Transforming Lives with Last Mile Fiber

Dr. Badri Gomatam
CTO, Sterlite Tech

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Broadband is an essential utility

The citizens' right to data access is **CRITICAL** to **Life** & **Lifestyle**

- ✓ Enables access to quality education, health, government services, etc.
- ✓ 10% increase in broadband penetration rate helps enhance per capita GDP of a nation by about 1.4%

Source: World Bank

BB infrastructure is now the Govt's top agenda

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2 Years of Modi government: 50,465 Gram Panchayats already connected with broadband #TransformingIndia #DigitalIndia

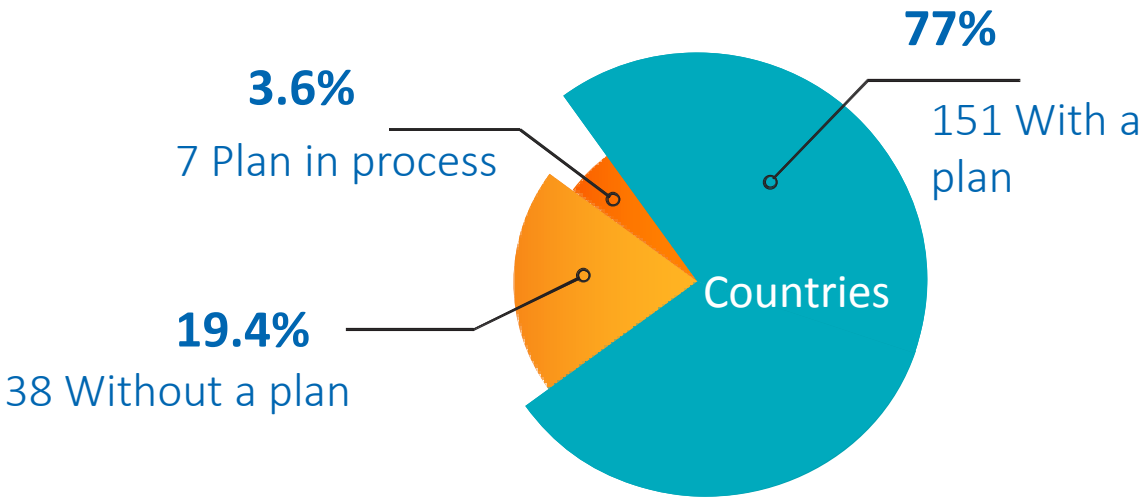
Rural Broadband	$12 Bn
Access Networks	$20 Bn
Application Software	$5 Bn
100 Smart Cities	$5 Bn
Other PSU Networks	$3 Bn

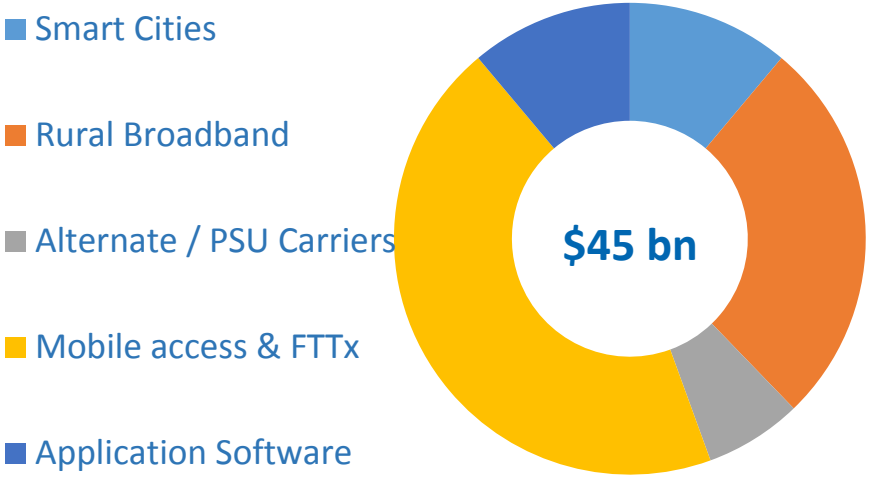
$ 45 Bn ICT
Investment is unfolding in next 3-4 years

✓ **Focus on Broadband as Utility for Digital Inclusion**

Source: **The World Bank, Digital dividends report 2016,** Sterlite Strategy group, Government papers, NTP 2012 Memorandum, TRAI

151 countries focus on Broadband Infrastructure





151 Countries focus on national broadband plans

Indian Govt focus on Digital Infra High

Private sector responding to Data consumption growth

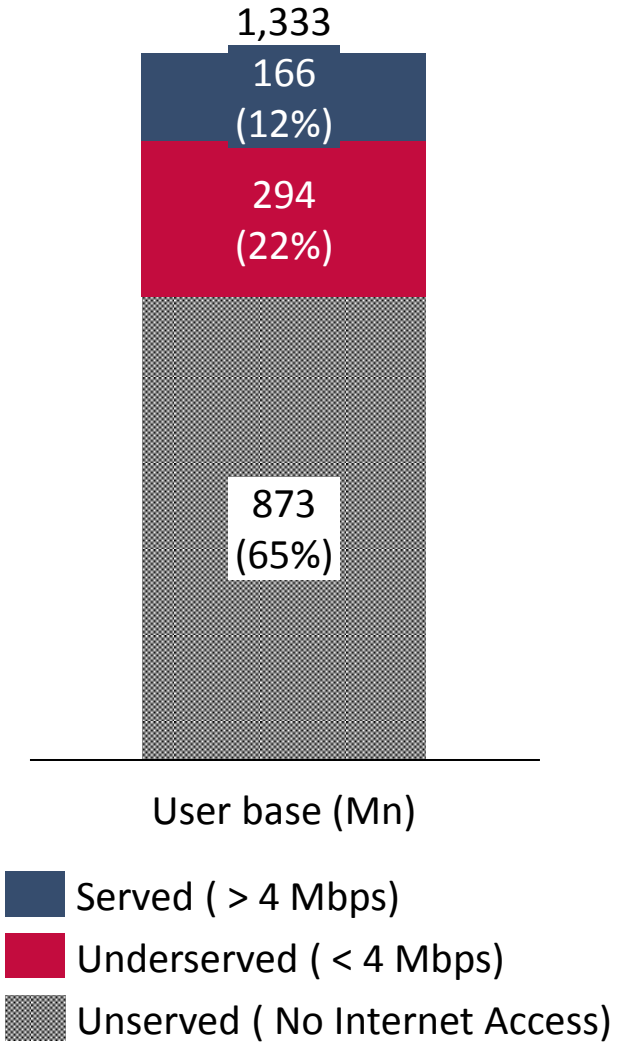
Sustainable, fiberized **Smarter Networks** is the need of the hour

Source: The state of broadband 2016 report & Sterlite Estimates

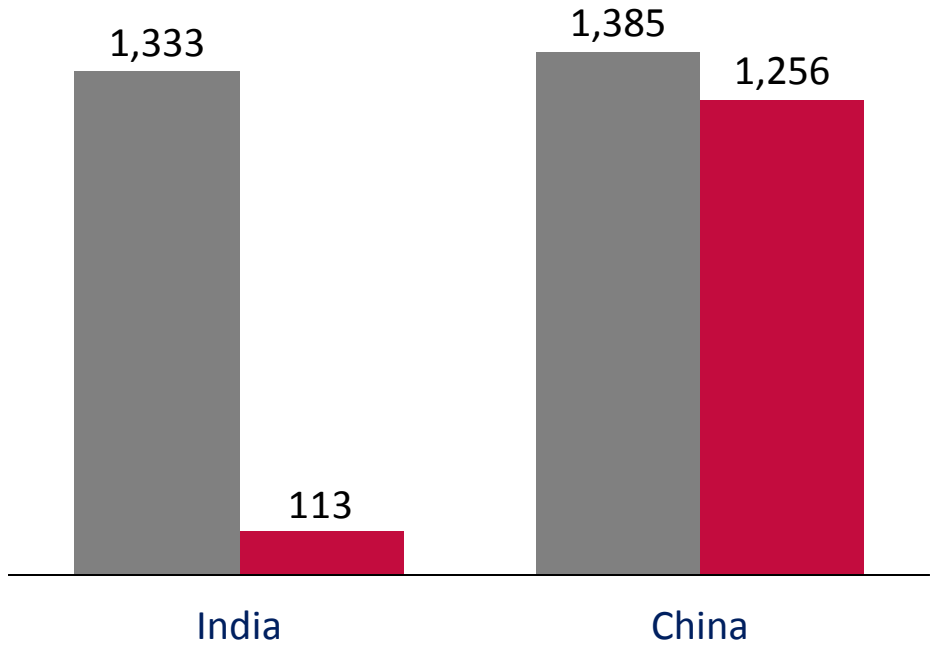
India Overview: Subscribers & Connectivity Perspective

India: Access & Connectivity

Internet Access



Connectivity



Population (Mn) vs Cumulative Fiber Deployed (Mn Fkm)

Population
Cumulative Fibre Deployed

India: Key Programs for Driving Connectivity

	Categories	Programs	
A	**Service Providers (Telecom)**	1. Connectivity through 3G/4G Spectrum & Microwave backhaul 2. Beginnings of FTTx deployment	
B	**Service Providers (Local ISP / CATV Operators)**	1. Local and Fragmented Market 2. Till date Mainly through Copper Coaxial 3. Now moving towards some Fiber & Copper Category cable	
C	**Rural Broadband**	1. Fiber rollout to 250,000 (Village clusters- Panchayat) with access to 600,000 villages 2. Ambitious well funded program, connecting 600 Mn people 3. Currently : Rollout challenges and service provisioning issues	BBNL Bharat Broadband Network Limited
D	**Urban Smart Cities**	1. Program to create 100 smart cites 2. Core connectivity infrastructure creation: Fiber + Wifi being focused 3. Early days for standardization and rollout	SmartCities

A. Rural Broadband (Un-served)

Project Overview

Connectivity for 250,000 village clusters

District — **640 Districts**

Fiber

Block — **~6,000 blocks**

Fiber

Panchayats — **250,000 Village Clusters**

600,000 Villages → Wifi → **~ 600 Mn rural citizens**

Funded by Govt. of India: Total $11 bn in 3 phases

Current Status

Phase 1	Connect 100,000 villages clusters by Dec 2017
Phase 2	Connect 150,000 villages clusters by Dec 2018

Challenges: Phase 1

- Procurement in separate parts
- Slow rollout: Government utilities driven
- No network Manager: Service SLA's
- No Clear Plan for Service Provisioning

B. Urban Broadband (Under-Served)

Overview: Smart Cities for ~ 400 Mn population

- 500 cities (Population> 100,000)
- 109 Cities selected as " Smart Cities"

Funded by:

Central Govt.

State Govt.

City Councils

Initial Fund Committed ~15 bn

Current Status

- Phase 1 Smart Cities Mission : 109 cities to be developed as Smart Cities
- Execution /rollout in ~10 cities
- RFP released in 12 cities

Challenges:

- No standardized definition for Smart Cities
- Lack of Standards in Design
- Different cities approaching problem based on their city needs
- Rollout in several Phases

Connecting the Unconnected & Under-connected

A quick Google check…

About 4,96,000 results (0.30 seconds)

The Challenge Of Connecting The Unconnected | TechCrunch
https://techcrunch.com/2014/11/01/the-challenge-of-connecting-the-unconnected/
Nov 1, 2014 - Editor's note: Hassan Baig is an entrepreneur who runs ClubInternet, a " connecting the unconnected" startup. Every time we return to or sign up ...

[PDF] Connecting the Unconnected - Broadband Commission
broadbandcommission.org/Documents/ITU_discussion-paper_Davos2017.pdf
Jan 17, 2017 - CONNECTING THE. UNCONNECTED. Working together to achieve. Connect 2020 Agenda Targets. A background paper to the special ...

Connecting the Unconnected - Cisco Blog
https://blogs.cisco.com/digital/connecting-the-unconnected
Jul 18, 2014 - Connecting the Unconnected. "The Internet of Things is the next technology transition where devices will allow us to sense and control the ...

Connecting the Unconnected - Home | Facebook
https://www.facebook.com/ConnectingTheUnconnected/
Connecting the Unconnected. 6230 likes. Help connect the connected world with The Unconnected. Over 70% of the world has no access to internet, let's...

Rural Roads: Connecting the unconnected | The Indian Express
indianexpress.com › India
Feb 25, 2016 - Rural Roads: Connecting the unconnected. Not many programmes have impacted the Indian hinterland the way Pradhan Mantri Gram Sadak ...

Images for connecting the unconnected

More images for connecting the unconnected Report images

Connecting the unconnected: Experience from the First Phase of our ...

About 2,00,00,000 results (0.48 seconds)

Connecting the Next Four Billion | U.S. Agency for International ...
https://www.usaid.gov/documents/15396/connecting-next-four-billion
Feb 16, 2017 - file icon (873k) Connecting the Next Four Billion: Strengthening the Global Response for Universal Internet Access. As the global community ...

[PDF] Connecting the Next Four Billion - usaid
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Feb 21, 2017 - CONNECTING THE NEXT FOUR BILLION: STRENGTHENING THE GLOBAL RESPONSE FOR. UNIVERSAL INTERNET ACCESS ...

Universal Internet Access for the Next Four Billion | ICT Works
www.ictworks.org/2017/03/08/universal-internet-access-for-the-next-four-billion/
Mar 8, 2017 - Connecting the Next Four Billion: Strengthening the Global Response for Universal Internet Access built on existing research to determine ...

Connecting and Enabling the Next Billion(s)
www.intgovforum.org/cms/policy-options-for-connection-the-next-billion
About. 2016. IGF 2016 Community Intersessional Programme - Policy Options for Connecting and Enabling the Next Billion - Phase II. Final 2016 Framework ...

Connecting the Next Four Billion: Strengthening the Global Response ...
www.mhealthknowledge.org/.../connecting-next-four-billion-strengthening-global-res...
Connecting the Next Four Billion: Strengthening the Global Response for Universal Internet Access. We live in a world where the Internet is increasingly ...

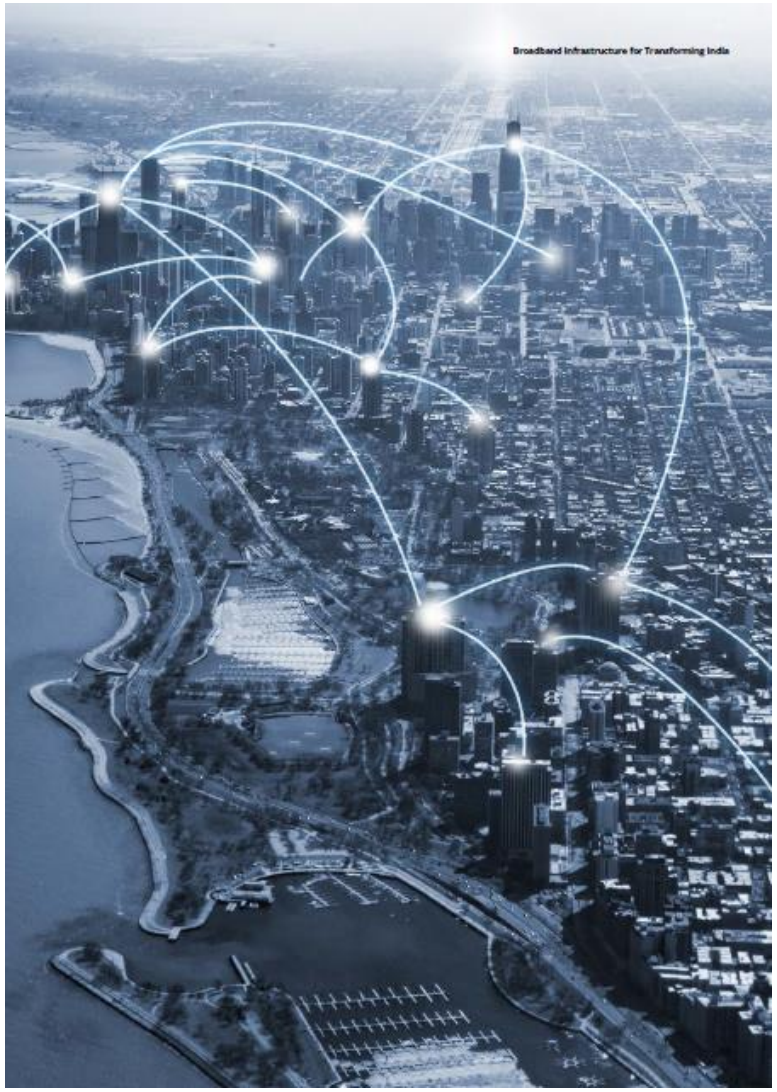
Here's the Real Way to Get Internet to the Next 4 Billion People | WIRED
https://www.wired.com/2015/09/heres-real-way-get-internet-next-4-billion-people/
Sep 16, 2015 - The real way to bring Internet to the next 4 billion people is ... backhaul services—the networks that connect access providers themselves to the ...

Customer First: Quality of User Experience, Rural or Urban

- Low latency upload and download → customer satisfaction, monetization
- High speeds per user → adoption & growth of broadband across the country
- A network that is always up & reliable → value for money
- At the right price points → affordable

Fiber has the least down time, lowest cost per GB and can provide services to very high data usage customers. Fiber roll-outs in India need to match the surge in data consumption as well as digitization initiatives that are under-way.

Source: Deloitte, 2016



How do we get there ?
Focus on Quality & Reliability of Network

Study Objectives and Methodology

Objectives:

Understand challenges and best practices in fiber network design and build

Methodology:

Primary interviews

1. Indian Telco Technology organization
2. Global design and deployment companies
3. Strategy consultants and Sterlite experts

Fiber network health monitoring data

1. Network health data of key Telcos in India analysed to derive key insights

Study Dimensions

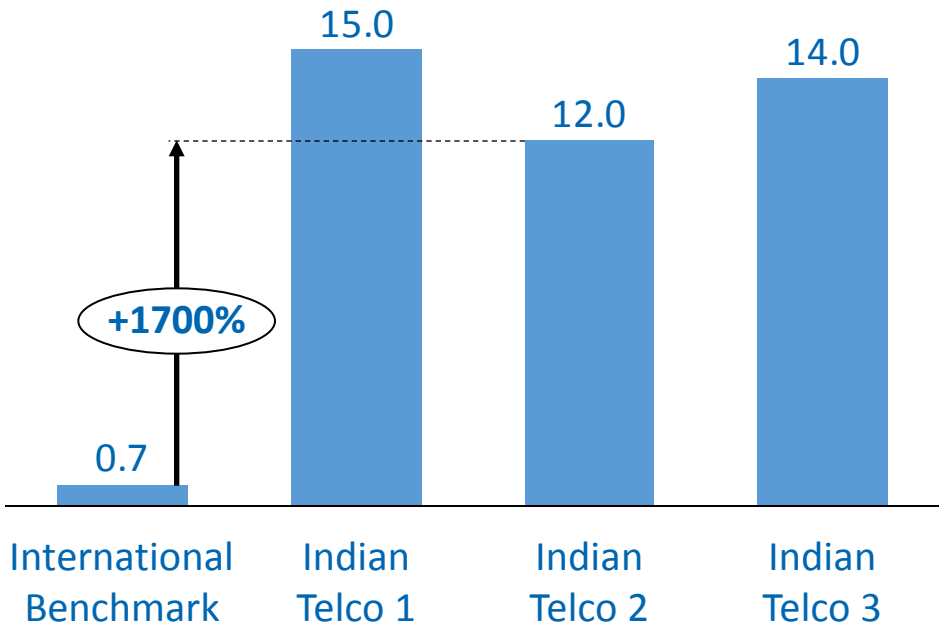
1. Network design practices
2. # of cuts in fiber networks and its impact on network life
3. Passive network redundancy practices
4. Active network redundancy practices
5. Network traceability

Policy Framework: End-to-End Infrastructure Manager

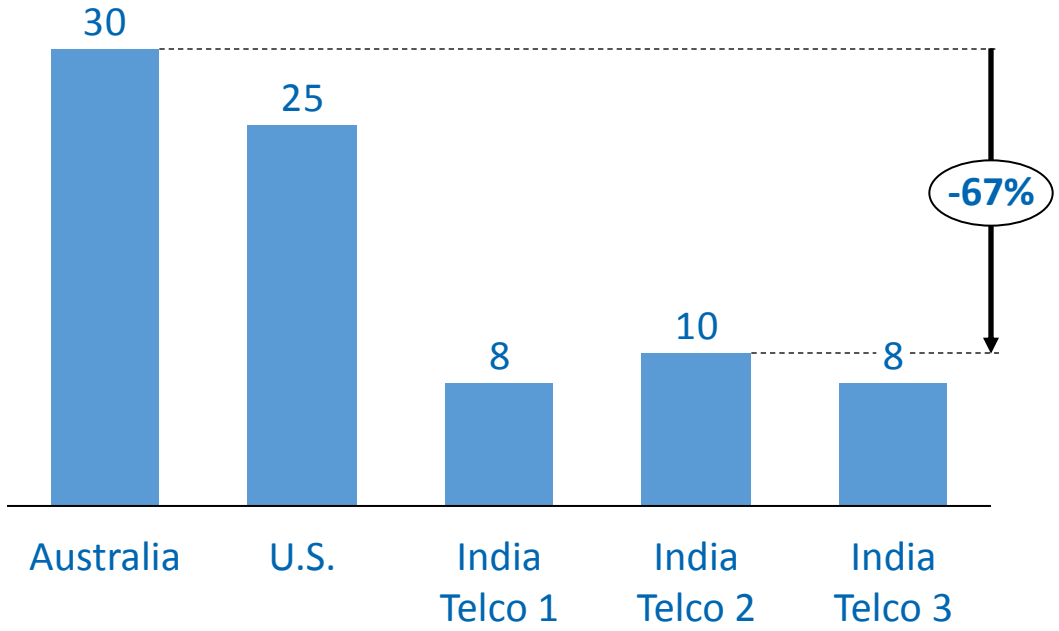
- Managed service provider needed for end-to-end infrastructure reliability, uptime via SLAs
- For Smart Building- Building Codes must include Fibre with Water, electricity
- Design, build & manage a complete network – Actives & Passive
  - Stitching together a complete solution involving components from multiple vendors and agencies.
- Develop and enforce a **“Standard”** Infrastructure Delivery Model / Template
  - Centrally held guidelines to ensure uniformity and interoperability- towards a robust infrastructure.
  - Ensure accountability via a standards based governance model

1 Higher number of cuts in fiber network results in lower life

# of Cuts per 1,000 kms per Month
(Intra-city average)



OFC Network Attenuation Life
(in years) (doubling of link attenuation)



Indian Telcos have 2-3 times faster fiber network CAPEX replacement cycle compared to global benchmarks

Source: Results from STL network health monitoring project or shared by Telco
International benchmark data sourced rom partners working with those Telcos (includes Australia, Western Europe, U.S).

2 Network life: How important is cable cut, all other factors being equal?

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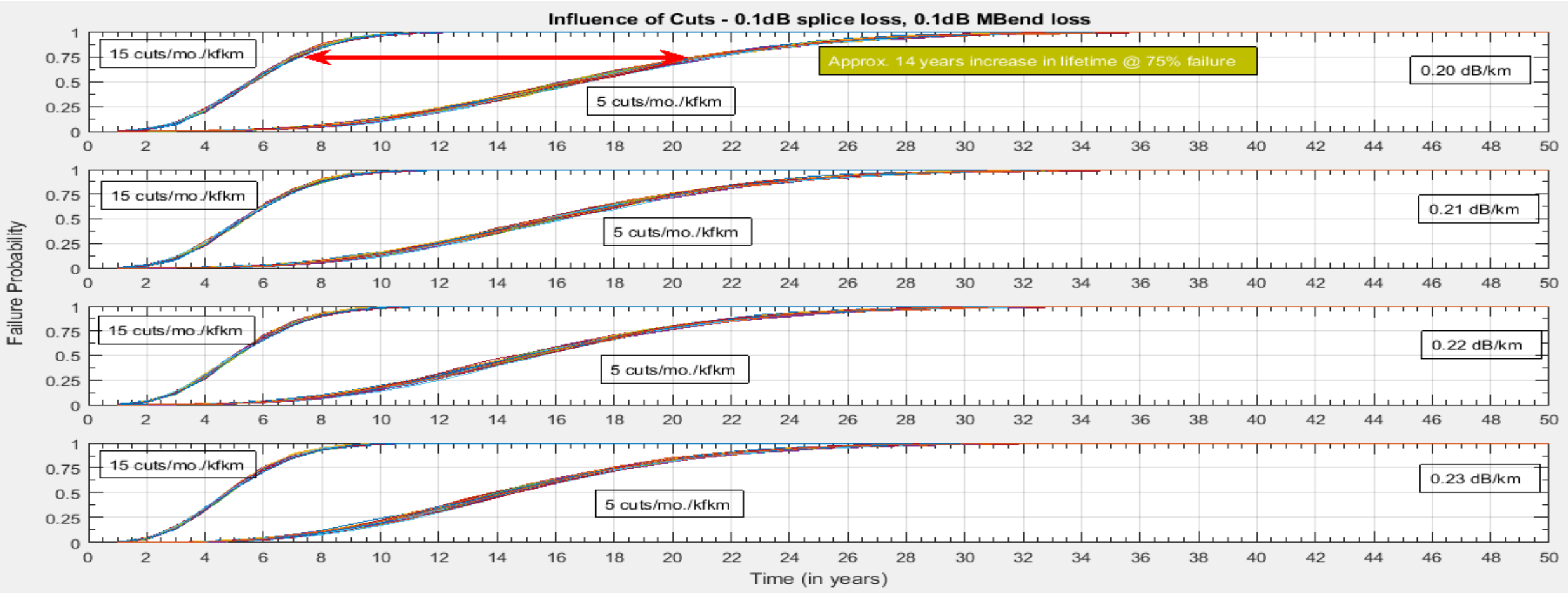
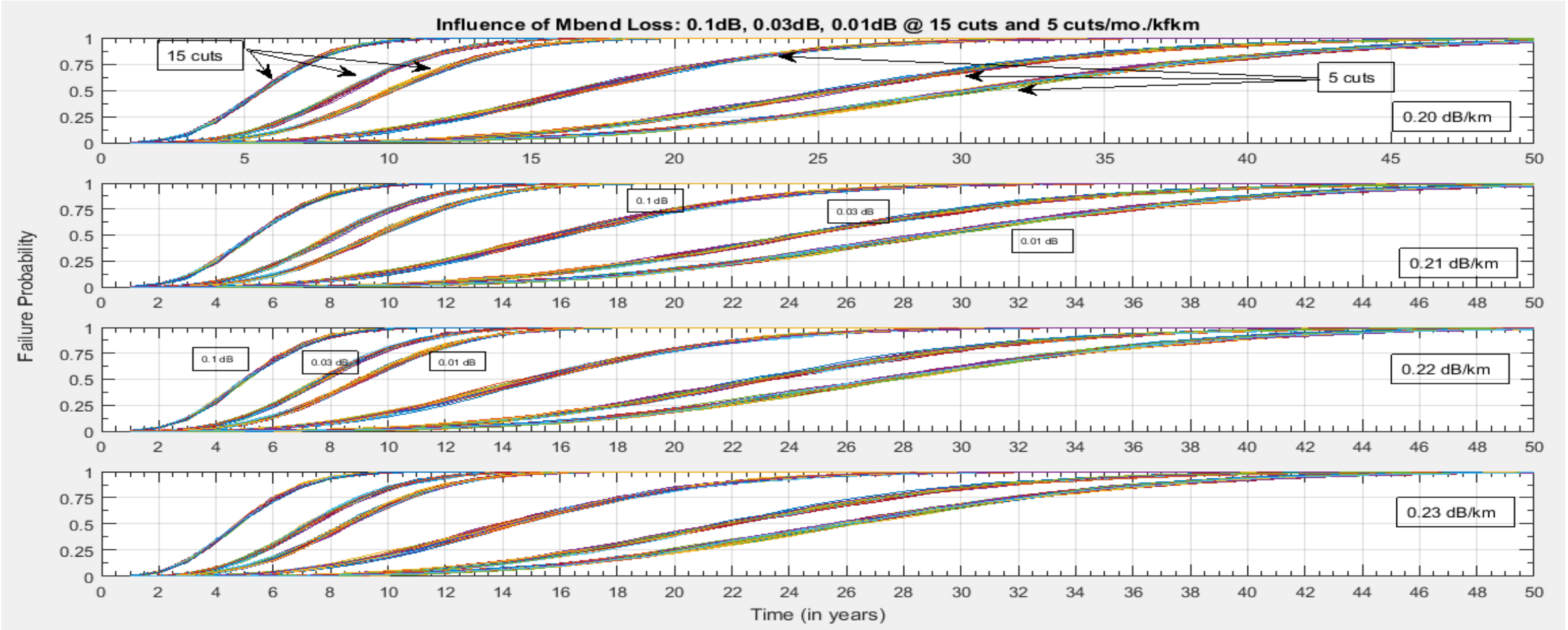
Network Life Simulation Model Output



Bringing cuts from 15/m/kfkm to 5/m/kfkm adds 12-14 years life @75% failure

Network life: How important is Bend Insensitive Fiber, all other factors being equal?

Network Life Simulation Model Output



Bend Insensitive Fiber adds 6-18 years life @75% failure

4 Passive network redundancy

Network Type	Current Duct Configuration
NLD	1+1
Intra-city	1+2
FTTH	1+1

Problem

1. Duct repair is not a common practice in India
2. Therefore, spare ducts become un-usable after 4-5 years due to frequent cuts and soil penetration

5%-10% improvement in CAPEX productivity due to duct planning optimization

Source: Primary interviews

5 Active network redundancy

Network Type	Current Duct Configuration
Access	1+1
Aggregate	1+1
Core	1+2 or 1+3

Problem

1. High number of cuts force planners to build redundant logical routes
2. This increases the active transport CAPEX significantly

Solution

Highly reliable network can eliminate the need for redundancy CAPEX

- Global installation and PMO practices
- SLA based O&M for network built to global standards

20%-30% improvement in Core Transport network CAPEX productivity due to improved network reliability

6 Network traceability

Network Traceability
(after 5 years)

Telco 1	**> 30% of network is not traceable**
Telco 2	**> 40% of the network is not traceable**

1. Limited network traceability (no single source of truth) as planning, deployment and O&M is done by different organizations
2. GIS based planning and single partner can help improve network traceability

Source: Primary interviews

Can Technology Help?

A Unified Technology Plan is Necessary

Fiber & Cable

1. High bandwidth/ band insensitive Fiber products
2. Fiber as Sensors (For Smart Cities)
3. Low Diameters, High Capacity Cables
4. Green Solutions: Improve fiber usage – reduce duct waste
5. Integrated Data + Power Solutions for Smart Cities (Cities/ Rural)

Services & Software

1. Detection & Mapping of Utilities in Cities
2. Fast Deployment of Cables in Cities
3. Robust & Low cost design for Rural & City Networks (With Open Source Hardware)
4. Disruptive Access Technologies (non-fiber based)

A holistic design, build and management framework is essential

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	Challenge	Impact	Solution
1	Multiple agencies without clear end-to-end accountability	Gaps in SLA management	End-to-end infrastructure manager
2	High cuts leading to lower life	2-3 times faster CAPEX replacement cycle compared to global benchmarks	▪ Global installation and PMO practices
3	Passive network redundancy	5%-10% improvement in CAPEX productivity	Currently available technology innovation
4	Active network redundancy	20%-30% improvement in core transport CAPEX productivity	SLA based O&M on network built to global standards
5	Network Traceability	> 30% of the network is not traceable after 5 years	GIS based planning and single partner (design, build and manage) can help improve network traceability

Key Characteristics in the Indian Context – Semi Skilled Manpower with Fast Deployment

1. FTTH Plug & Play for MDU

- Speed of deployment
- Semi-Skilled manpower & User friendly

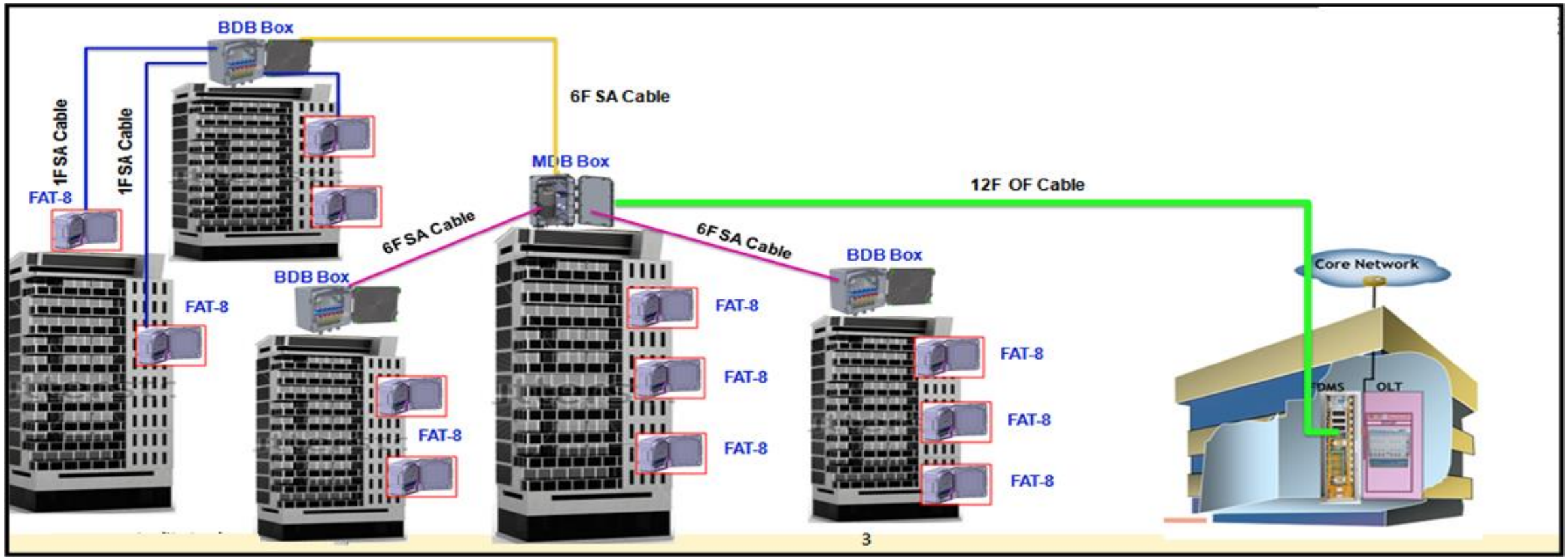
2. FTTH/S for Shared Operator Infrastructure

- Specific Designs to accommodate regulatory needs

3. FTTH Conventional & Plug play solution for BharatNet

- Speed of deployment
- Semi-Skilled manpower & User friendly

Reference Diagram – MDU Passive – Tier 1/Urban Cities



Reference Diagram – SDU/Tier 2/3 Cities Passive

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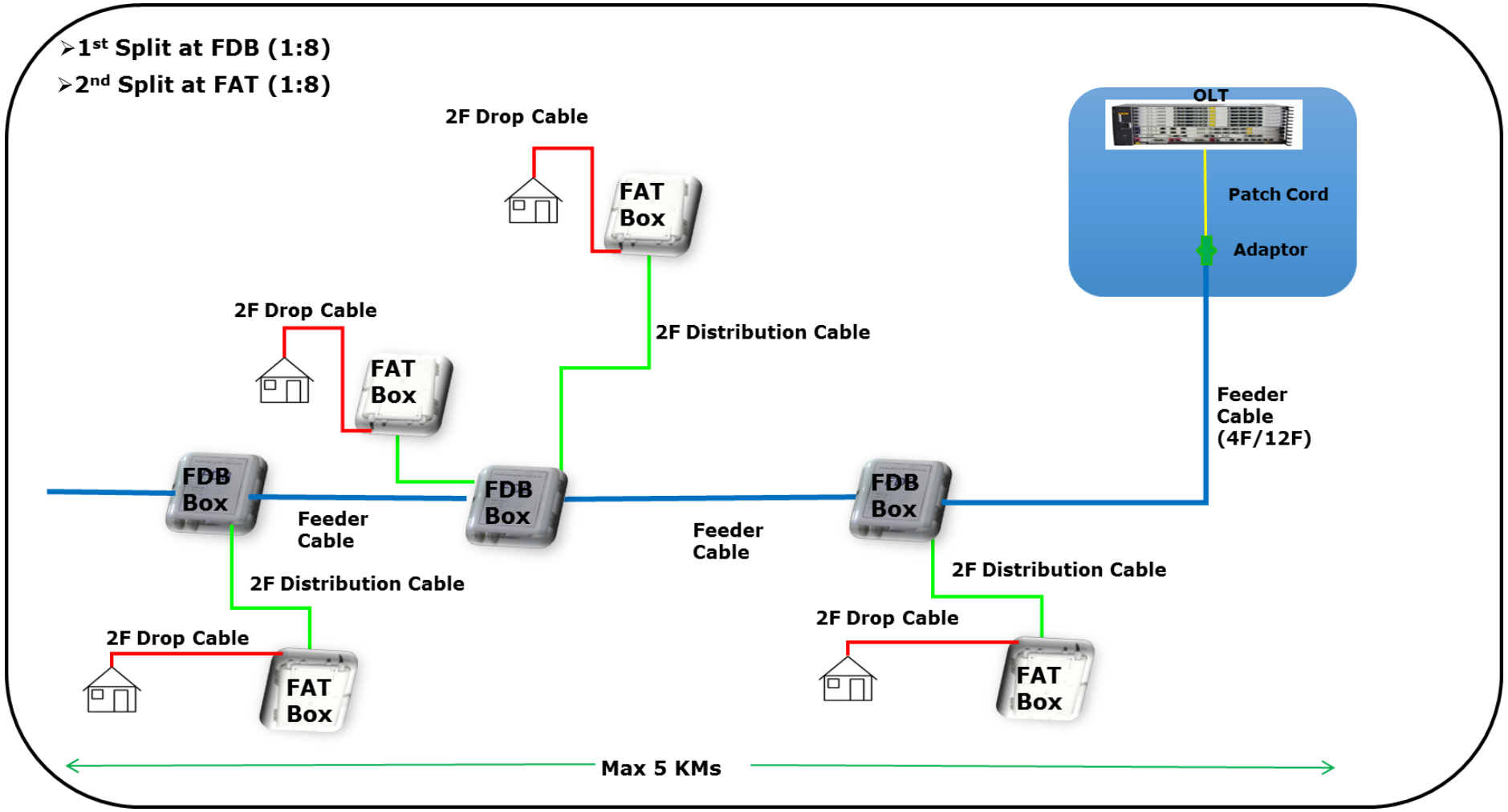


Next Generation in Access: SDN/NFV & Open Source

Telecom CO and Access Networks can benefit tremendously with new design philosophy

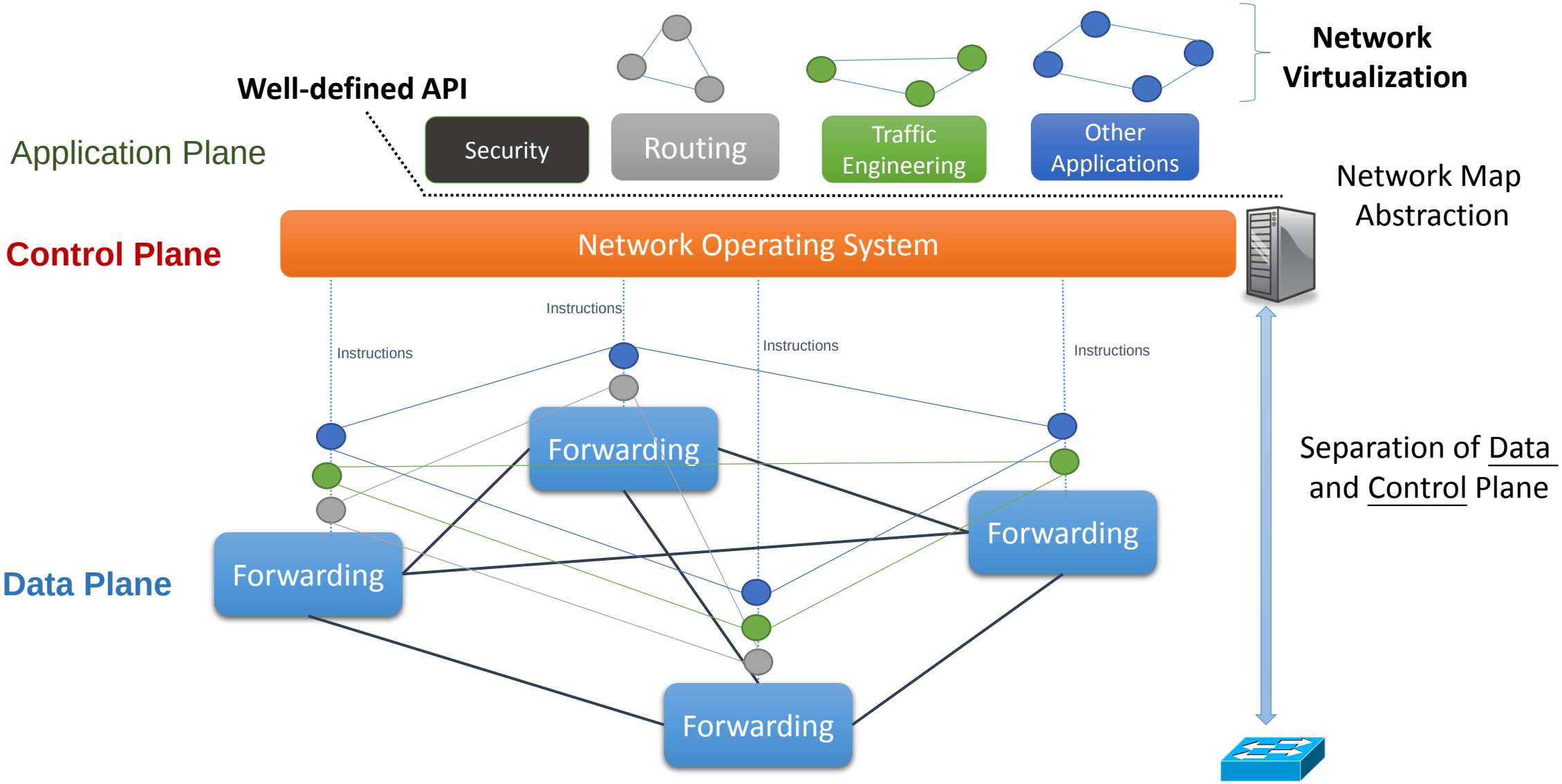
Large number of COs

Evolved over 40-50 years

300+ Types of equipment
Huge source of CAPEX/OPEX

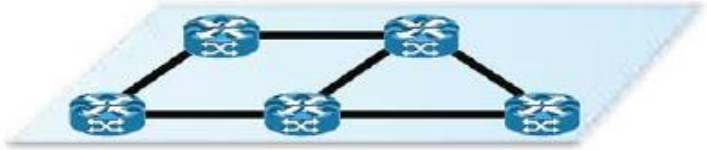
- Large number of complex facilities
  - AT&T alone operates 4-5k Central Offices
  - Each serves 10-100k residential, enterprise & mobile customers
- Evolved piecemeal over the past 40-50 years
  - Source of huge CAPEX/OPEX costs
  - Difficult to introduce new services
- Especially when compared to OTT cloud providers!

Software-Defined Network with key Abstractions



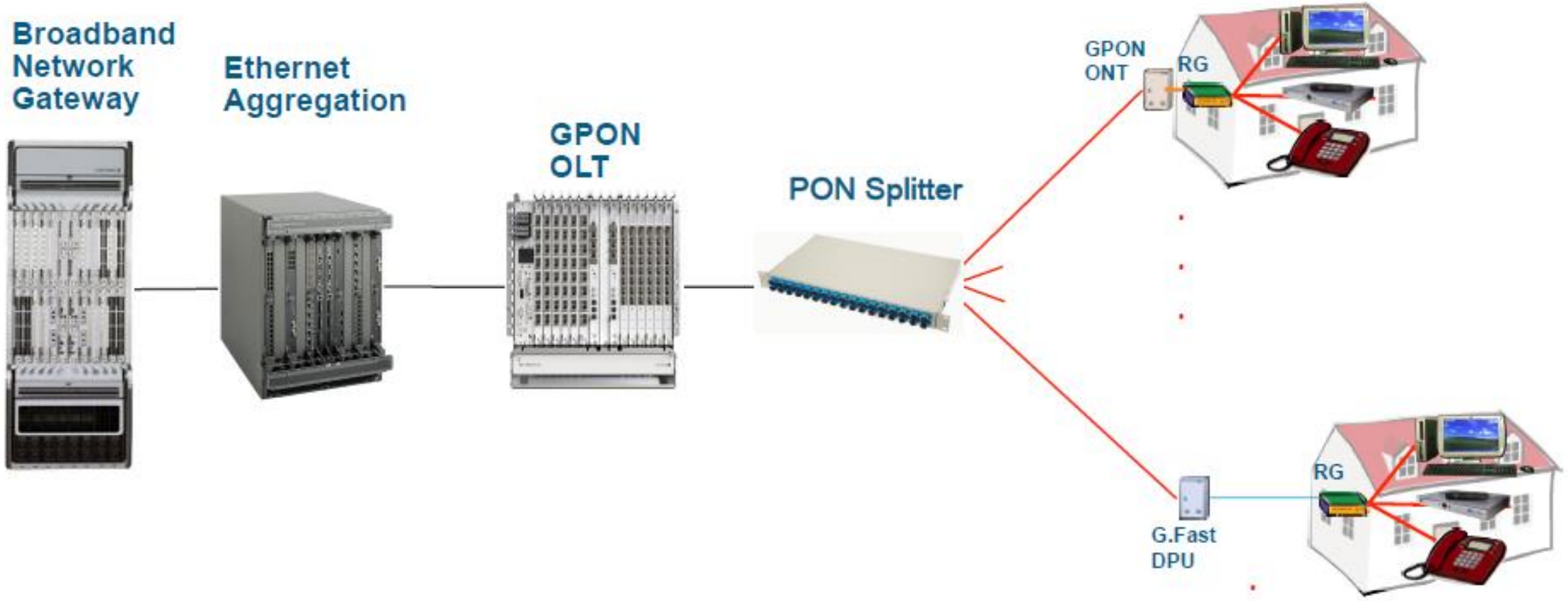
An example: OpenFlow

SDN Concept	Different layers (e.g OpenFlow)	Functions
Management plane (Application Plane)	Network Applications	Routing, load balancers, security, etc.
	Programming Languages	
	Language-based Virtualization	
Control plane	Northbound Interface	
	Network Operating System	Make decisions and instructions
	Network Hypervisor	
Data plane	Southbound Interface	Firmware handling instructions from control plane (e.g Open Vswitch) via flow tables.
	Network Infrastructure	Hardware (switches)



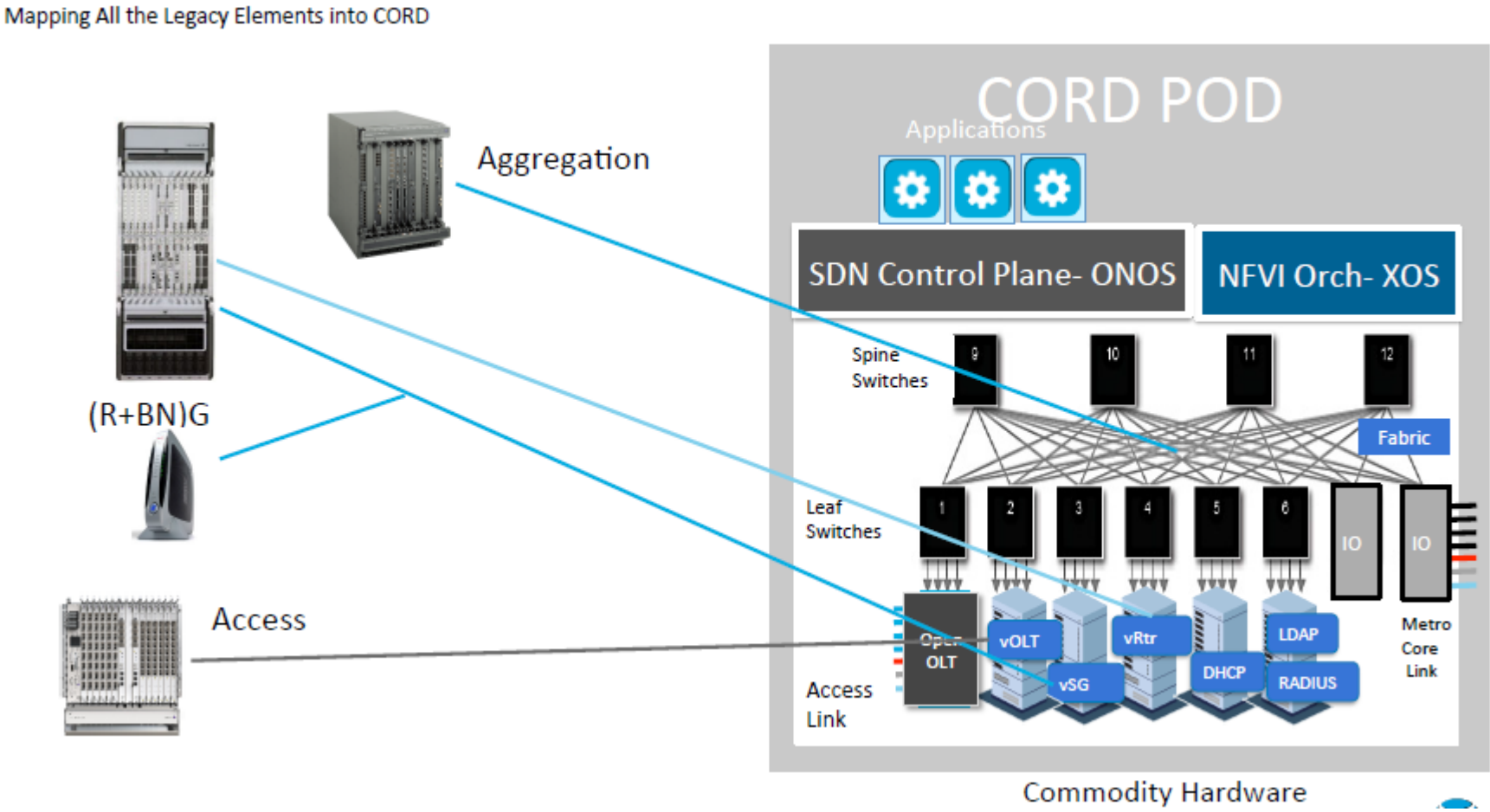
Example – Legacy GPON Architecture

Legacy Broadband Access Architecture
(Using GPON as well as G.Fast)



Source: opencord.org

Example – ON.Lab reference implementation of GPON



Source: opencord.org

Future Access Network Implementation: Disaggregated HW ecosystem with Common SW Infrastructure

List of Goods, Assembly and Test Instructions

Server Racks

Access & Fabric Racks

White Boxes

Residential OLT Services

Mobile Services (later)

Enterprise Services (later)

Common Services

SW Infrastructure: ONOS, OpenStack, XOS

Embedded OS: Switch, OLT, BBU

Source: opencord.org

Sterlite Tech Overview

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Our Purpose

Our Customers

Our Focused Strategy

Integrated Offerings

Transforming Everyday Living by Delivering Smarter Networks

Service Providers

Smart Cities

Rural Broadband

Defense/ Utilities

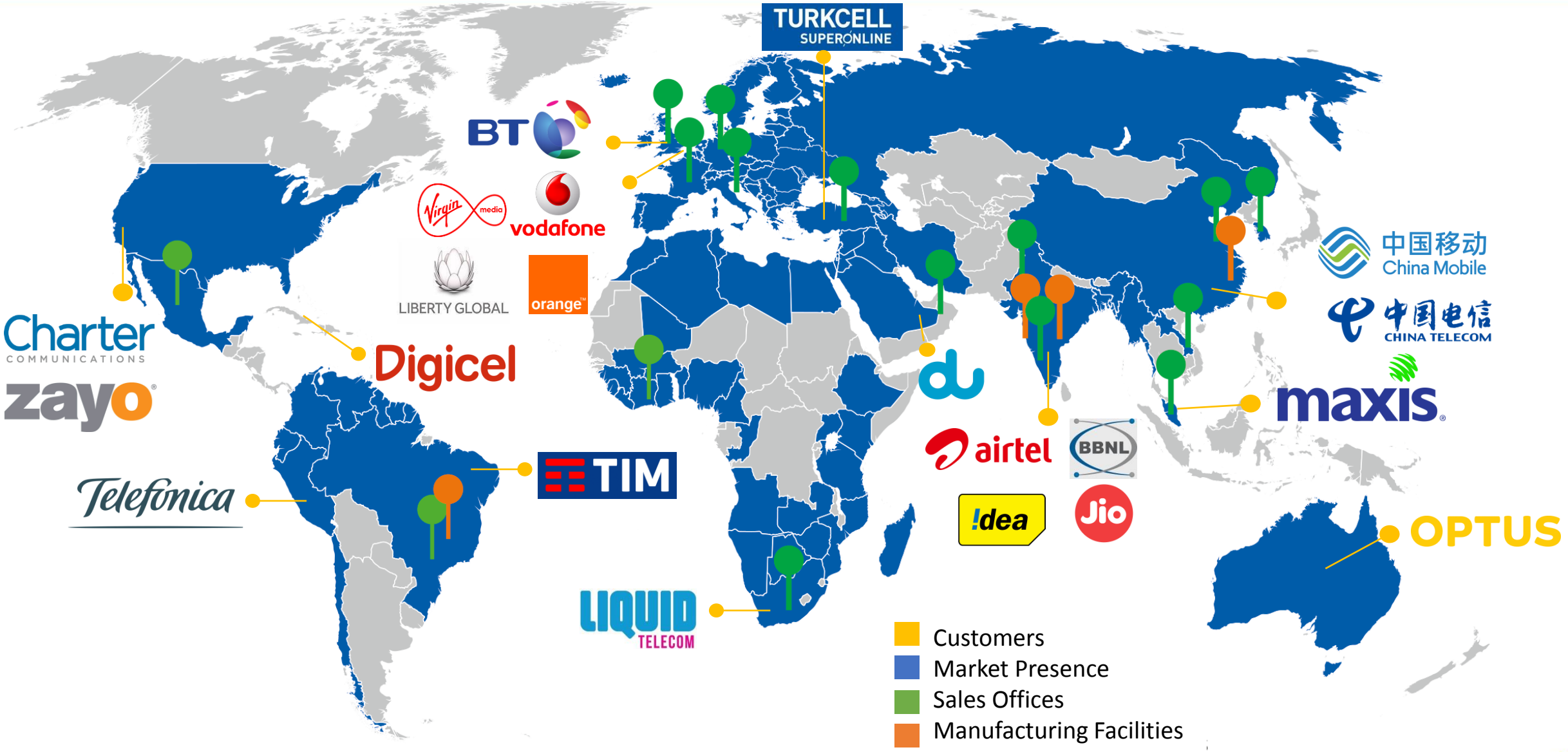
Sterlite Tech : Design, Build & Manage Smart Data Networks

Products:
Glass, Fiber & Cable

Services:
End to end System & Network Integration offerings

Telecom Software:
OSS/BSS Products and Solutions

Our Global Presence: Service customers in 100+ countries



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Thank You

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