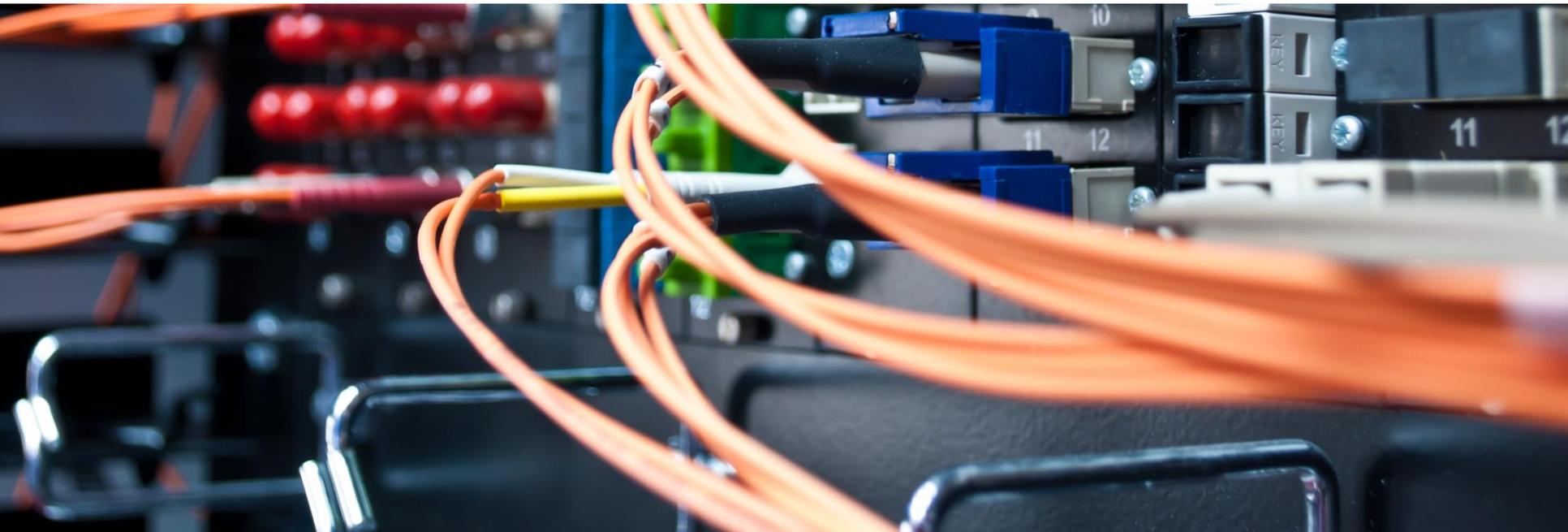# The road to NBN Training

Topic 1: NBN Fundamentals

Content

- What is Broadband? What are the usual speeds and how it compares with the narrowband data services?

- Overview of different technologies that deliver broadband

- Options for an NBN network architecture

- The different commercial models for delivering NBN services

What is Broadband?

The term "broadband" may refer to multiple aspects of the network and services, including

1. The network infrastructure or "pipes" used to deliver services to users,

2. High-speed access to the Internet, and

3. The services and applications available via broadband networks

Many countries have established their own definitions of broadband based on

*   Speed, typically in Mbit/s or (kbit/s), or

*   Functionality, that is the types of services and applications that can be used over a broadband network such as IPTV.

In this brief, 'dial-up' or 'narrowband' internet access is used to mean access speeds up to and including 128 kilobits per second (kbps).

In this brief 'broadband' is used to refer to higher bandwidth, always-on services, offering data rates of 128 kbps and above.

Ofcom

What is Superfast and Fibre Broadband?

Super-fast broadband is generally taken to mean broadband products that provide a maximum download speed that is greater than 24 Mbit/s. This threshold is commonly considered to be the maximum speed that can be supported on current generation (copper-based) networks. In could be delivered via copper VDSL (FTTC), cable or FTTH


Fibre broadband is referred to broadband products that are delivered over fibre to the home network. Speed could vary but typically is 50-100 Mbit/s or even 1 Gbp/s. If delivered over GPON technology its asymmetrical and if delivered over Ethernet is symmetrical i.e. download speed and upload speed are the same.

Why is Broadband important?
Impact on Gross Domestic Product

Due to their potentially wide-ranging impacts and ability to provide easier access to information that increases efficiencies and productivity in the economy, it is unsurprising that increased use of broadband networks and services has been found to produce positive outcome, particularly involving GDP

A frequently cited World Bank study found that low-income and middle-income countries experienced "about a 1.38 percentage point increase in GDP for each 10 percent increase in broadband penetration" between 2000 and 2006

1: Broadband Strategies handbook, Tim Kelly and Carlo Maria Rossotto
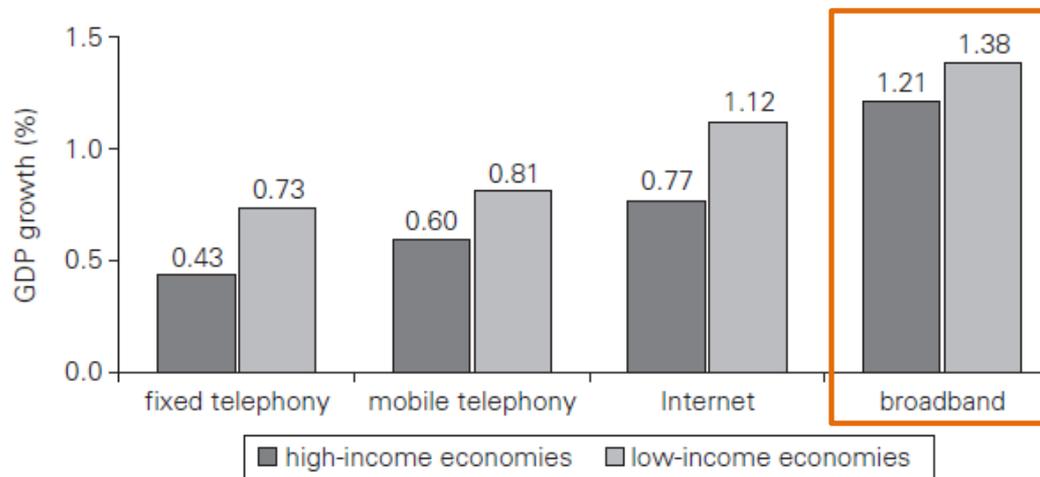
Why is Broadband important?
Impact on Job Creation

Broadband enables job creation through three main channels:

1. direct jobs created to deploy the broadband infrastructure,

2. indirect and induced jobs created from this activity, and

3. additional jobs created as a result of broadband network externalities and spillovers.

Numerous studies have estimated the impact of broadband on job creation in specific countries by calculating employment multipliers for each of these job creation categories.

While these studies are country specific and cannot be applied directly to other nations, they provide an estimate of the potential employment gains that could result from effective broadband development, which is between 2.5 and 4.0 additional jobs for each broadband job.

Study	Scope	Type I	Type II	Network effects
Crandall, Jackson, and Singer 2003	United States	—	2.17	—
Katz, Zenhäusern, and Suter 2008	Switzerland	1.40	—	—
Atkinson, Castro, and Ezell 2009	United States	—	3.60	1.17
Katz and Suter 2009	United States	1.83	3.43	—
Libenau et al. 2009	United Kingdom	—	2.76	—
Katz et al. 2009	Germany	1.45	1.93	—
Average		1.56	2.78	1.17

Broadband Strategies handbook, Tim Kelly and Carlo Maria Rossotto

Note: Type I = (direct + indirect) / direct; type II = (direct + indirect + induced) / direct; — = not available.

Benefit targets of some NBN programmes

Access to high speed broadband is linked with the economic prosperity of the country

Stimulating demand and supporting the national rollout are key initiatives and part of every national ICT plan

Main Goals

	🇸🇬	Qatar
Broadband adoption	90%	90%
ICT contribution to GDP	x2 ($26 bil)	x2 ($3 bil)
ICT jobs increase	66% (80K adds)	100% (20K adds)

Source: IDA Singapore and ictQatar

Singapore IN2015 and Qatar ICT Plan 2015

iDA SINGAPORE ⟷ n∞ Next Gen Nationwide Broadband Network
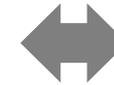
ict QATAR ⟷ Q.NBN Qatar National Broadband Network

Examples of Broadband's Effects on Economic Growth around the World

Canada

In a 2005 survey commissioned by Industry Canada in the rural areas of British Columbia, more than 80 percent of all business respondents reported that their businesses would be negatively affected if they did not have broadband access, and over 18 percent stated that they would not be able to operate their businesses without broadband.

India

A study released by Analysys Mason in December 2010 on the deployment of wireless broadband in India found that each percentage point increase in mobile broadband penetration could increase India's GDP by 0.11 percent by 2015, which would yield Rs 162 billion (US$3.8 billion).

1: Broadband Strategies handbook, Tim Kelly and Carlo Maria Rossotto

Examples of Broadband's Effects on Economic Growth around the World

South Africa

A 2010 study by Analysys Mason reviewed the likely direct and indirect effects that the broadband policy might have, finding that wireless broadband is expected to increase the country's GDP by 1.8 percent—over R 72 billion (US$9.4 billion)—by 2015.

In addition, wireless broadband is expected to create about 28,000 new jobs directly, not including jobs created outside the communications industry.

As a result, the direct effect of wireless broadband alone (that is, spending on broadband services and broadband-enabled devices) is expected to increase the GDP of South Africa by 0.71 percent by 2015, or R 28.5 billion (US$3.7 billion). However, the biggest impact on GDP is expected to come from productivity and efficiency gains.

1: Broadband Strategies handbook, Tim Kelly and Carlo Maria Rossotto

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Typical technologies for delivering broadband

1. Fixed broadband technologies: Fibre (Passive GPON and Active Ethernet), VDSL and ADSL

2. Wireless Broadband technologies: LTE, WiFi, WiMax

3. Satellite Broadband technologies
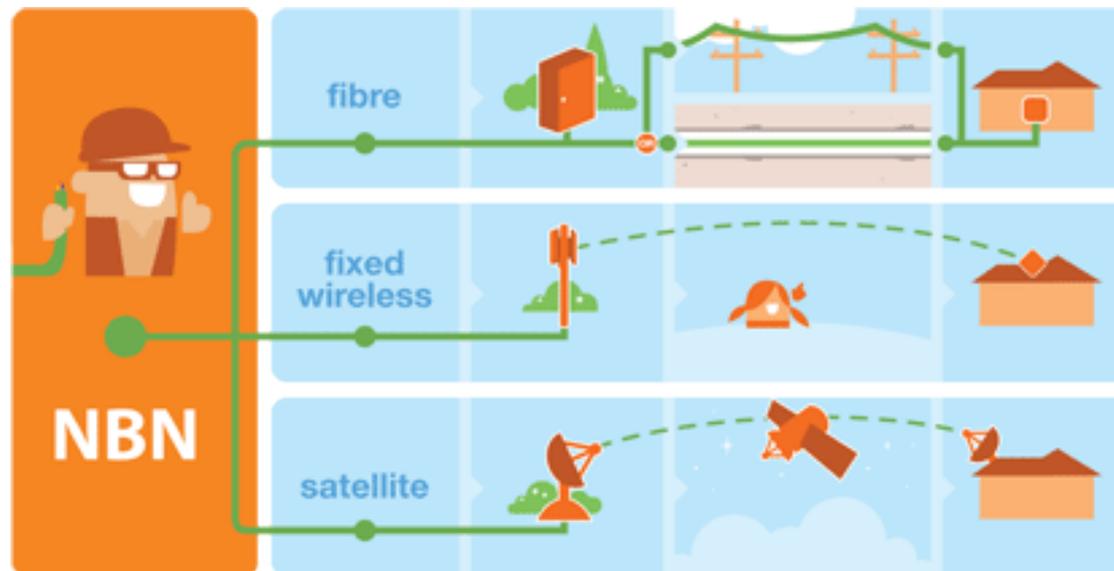
Fixed broadband technologies

Access Technology	What does it offer?		What's involved?		When does it make sense?
ADSL 2+ (up to 20 Mbps)	10 Mbps / 1-20 Mbps	ADSL is capable of download speeds of **10 Mbps** (at approx 2 km) and **up to 20 Mbps** depending on length		Primary node cabinet	
VDSL2 (up to 40 Mbps)	20 Mbps / 40 Mbps	Capable of delivering average download speeds of **20 Mbps** (at approx 1.5 km) and **up to 40 Mbps** depending on copper length		Secondary node – reuse of last mile	Medium time payback for medium term asset life
FTTH (GPON) (up to 100 Mbps)	100 Mbps	GPON with **up to 100Mbps or even 1 Gbps**		Replacement of last mile – Major disruption	Long time payback for long term "unbeatable" asset
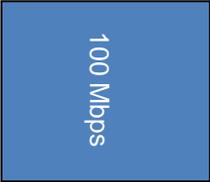
Superfast Broadband

Wireless broadband technologies

Mobile broadband
Providing seamless mobility and delivered directly to the end device such as phone or a tablet

Fixed Wireless broadband
Delivering fixed replacement broadband to the home via wireless means. Used for remote areas.
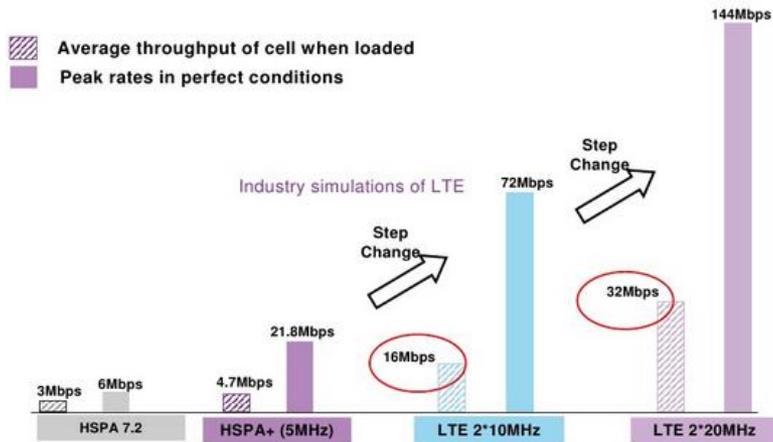
Source: Vodafone
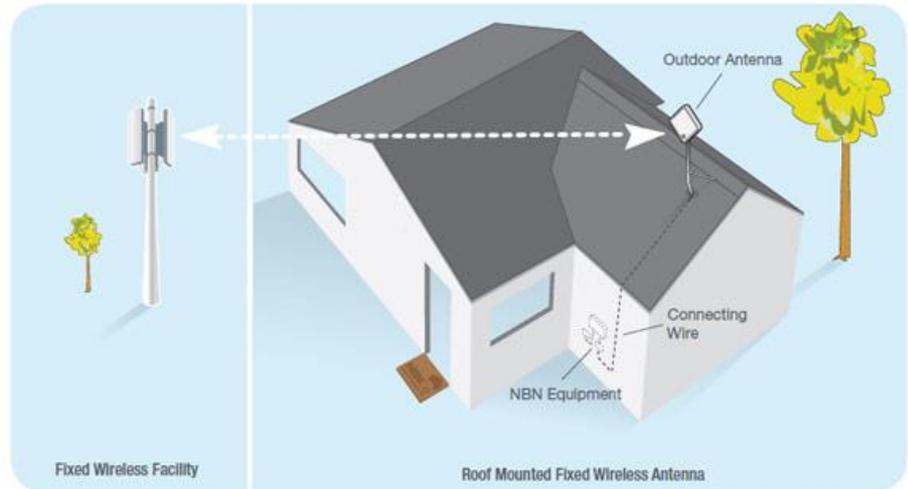
Mobile broadband is becoming more popular

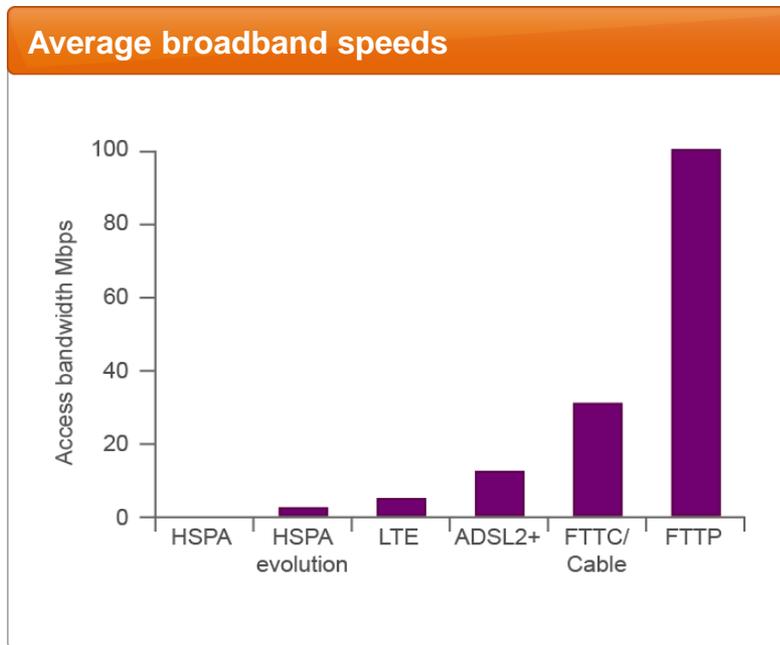Figure 2: Mobile Broadband Bridges the Gap: Fixed Broadband and Mobile Subscriptions, 2009-2018
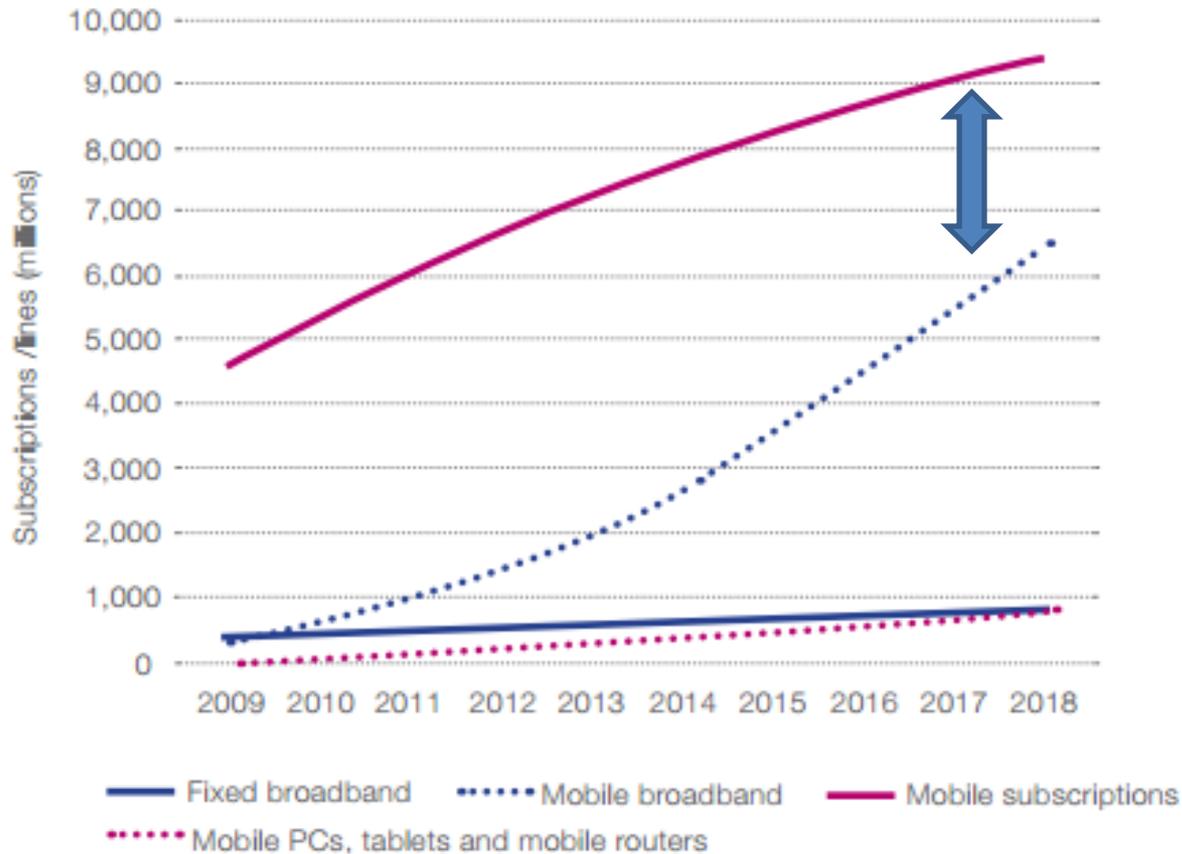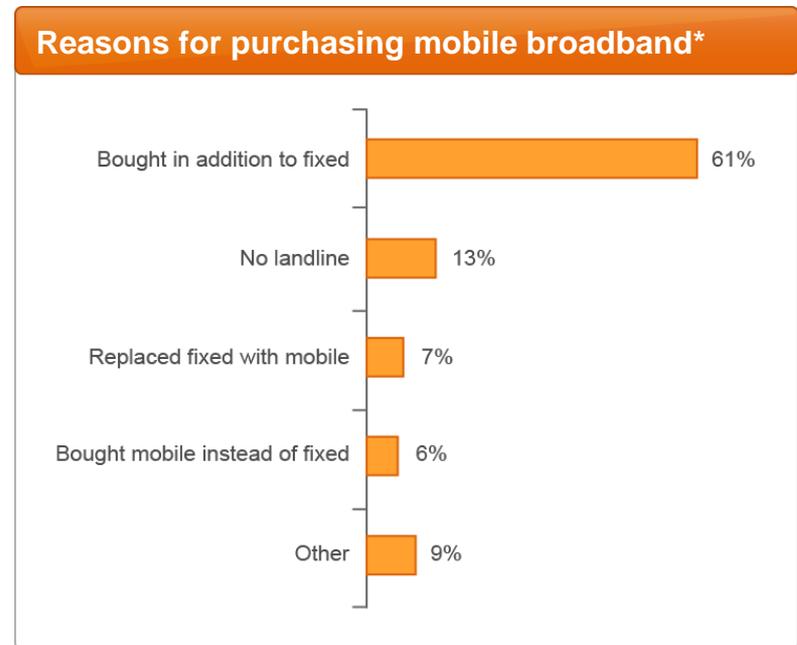
Source: Ericsson Mobility Report, June 2013

Mobile broadband complementary to fixed

Fixed broadband is the performance leader

Average broadband speeds

Source: Ofcom "UK Broadband Speeds 2009". Motorola publication "Realistic LTE Performance – From Peak to Subscriber Experience" Aug 2009. BT FTTP product definition

Mobile broadband will be largely complementary and not a substitute for fixed broadband

Reasons for purchasing mobile broadband*

- Bought in addition to fixed — 61%
- No landline — 13%
- Replaced fixed with mobile — 7%
- Bought mobile instead of fixed — 6%
- Other — 9%

Source: YouGov Dongle Tracker, October 2009. "Which of the following statements best describes why you purchased a dongle, modem stick, or datacard to connect to a mobile phone network?"

Satellite broadband

End User Premises — NBNCo Network

End User device · Customer Equipment · Outdoor Unit · UNI (User Network Interface) · Modem · Satellite · Satellite Gateway Facility · INTERNET
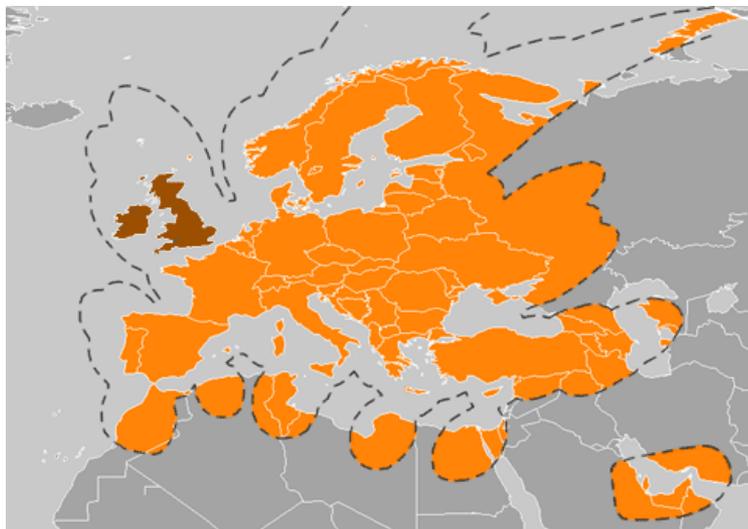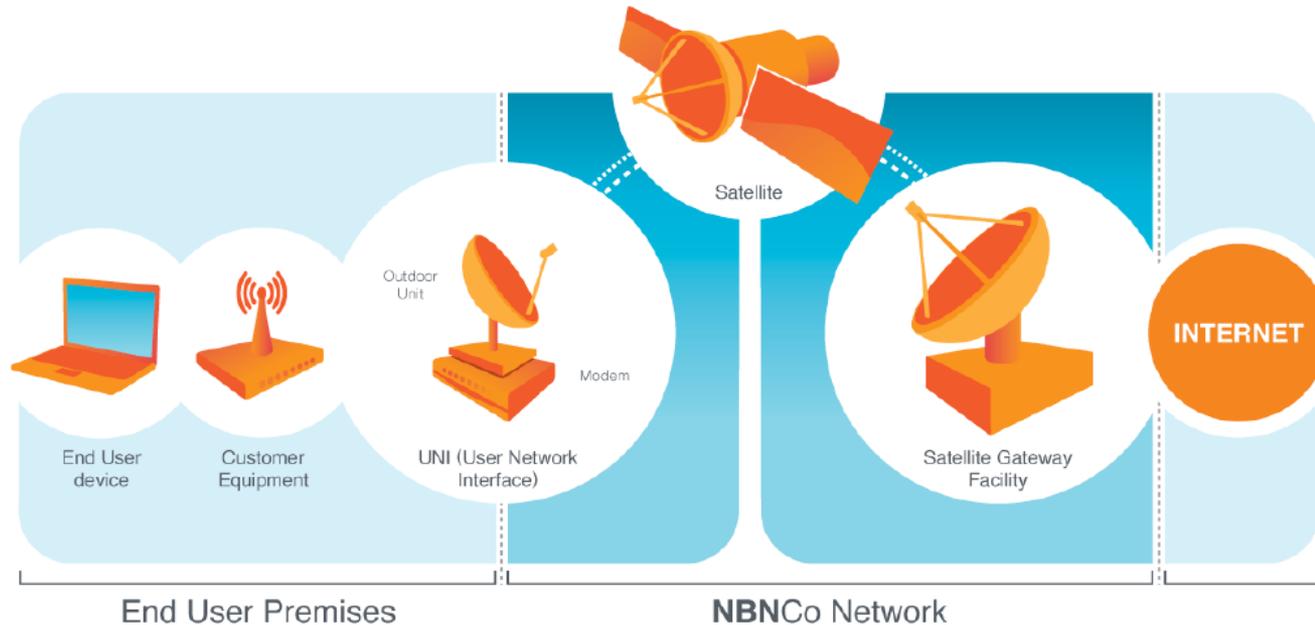
Ka band

Ka band satellite is the most common used for internet services. Some existing satellites provide coverage over Oman
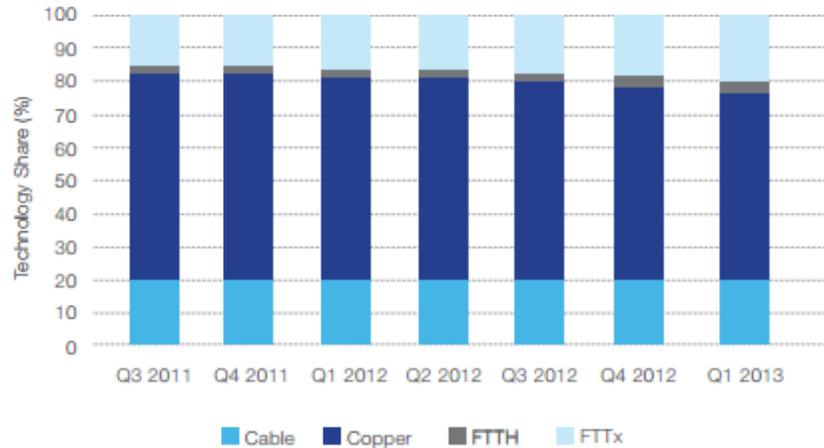
NBN CO example

NBN Co is planning to launch two Ka band satellites by 2015, each offering 80 Gbps of bandwidth, compared to four to six Gbps per second capacity available from current satellites servicing Australia. Speed is 6 Mbps per household.

Split between the technologies

Broadband Market Share by technology, 2011-2013

Broadband Market Share by technology, Q1 2013

Figure 8: Global Fixed Broadband Market Share by Technology, 2011-2013
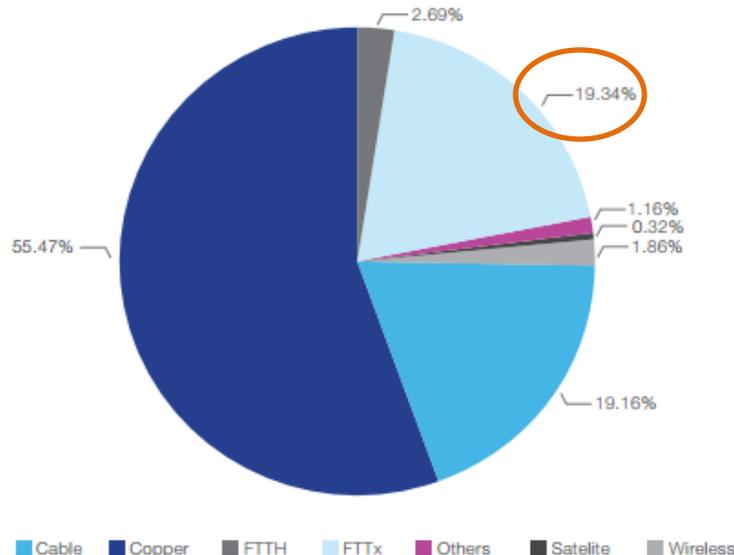
It is interesting to note that in countries where FTTH might not be affordable by the incumbent, FTTC programmes are becoming popular.

Generally FTTC is seen as an upgrade path between traditional copper ADSL and FTTH technology

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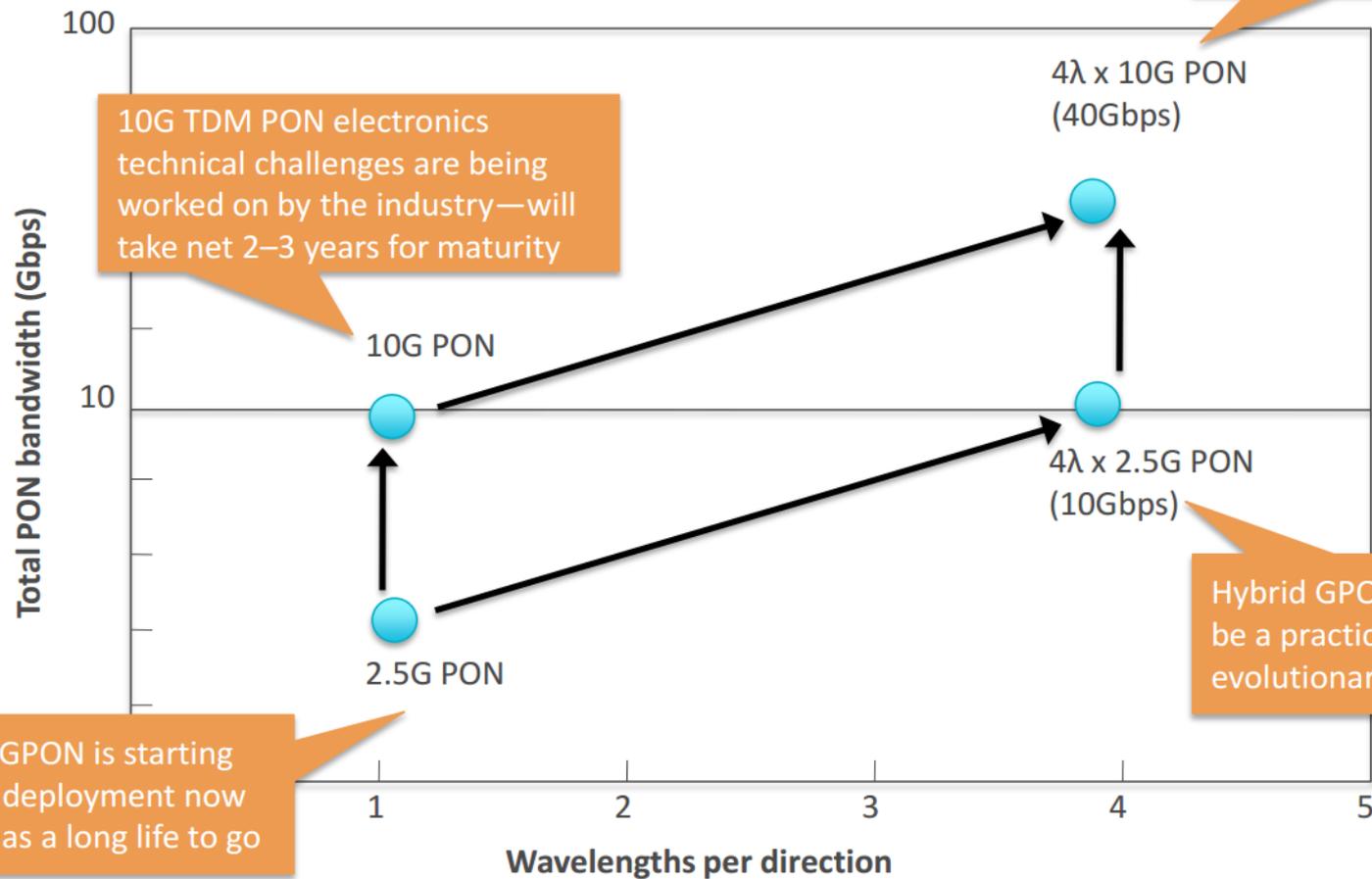- The different commercial models for delivering NBN services

FTTH network design

FTTH network design - Australia

Fibre Serving Area – Indicative Access Infrastructure
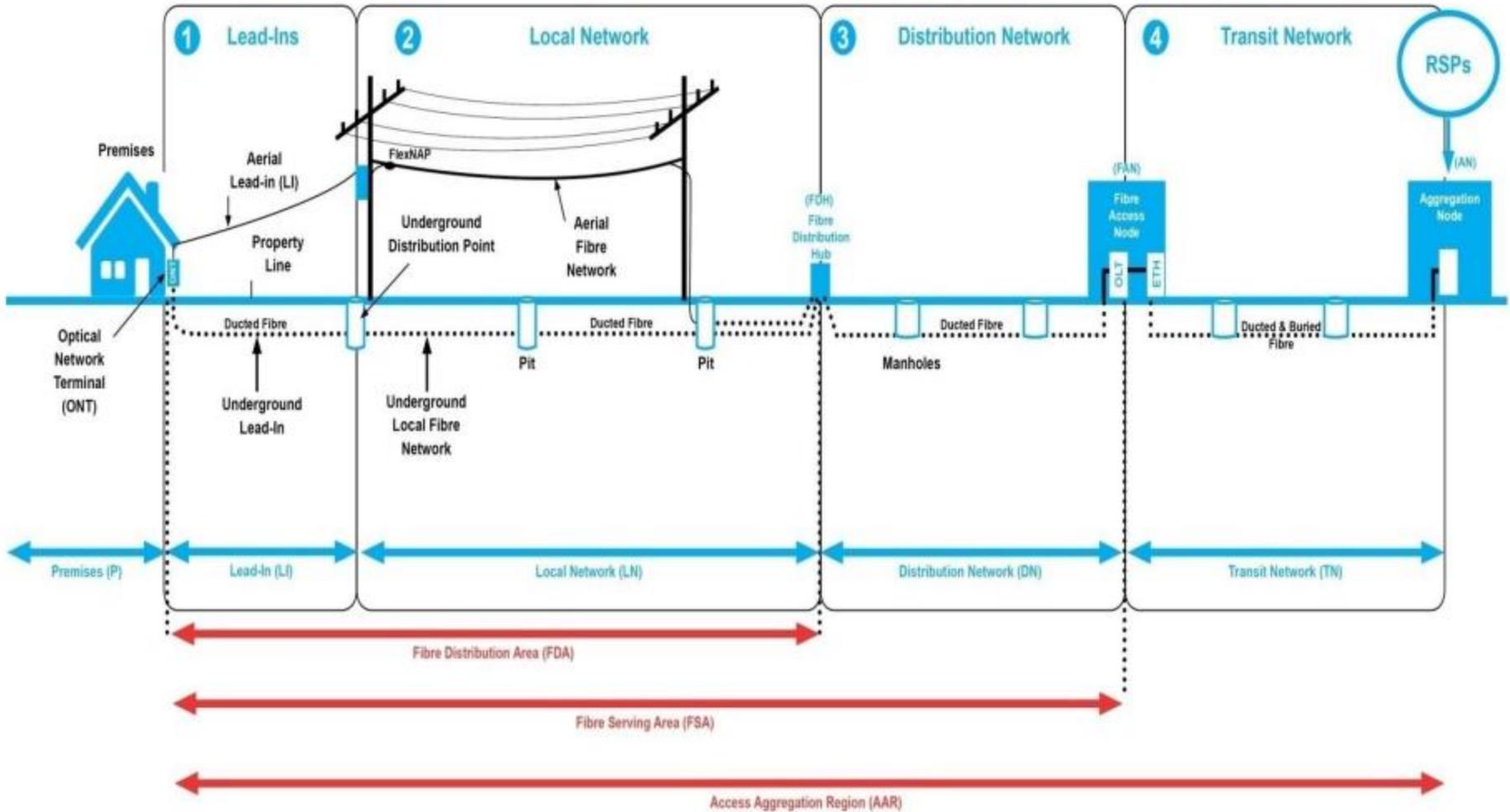
Gigabit Passive Optical Network (GPON) architecture
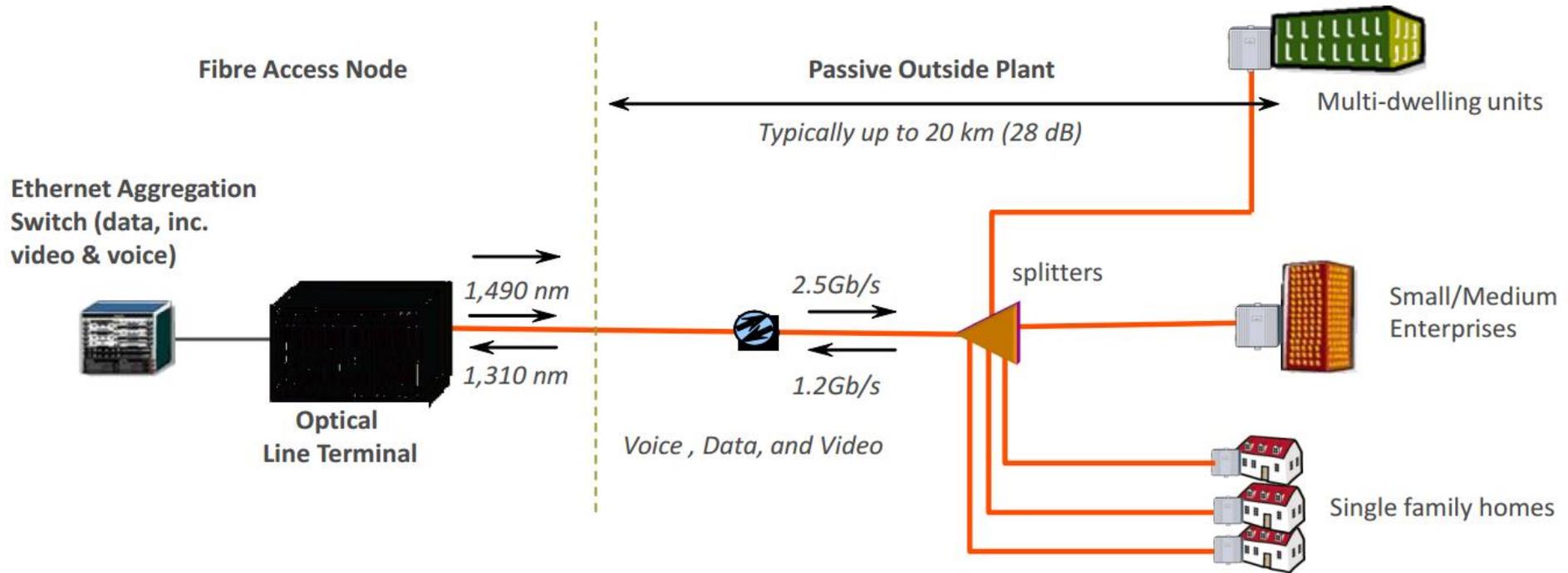
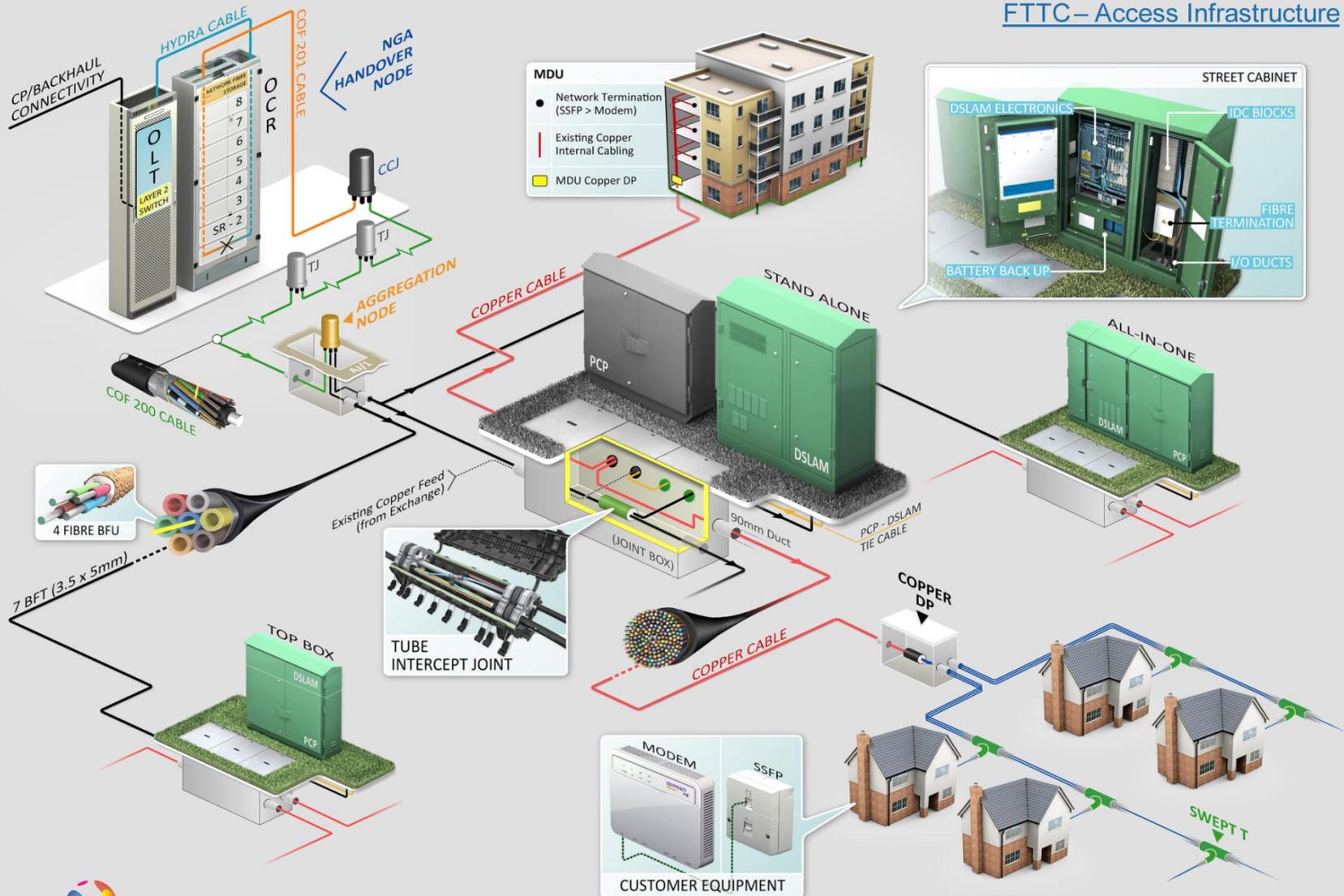# Passive Optical Network (PON) - Technology advances

No fork-lift upgrade for 10G GPON

Wavelength overlay in both uplink and downlink
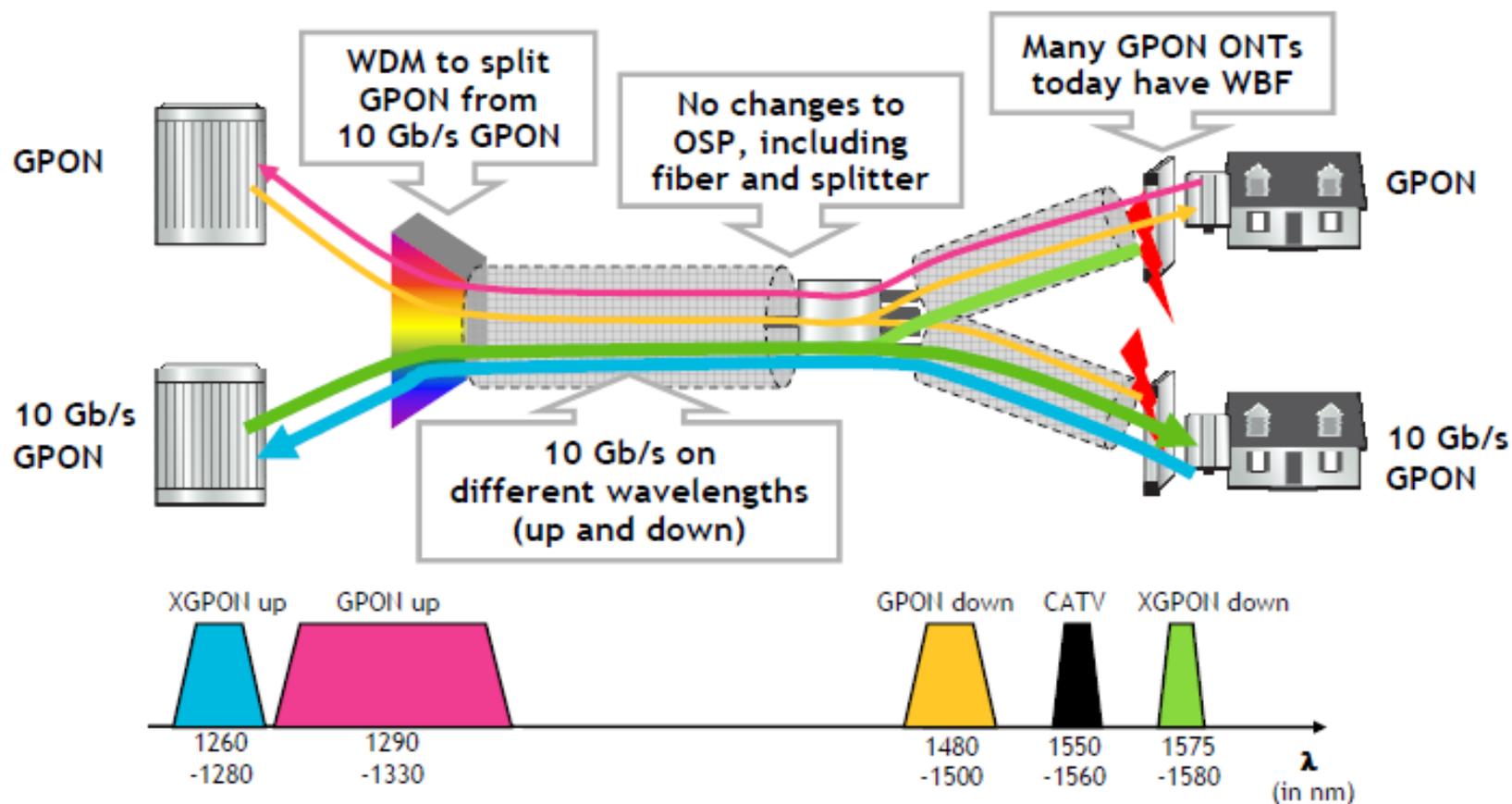
No stranded investments: GPON OLT, ONT and OSP can be reused

FTTC – Access Infrastructure

FTTC Access Infrastructure (version 2.0)

Fixed Wireless Broadband

Fixed Wireless Facility

Roof Mounted Fixed Wireless Antenna

Outdoor Antenna

Connecting Wire

NBN Equipment
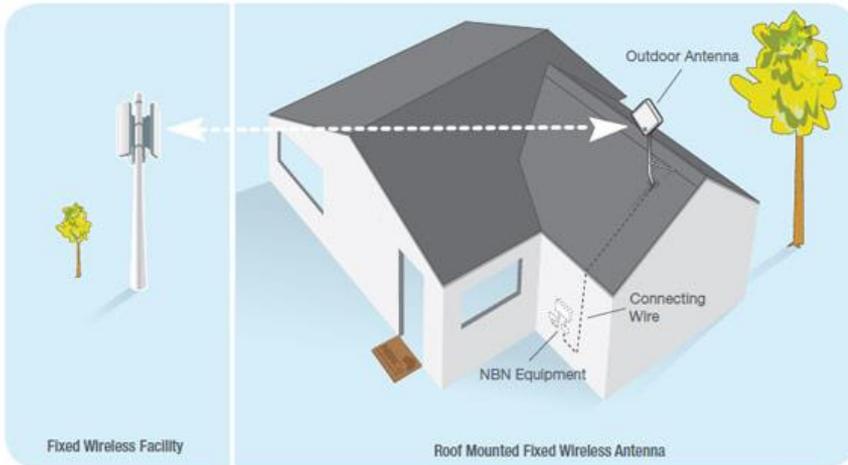
NBN Co example

NBN Co will deploy a 4G Long Term Evolution fixed wireless network covering approximately 4 per cent of the population outside the fibre footprint.

Outdoor Antenna

450mm

NBNCo

Outside your premises ◀ ▶ Inside your premises

220mm

Network Termination Device

127mm

Wall Outlet
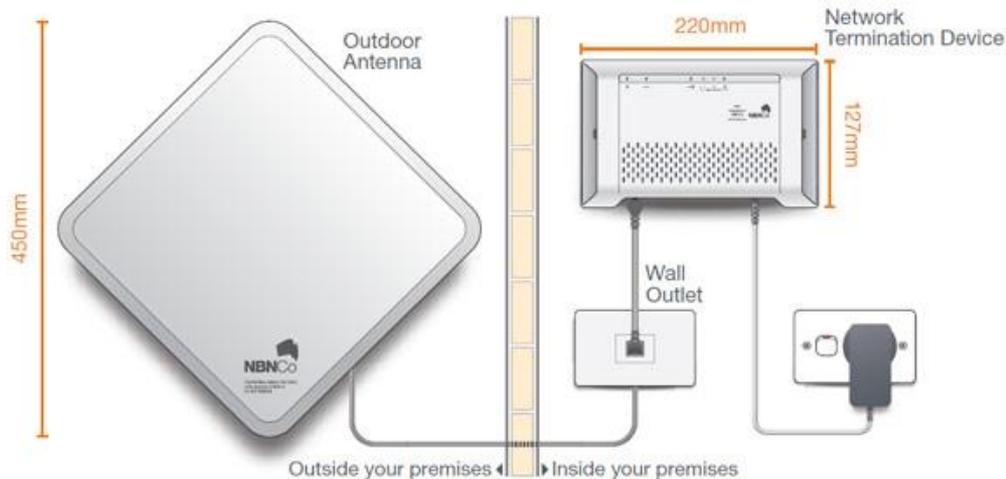
The premises in the fixed wireless footprint will be hooked up to an antenna allowing a connection to a wireless base station; the base station links via a backhaul. Unlike the mobile networks, only premises can connect to the NBN's fixed wireless network

Speed of 12 Mbps with upgrade to 24 Mbps is available.

Best fit technology per geotype

Passive GPON deployment is best suited for sparse and SDU housing scenarios

**Active Ethernet deployment with CAT5/6 cabling is best suited for denser MDU**

Technologies such as long reach GPON or repeated signal technology might need to be used

GPON vs Active Ethernet

| FTTH technology	PROS	CONS
GPON	• Passive technology so no active equipment or power requirements • Lower cost of deployment • Low OPEX • Good scalability	• Asymmetric bandwidth • Shared fibre medium with contention ratio at the splitter
Active Ethernet	• Symmetric bandwidth provision is more aligned with future user requirements • Familiar LAN based technology • Better support for open access network as separate fibre per user	• Higher cost of deployment • Active elements in street cabinets need power feed and airconditioning • Higher OPEX spend • Less scalable

Source: Salience

Extending the reach of GPON
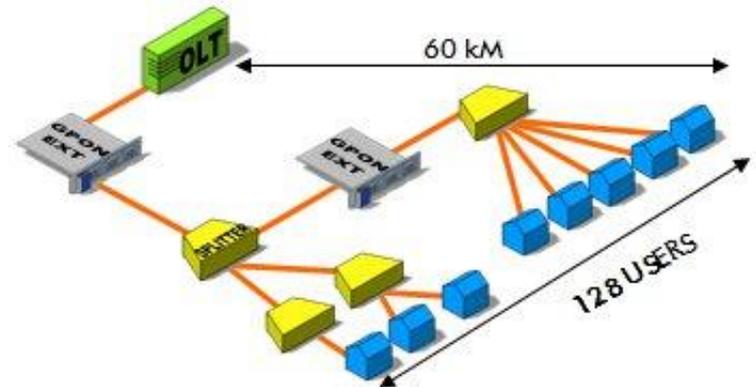
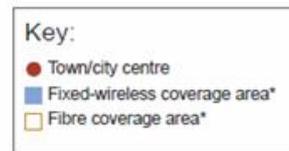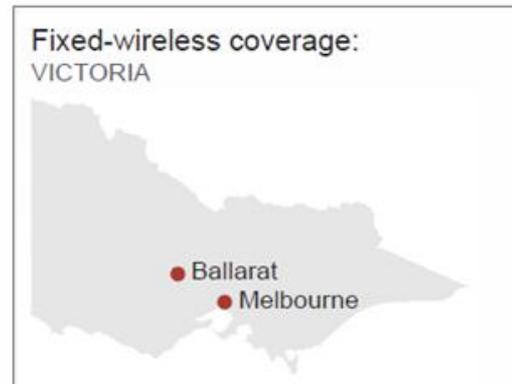Source: Telnet

Co existence FTTH and FTTC – STC Saudi
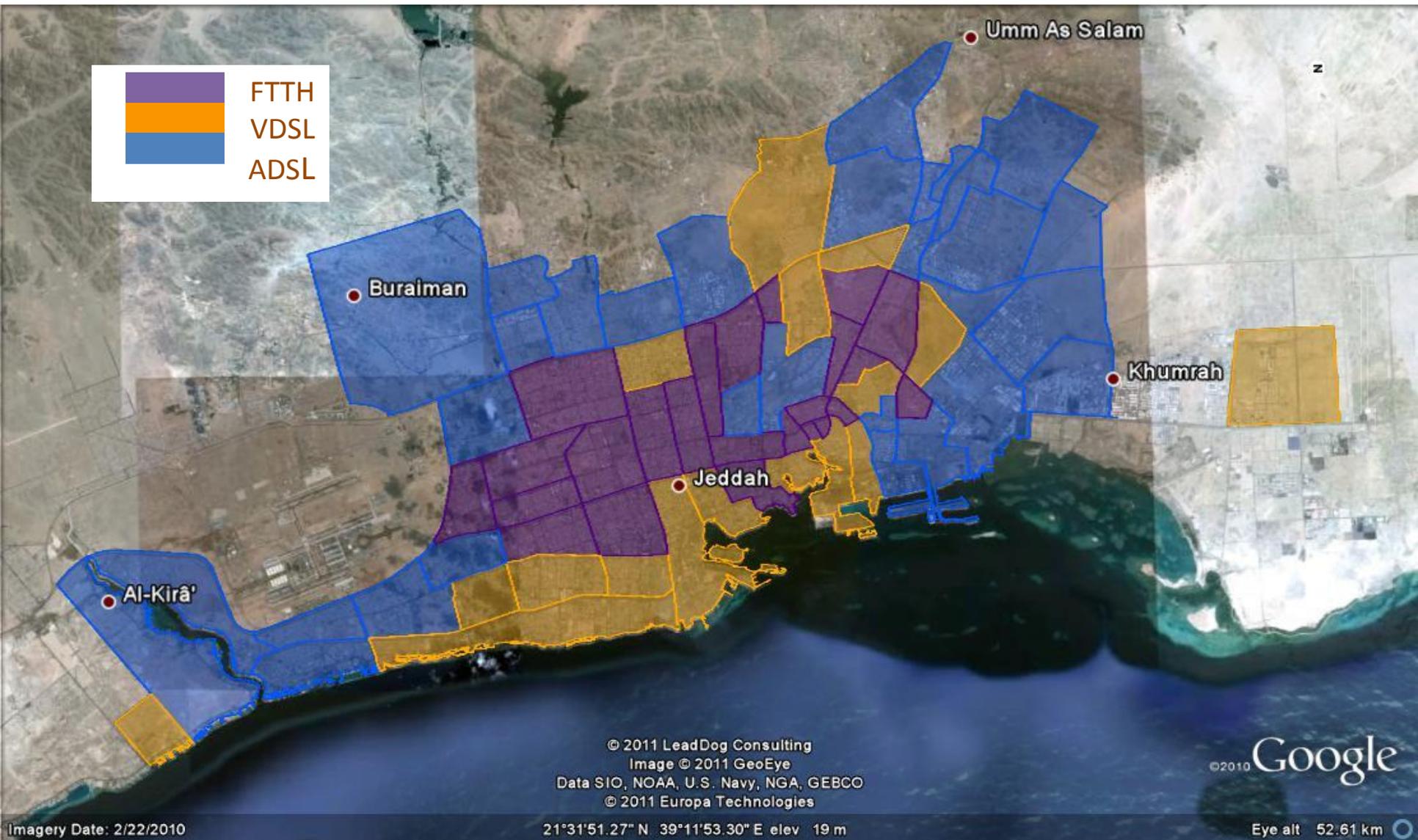
Co existence FTTH and fixed wireless - Australia

Fixed-wireless coverage maps

Ballarat surrounds

VICTORIA

NBNCo Limited

Fixed-wireless coverage:
VICTORIA

● Ballarat
● Melbourne

Key:
● Town/city centre
▬ Fixed-wireless coverage area*
▢ Fibre coverage area*

Indicative only*
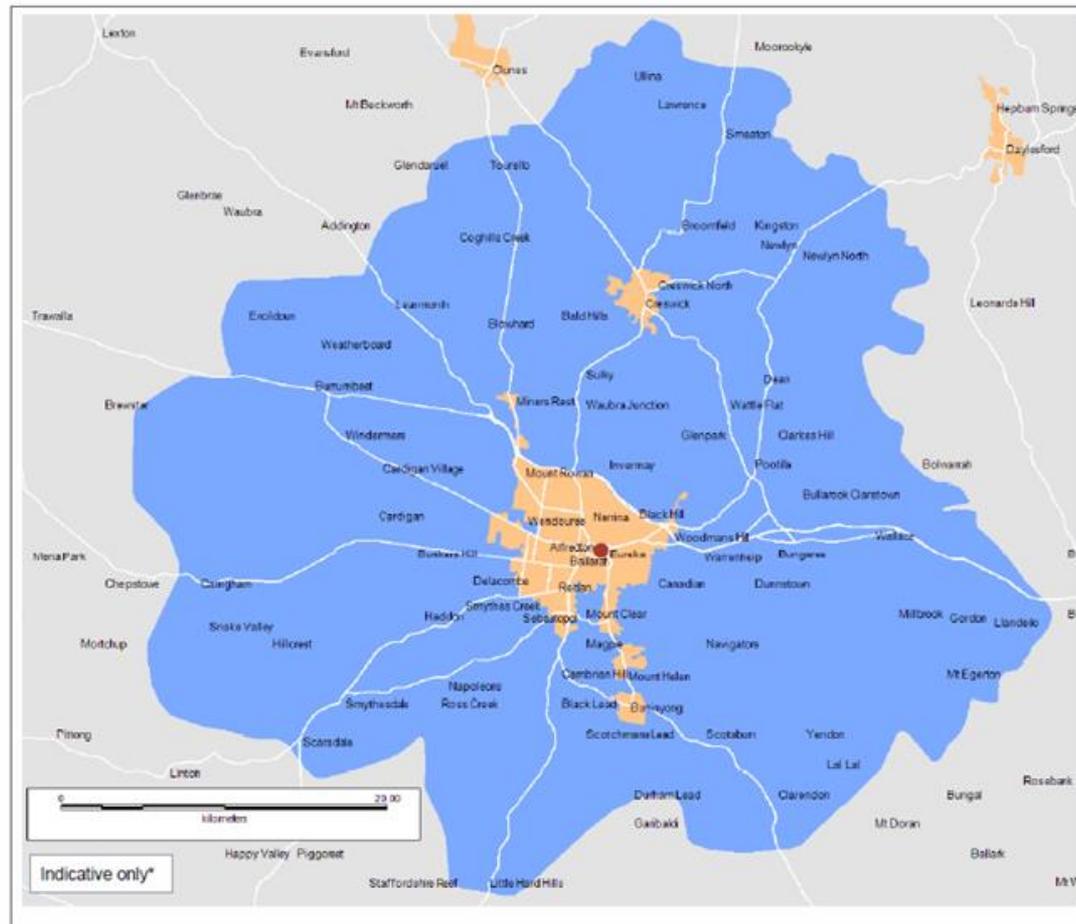
* These maps show the estimated likely coverage areas based on our rollout schedule, which may change. Network performance depends on your location, equipment and retail service provider's products. Eligibility for a wireless service is subject to meeting NBN Co's minimum connectivity requirements.

Oman is big country with rural communities

Due to Oman's size deploying fibre across the country will be expensive due to the distances to reach households.

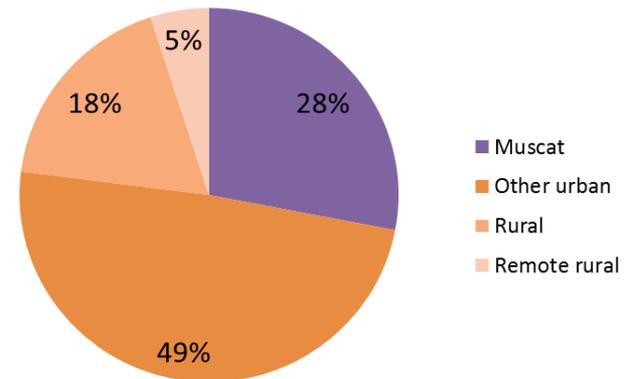**Deploying fibre on commercial grounds might be difficult for 70% of the population.**

Big divide: the rural population cost per household is 100 times more than dense urban

Geographic size comparison

Qatar

X 27 =

Singapore

X 436 =
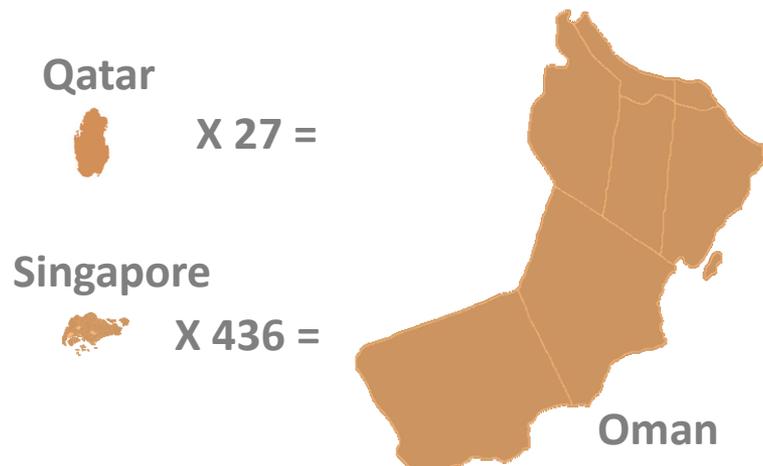
Oman

Source: Wikipedia

Population split

- Muscat — 28%
- Other urban — 49%
- Rural — 18%
- Remote rural — 5%

Source: National Statistic of Oman

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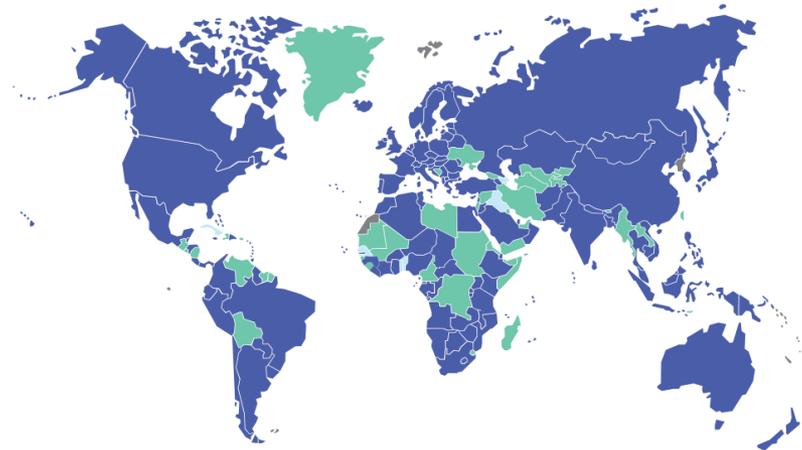- The different commercial models for delivering NBN services

Countries with developed NBN plans

Figure 4: Growth in National Broadband Plans, 2005-2013
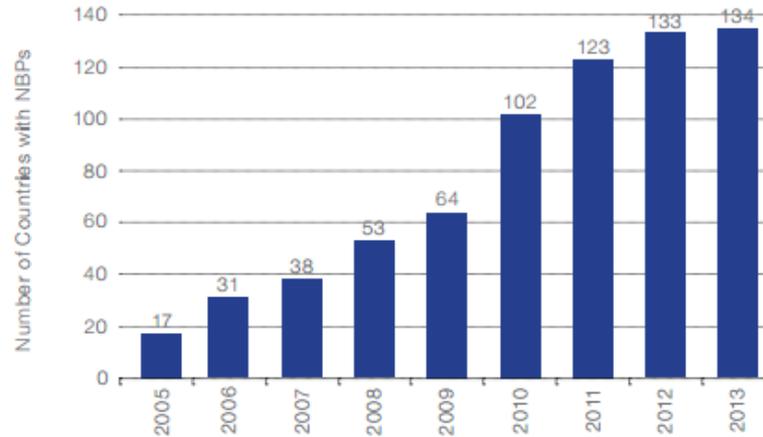
Source: ITU/UNESCO Broadband Commission and ITU Telecommunication/ICT Regulatory Database.

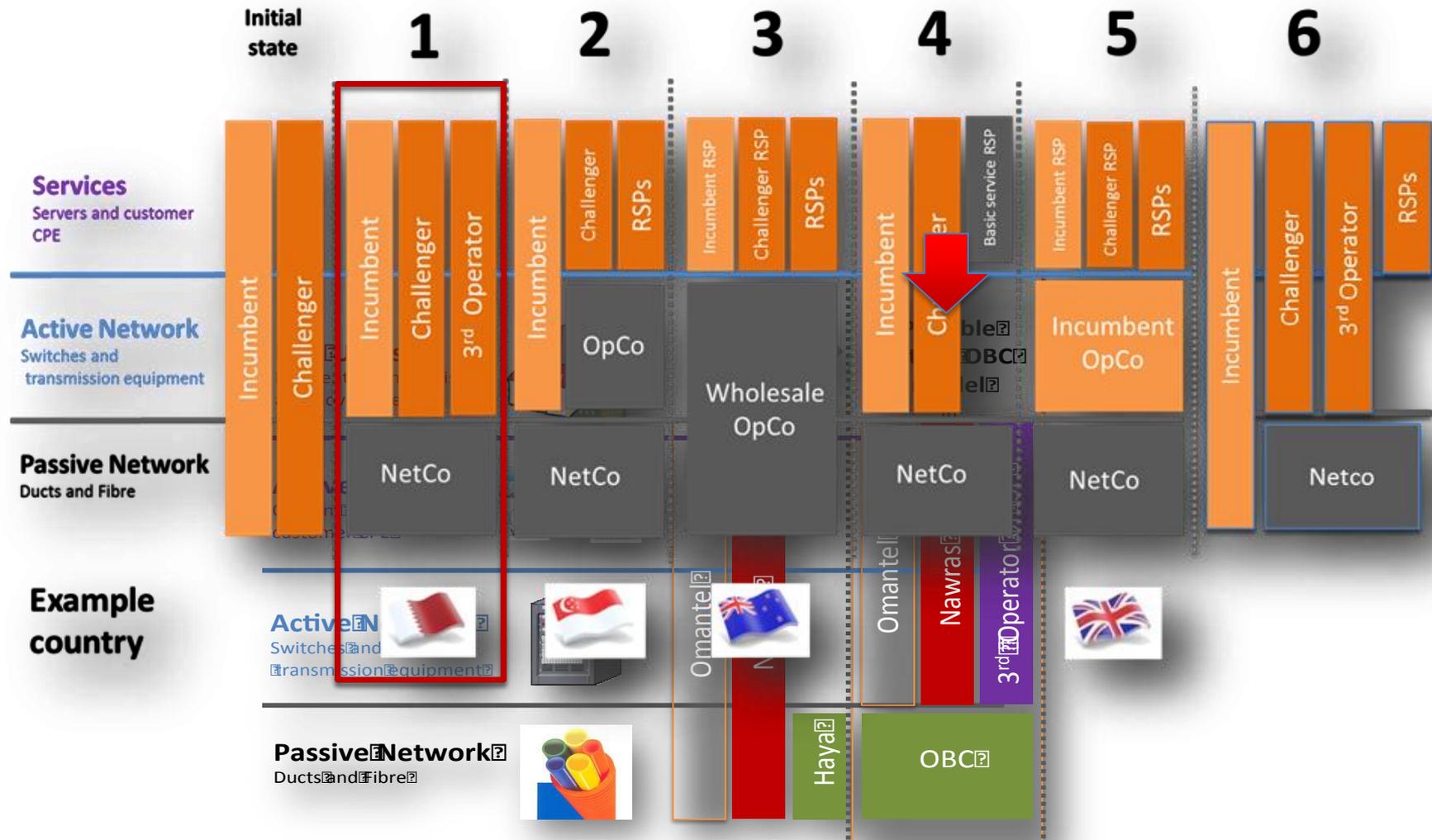World Map, according to status of National Broadband Plan (NBP)

Source: ITU/UNESCO Broadband Commission and ITU Telecommunication/ICT Regulatory Database.

NBP - yes   NBP - no   NBP - planning   No data

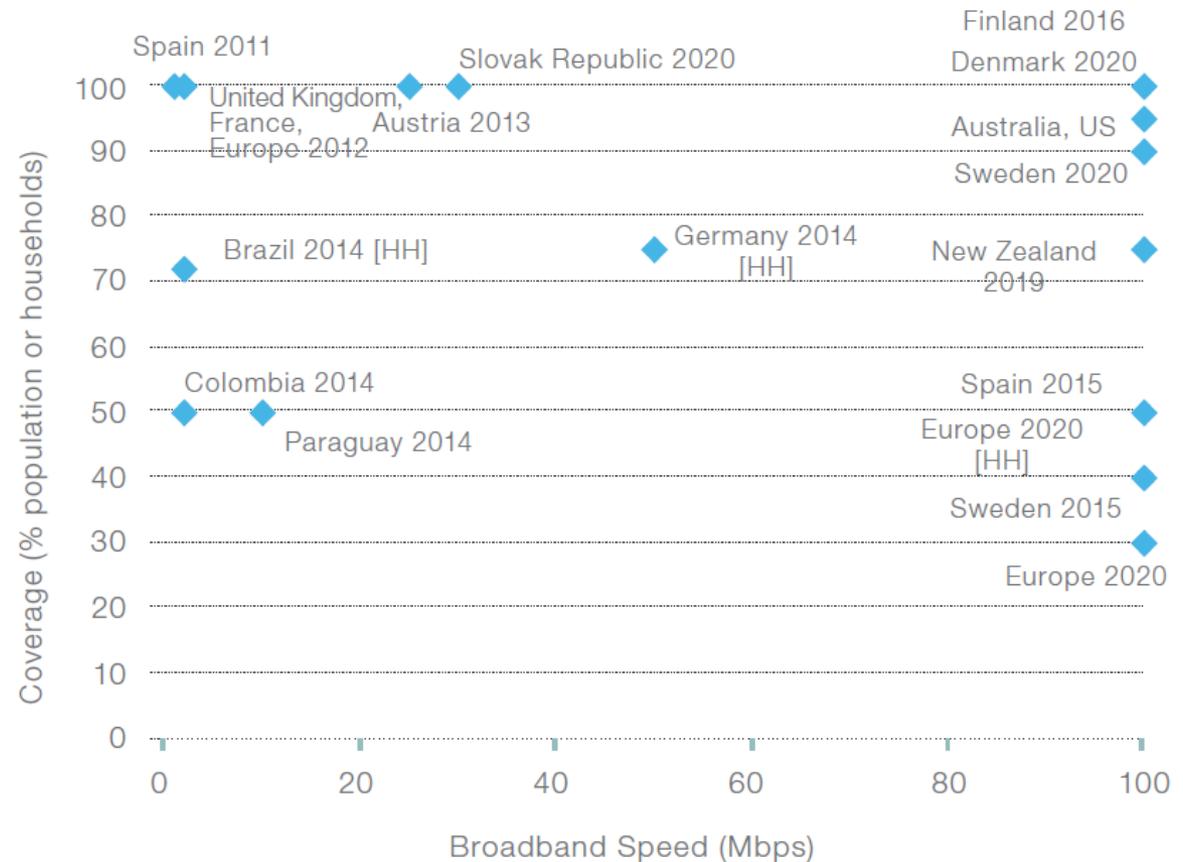# Models differ in the level and scope of government involvement

NBN speed and coverage targets

Source: ITU.

Note: Australia's targets specify 100% geographic coverage, with 93% at 100 Mbps and 7% at 12 Mbps.

EU objectives are 30 Mbps for all EU households and 100 Mbps for 50% of EU households, by 2020, shown as [HH].

Regulatory exclusivity is the only model that works without government subsidy

	Regulatory exclusivity	**Regulated access**	**Separation (functional/structural)**
Subsidy		**To incumbent** Japan Taiwan **To third party** Singapore	New Zealand Australia Qatar Oman
No Subsidy	United States Hong Kong South Korean	European Union	United Kingdom

Government intervention

Regulatory outcome