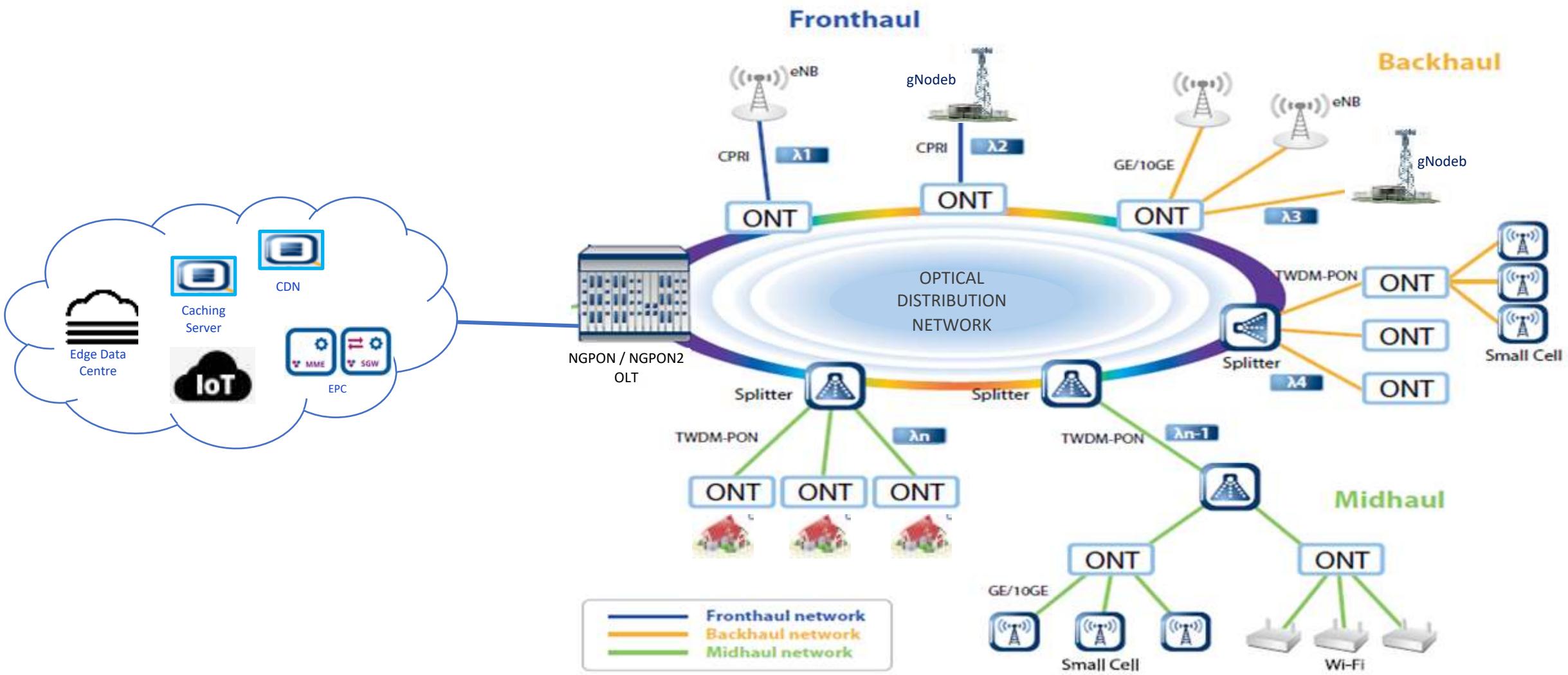
Denser Networks

Access layer end points will multiply

Deep Fiberization

Fiber intensive network to support latency and capacity requirements

Sample view of such a city wide network



New networks – Perform better, provisioned faster and cost less

1

Enhanced network performance

Optical products ensuring optimized power budget throughout network lifetime

2

Reduced network ownership cost

Optical products ensuring lesser network capital and operational expense

3

Faster network provisioning

Solutions enabling faster network deployment and thus, faster customer on-boarding

Deep dive into each one of these

Optical solutions solving for these challenges

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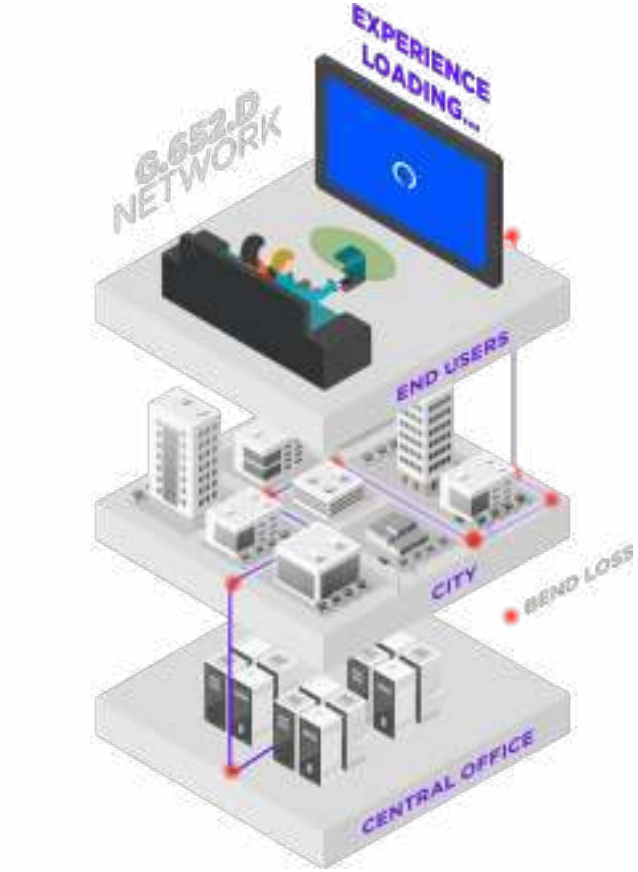
Networks are susceptible to optical losses

Macro Bend Loss

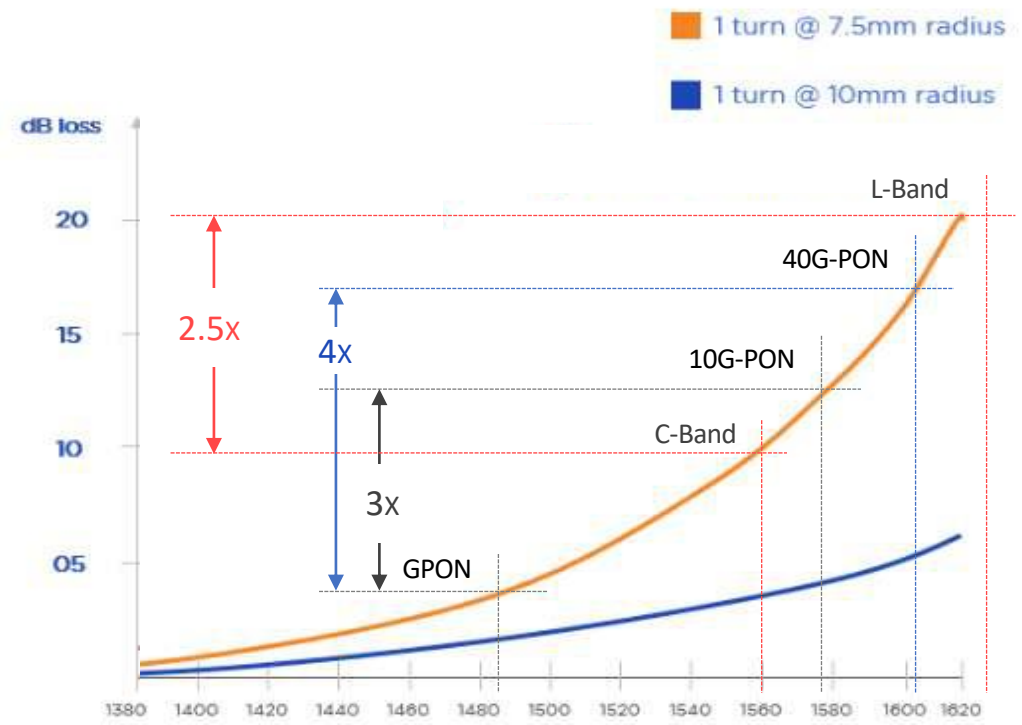
Increasing geographical spread

More no. of tight bends & turns



Legacy fibre (G.652.D) loss increasing

At higher wavelengths and tighter bends



Macro-bend loss prevalent in passive ancillaries

Long distance route

1.06dB avg. macro bend loss

per macro-bend point with legacy G.652.D fibre @ 1625nm

Location	Total fibre tested	Length (Km)	No. of M-bend	Total M-bend loss (dB)		Average M-bend loss (dB)	
				1550 nm	1625 nm	1550 nm	1625 nm
Link 1	2	37.6	4	1.22	3.78	0.31	0.95
Link 2	1	45.2	2	0.43	0.8	0.22	0.40
Link 3	2	54.7	3	1.45	2.25	0.48	0.75
Link 4	2	59.4	3	2.97	5.94	0.99	1.98
Overall average / macro-bend points						**0.51**	**1.06**

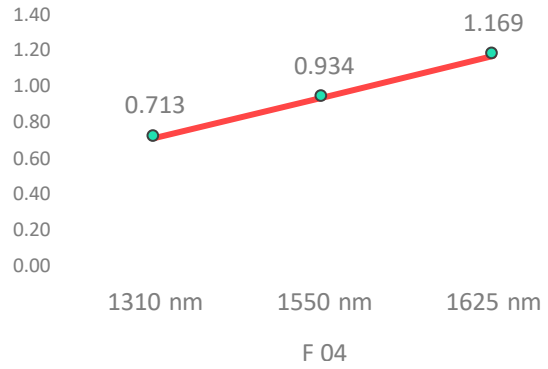
Source: Route survey of a leading Indian Telco

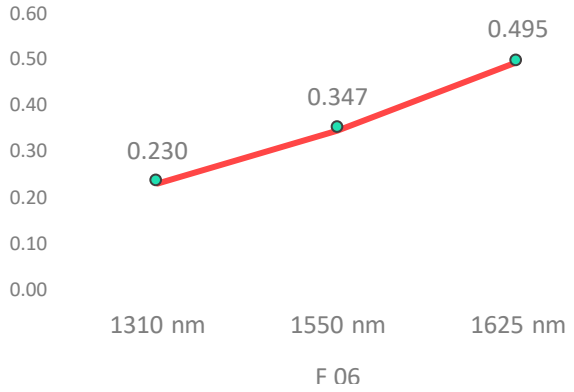
Macro-bend prevalent in passive ancillaries

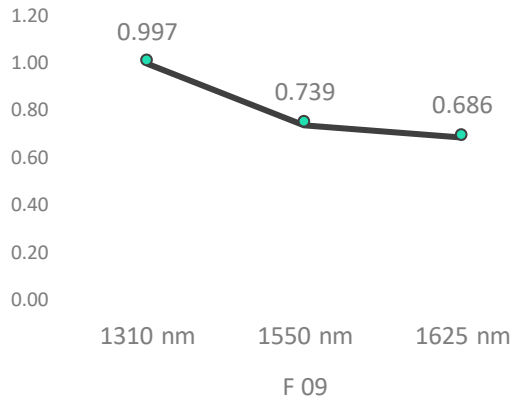
Access networks

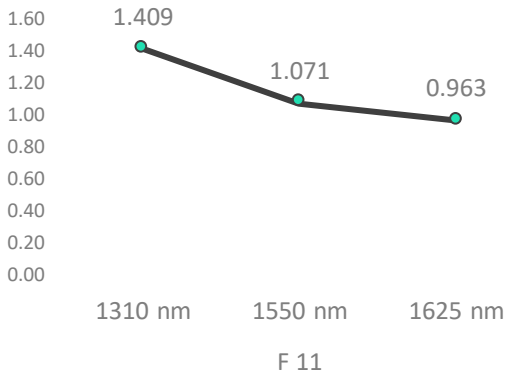
6 out of 16 routes tested positive for losses

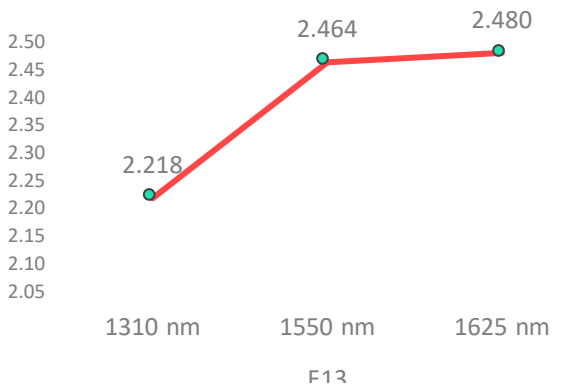
Significant (>0.5 dB) macro bend losses found in JBs, Tapping Boxes etc.

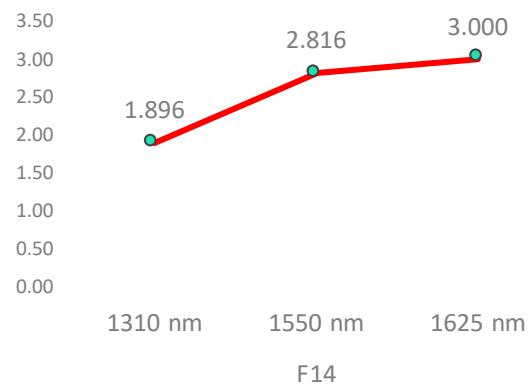












Several factors across network span lead to macro bend losses

Feeder Network

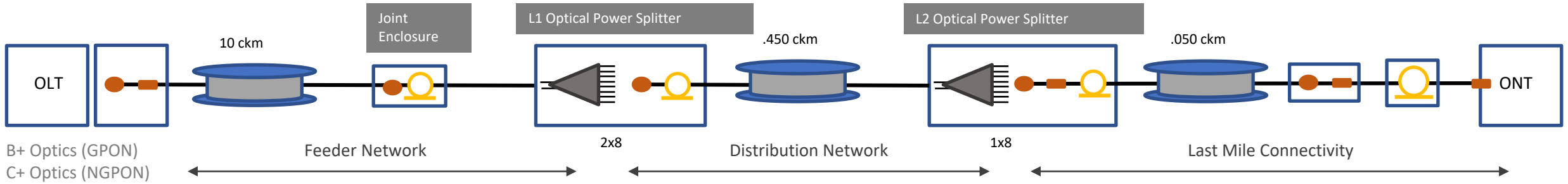
- Joint Splicing
- Fiber Attenuation
- Fiber Cuts
- Connector Loss
- Accidental Bends

Distribution Network

- Splitter loss
- Connector loss
- Splice loss
- Accidental Bend

Last Mile
Inside Building

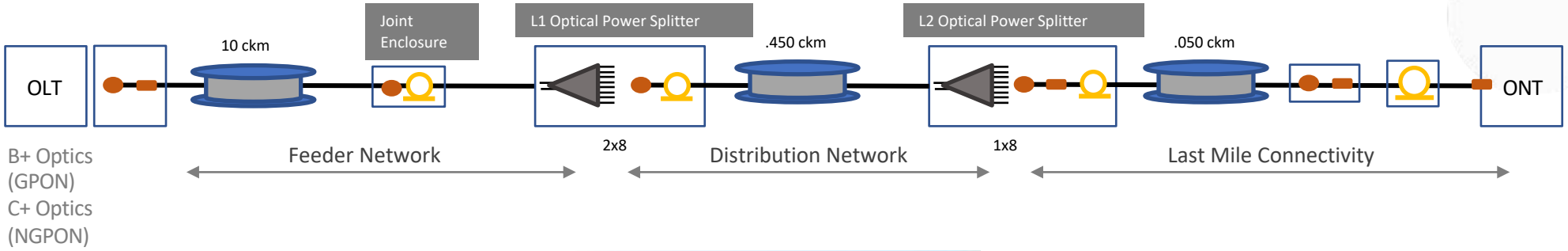
- HTB connector loss
- Bend loss
- Staple loss
- Accidental Bend during O&M



Schematic of a 10Km FTTH network

Connector Splice Macro Bend

One accidental bend →
Data transmission interrupted with legacy fibre

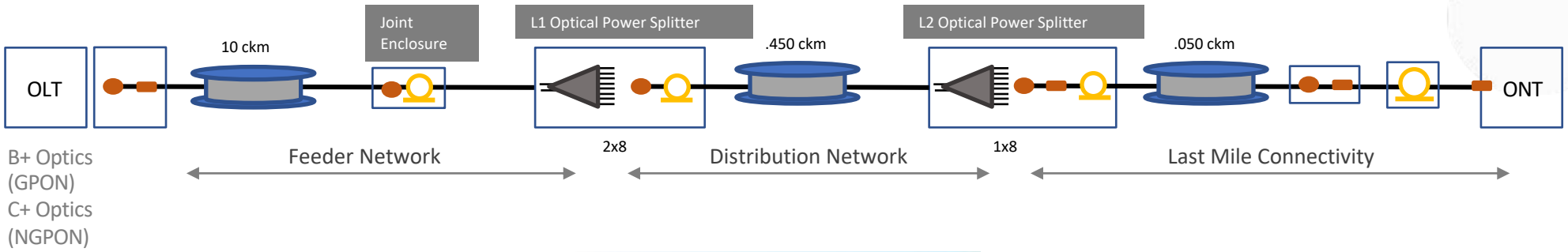


	Fiber Attenuation (10.5Ckm)	+ Splice Losses (15 splices)	+ Connector losses (2 Connector + 4 FMC)	+ Splitter losses	+ Accidental Bends (10mm / 7.5mm)	+ Bend and Staple loss	= Total
GPON 28dB budget	2.11 dB	1.0 dB	1.52 dB	20 dB	**0.5 dB / 3.755 dB**	.15 dB	25.28 dB / 28.53 dB
NGPON 32dB budget	2.43 dB	1.0 dB	1.52 dB	20 dB	**1.5 dB / 6.275 dB**	.75 dB	27.20 dB / 31.92 dB

Due to
- Accidental bends during cut repairs
- Faster rollout & unskilled manpower

Connector Splice Macro Bend

A Bend insensitive fibre solves the challenge



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GPON 28dB budget	2.11 dB	1.0 dB	1.52 dB	20 dB	**0.1 dB / 0.5 dB**	.15 dB	**24.88 dB / 25.28 dB**
NGPON 32dB budget	2.43 dB	1.0 dB	1.52 dB	20 dB	**0.2 dB / 1.0 dB**	.75 dB	**25.9 dB / 26.7 dB**

Resilience to
- Accidental bends during cut repairs
- Deskilled installation for faster rollout

Connector Splice Macro Bend

Deep dive into each one of these

Optical solutions meeting all these demands

1

Enhanced network performance

Optical products ensuring optimized power budget throughout network lifetime

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Reduced network ownership cost

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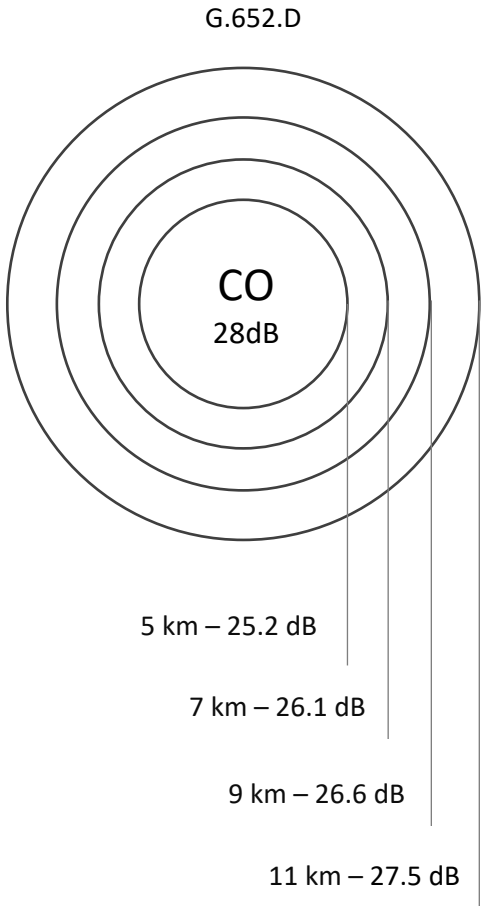
Solutions enabling faster network deployment and thus, faster customer on-boarding

Legacy (G.652.D) fibre designed for yesterday’s requirements

Limited PON reach of 11 kms

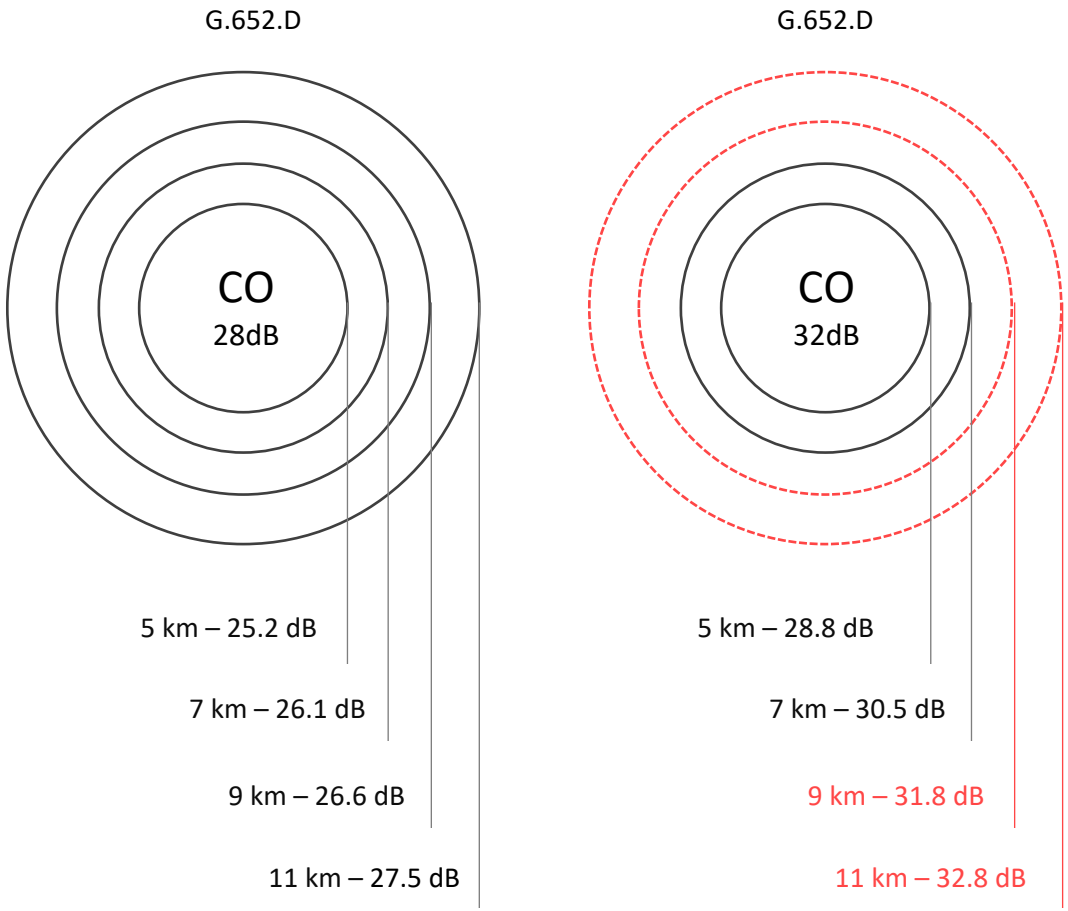


Restricted technology migration with G.652.D fibre

Incremental capex required

~50% reduction in PON reach to 7 Kms.

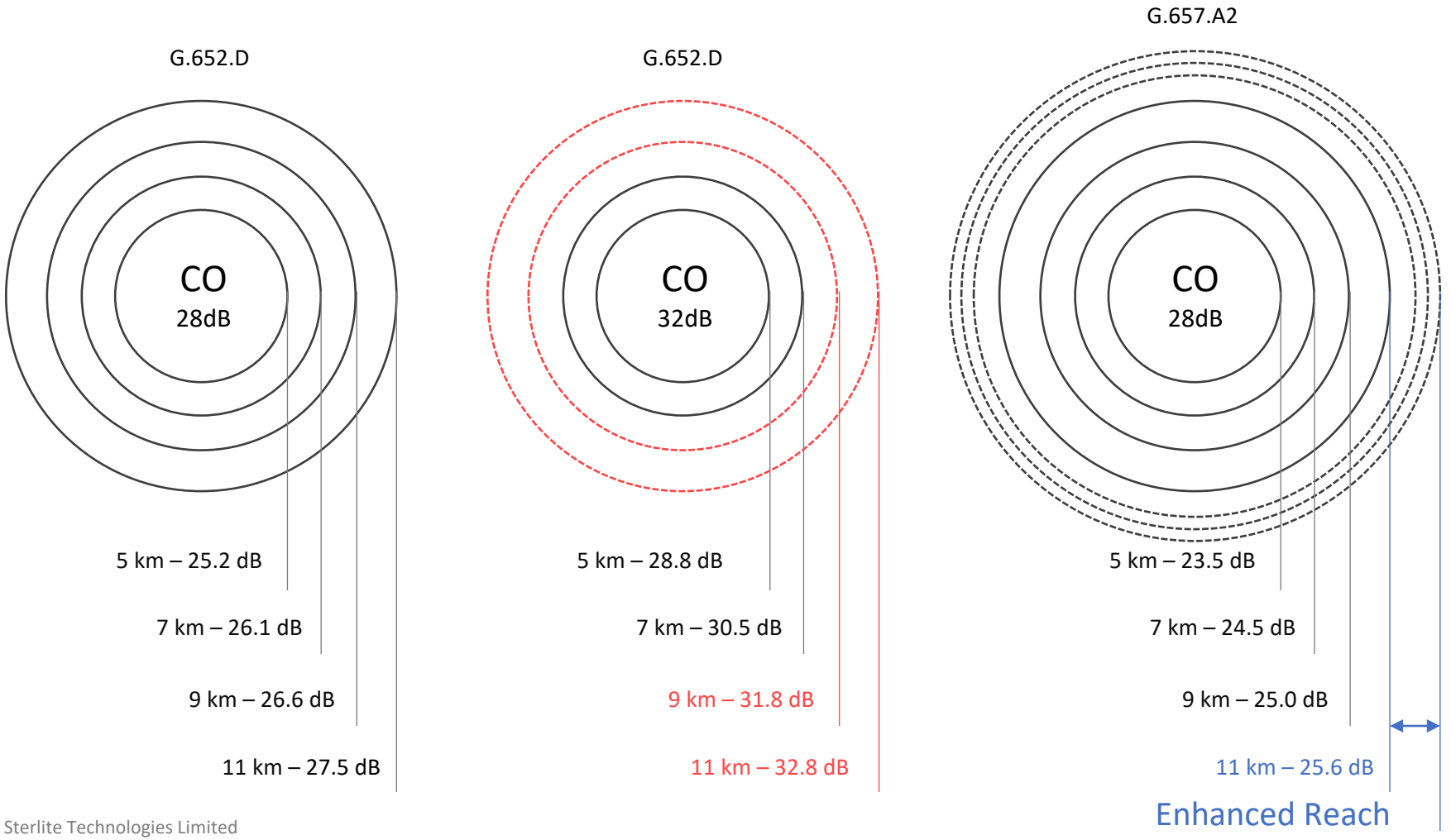
Power budget increased to 32dB in case NG-PON scenario



Bend insensitive fibre enhances PON reach…in today's scenario

~2.5dB cushion even after 11 kms.

Cushion utilisation in terms of higher splitting - "Faster to Market"

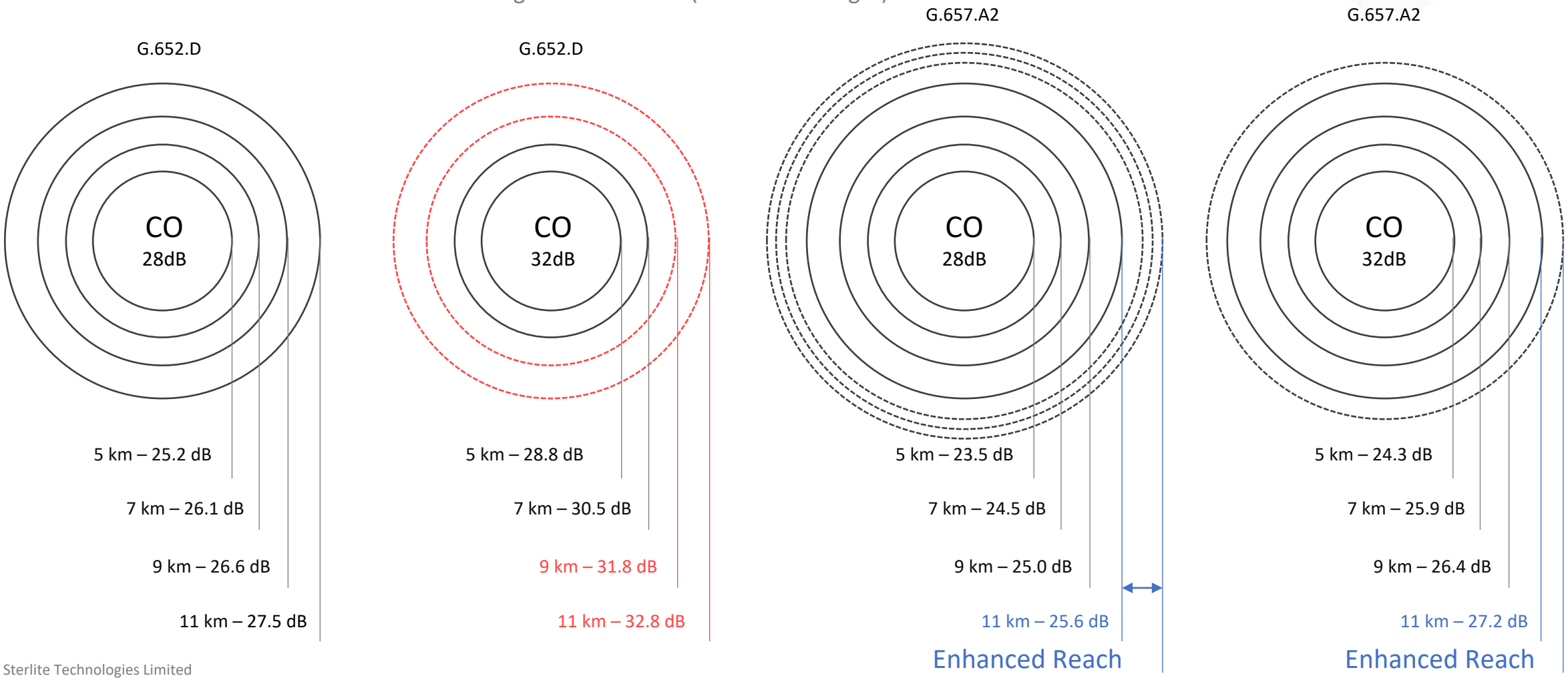


Enables easier tech migration for future readiness

No incremental capex required

~5dB cushion even after 11 kms.

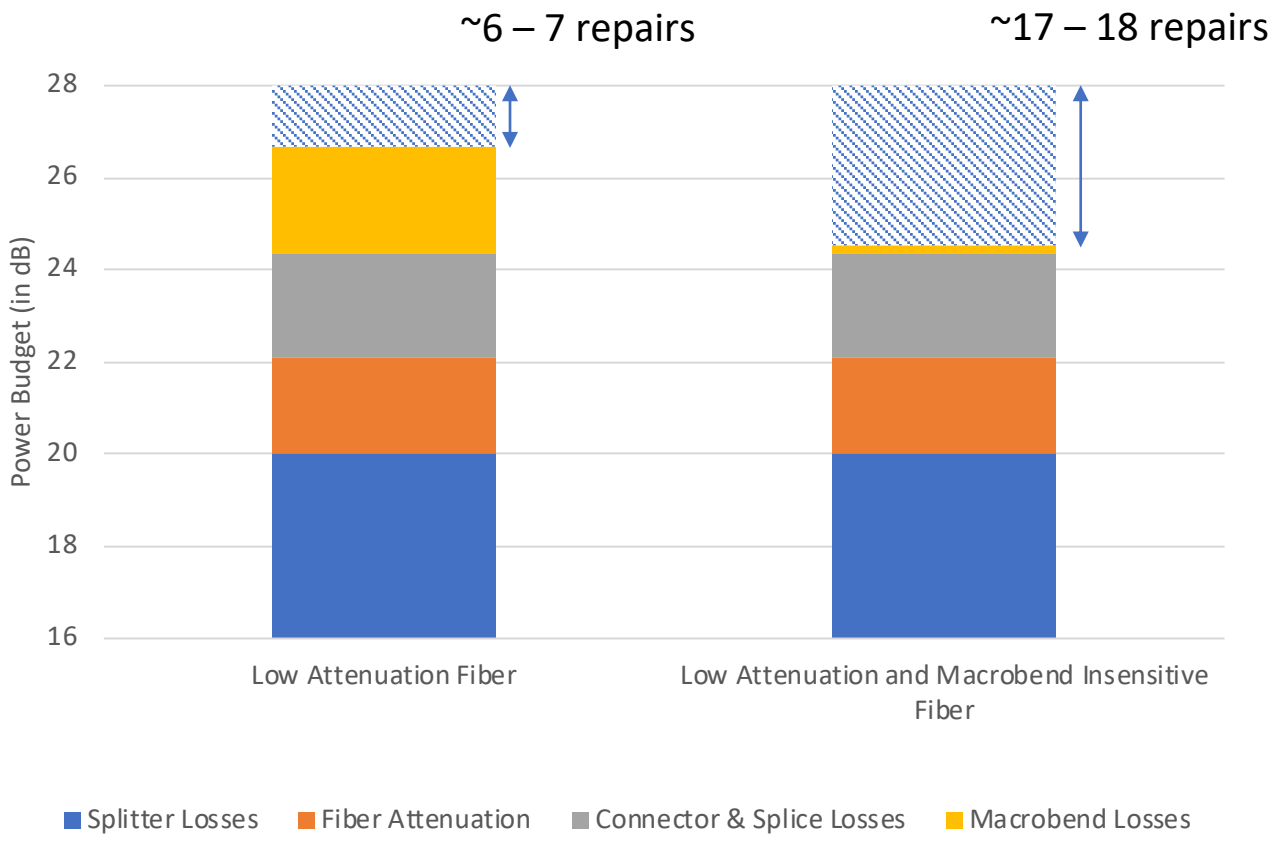
2x increase in cushion available with newer technologies like NG-PON (32dB total budget)



Reduced operational expense with Bend insensitive fibre

10+ years increased network life*

Lower loss increases repair resilience enhancing overall network life

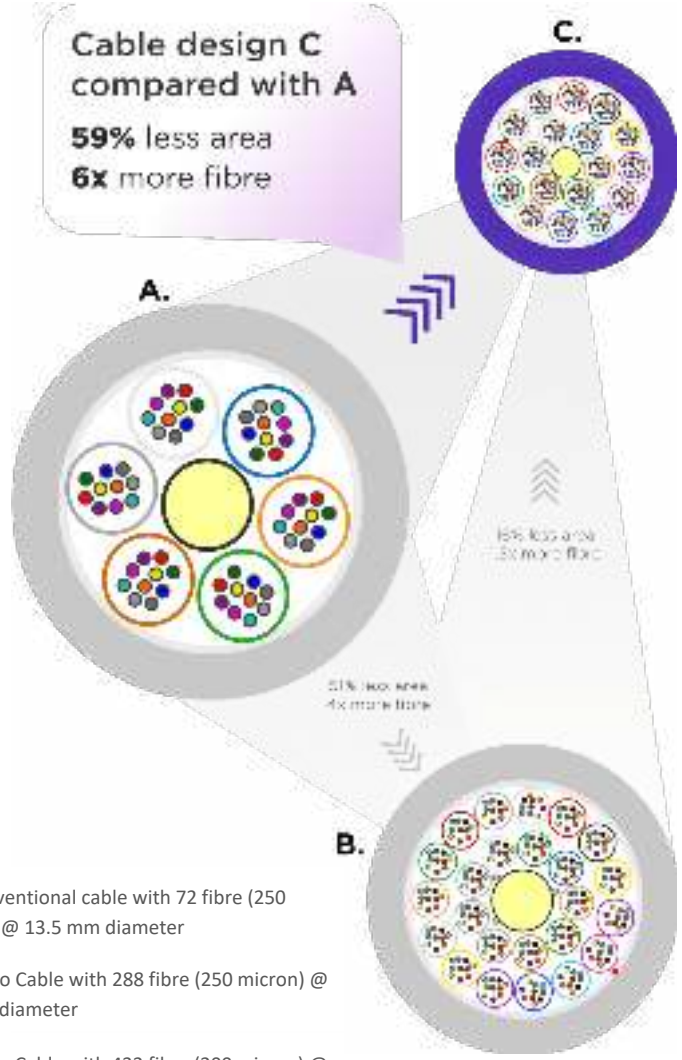


Assumptions:

- *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: 5 and 10*
- *BOL drum attenuation: 0.20/0.21/0.22/0.23 dB/km*

High fibre density designs possible with BIF fibre

Cost effective brownfield capacity augmentation



A. Conventional cable with 72 fibre (250 micron) @ 13.5 mm diameter

B. Micro Cable with 288 fibre (250 micron) @ 9.4 mm diameter

C. Micro Cable with 432 fibre (200 micron) @ 8.6 mm diameter

12-13% improved Micro-bending performance allows for tighter cable design without compromising on attenuation/km

Maximum Packing density	Micro-duct size	Maximum Feasible Fiber Count	
		G.652.D Fiber	Bend Insensitive Fiber*
80%	16mm/13mm	192	~~192~~ 432
	12mm/10mm	144	~~144~~ 192
	10mm/8mm	72	~~72~~ 144

** 200 um Fiber*

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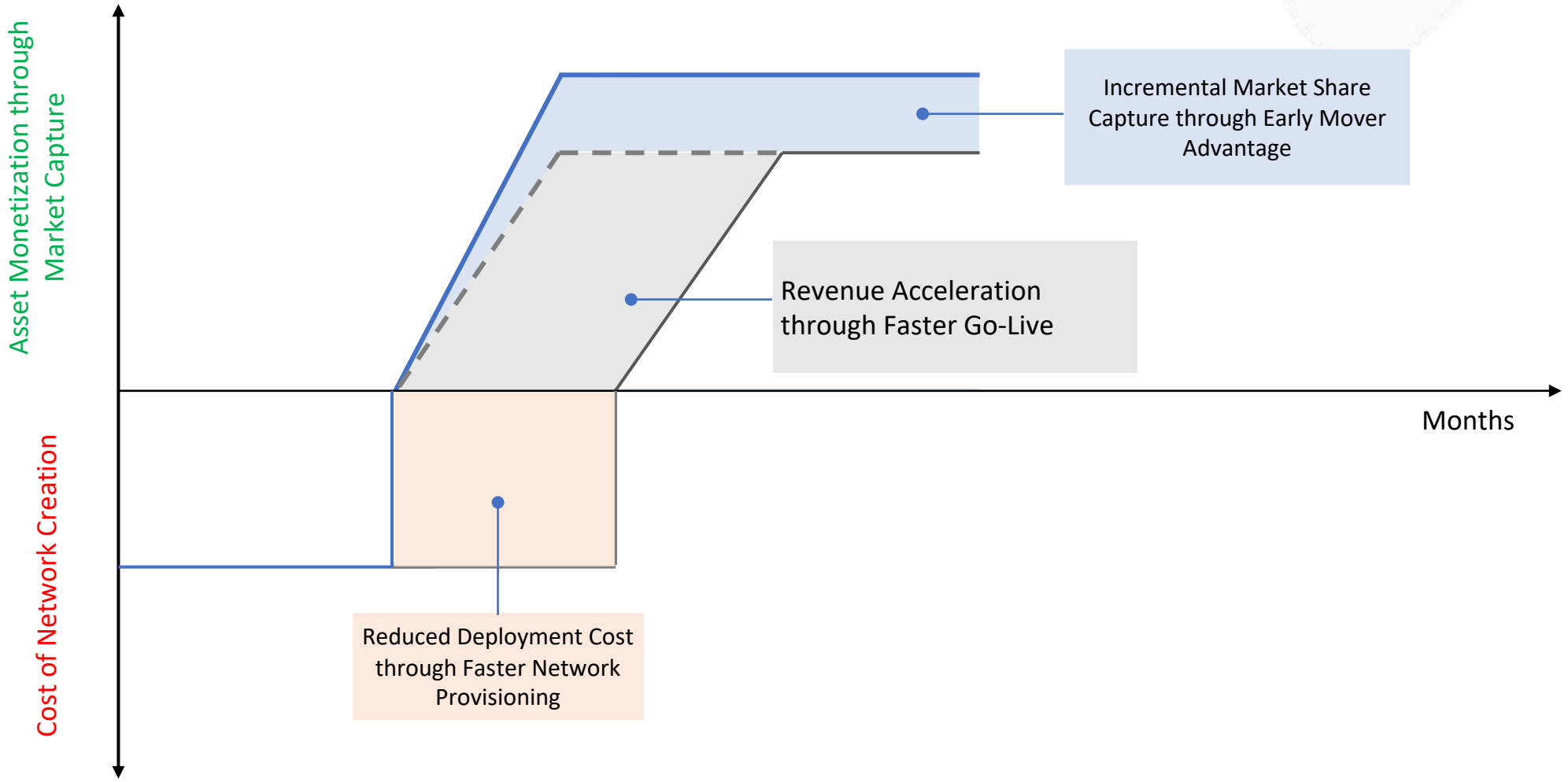
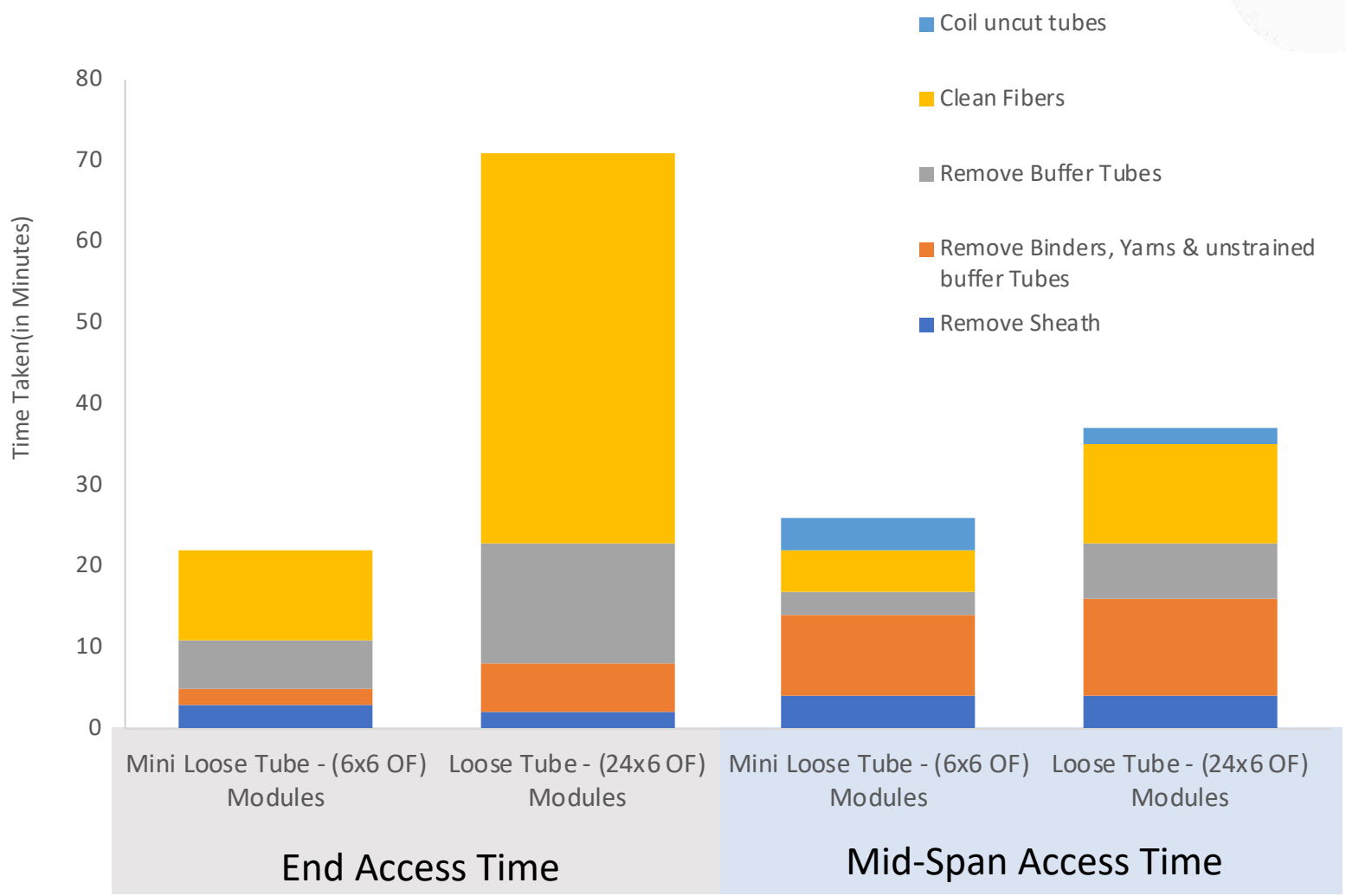
Faster provisioning enables greater market share and early asset monetization



Cables based on legacy fiber - Not suitable for faster network densification

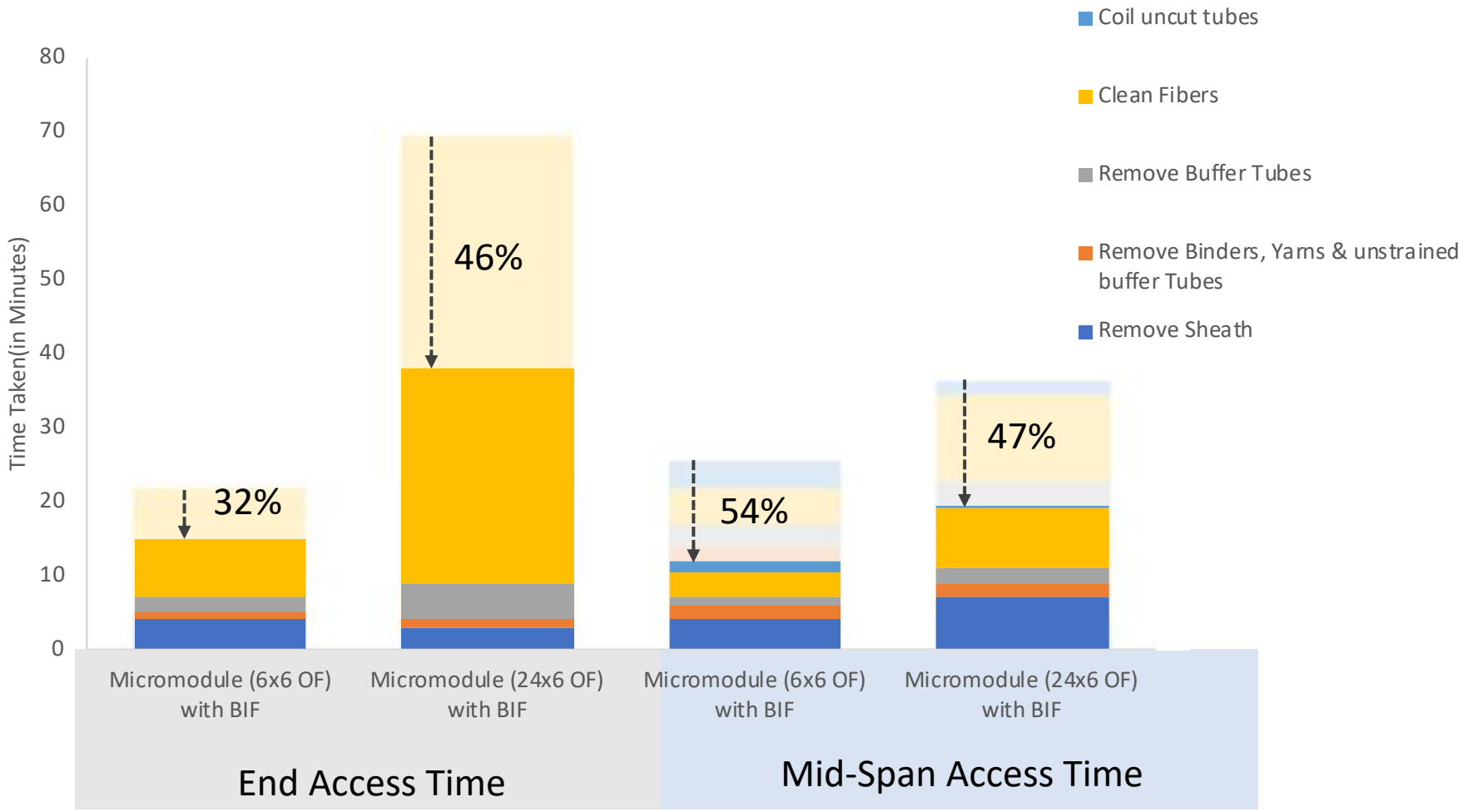
End-to-end joint splicing process of ≥144 fiber count cables can take an entire day!



Bend insensitive fibre enables faster network provisioning

40% reduction in installation time

Micro module designs made using bend insensitive fibre



So, while BIF enables all these…

New network provisioning or capacity augmentation

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The challenge that still remains

MFD mismatch

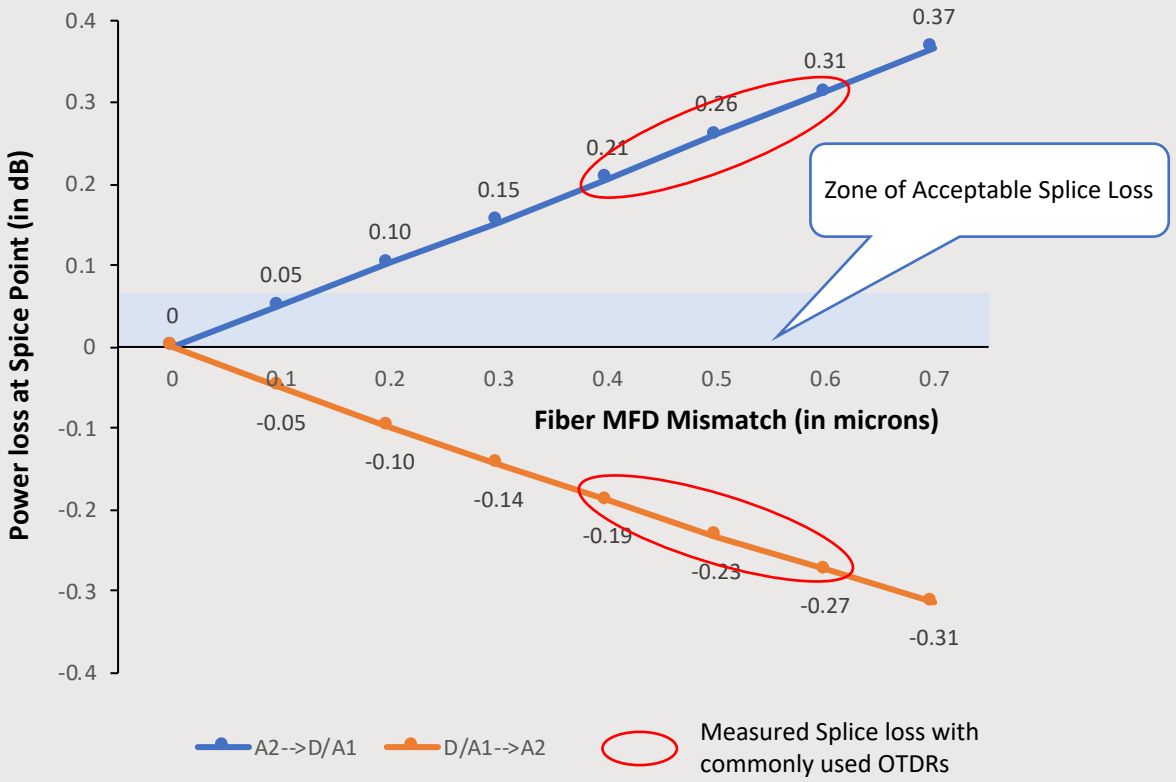
G.652.D with 9.1 +/- 0.4μ MFD @ 1310 nm

G.657.A2 with 8.6 +/- 0.4μ MFD @ 1310 nm

MFD mismatch makes fiber splicing inconvenient

OTDR reading mismatch → Apparent bad splice

Time wasted in replacing by installer



On-field test results

wide variability in splice loss readings taken from Unidirectional OTDR

Unidirectional OTDR Reading @1550 (in dB)		
Sample No.	D to A2	A2 to D
1	0.172	0
2	0.21	-0.154
3	0.236	-0.124
4	0.157	0
5	0.359	-0.114
6	0.24	0
7	0.343	-0.141
8	0.206	-0.115
9	0.122	0
10	0.235	-0.138

Moderate deviation from acceptable reading

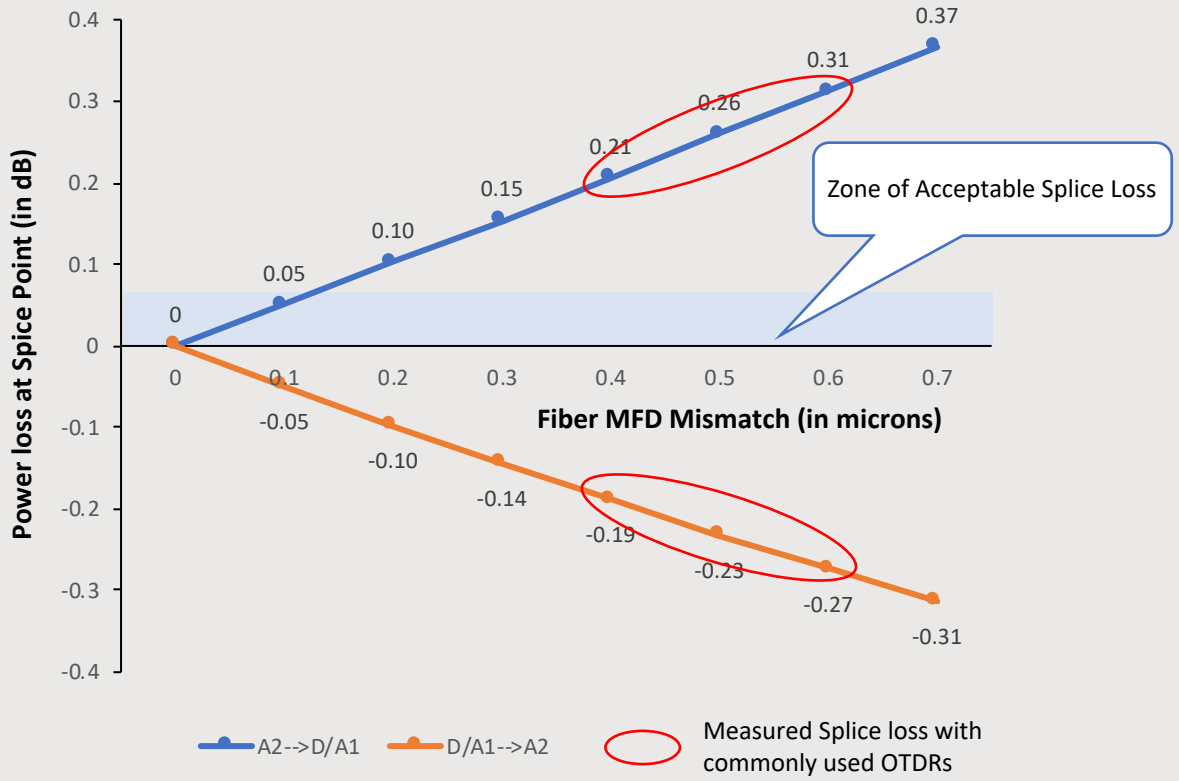
Significant deviation from acceptable reading

Installers aren’t ever sure of splice quality

Loss from bad splice gets hidden in the apparent loss in uni-directional OTDR

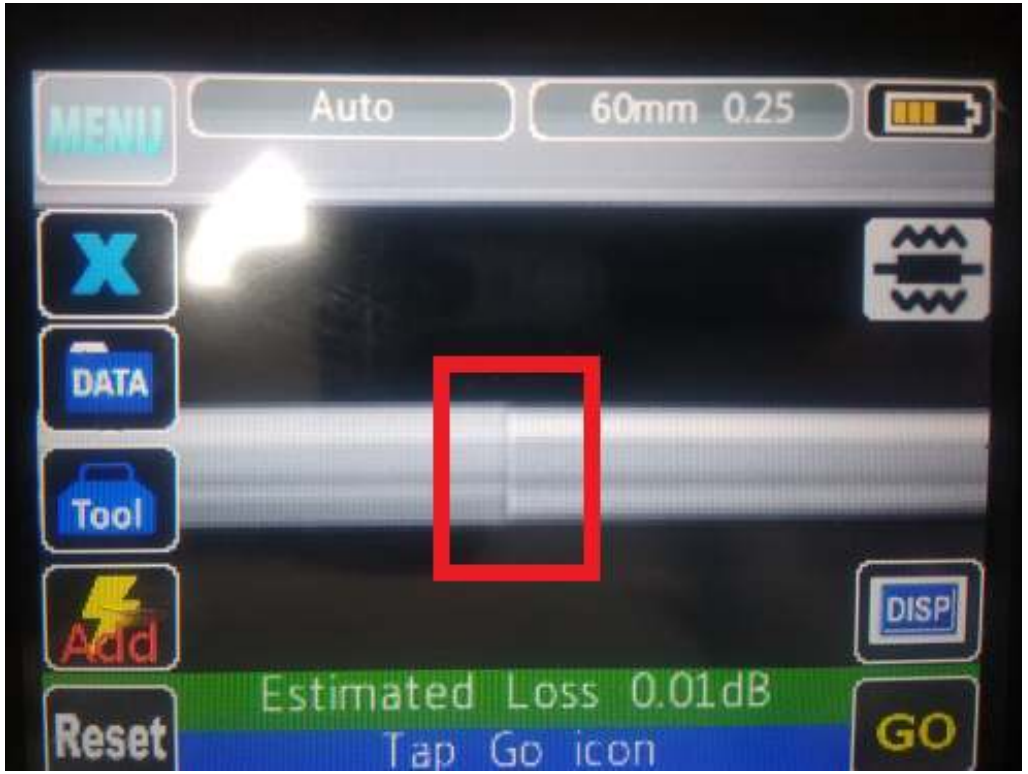
OTDR reading mismatch → Apparent bad splice

Time wasted in resplicing by installer



Confusion over splice and fibre quality

A thin line observed at each splice point on splicing device’s screen



One Product, multiple applications

Bringing the best of both worlds

We’ve achieved the right balance

Best-in-class attenuation and bend insensitivity

Attribute	OH-LITE NOVA (Enhanced A1 + D)	BOW-LITE (E) (A2 Fibre)	stellar
Typical Attenuation Values (in dB/km)			
@ 1310nm	0.33	0.34	0.33
@ 1550nm	0.19	0.20	0.19
@ 1625nm	0.21	0.22	0.21
@ 1383nm +/- 3nm	0.31	0.34	0.31
MFD @ 1310nm	9.1 +/- 0.4µ	8.6 +/- 0.4µ	**9.1 +/- 0.4µ**
Typical Macro Bend Loss Values (in dB)			
1 turn 10mm radius, 1550nm	≤0.5	≤0.1	≤0.1
1 turn 10mm radius, 1625nm	≤1.5	≤0.2	≤0.2

Upto 10x reduced bend losses than OH-LITE NOVA

1 Core Business

We are the

Data Networks Innovator

3 Innovation Engines

We drive innovation through

Connectivity Solutions

Network Services

Network Software

9 Distinguished Capabilities

backed by our unique capabilities in

- Advanced Photonics
- Materials Science
- Precision Manufacturing
- Algorithmic Design
- Ultra Fast Deployment
- Automation & Robotics
- AI Analytics
- Programmable Networks
- Web scale DevOps

STL in numbers

Customers

- Partnering with 8 of 10 Top Telcos
- Working with Top 2 Cloud Co.
- Operating in more than 100 countries

Innovation

- 4 Innovation Centres
- 90% -Y-o-Y patent filing growth in FY19
- 103% - 5-year CAGR for optical fibre cable patent portfolio growth

Global Footprint

- 7 Global Production Facilities
- 50 million fkm Fibre Capacity

People

- 3.1k+ Associates
- 30+ Nationalities
- Great Place to Work Certified

Financials

- $1.5 billion Order Book
- $737 million in revenue
- 43% revenue from exports

Environment & Society

- 100% Recyclable Packaging Material
- STL Garv Rural-connectivity platform
- STL Academy 1.5k certified youth
- Zero Waste to Landfill

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beyond tomorrow