

Building the Fiber Nation: ***FTTx Technologies & Deployment Scenarios***

Different Sources

(Alcatel-Lucent, OECD, FTTx Council, CORNING, Berkman, World Bank, etc.)

November 2009

A quick and inexpensive way for fast access



Distribution box for aerial fiber cable



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- ☐ Rights of way and new building requirements for broadband services in Lebanon
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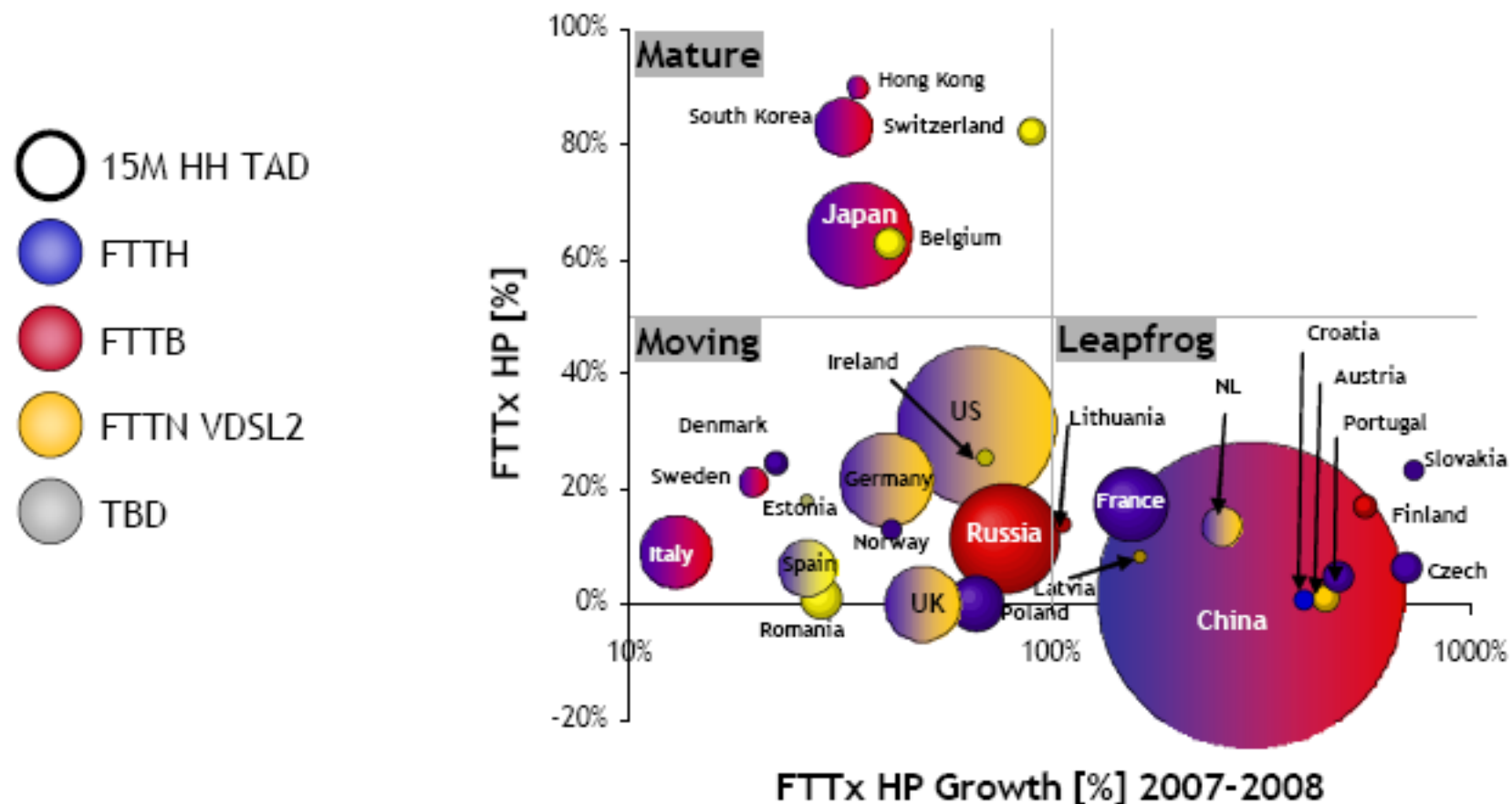
Fiber nations on the move

- ❑ The debate is no longer about if or why fiber should be deployed in the access network; it's rather focused on “**how**” and “**when**”.
- ❑ FTTx is a transformational technology whose impact today is equivalent to fixed-line telephony in the 1880s and mobile telephony in the 1990s
- ❑ The ‘potential difference’ between cities and the suburbs and rural areas should drive public policy, regulation and targeted investment towards resolving this problem
- ❑ The position of Service Providers’ with respect to fiber in the access network has changed dramatically; **FTTx is being considered necessary for next-generation broadband, with FTTH as the ultimate objective**



Fiber Nations On the Move

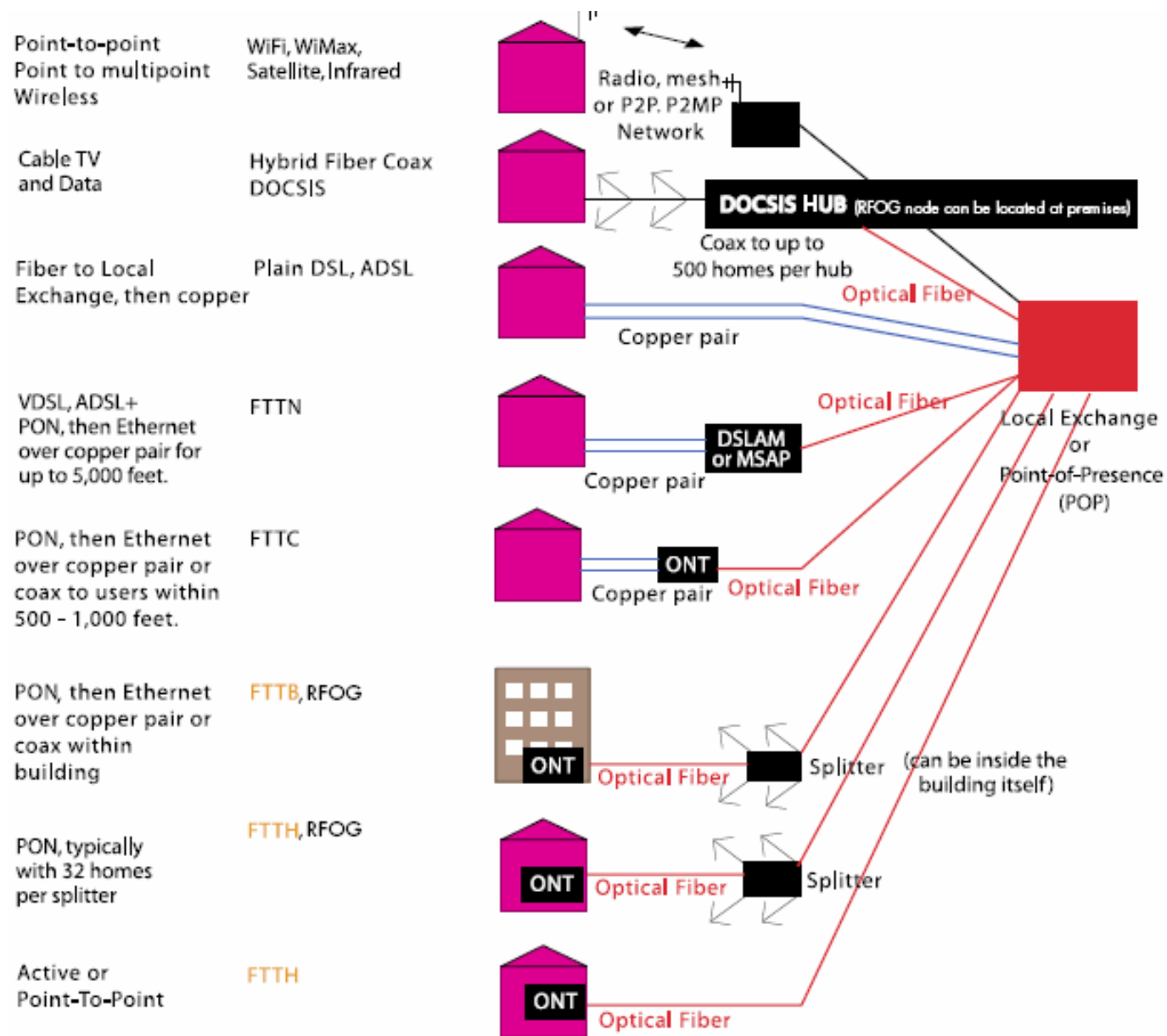
FTTx has passed the Point-of-No-Return



Source: Alcate-Lucent analysis of industry blend: iDATE, Ovum, Point Topic

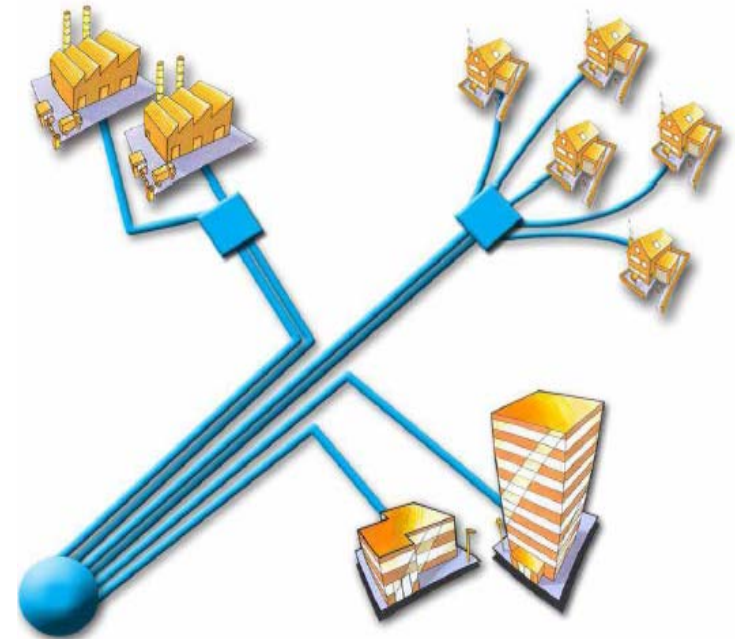
14% of broadband subscribers on FTTx end 2008

Topologies of the first mile – only FTTH pure fiber solutions are future proof



Point-to-Point FTTx topology

- A point-to-point network is a network where a dedicated fiber (or fibers) between the POP the end-user.
- Each end-user is connected by a dedicated fiber pair to the POP. This is the same design as is currently used for the PSTN.
- Alternatively, instead of a pair, a single fiber with bidirectional transmission is used with different wavelengths for the Up and down links.
- The cost of this solution grows linearly with the number of ONTs at customer premises



Point-to-Point FTTx advantages & disadvantages

Advantages

- Every user has a dedicated connection. There is no contention with other users on download or upload speeds.
- An individual connection can be upgraded by changing the lasers at both ends. If an end-user has a 100 Mbit/s connection and wants to upgrade, it is possible to change the lasers on both ends to 1 Gbit/s or 10 Gbit/s. There is even a possibility for the inclusion of WDM technologies if so desired and to add different link layer protocols.
- Ethernet is the same data link layer protocol that is used for Local Area Networks, allowing for easy integration.

Disadvantages

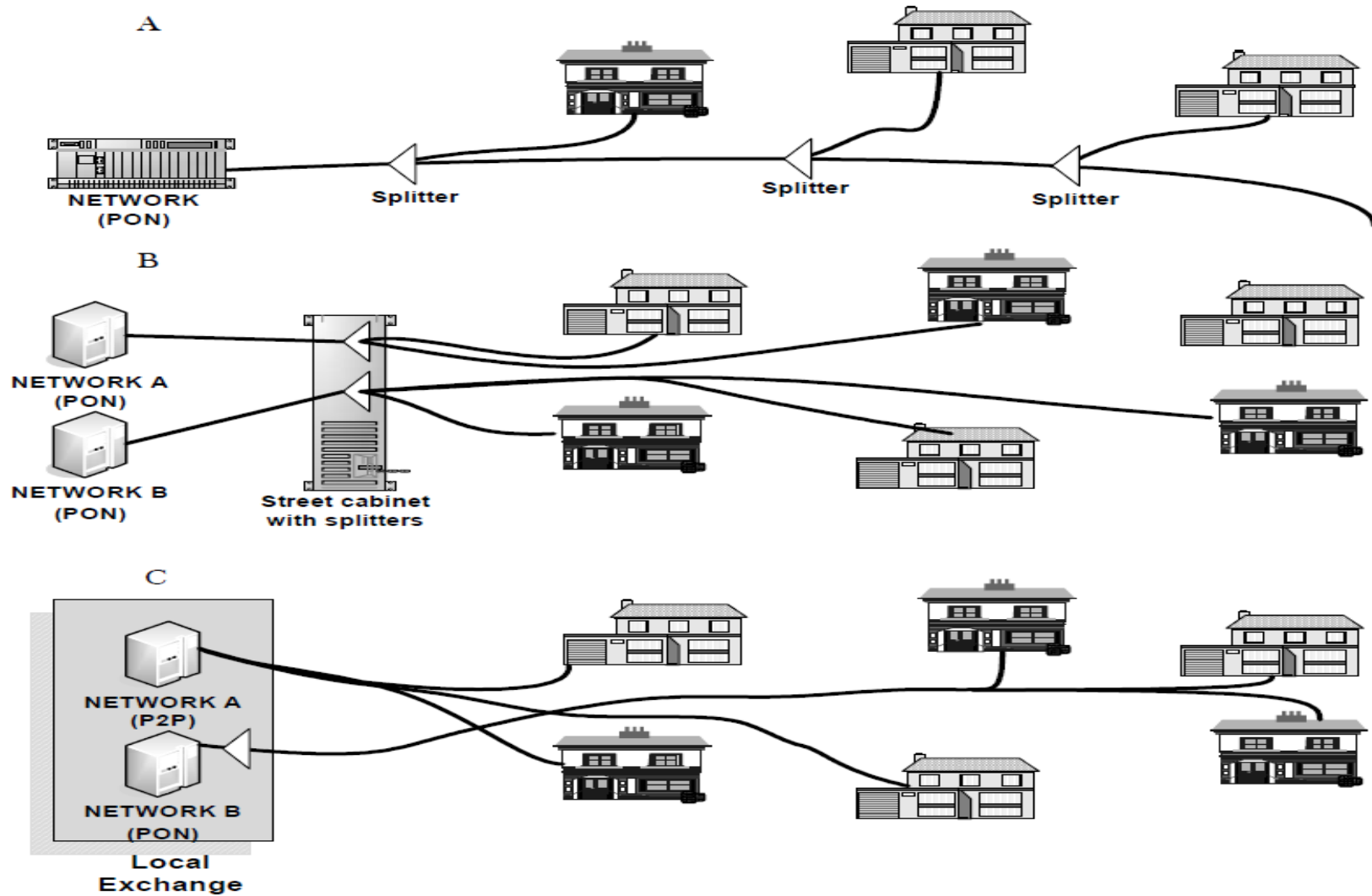
- Central offices must be equipped with a dedicated port per customer. This adds to the price for both switching locations and for switches.
- More fibers necessary for rollouts, compared to other topologies, this adds to the price of the rollout.

PON FTTx topology

- PON uses one fiber to connect multiple end users
- The main characteristic of a PON-Network is that the fiber in the network is shared by various users. The infrastructure is a shared medium, where the users need to share the available bandwidth.
- Up to 128 users can be connect off 1 PON



PON topology models



PON FTTx advantages & disadvantages

Advantages

- One optical port at the central office, allowing for cheaper transmission hardware and less maintenance.
- Smaller footprints for the central equipment than point-to-point networks.
- It is possible to split the fiber later on to add new subscribers.
- Long-distance transmissions for up to 60 km to reach up to 128 customers.

Disadvantages

- Shared bandwidth, so usage from one user can influence other users. This is known as split-ratio.
- Hard to upgrade individual end-users to higher bandwidth. Users need to be upgraded all at once.
- Central switches require more logic and encryption to integrate and separate customer streams.

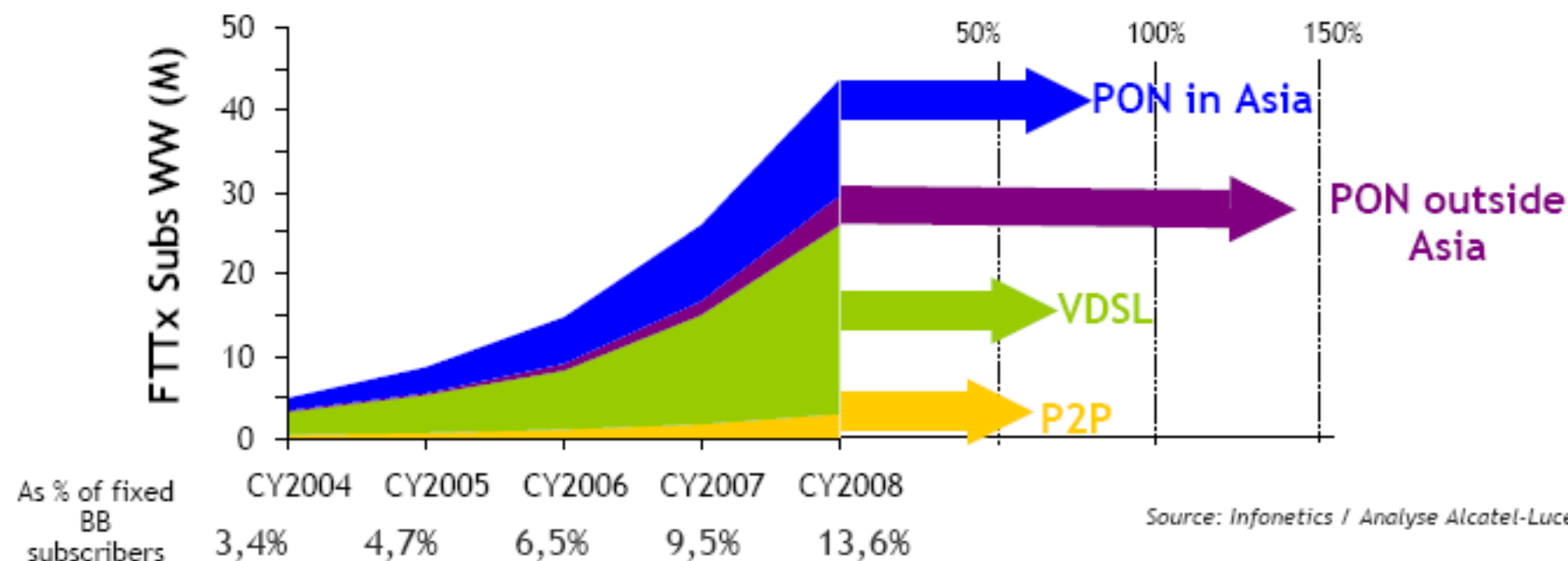
FTTx transmission technologies

PON standard	Standard used		Downstream	Upstream	SPLIT	Protocol
APON/BPON	ITU G.983	1995 & revised in 2001	622 Mbps	155 Mbps or 622 Mbps	32-64 way	ATM
GPON	ITU G.984	2004	2.5 Gbps	1.25 Gbps	64 – 128	ATM or Ethernet or GEM
10GPON/N G-PON	ITU G.984	Being tested	10 Gbps	4x1.25 Gbps	64 – 128	Constantly evolving
EPON	IEEE 802.3 ah	2004	1.25 Gbps	1.25 Gbps	Dedicated fiber (s)	Ethernet
10G-EPON	IEEE 802.3 av	Sept 2009	10 Gbps	10 Gbps	Dedicated fiber (s)	Ethernet



FTTx is translating into numbers, *PON and VDSL drives FTTx*

CAGR 2004-2008



PON in North America and EMEA showing strong size and highest growth



Reality check: GPON and P2P

Larger networks are dominated by PON

Public announcements in top BB countries

FTTN	FTTAmplifier for HFC
ePON / GPON	P2P / AE
N/A or TBD	

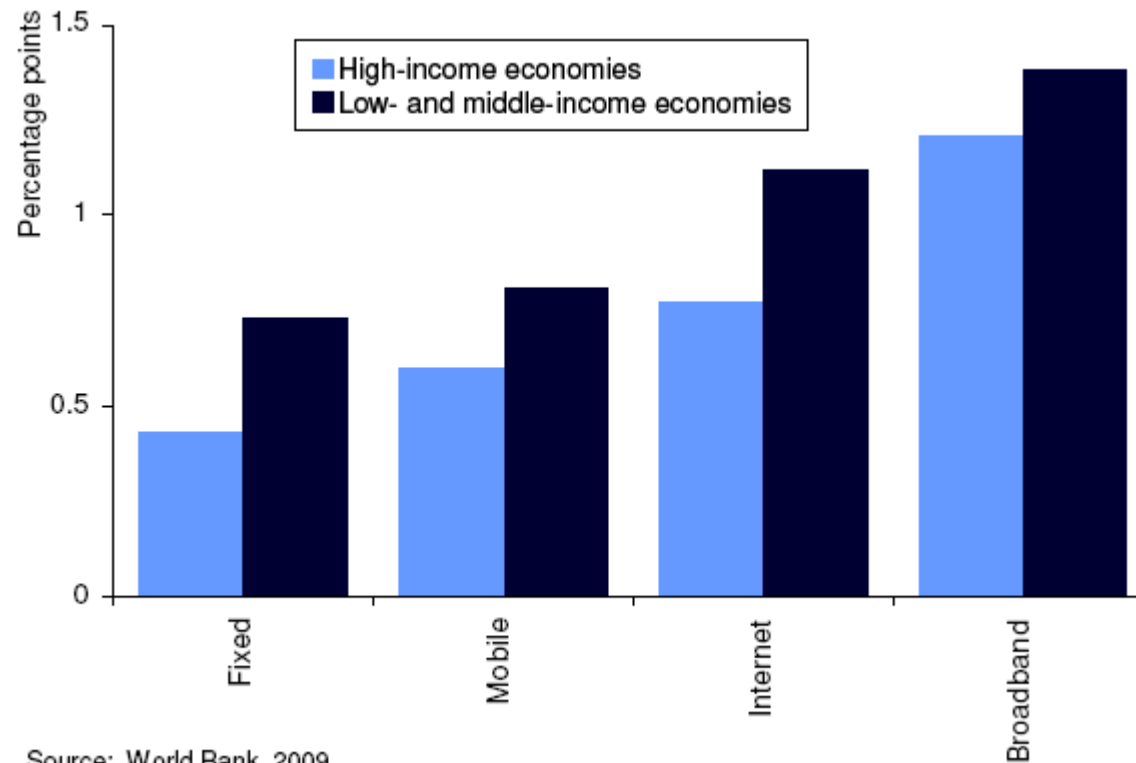
70% top national carriers with GPON

50% countries with at least two operators with GPON

GPON in volumes initially in the USA

	Incumbent	Alternative	Munis/util.
Australia			
Belgium		Cable	
China		Cable	
Denmark			
France			
Germany			
Hong Kong			
Iceland			
Ireland			
Italy			
Japan			
Korea			
New Zealand			
Norway			
Singapore			
Spain			
Sweden			
Switzerland		Cable	
The Netherlands		Cable	
UK		Cable	
USA and Canada		Cable	

Why FTTx – World Bank estimate of BB impact on GDP



GDP %growth for 10 additional broadband subscribers
out of every 100 inhabitants

Why FTTx – Progress

- ❑ The commonly held view is that high-definition IP television and improved multimedia web surfing will be the principal drivers for bandwidth.
- ❑ However, the growth in mass collaboration and social networking sites might quickly surpass the magnitude of these drivers; For example, in 2007, YouTube consumed as much Internet bandwidth as the entire Web in 2000. Netflix will be sending movies over the Internet.
- ❑ The impact of very high speed services on remote areas should not be overlooked. For instance, Web commerce, tele-working and public services such as e-care, and e-government are gaining importance for in rural locations

75% of the total mobile data traffic will be generated in user homes, offices or other buildings by 2015

Most indoor radio coverage is good enough for voice services and SMS, but not multimedia services (Web browsing, video, other downloads, emails with attachments and audio streaming)

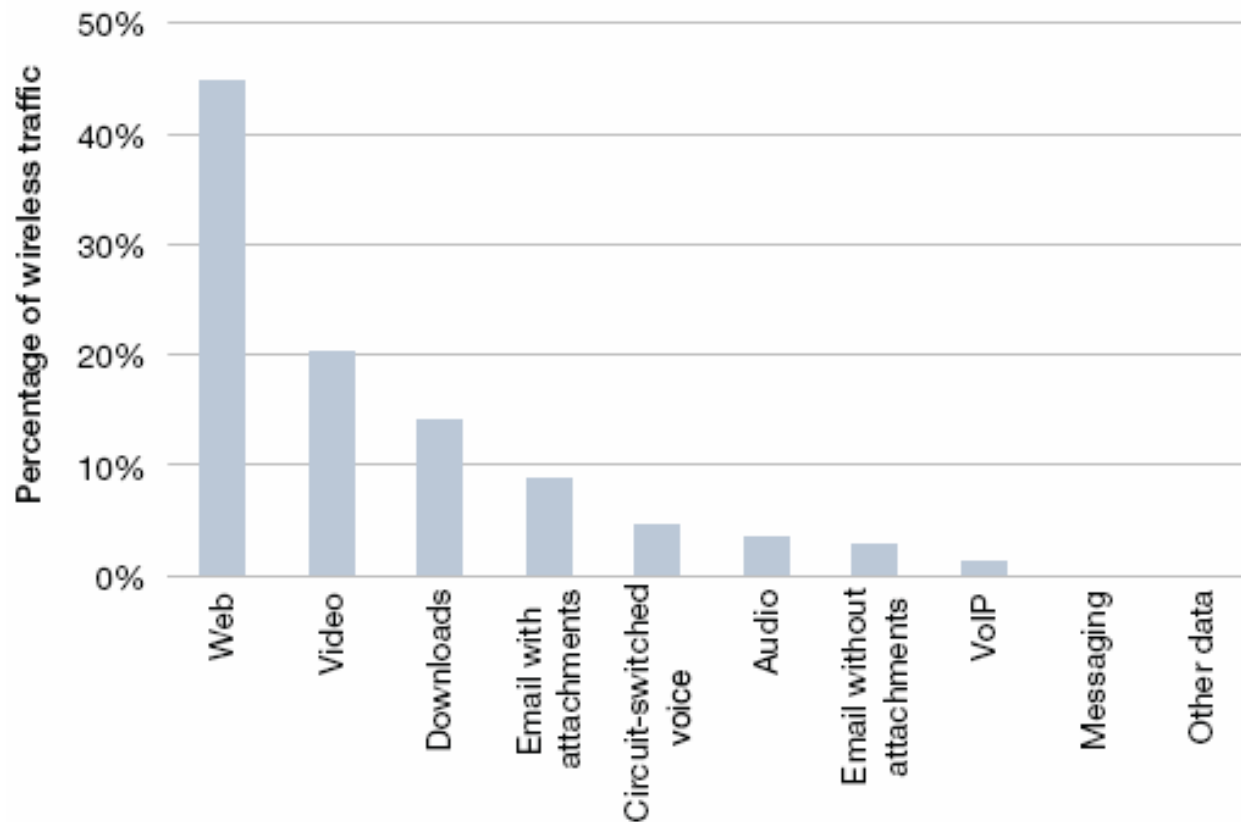
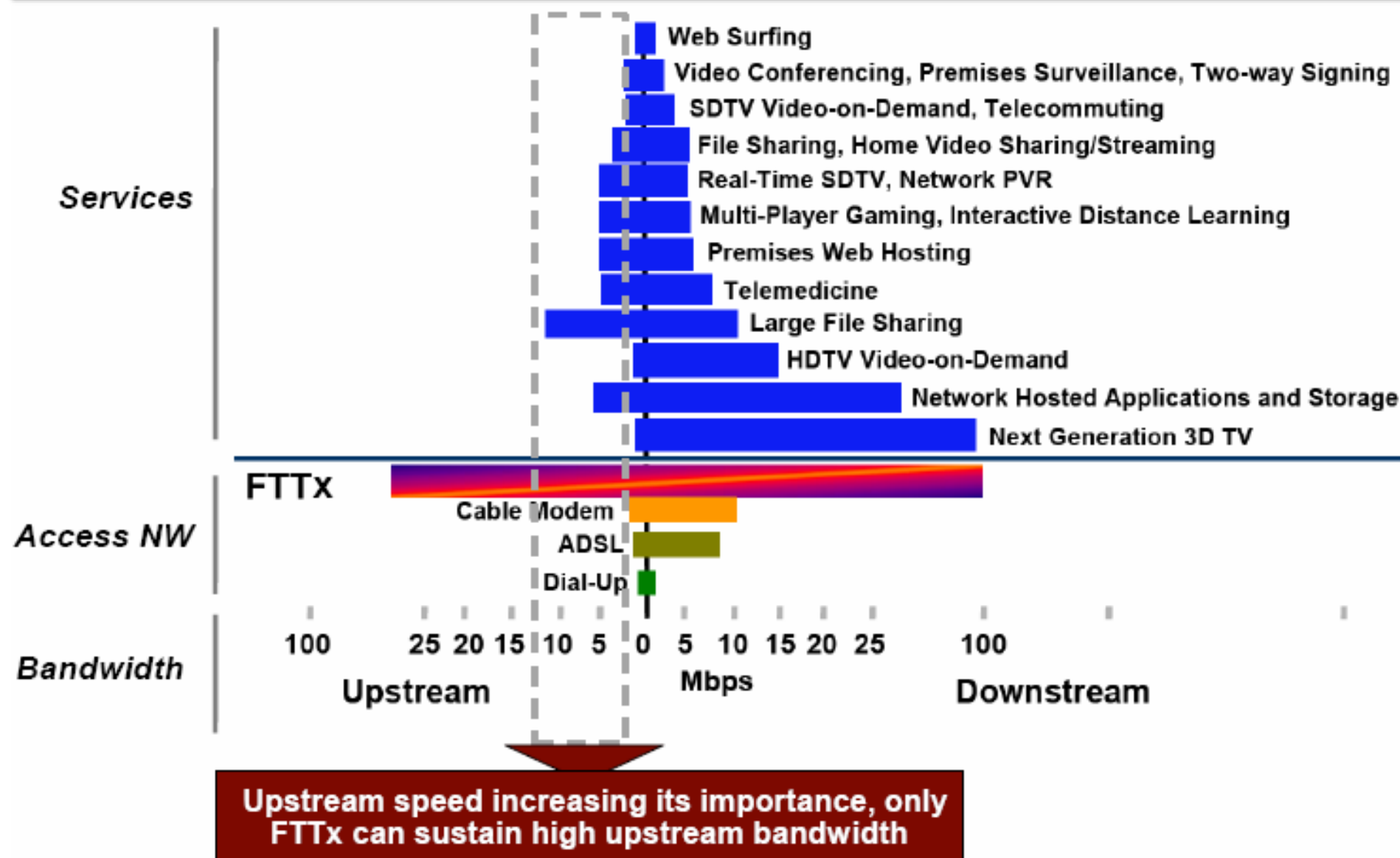


Figure 1: Downlink wireless network traffic by service type in developed regions, 2015 [Source: Analysys Mason, 2009]

Bandwidth limits will become apparent once the new advanced services will take up



FTTx cost

- ❑ If the complete capital expenditure of ADSL is represented by 1, the capital expenditure of FTTN VDSL is 4, FTTB VDSL is 9, and FTTH is 12
- ❑ **The higher capital expenditure, driven by the cost of the passive access infrastructure, corresponds to an extended time-to-market.** That's why some operators have moved quickly to adopt FTTN VDSL in order to compete with a rapidly improving broadband offering from cable operators
- ❑ **Given such variances, there is no easily transferable template for fiber success:** each operator's strategy must be carefully tailored to its local circumstances. These include: local market demographics, the extent and nature of the competition, local opportunities for cost and risk reduction, political will, as well as government and regulatory policy

US FTTH deployments averages place the cost to pass at ~\$700 per HH and cost to connect at ~\$650 per HH

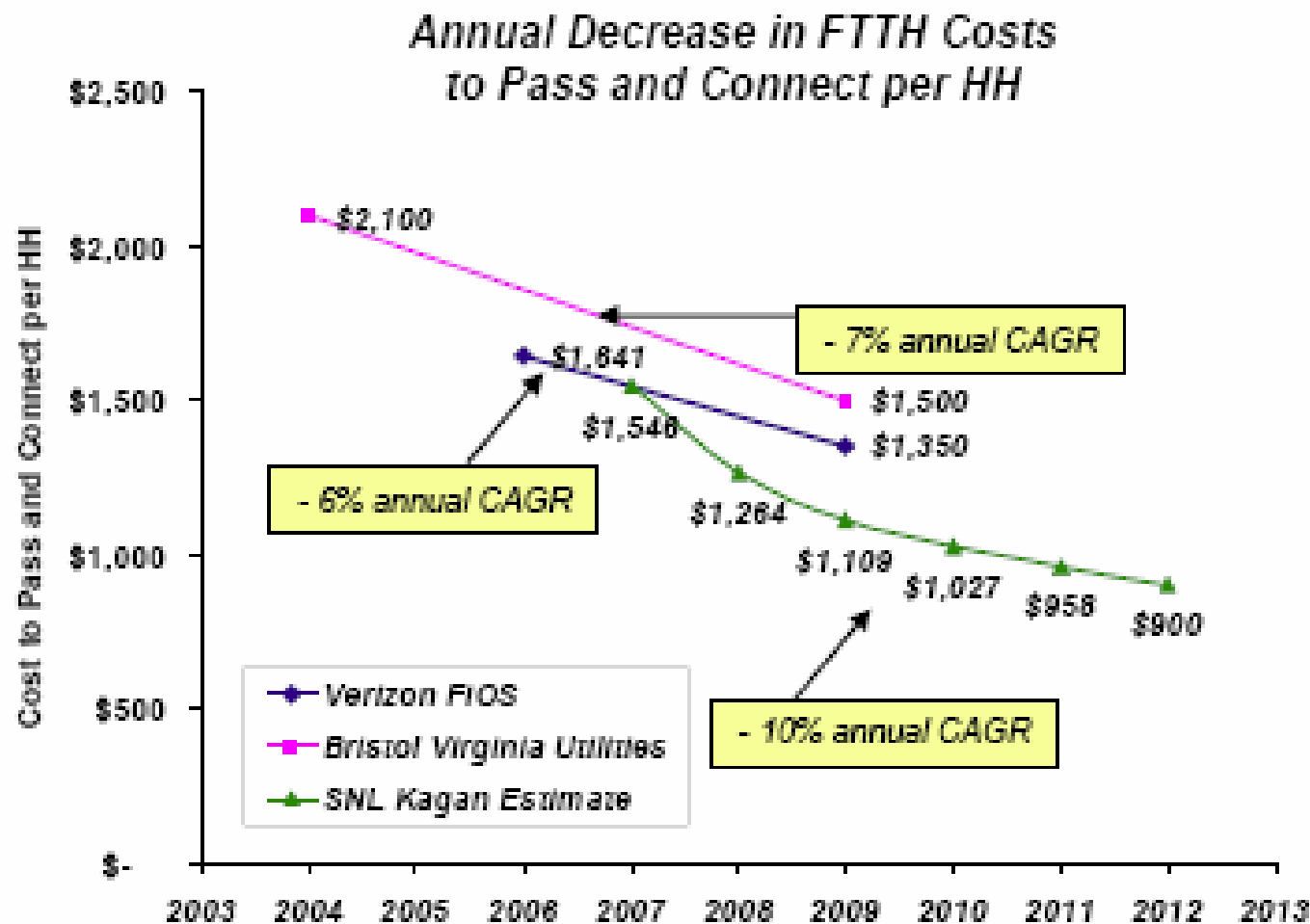
2009 Benchmarks - FTTH Cost to Pass or Connect – Urban and Suburban Builds

Carrier / Analyst Estimate	Cost to Pass per HH	Incremental Cost to Connect Per HH
Verizon FiOS	\$ 700	\$ 650
Jaguar Communications (Minnesota) ¹	\$ 474	\$ 586
Hiawatha Broadband (Minnesota) ²	\$ 800	\$ 750
Analyst Estimate - SNL Kagan	\$ 697	\$ 412
VARIATION IN COST	\$474 - \$800	\$412 - \$750

1. Jaguar Communications market - Blooming Prairie City MN (their sole urban market)

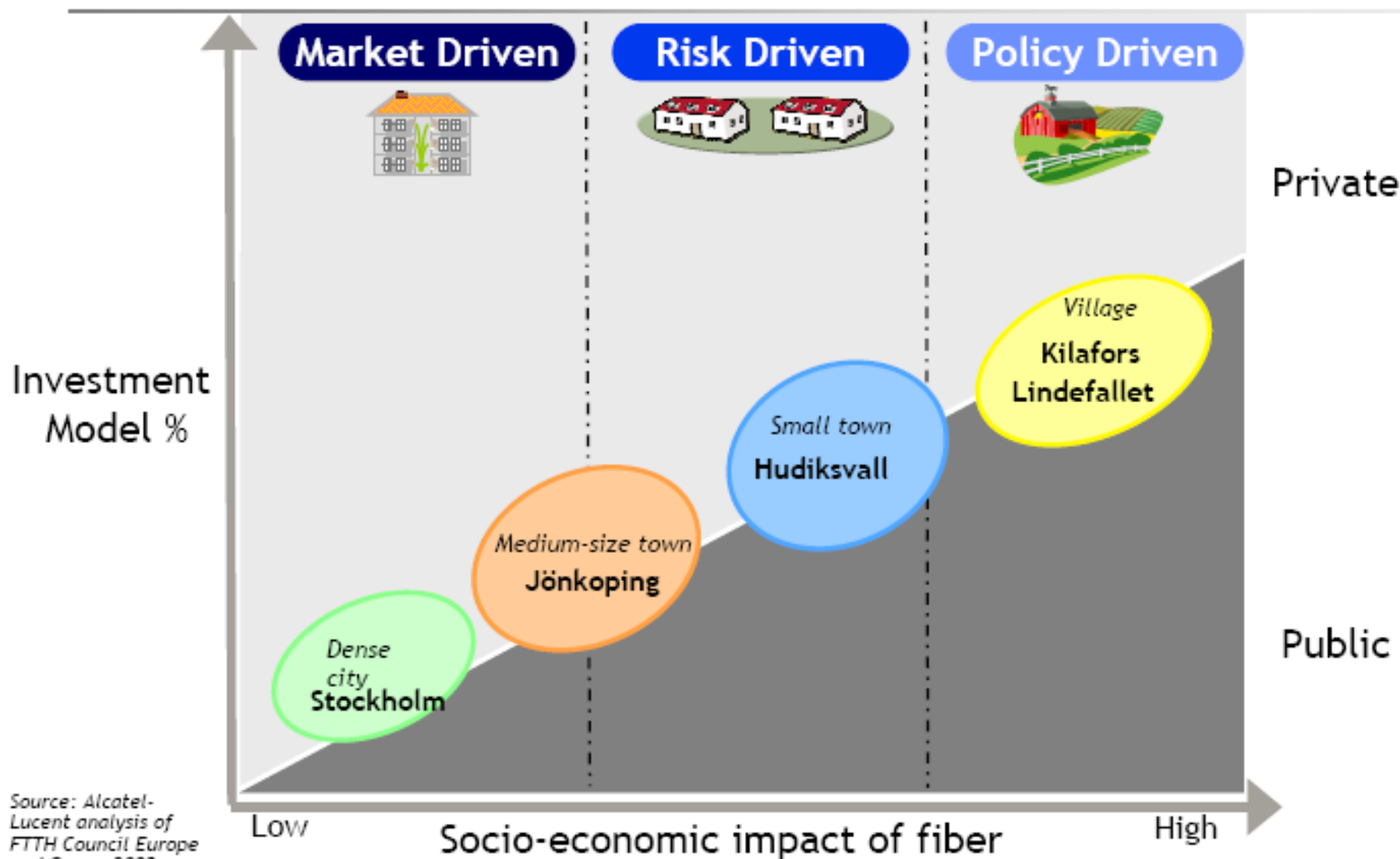
2. Hiawatha Broadband markets – Winona, Wabasha, St.Charles, Stockton, Lewiston, Rollingstone (all in MN)

Investment requirements for FTTH have decreased substantially over the past few years





Socio-economic Benefits Imply Public Investment Model Based on Geographical Segmentation

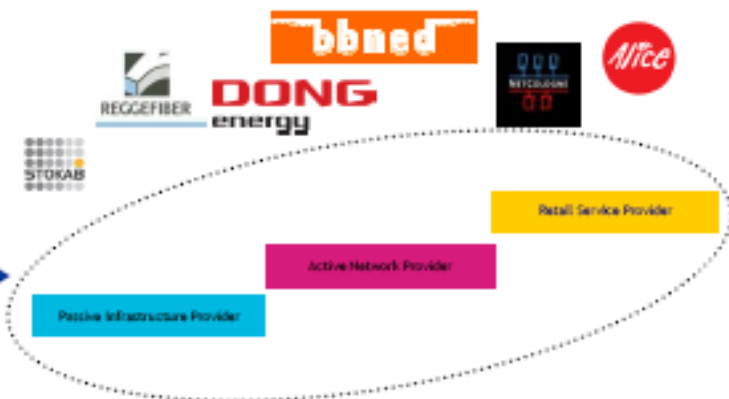
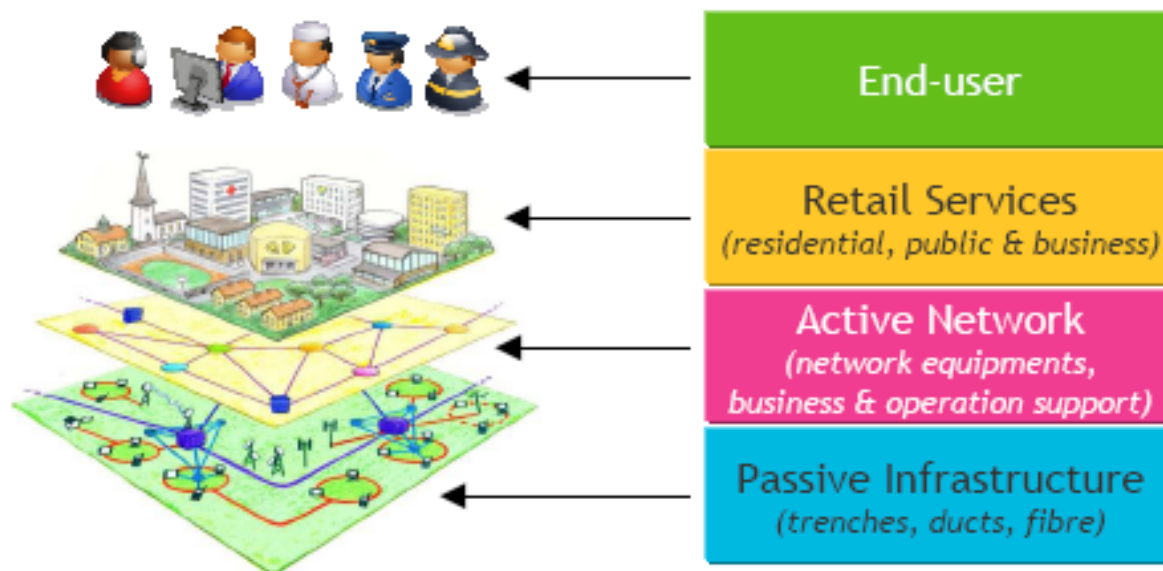


Source: Alcatel-Lucent analysis of FTTH Council Europe and Ovum, 2009



The layered business model

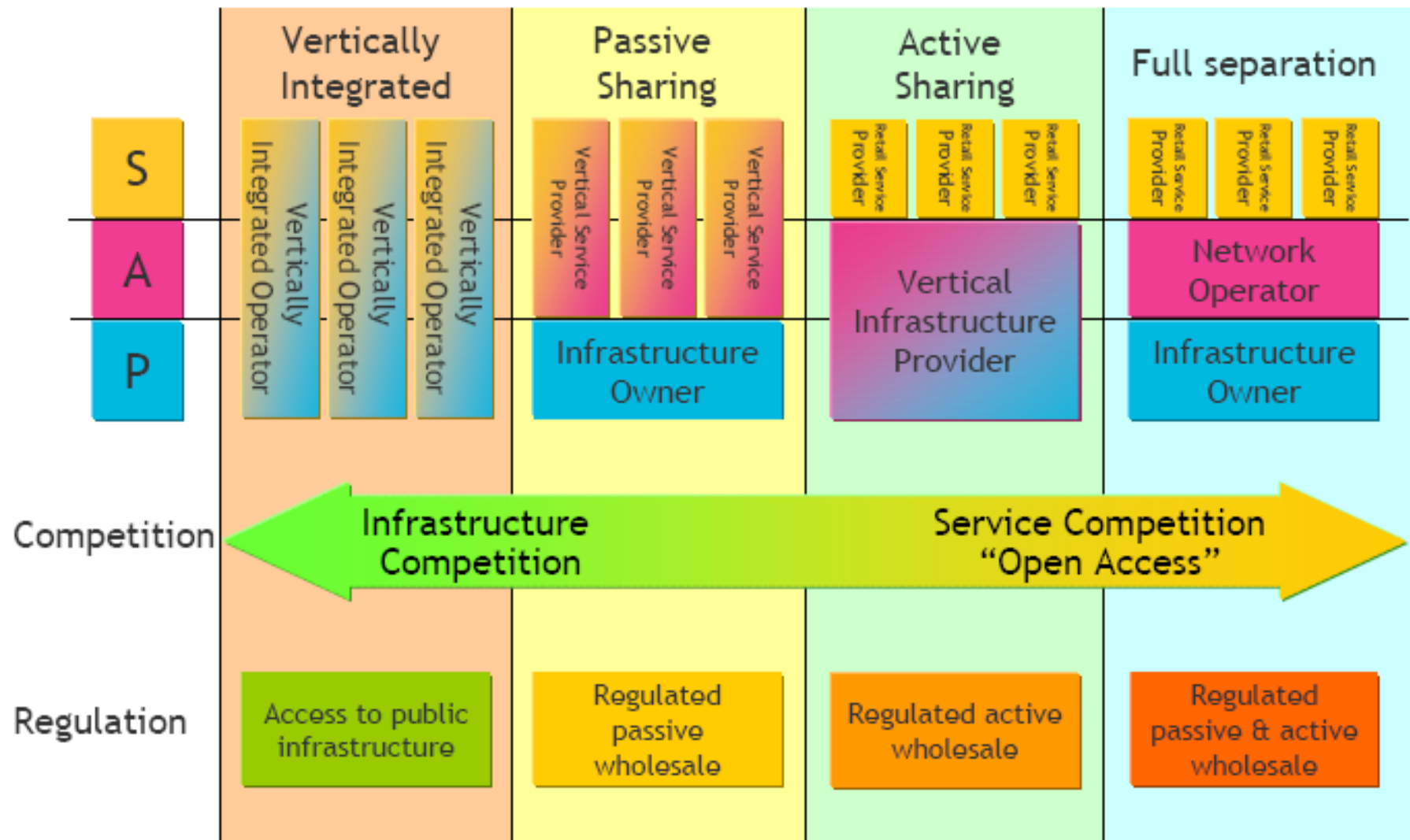
Integrated vs. separated? Public vs. private?





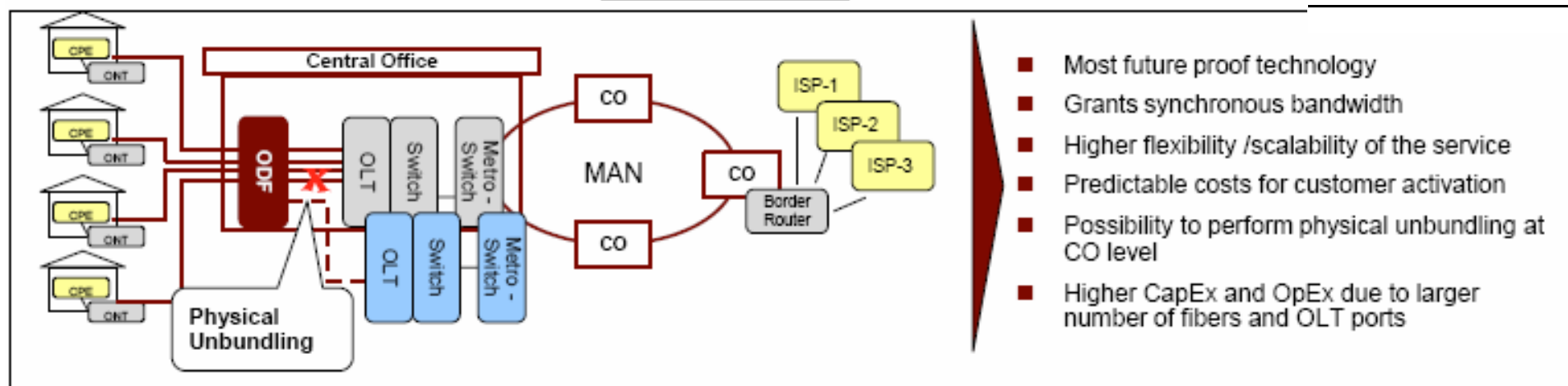
Infrastructure and service based competition

Different business models for different scenarios

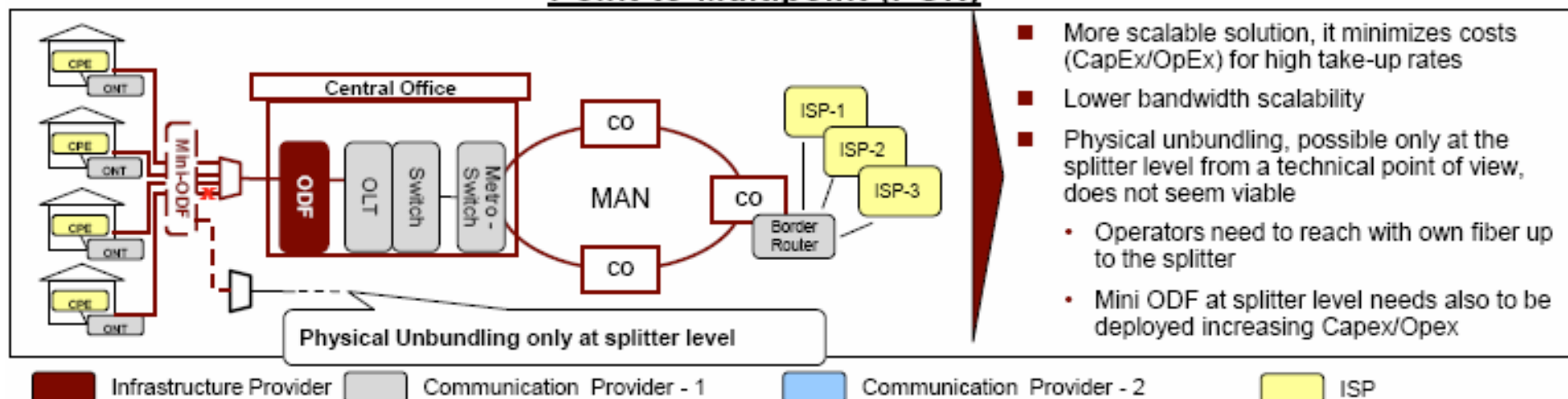


Both Point to Point and PON allow Bitstream, Point to Point makes easier potential opportunity for physical unbundling

Point-to-Point

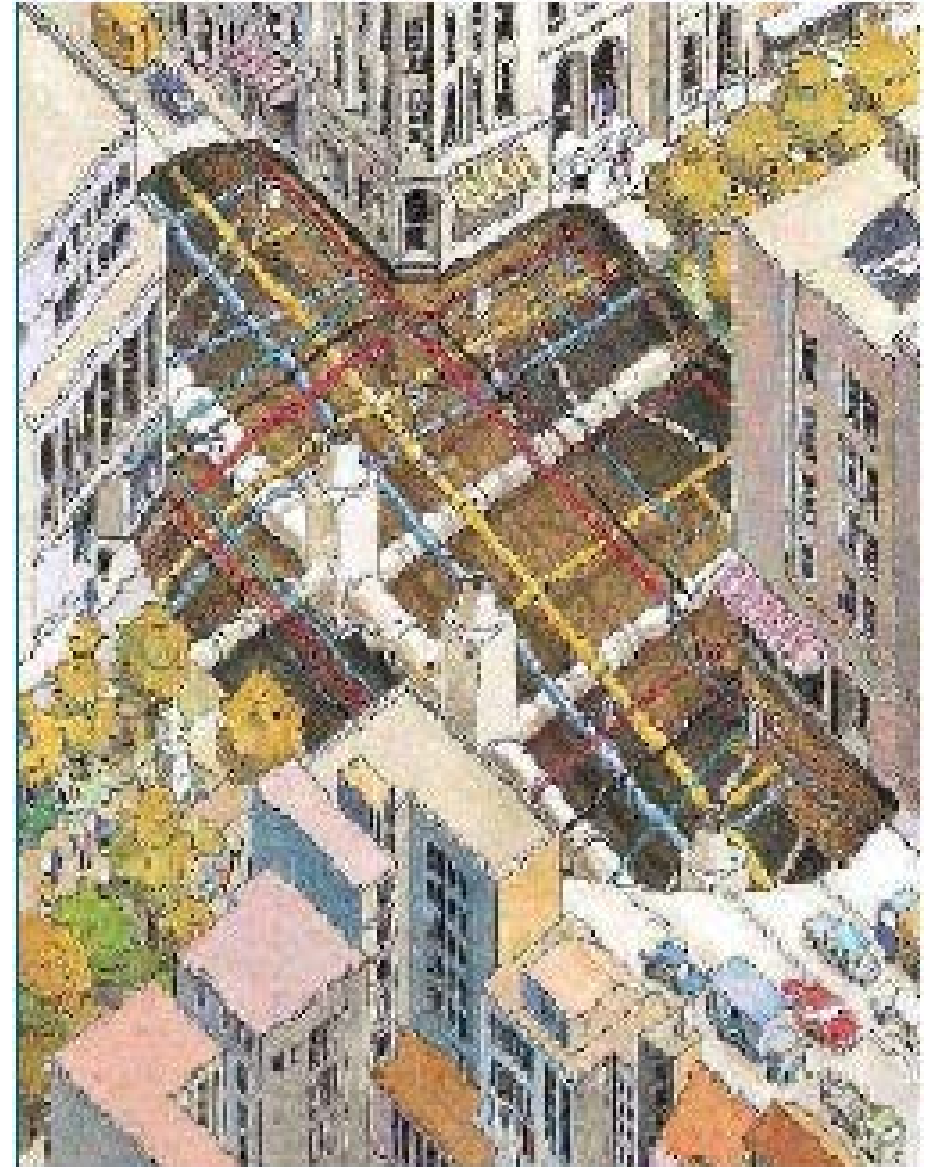


Point-to-Multipoint (PON)



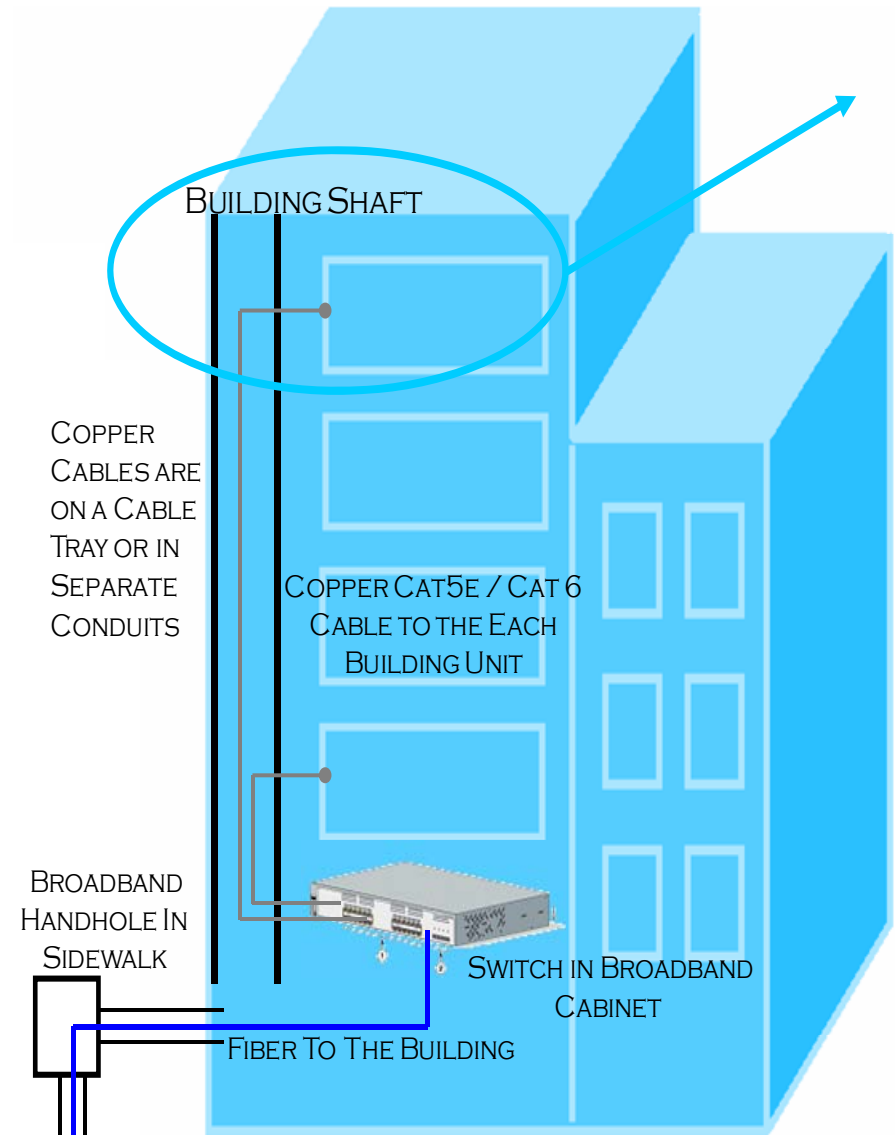
Right of Way decree for Lebanon facilitates the use of Public Properties & Utilities infrastructures by Service Providers

- **Scope:** All existing infrastructure owned by the RoL (Telecom – Fixed & Mobile, Electricity, water, Sewers, Roads, Highways, etc).
- **Purpose:** Pursuant to Telecom law 431, and in order to speed up the rollout of broadband networks, TRA drafted the RoW decree and issued it for public consultation .
- **The RoW decree** mainly sets the condition of use of the public property, clear procedures for such use, basis for allocation of charges and dispute resolution.



New building requirements for broadband service delivery

- **Entrance Facility:** 60x40x40 cm hand-hole and min. 2 conduits (90,100 or 110 mm) to the equipment room.
- **Equipment room:** 1.5m x 2m x standard height , contains the telecom cabinet (15U). Max distance 75m to any unit within the building.
- **Cable pathways:** dedicated tray or min 2 conduits/unit ($\geq 16\text{mm}$)
- **Customer premises:** min 2 RJ 45 interfaces connected by Cat5e or Cat6e from the equipment room.





Wrap-up



Who:

- 14% of BB subscribers on FTTx
- PON and VDSL2 dominating



Why:

- Socio-economic benefits underserved areas
- Geo segmentation for public investment



How:

- Prepare for competition at lowest feasible layer
- Technology neutrality:
Both P2P and PON have sweet spots,
=> let market decide