Alphion®
Enabling the photonic future

Perfect Storm: Fiber based Broadband

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Connecting Everyone Everywhere *tm*

Scope

- Fiber based Broadband Highways: Drivers
- State of Optical Broadband
- Deployment Momentum
- FTTX Technology: Global Choice
- Indian Perspective:
  - Opportunities, Challenges

Perfect Storm for Fiber based Broadand Highways

Alphion® Broadband Highways: Motivation

- Broadband for All: Urban + Rural Digitisation
- National Information Infrastructure
- Smart Cities
- Large opportunity for Businesses
  - Banks, Ecommerce, Education Institutes, Hospitals, Telecom and Mobile Vendors, Infrastructure Companies, …
- What is there for Common People?
  - Internet: Central Communication Platform
  - Socio-economic Hub
  - Educated, Informed and therefore Empowered Citizens

EMPOWERMENT BY DIGITISATION

Optical Broadband Access is a Disruptor

- Optical technology in the access network is much more disruptive
- Tremendous growth in Speed compared to Copper, HFC, and Wireless Technologies
- Provides optimal backhaul for 3G/4G/5G/WiFI Networks
- Enables Gigabit end-to-end optical communication between Broadband Access users.

FACILITATES REAL TIME ACCESS

… that makes Over The Top (OTT) even more compelling…

…which is already growing in leaps and bounds

- **NETFLIX** has over a petabyte of content with subscribers in over 50 countries with 118 Million+ subscribers.
- **YouTube** has 1Billion+ users, 6 Billion hours of video watched per month.
- **Facebook** is a social network 2.2 billion monthly active users.
- **Twitch** is a video game oriented, live streaming platform recently purchased by Amazon, with over 9.7 Million daily active users and over 2 Million broadcast streams per month.
- **Instagram** has more than 1 Billion monthly active users
- **DropBox** has over 500 million users, with over 1.2 Billion files uploaded daily, with over 100,000 new shared folders and links per hour.

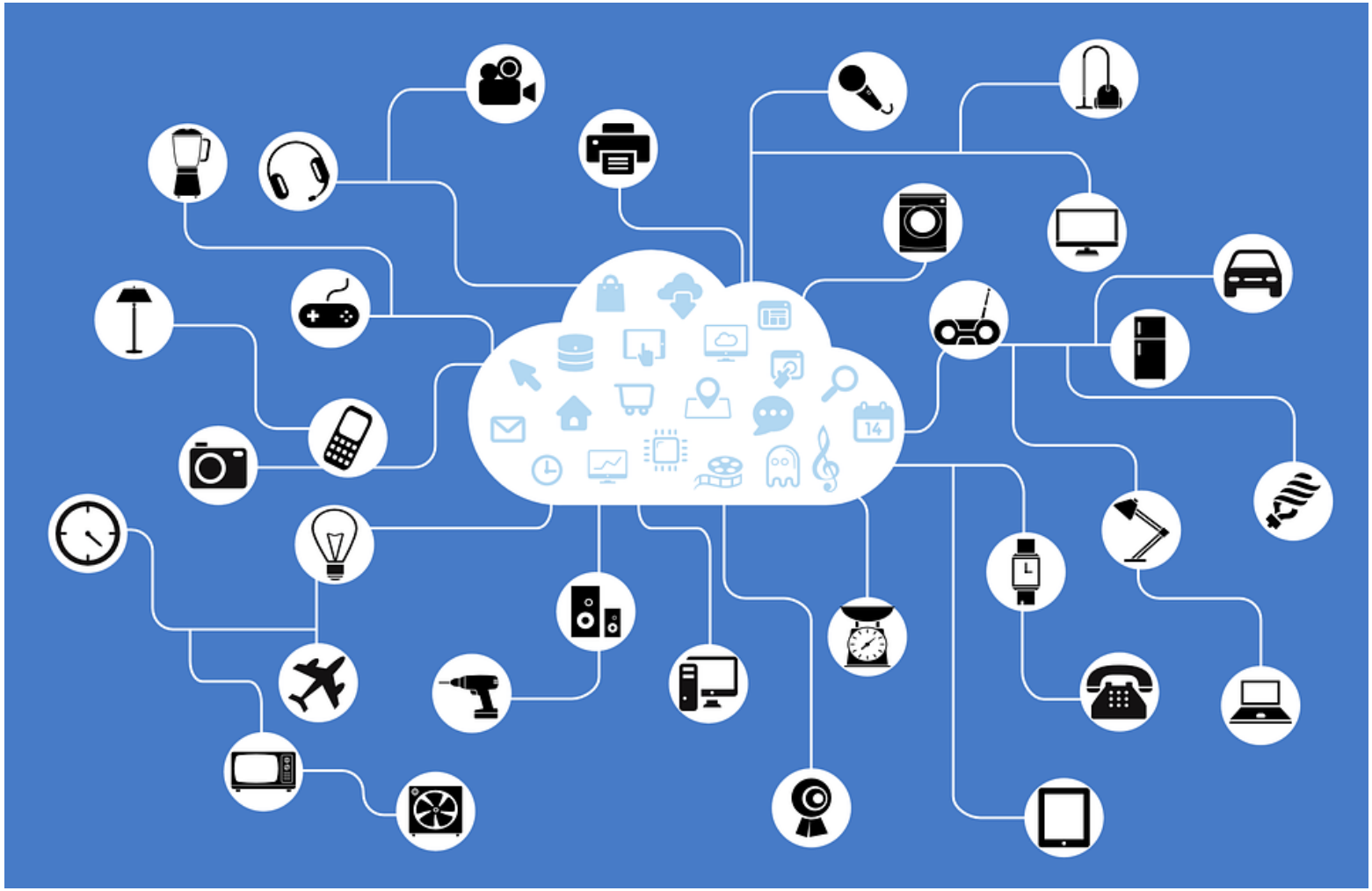
…and it is only really just the beginning.

Source: Netflix: https://www.comparitech.com/blog/vpn-privacy/netflix-statistics-facts-figures/#gref
YT: https://www.businessinsider.com/youtube-user-statistics-2018-5
Facebook: https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/
Twitch: http://mediakix.com/2017/02/top-twitch-statistics-live-streaming-game-platform/#gs.AHWG_IM
Instagram: http://expandedramblings.com/
Dropbox: http://expandedramblings.com/index.php/dropbox-statistics/

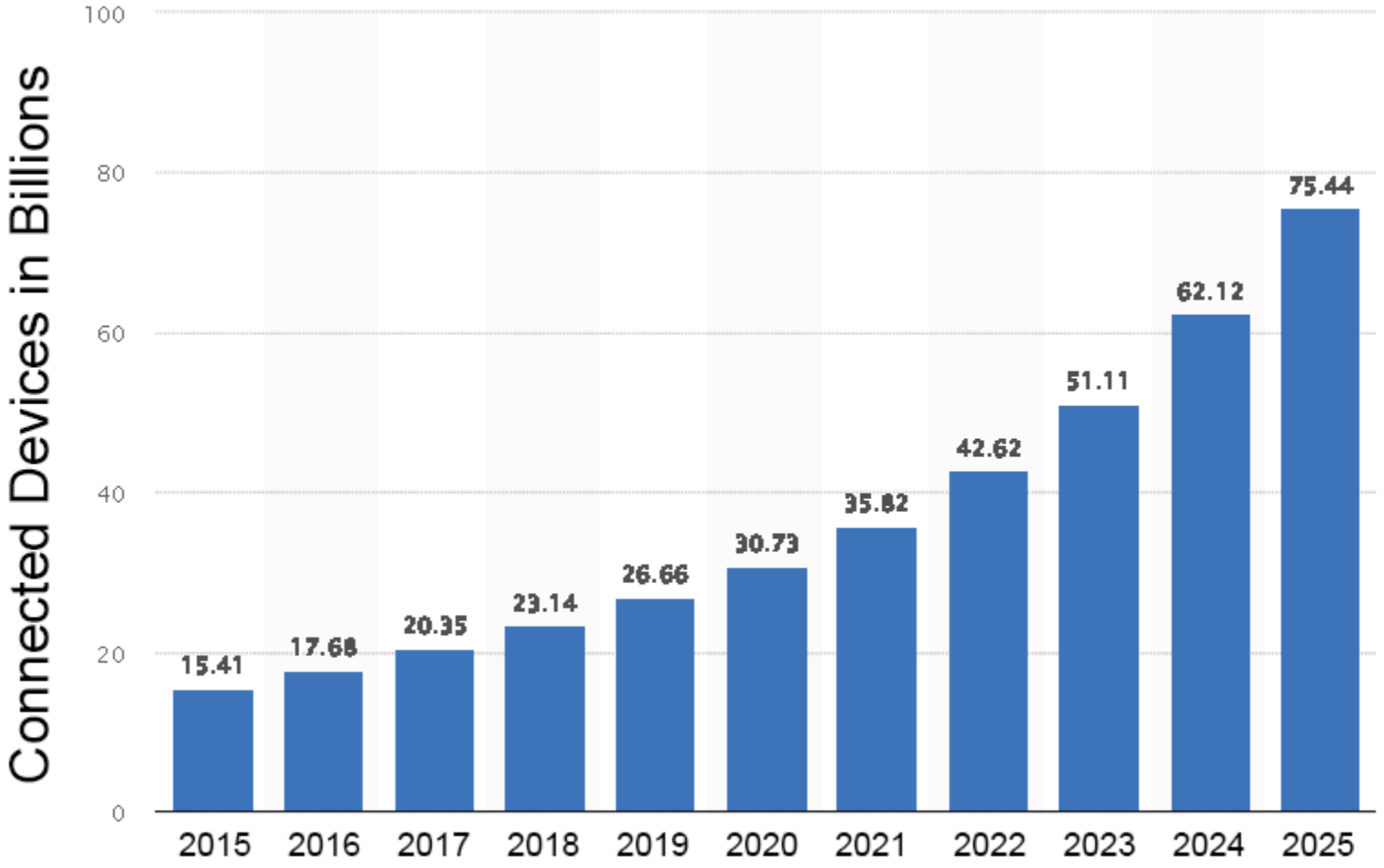
Internet of Things (IOT) – seeding the word with IOT devices

Image: Jon Berkeley, The Economist, "when everything connects" cover, April.28.2007

Internet of Things (IOT) – connecting the world around us in 2018



IOT Devices Growth



Source: Statista 2018

Broadband Status...

Fixed Broadband

Rank	Country	Subscriber per 100 Residents
1	Monaco	49.9
2	Switzerland	45.4
4	France	43.8
5	Denmark	43.2
9	South Korea	41.6
19	Hong Kong, China	35.9
23	USA	33.9
95	Jamaica	8.3
136	India	1.3

5 Billion people To have Internet Access by 2020!

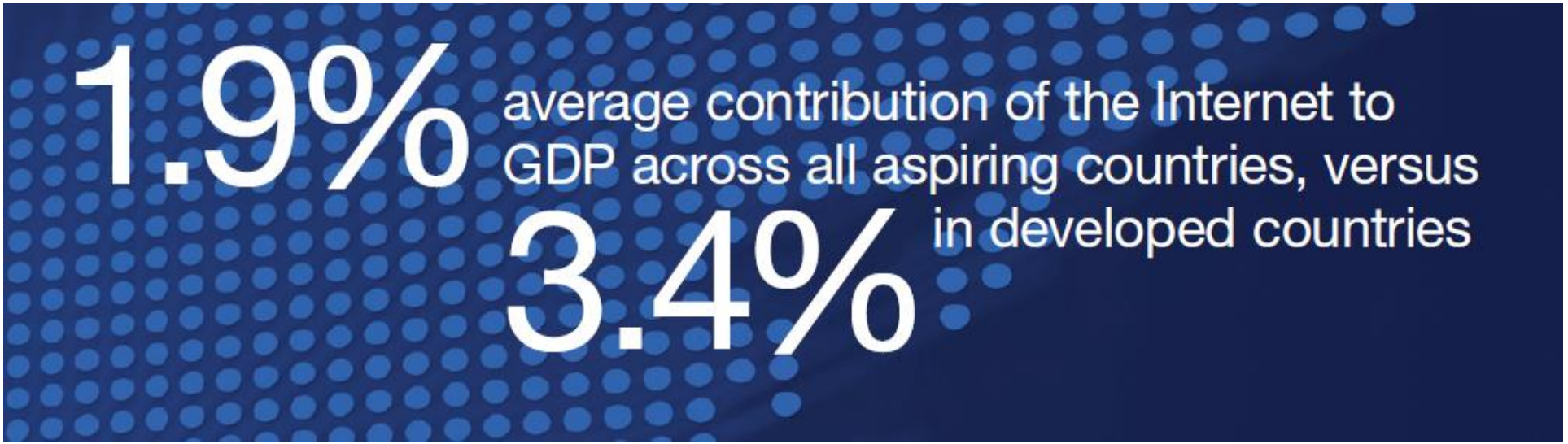
Mobile Broadband

Rank	Country	Subscriber per 100 Residents
1	Macao, China	321.8
2	UAE	243.3
3	Kuwait	227.9
9	Japan	133.2
20	South Korea	112.8
25	Hong Kong, China	105
43	UK	88.1
50	China	83.6
146	India	25.8

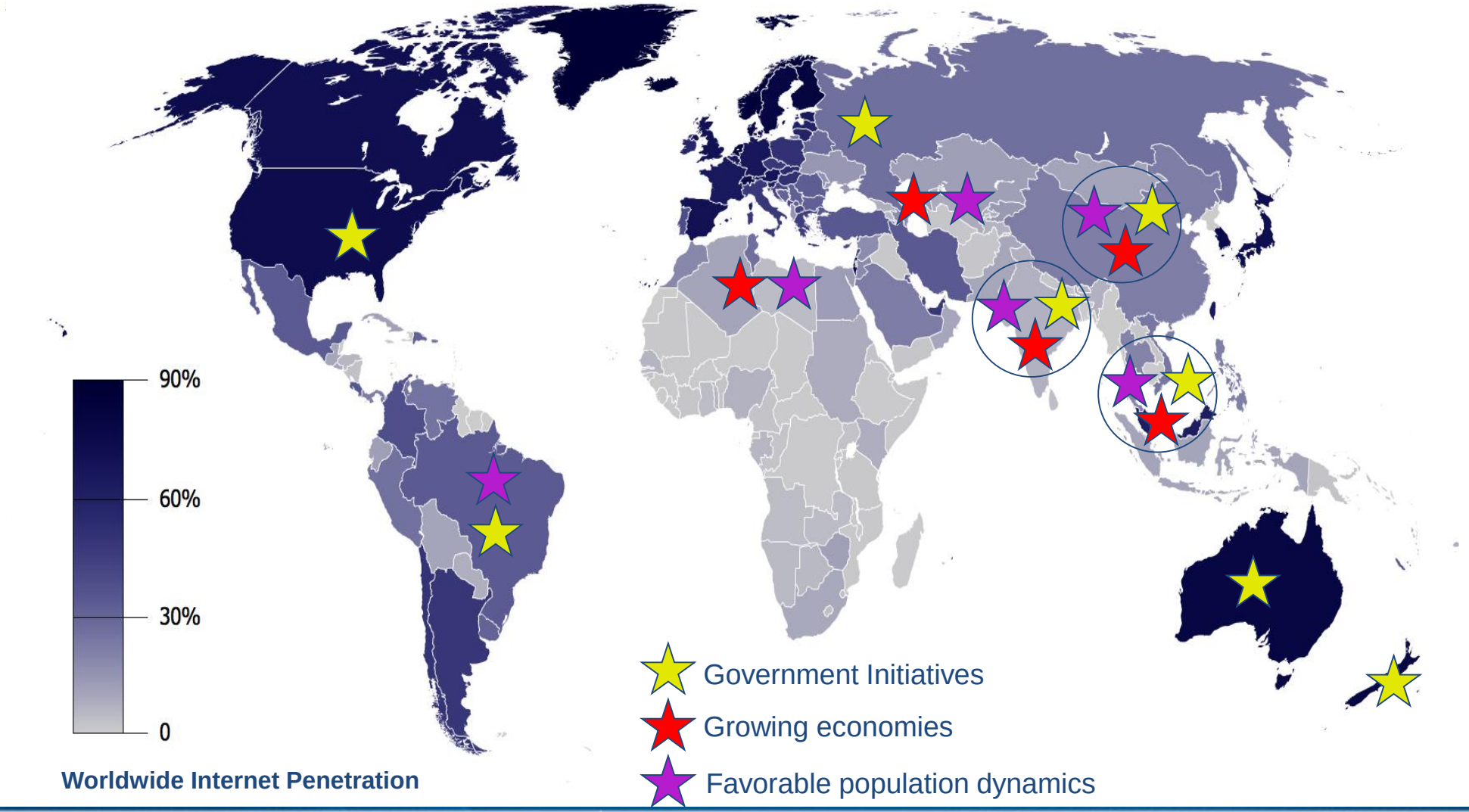
Source: The State of Broadband, ITU September 2018

But with it comes the opportunity of the Digital Economy* to the users…

- What the McKinsey &Company Report "Online and upcoming: The Internet's impact on India" back in 2012 still holds today:



FTTx Deployment Momentum



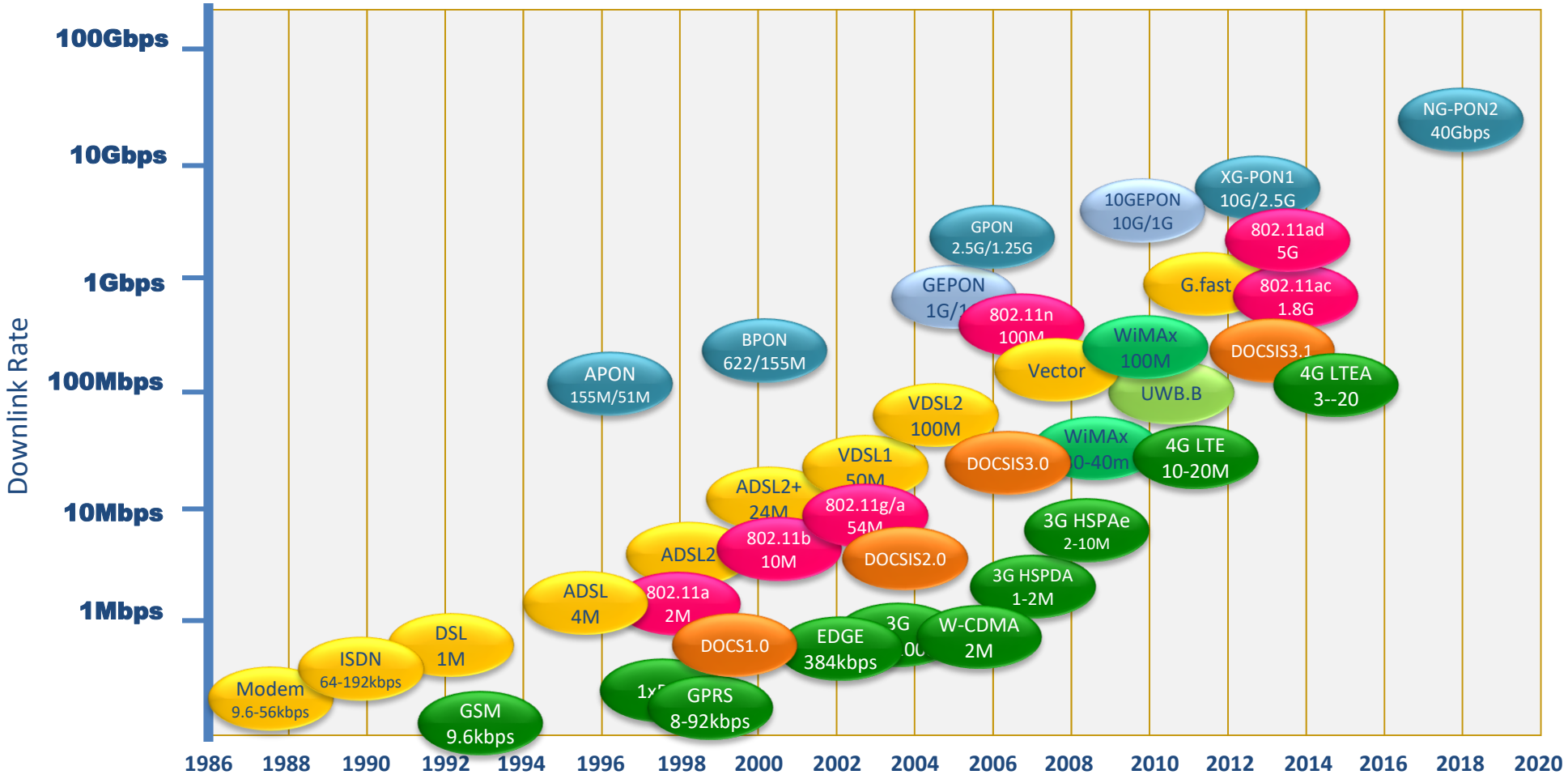
Worldwide Internet Penetration

Alphion Deployments

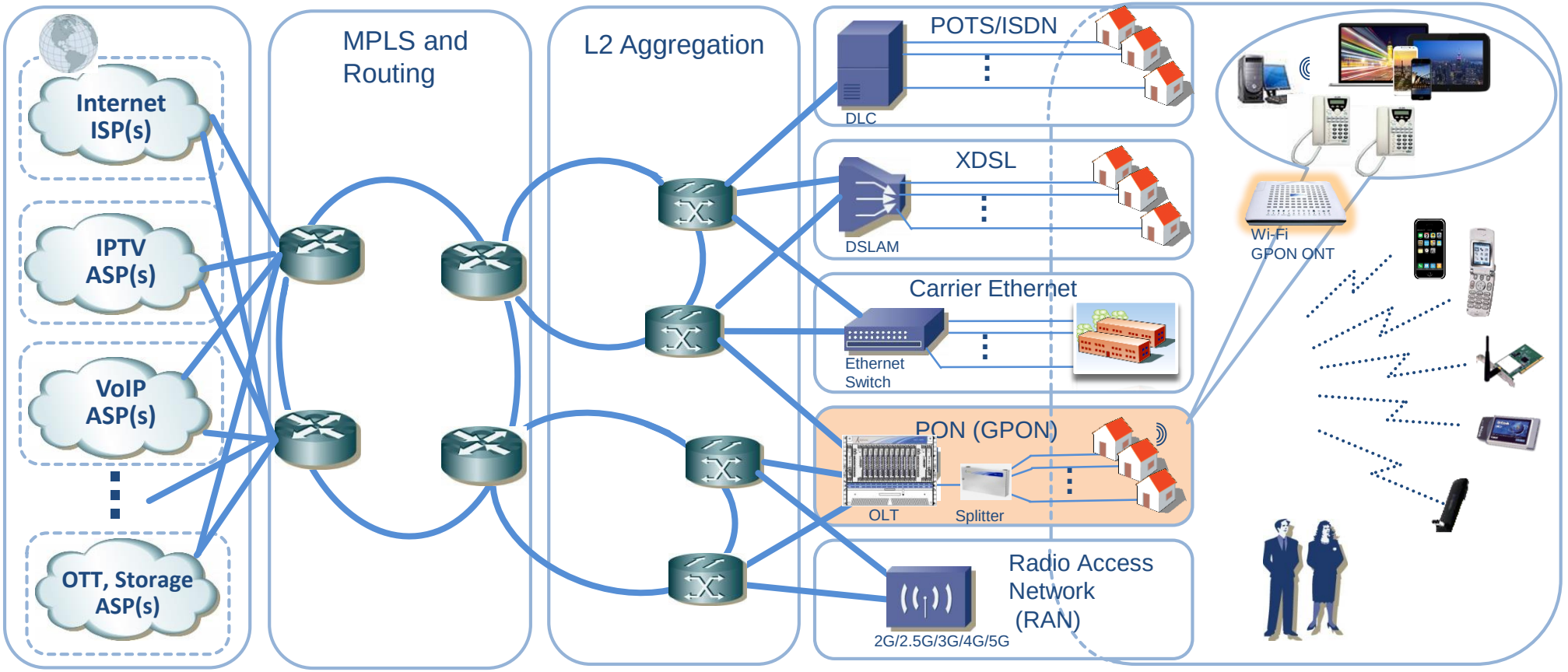
Deployed In 24 countries

Deployment in 200+ cities in India

Access Technology Evolution



PON & RAN: Optimal Technologies



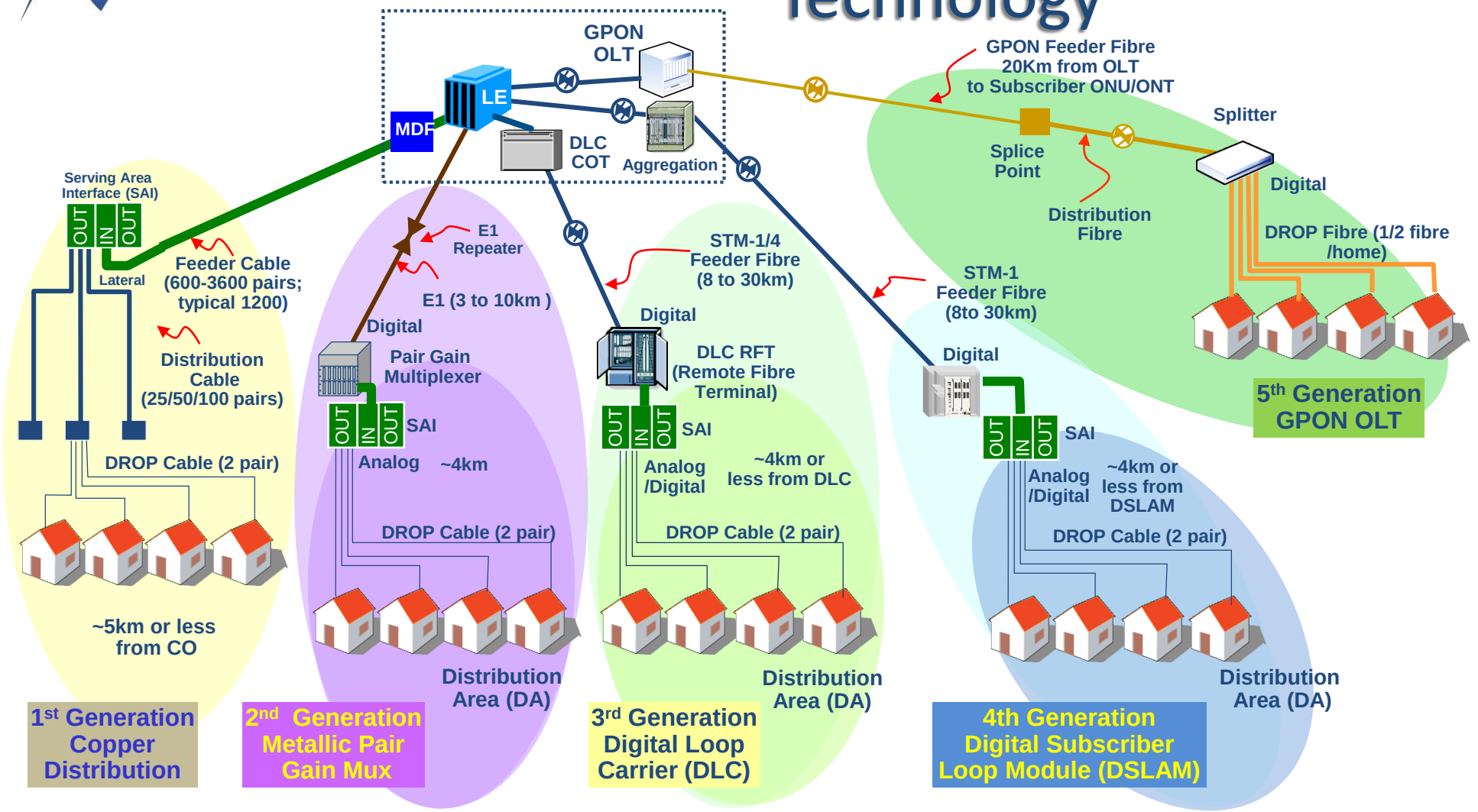
ASP (Application Service Provider)
ISP (Internet Service Provider)
IPTV (Internet protocol TV)

OTT (Over The Top)
MPLS (Multiprotocol Label Switching)
POTS (Plain Old Telephone Service)

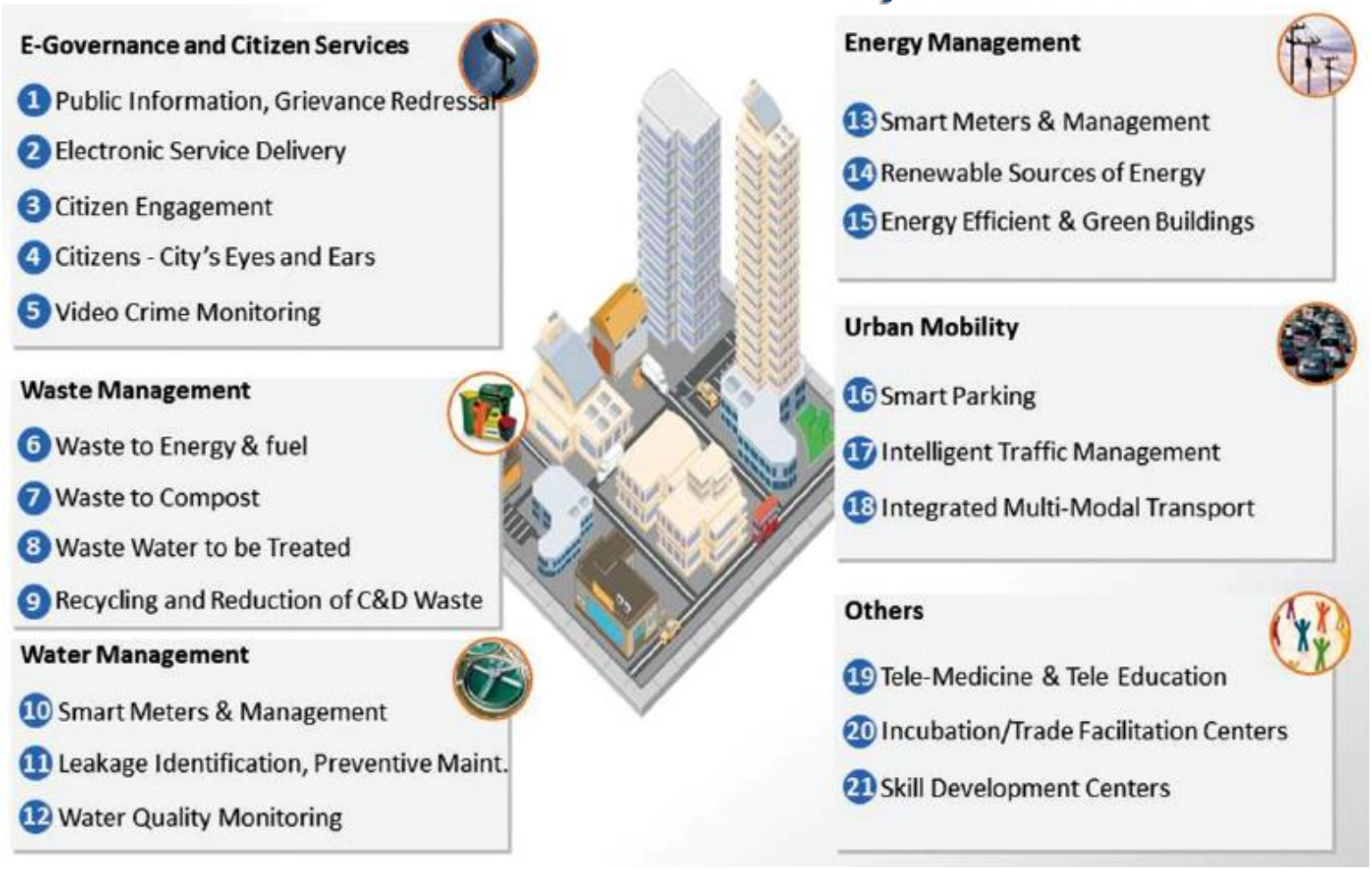
xDSL (Digital Subscriber Line)
HFC (Hybrid Fibre Coax) (not shown)
PON (Passive Optical Network)

RAN (Radio Access Network)

GPON is 5th Generation landline Access Technology

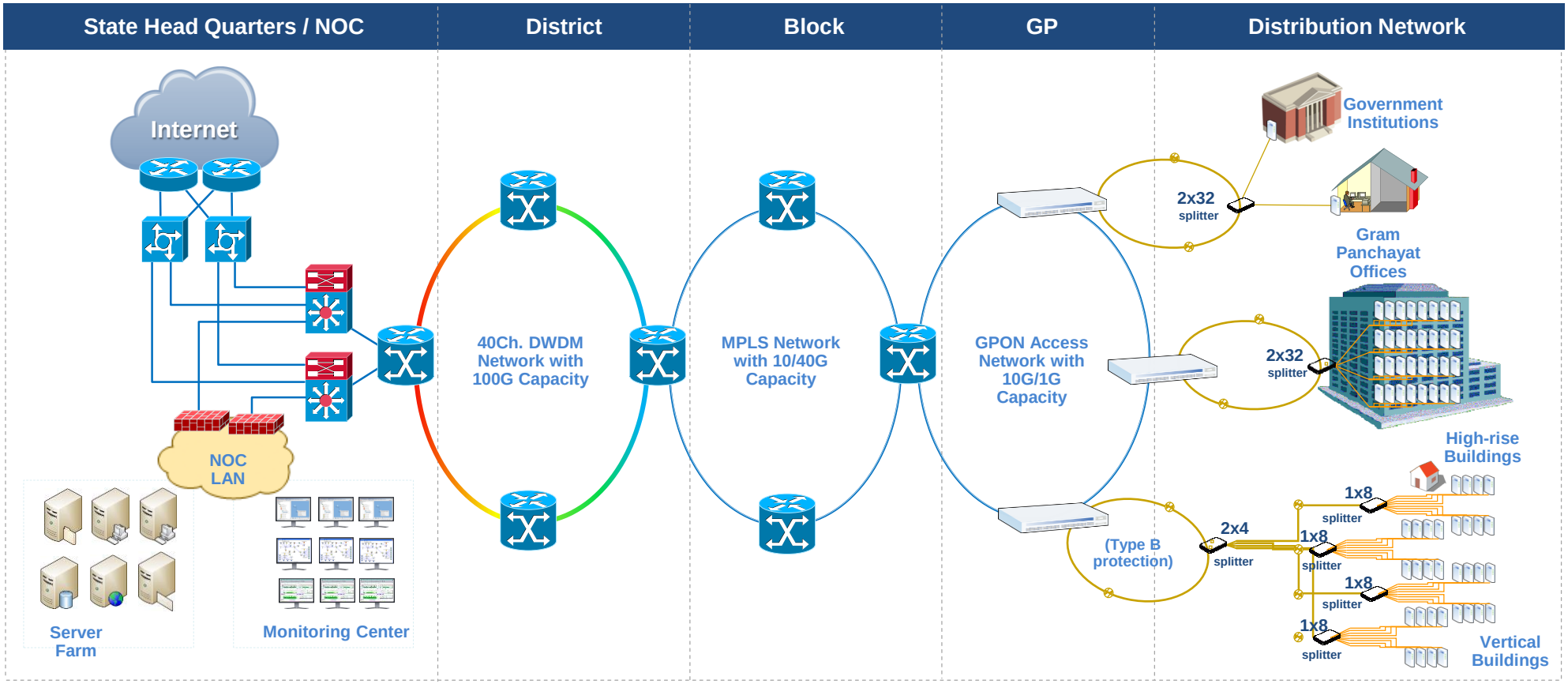


Smart City Solutions

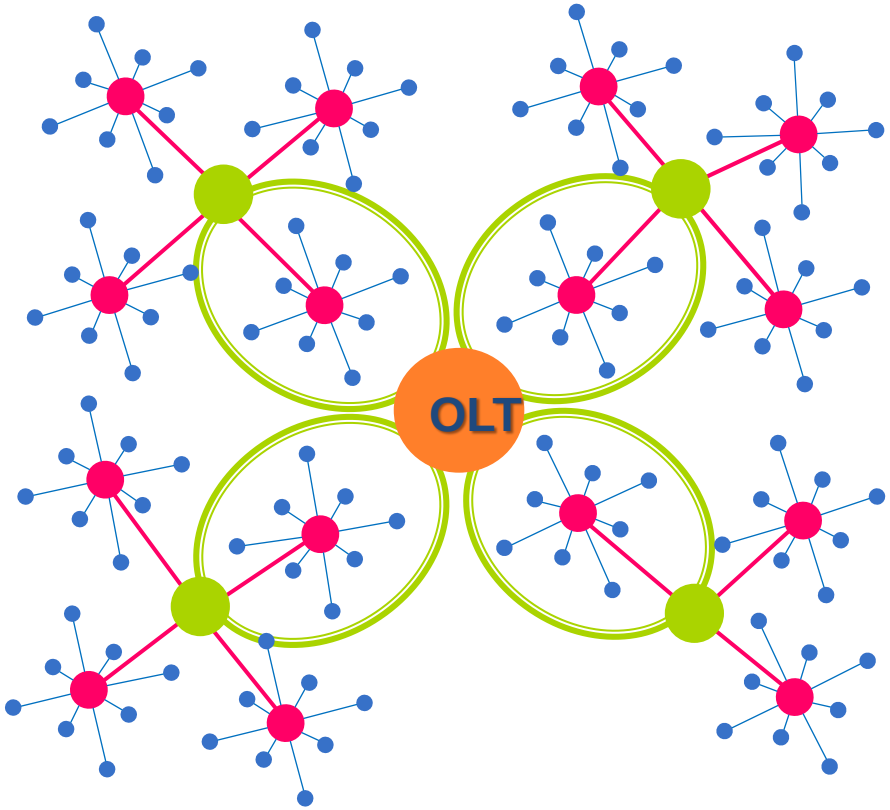


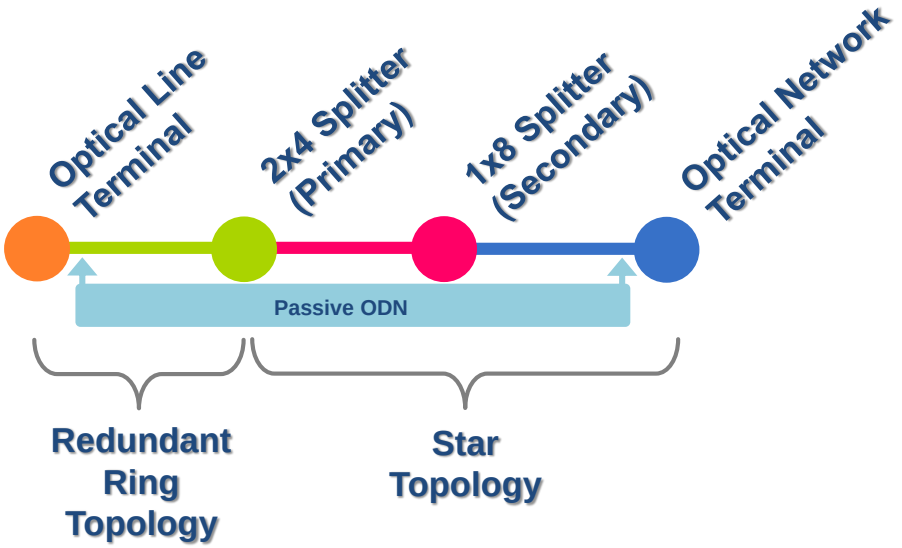
Source: ***Mission Statement & Guidelines - Smart Cities*** *by Ministry of Urban Development, Government of India, June 2015*

Network Architecture: NOFN- Removing Digital Divide



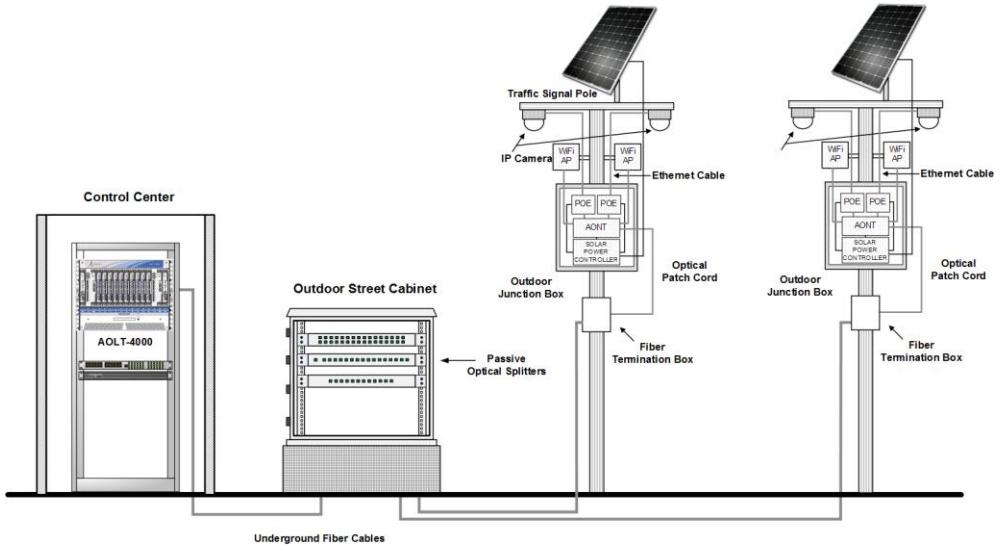
GPON Topology for Smartcity





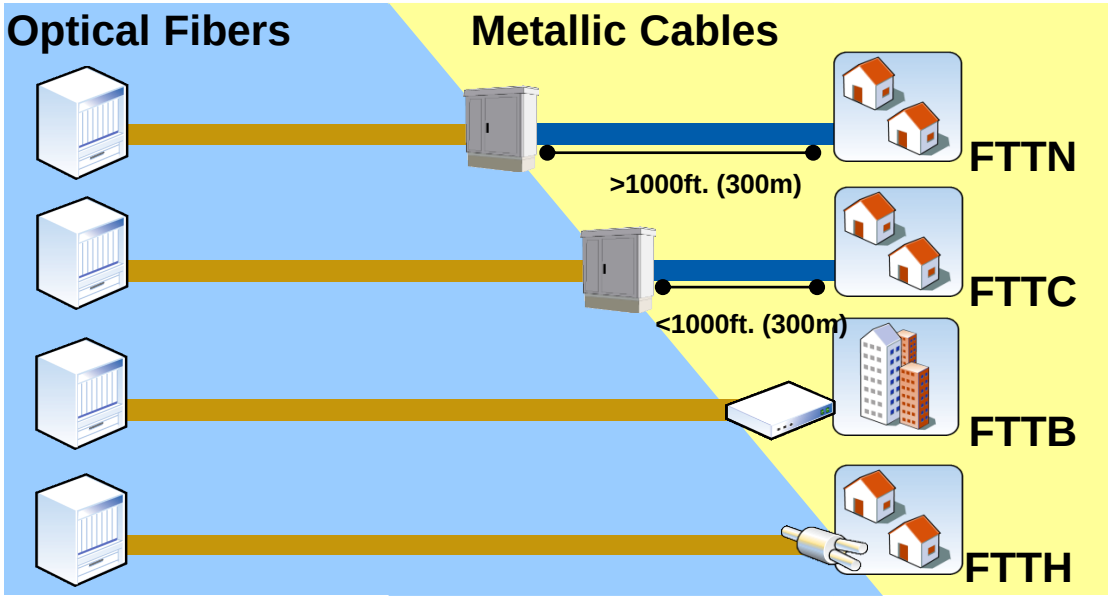
- Topology shown for AOLT-4200 with 8 PON Ports in 4 Active and 4 Standby configuration mode
- Based on 1:32 Split ratio, 32 ONTs per Protected PON Port
- Up to 128 ONTs Servicing from a POP

Smart Pole with GPON



- Smart LED lights
- Security Surveillance
- WiFi Hotspot
- 4G Microcell

Opportunities and Challenges



- Poor and aged copper infrastructure
- Greenfield construction boom
- Lower Labor Costs
- Higher comparable purchasing power parity
- Favorable Public Policy

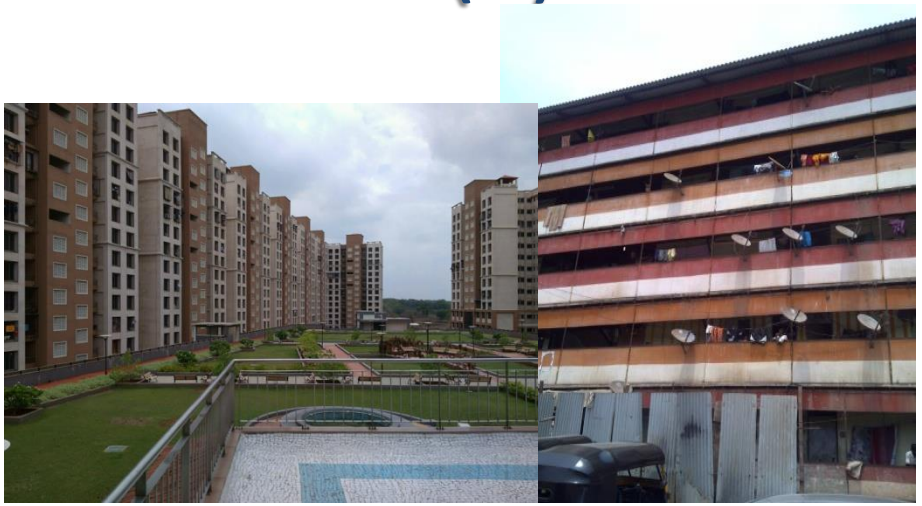
- Lower ARPU
- More CAPEX outlays for Wireless technologies for faster rollout and wider reach compared to FTTH
- Right of Way
- Premise Fibering

Keys to Success (1)

- Low Cost Deployment Models
- Cost per home connected is the key metric
- Lower ARPU
- Reliability of network components
- Watch out for the construction crew !
- And the constant power cycling !!
- Capacity Utilization is important in a world of CAPEX Conservation paradigms
- If you build it, they will come – just not that fast
- Application driven growth

Keys to Success (2)

- Open Access
- It is no longer a product sale – it is a solution sale
- Ecosystems are the “in” thing
- Its an “App” world – applications sell, networks don’t



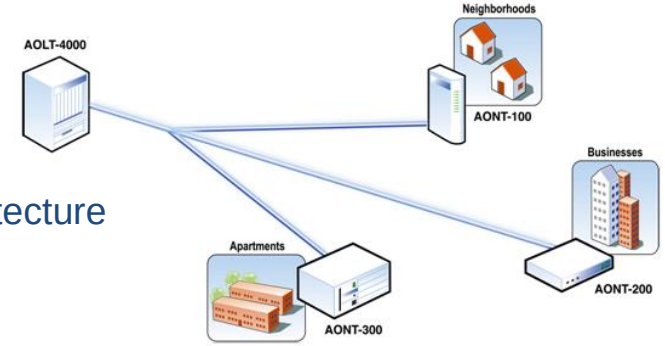
- Experiment with unique business models
  - Revenue share – everybody needs to put skin in the game
  - “Smart Wholesale” models are smart !! - Customer Intimacy is key to higher take rates
  - NGOs & Universities

But there are additional aspects that affect Optical Access rollout

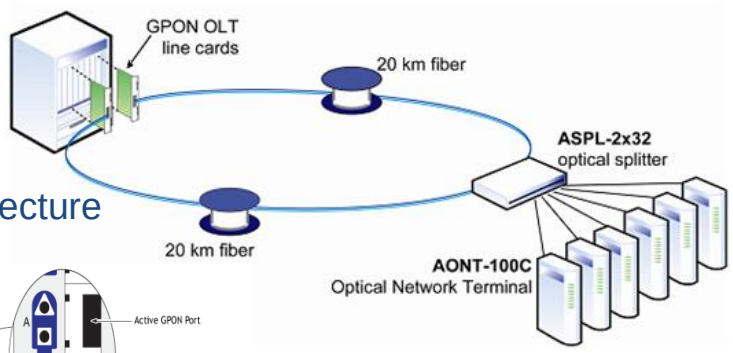
- Backwards compatibility: Applications and Devices
- Blurring of historical lines between Telcos (xDSL) and MSOs (HFC)
- Telecom encroachment on MSO TV space, especially non-Live TV - Territorial disputes between Telco and MSOs
- ODN Plant builds – aerial vs. underground, ROW Issues
- Impact of Optical Access bandwidth on Core and Metro networks: especially with new technologies such as NFV and SDN
- Role of Network Management
- Impact of 'Make in India' on Manufacturer's of the equipment

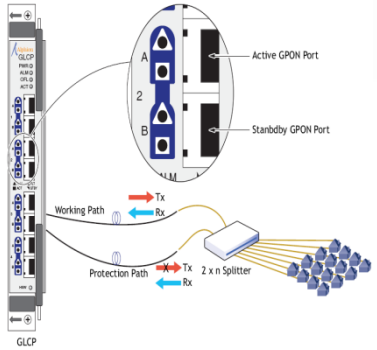
Reliability of Access Networks

Star Architecture



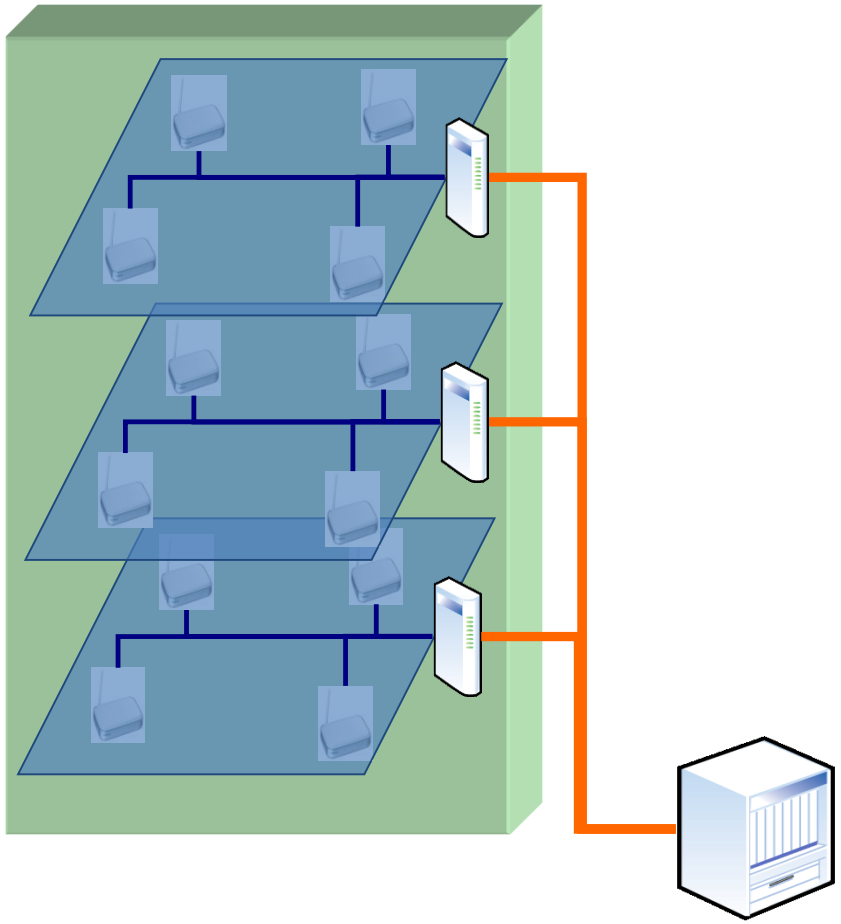
Ring Architecture





- Redundant fiber paths in subscriber access reduce down times
- Critical components need redundancy
- Higher network reliability at lowest incremental CAPEX and OPEX

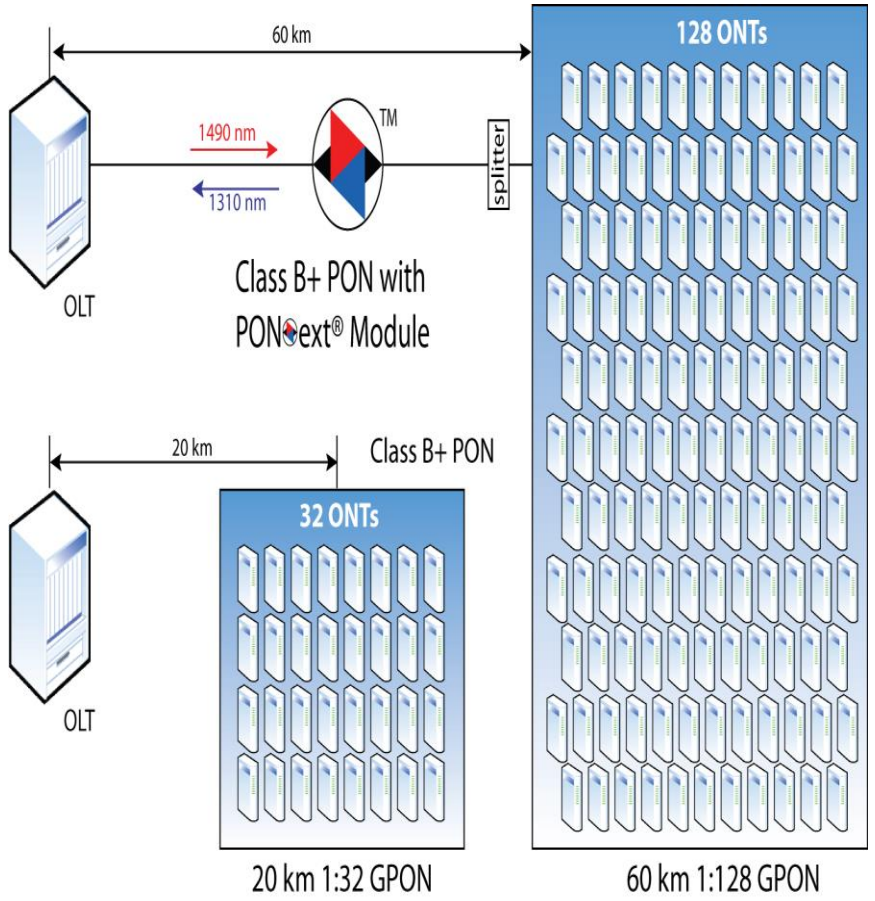
Low Cost Deployment Models: FTTF



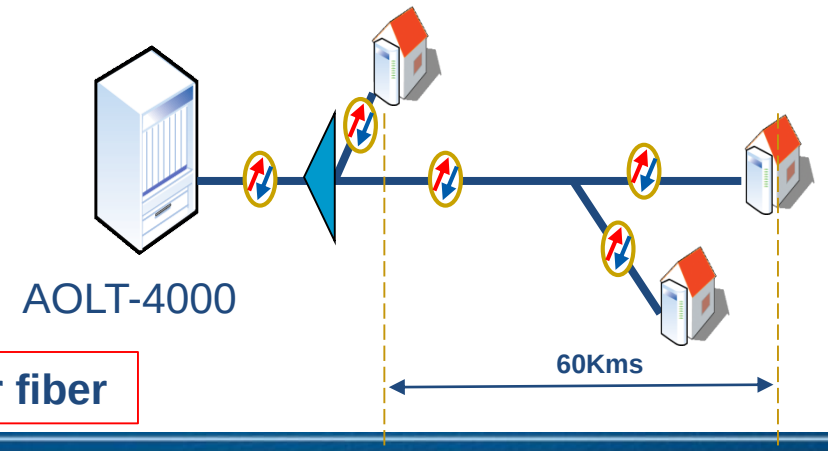
Fiber To The Floor ™

- Economical FTTB Deployment Model for High Rise Apartments are critical
  - Vertical Fiber and Horizontal Copper
  - "Poor Man's MDU"
- Low Cost Deployment Models are not equal to "Cheap Products"
  - Product Features cannot be compromised
- Frugal Engineering of products for emerging markets can improve margins in mature markets

Better Capacity Utilization



- PON Extension techniques to increase the reach of existing OLT deployments
- Increased differential reach helps to improve take rate on each port



3x longer distance and 4x more customers per fiber

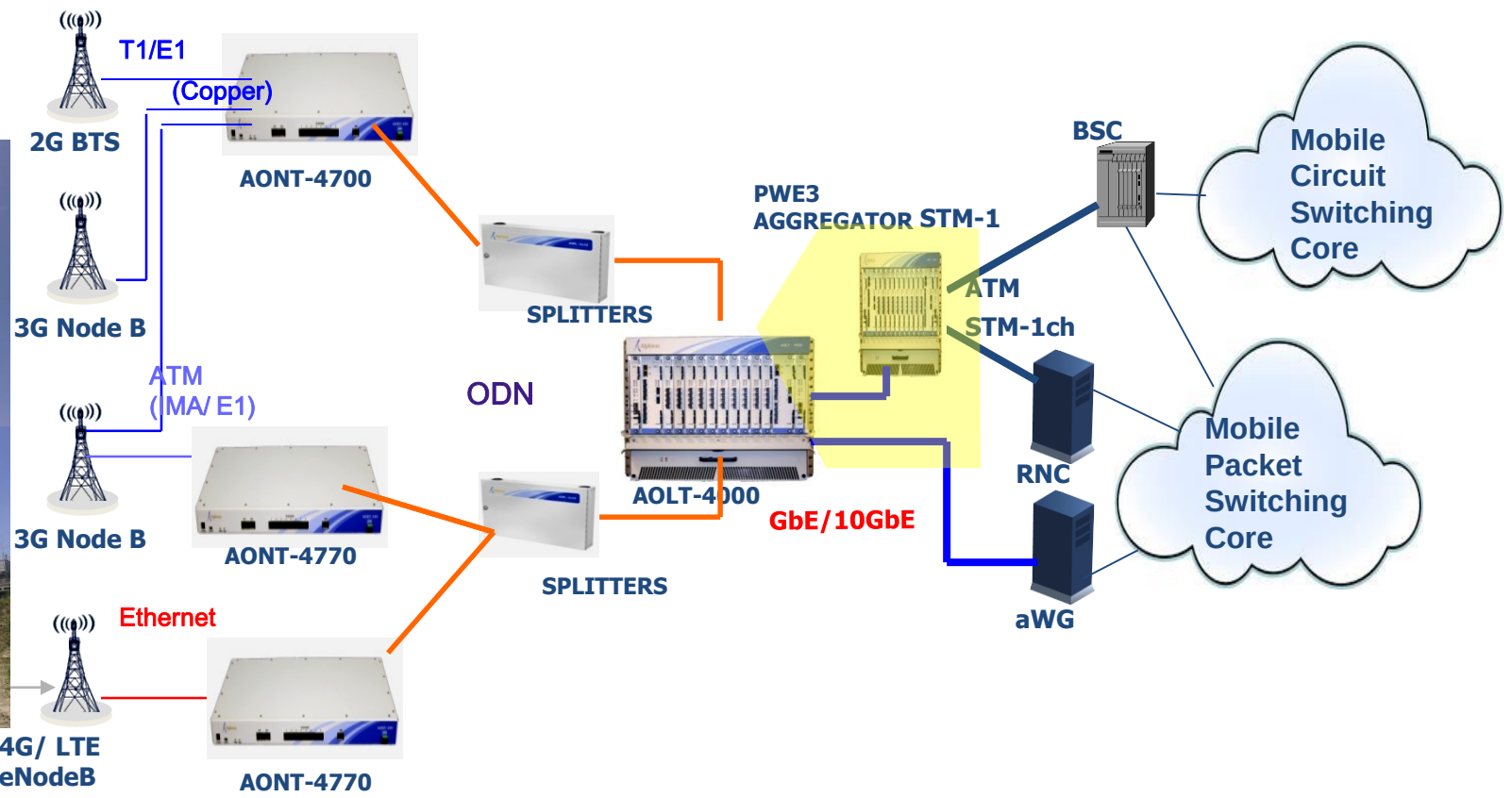
Application Driven Subscriber Growth

- FTTx Access Equipment not be positioned as “Broadband Pipes” but rather as “Application Enablers”
- Don’t go at it alone, take your partners along and share the rewards

- Plan Growth Strategy for FTTX Networks Driven by Applications
- Rural Subscriber Growth can be achieved by offering basic applications like access to the Internet
- Urban subscriber growth requires innovative applications and is executed with partners

FTTx Synergy with Mobile Rollout

Cell Site	Mobile Backhaul using ODN	Mobile Core Network



Enable cost effective RAN with Ethernet for All-IP LTE/4G/5G Evolution

Rural Fiber Deployments in India

- India
  - Population 1.3B (2016)
  - 67.5% rural (820M)
  - #136 for BB penetration (1.3%) (2018)
  - 241M Facebook users (Jul 2017)

- 250,000 Panchayats and 600,000 villages to be connected by FTTH

Source: https://www.livemint.com/Consumer/CyEKdaltF64YycZsU72oEK/Indians-largest-audience-country-for-Facebook-Report.html
http://www.worldometers.info/world-population/india-population/

Changes to Business Models

- Optical Access Networks: 'Lightspeed' communication
- Charging per bandwidth are not sustainable
- Operators will need to adopt the hybrid models including bits, bandwidth, and applications
- Open access networks: Net Neutrality
- Cannot reject innovations: "Customers can't use them" vs "Optical Access Networks" are here.

Commercial Challenges from Indian Market Standpoints

- Commercial Factors Impacting Selections in India:
  - Cost - Investment in New Fibre Infrastructure required
  - Legacy Services will still need to be supported during transition
  - Organizational Difficulties in supporting Multiple landline technologies
  - Obsolescence of current copper Technology will require write-downs
- This is compounded by the normal inertia to change and inability to take risks.

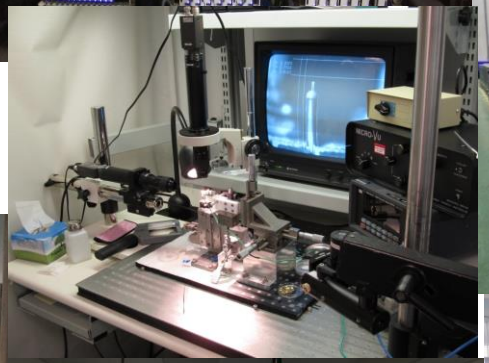
Make in India: Opportunities & Challenges

- Opportunity for local OEMs
- Preferred Market Access with % of Local Value Add
- Fewer OEM companies in India: Difficult to have IP resident in India
- Lack of local fabrication facilities (fabs) for Electrical and Optical components
- Investment for Manufacturing Infrastructure
- Cost of Project Financing

Make in India…









- End to End R&D, Optics
- Optical Sub assembly
- Complete CKD Assembly
- Clearnoom for Optical Component

Broadband Highways: Paradise for Innovations

- **Gigabit to the Cloud**
- **Enterprise Cloud**
- **Storage data centers driver:** Opportunity for ‘Store in India’
- **Renewable energy appliances**: Opportunity for powering the off-grid devices in remote and rural areas.
- **Off-grid powering appliances:** New and novel renewable powering of the Optical network Terminal (ONT) and connected equipment is required.
- **High-density Fibre installation technology and components**
- **SDN and NFV opportunities**
- **Internet of Things (IOT) enabler:** New converged Wireless and Wired devices.

Conclusions…

- Perfect alignment of consumer, applications, technology, infrastructure, and govt. policies creating a Perfect Storm for Broadband Revolution
- Over the Top (OTT) Broadband applications are requiring more and better quality bandwidth to the consumer
- Optical Access Networks are essential for 3G/4G/LTE/5G Mobile Growth
- With over 1MM KM Route Fibre, Indian telecom Industry is poised to take advantages of Ultra-high speed Broadband Infrastructure
- India: Huge Opportunity coupled with challenges
- FTTx friendly govt. policies for right of way and open access will fuel growth
- Challenges are being overcome with alliances and success is infectious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