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Bahrain Society of Engineers
Next Generation Access

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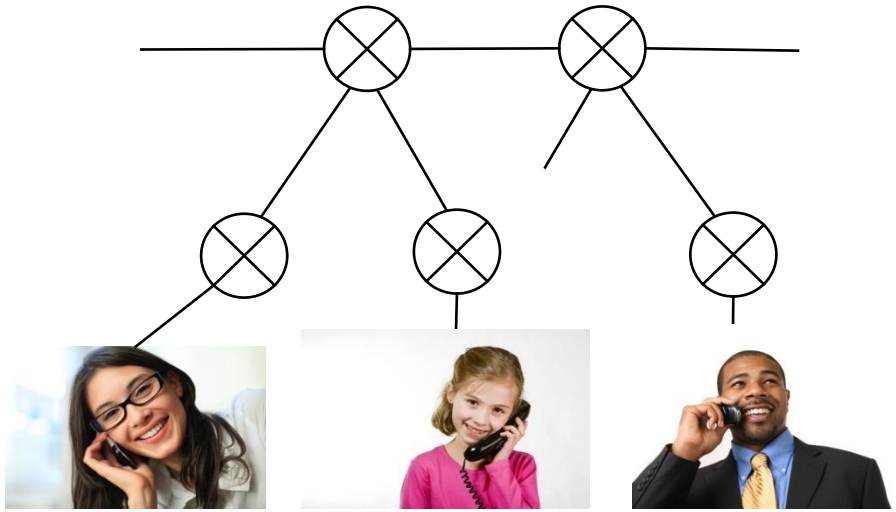
17th November 2009

- Evolution to multiple service networks
- Requirement for next generation access
- Example next generation access technologies
- Drivers and inhibitors

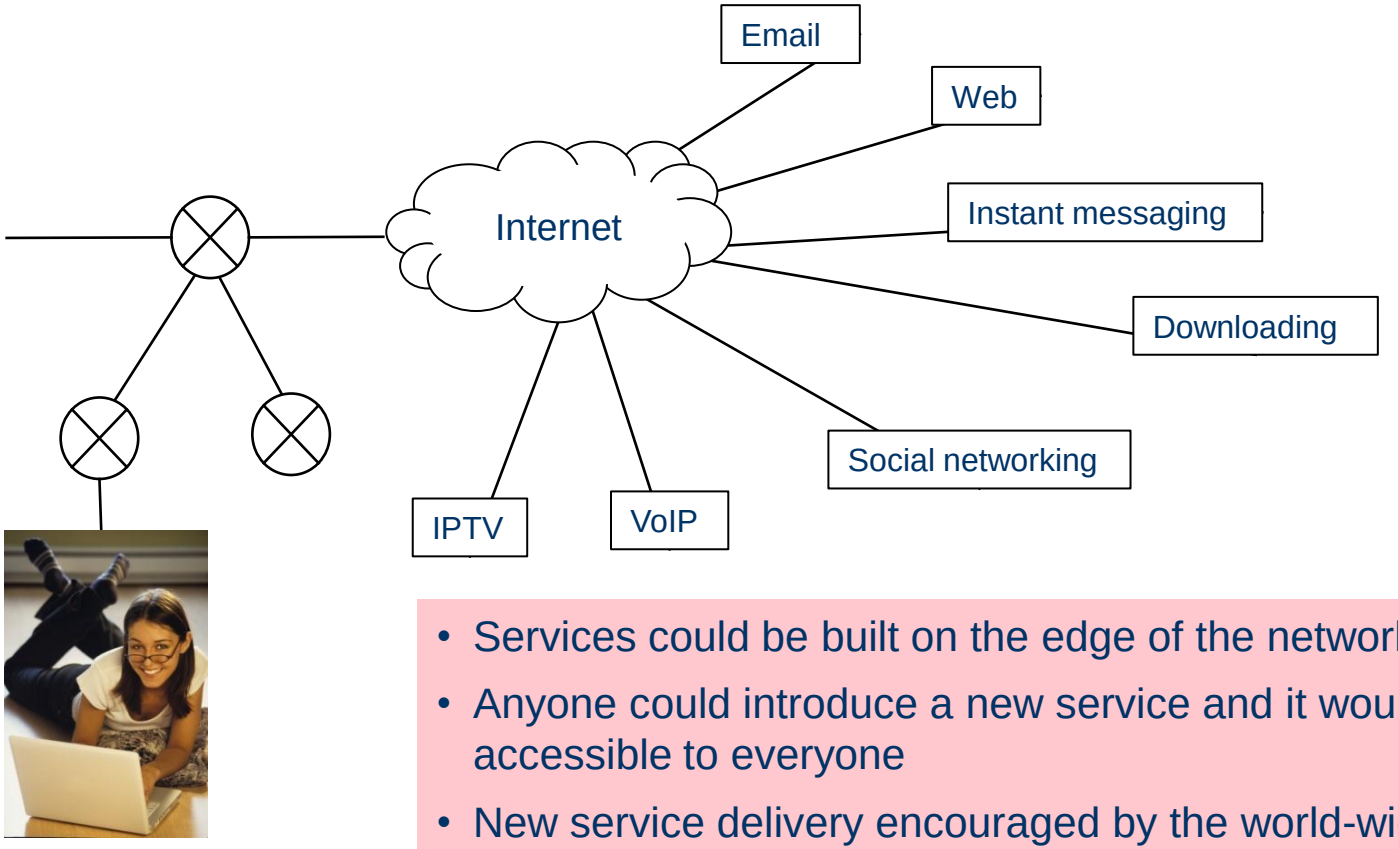
Once upon a time we only had fixed telephone networks ...



The Public Switched Telephone Network

- Service delivery limited by network
- 64kbs circuits delivered through circuit switches
- Services were built on the circuit switches
- Services were therefore ‘embedded in the network’
- Typically thousands of switches in a network
- New services required cross-network roll out
- This roll out and requirement for integration with the circuit switches limited the number of services
- And the operator had near complete monopoly on service provision

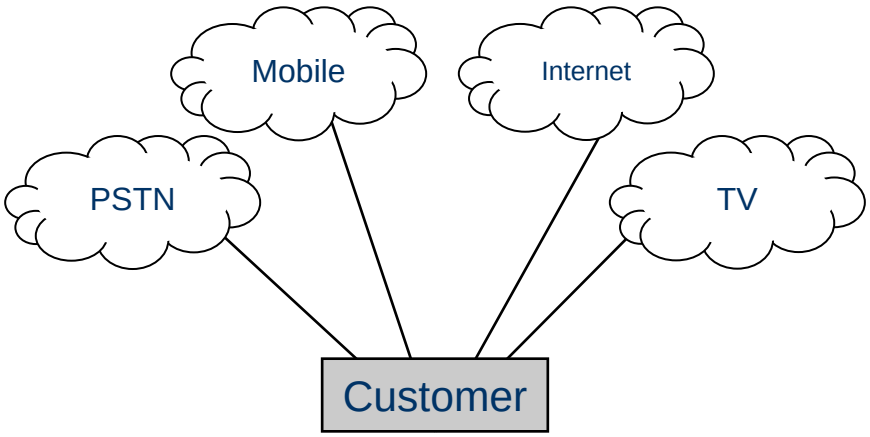
Then we got the internet ...



- Services could be built on the edge of the network
- Anyone could introduce a new service and it would be accessible to everyone
- New service delivery encouraged by the world-wide internet subscriber base
- A large number of innovative services developed
- New service providers able to compete with network owners through innovation and on price

Next Generation Network –multiple services on a common network

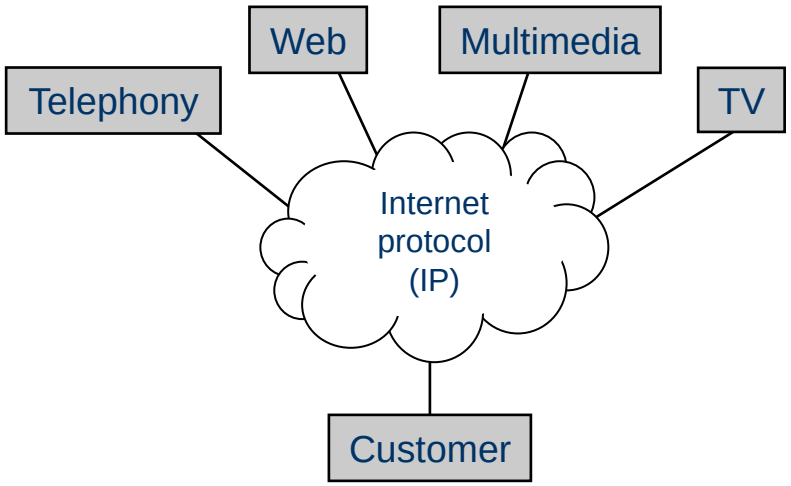
Old Model



Network Driven

- Services embedded in the network
- Limited number of services
- Service provision and delivery limited by network

Next generation network

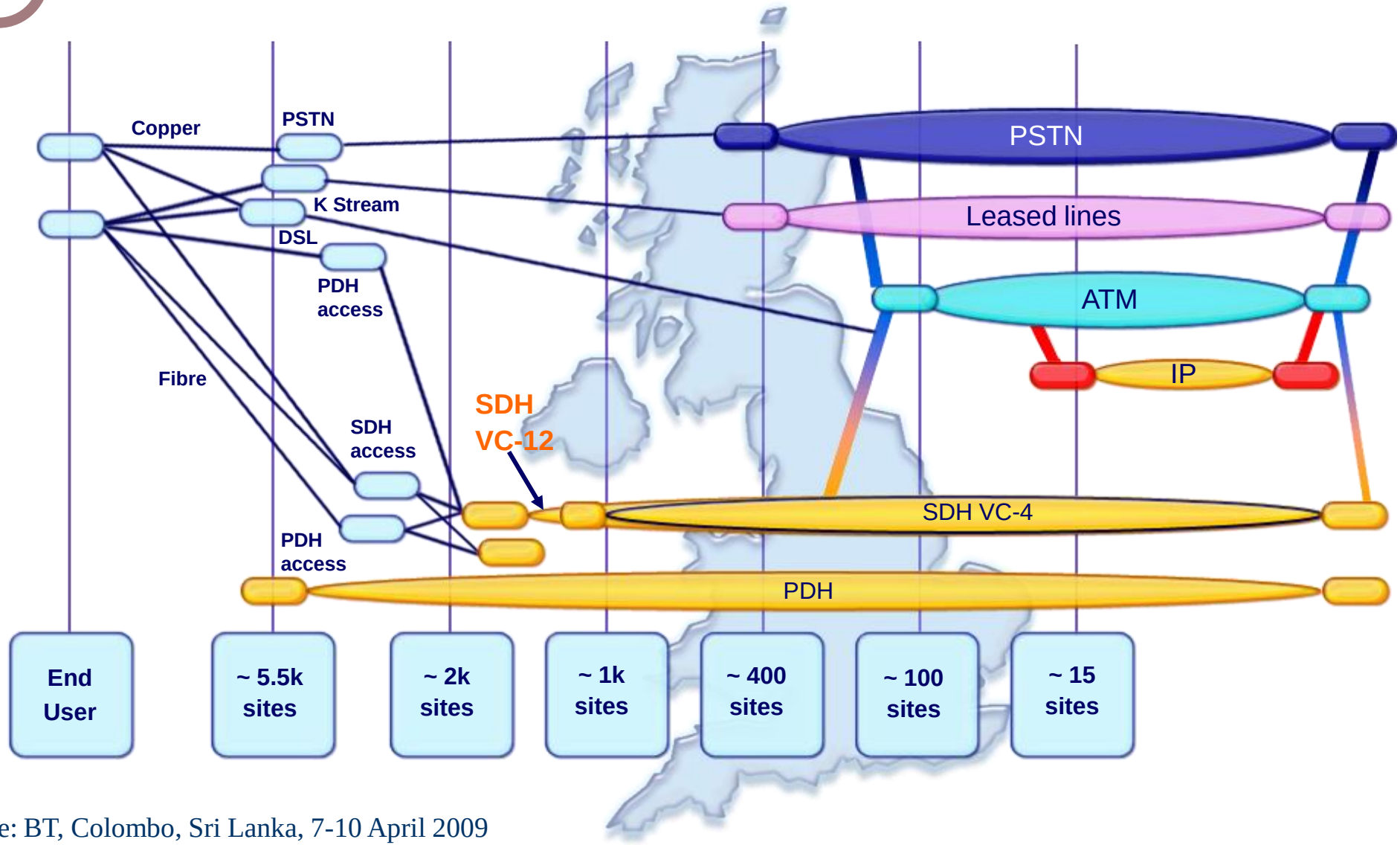


Services Driven

- Unlimited number of services
- No limits on service provision
- Service delivery limited by access and customer's device

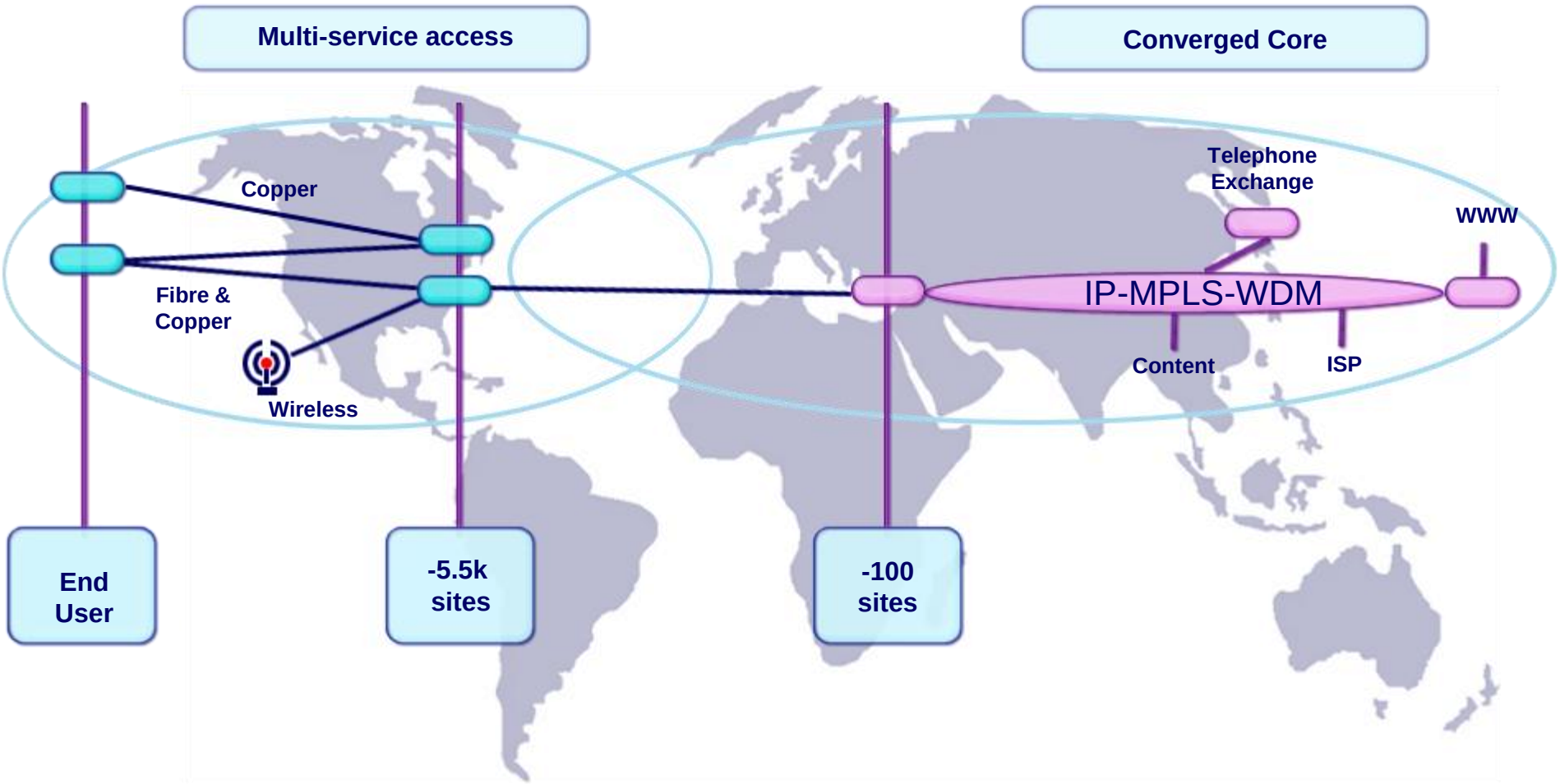
Migration from services embedded in a network to multiple services delivered over a common network

BT UK's Current Network, an example of a traditional network



Source: BT, Colombo, Sri Lanka, 7-10 April 2009

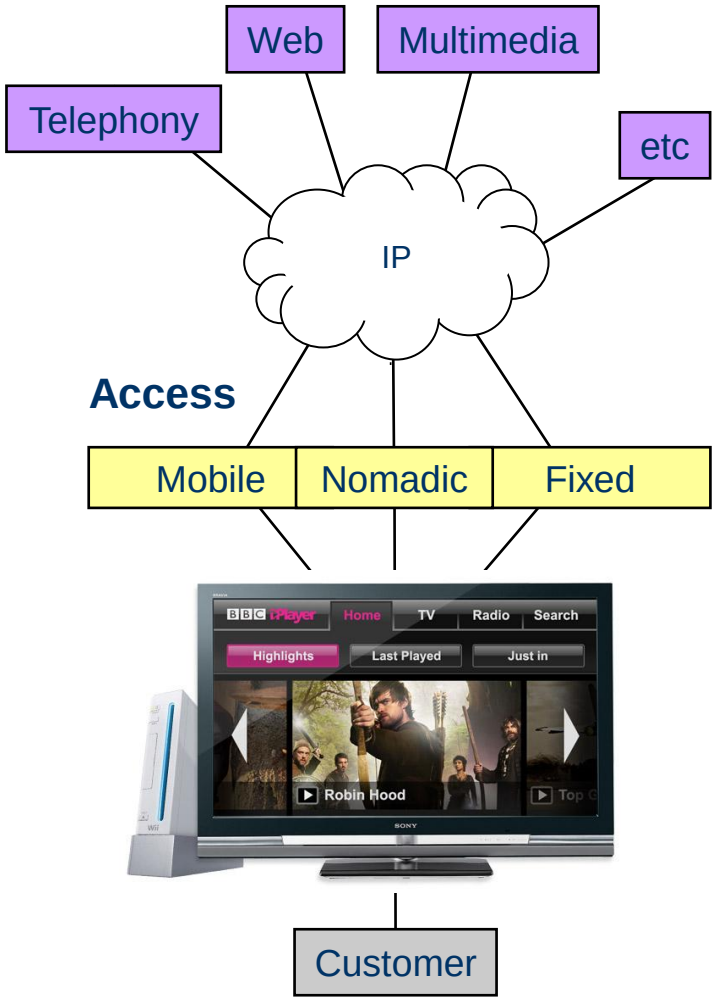
BT's World-wide Next Generation Network, Simplified



Source: BT, Colombo, Sri Lanka, 7-10 April 2009

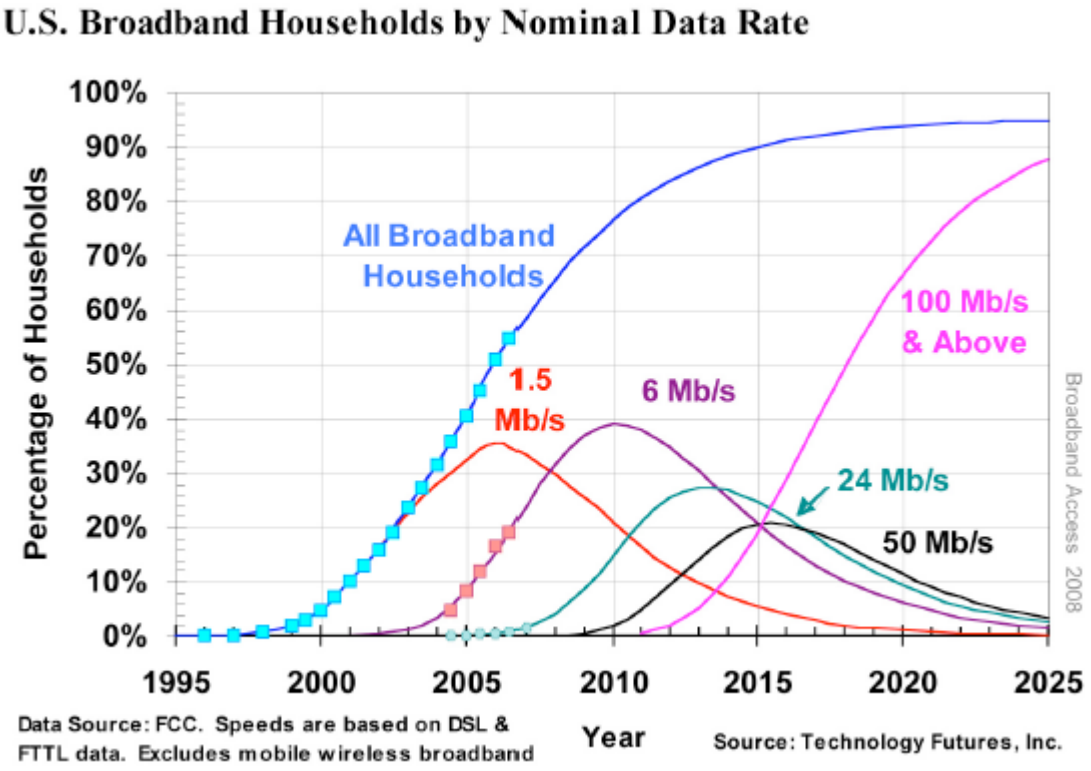
Device convergence and opportunities

- Wifi (IEEE 802.11) – a common means of accessing broadband in the home, business and at hot spots
  - 54Mbps (g) rising to claimed 160Mbps (n)
  - Many access devices in addition to PCs including Nintendo DS and Wii, and Xbox; many smart phones
- Differences in form factor are diminishing
  - Common operating systems
  - Improved screens, processing power and storage on nomadic and mobile devices
  - Media interfaces overcome differences in form factor
- Scope opportunities:
  - Content can be exploited in a variety of ways dependent on access



Access is now the constraint on service delivery

Broadband access requirement



Source Technology Futures Inc, 2008

Consumer Perspective of Triple Play Propositions

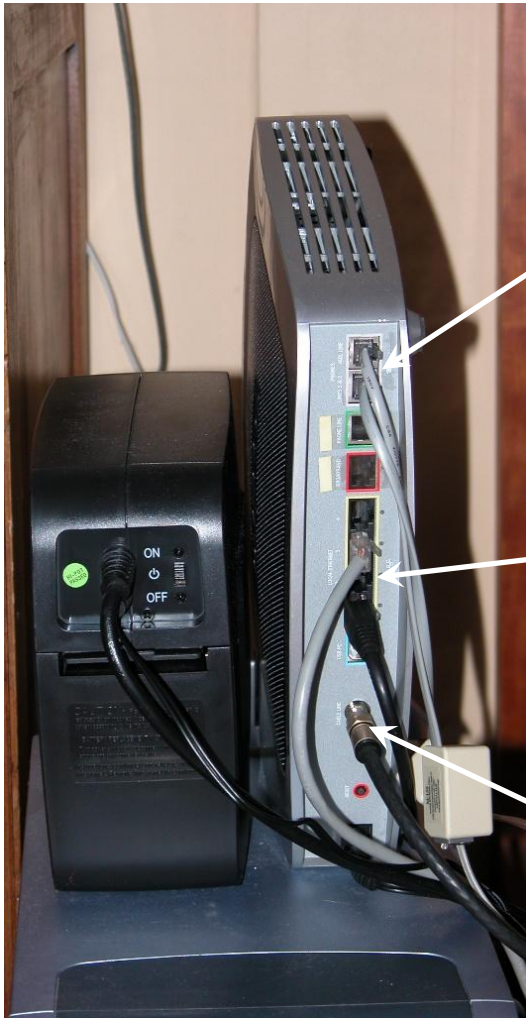
Switching from Comcast to AT&T – why not if comparable proposition costs less?

	Comcast Cable	AT&T U-verse
Technology	Digital Cable	VDSL (25 Mbit/s to home)
Subscription pm	~$200	~$150
Triple play bundle		
TV	Similar content (Digital)	Similar content (IPTV) - high quality DVR of up to 4 channels simultaneously
Broadband internet	15 Mbit/s Higher speeds available	6 Mbit/s (12 Mbit/s available for add $20 pm) Higher speeds available
Telephony	2 lines	2 lines (IP) Configurable over web, e.g. line busy, VM treatment, notification and retrieval
HDTV	Additional $20 pm	Additional $20 pm
Contract period	Unknown, possibly 6-12 months	None

Customer Premises Equipment
AT&T U-verse Gateway

Front View

Back View



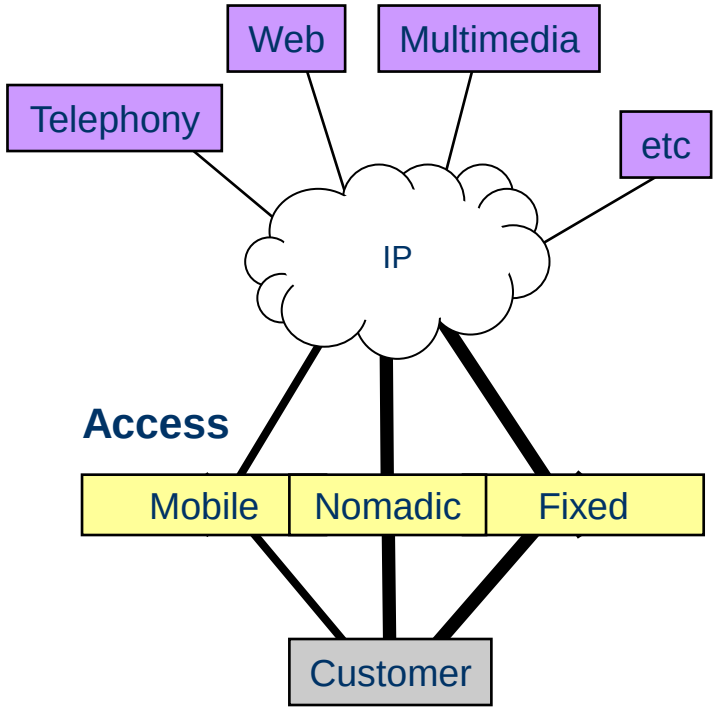
2 telephone lines (uses existing wiring in residence)

Ethernet ports (CPE includes WiFi)

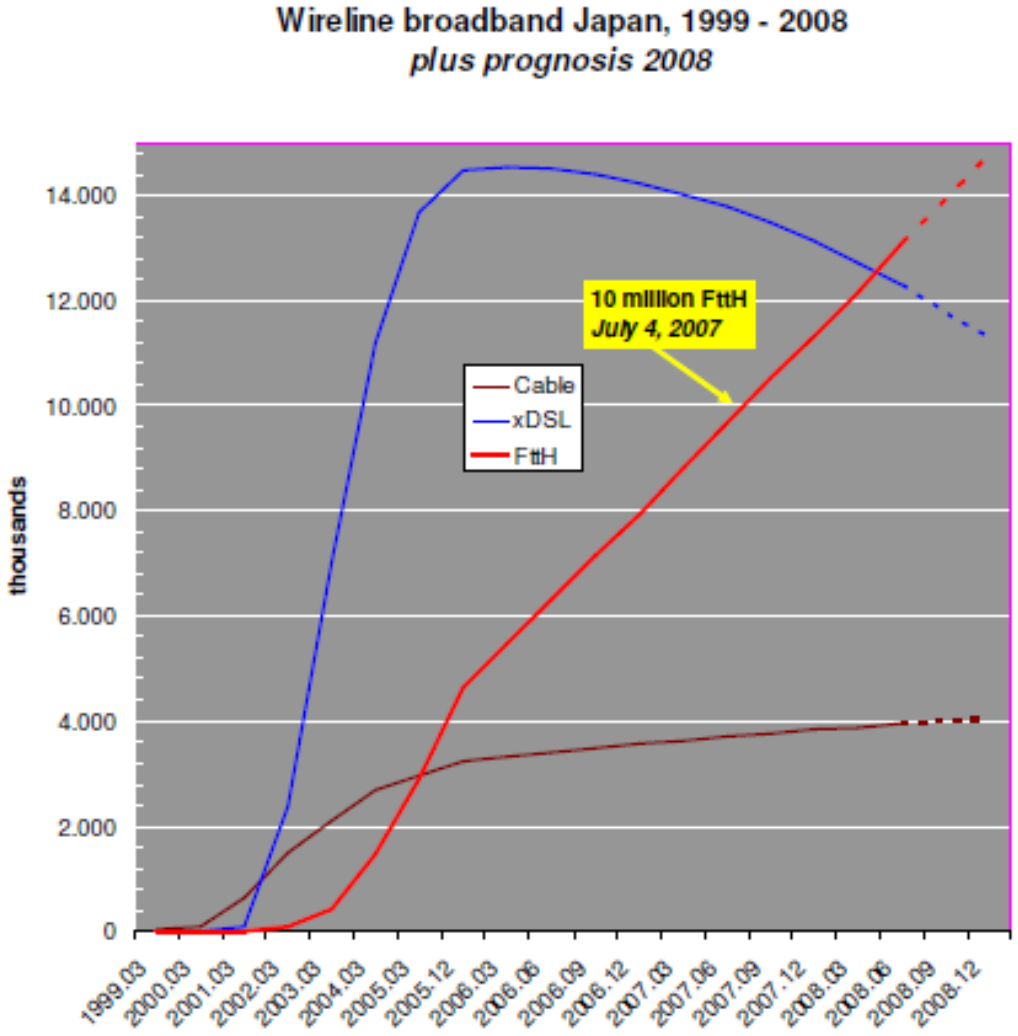
Coaxial Cable (uses existing coaxial cable in residence)

Next generation access (NGA)

- Meets headline speed expectations – up by 50% each year
- Meets requirements of HD IPTV – 17Mbps per channel
- Delivers vastly lower cost per bit carried
- Enables common access to services via IP
- Enables new service opportunities through greater speed and capacity, always on characteristics and push as well as pull
- Response to intense competition between fixed access providers
- Response to emerging competition from mobile broadband services



Japanese migration to NGA



Source: SBR, Dec 2008

Next generation access options

- Fibre to the cabinet (FTTC) – a common fibre to a street cabinet and VDSL over copper to the building
- Fibre to the home (business)
  - Passive Optical Network – broadcast TV and broadband on one or two fibres
  - Dedicated Fibre – individual fibre to each home
- Cable – Fibre to a street cabinet and coaxial cable to the building
  - Broadcast TV and broadband on one cable
- Wireless – WiMAX; Long Term Evolution (LTE)

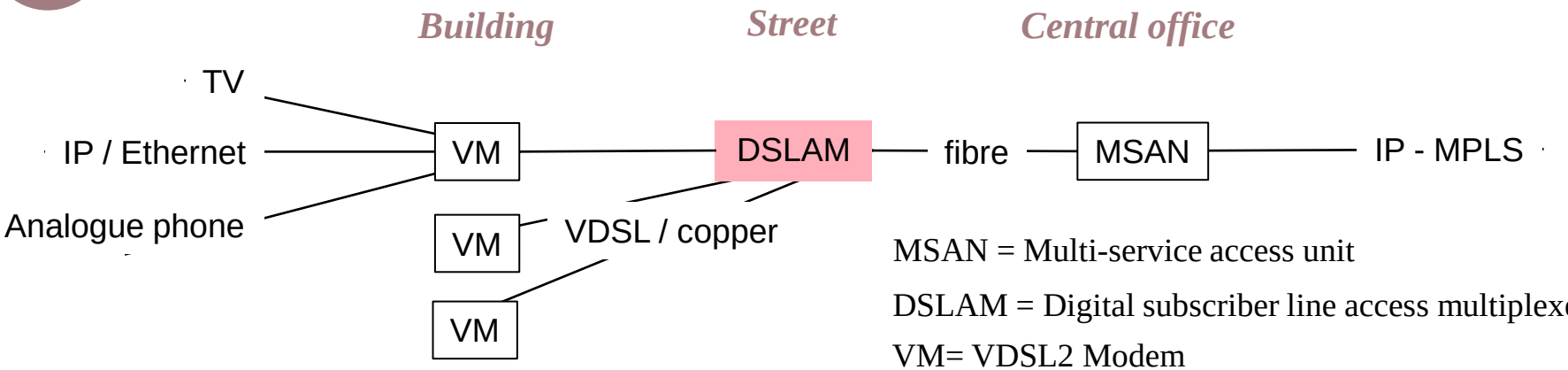
All provide an IP (Internet Protocol) standard interface to higher layer services for interactive services
All provide substantially more than 20Mbps access

Performance

	ADSL2+ Current)	Cable: DOCSIS 3.0	FTTC (+VDSL)	FTTP	WiMAX	LTE
Downstream Headline	24 Mbit/s	50 Mbit/s	40 Mbit/s	Nominally 100 Mbit/s	Nominally 144 Mbit/s per 20MHz	Nominally 360 Mbit/s per 20MHz
Downstream Typical	10 Mbit/s	20 Mbit/s	20 Mbit/s	30 Mbit/s		
Upstream Headline	0.8 Mbit/s	2 Mbit/s	10 Mbit/s	Nominally 50 Mbit/s	Nominally 35 Mbit/s per 20MHz	Nominally 80 Mbit/s per 20MHz
Upstream Typical	0.4 Mbit/s	0.5 Mbit/s	5 Mbit/s	15 Mbit/s		
Cost of Deployment			BD110 → BD220/line	~BD330/line		
Regulatory Position (UK)	Local Loop Unbundling & Bitstream (wholesale broadband) required		Bitstream required, Issues over local loop unbundling	Bitstream required, price forbearance until market understood	As for mobile services	As for mobile services

Sources: mainly BT, Colombo, Sri Lanka, 7-10 April 2009; Agilent Technologies

Fibre to the cabinet

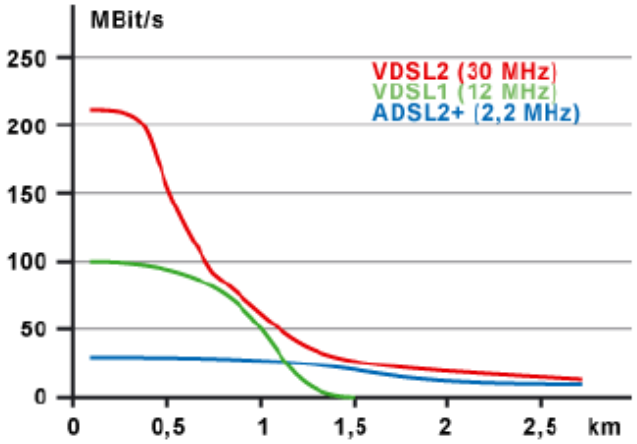


MSAN = Multi-service access unit

DSLAM = Digital subscriber line access multiplexer

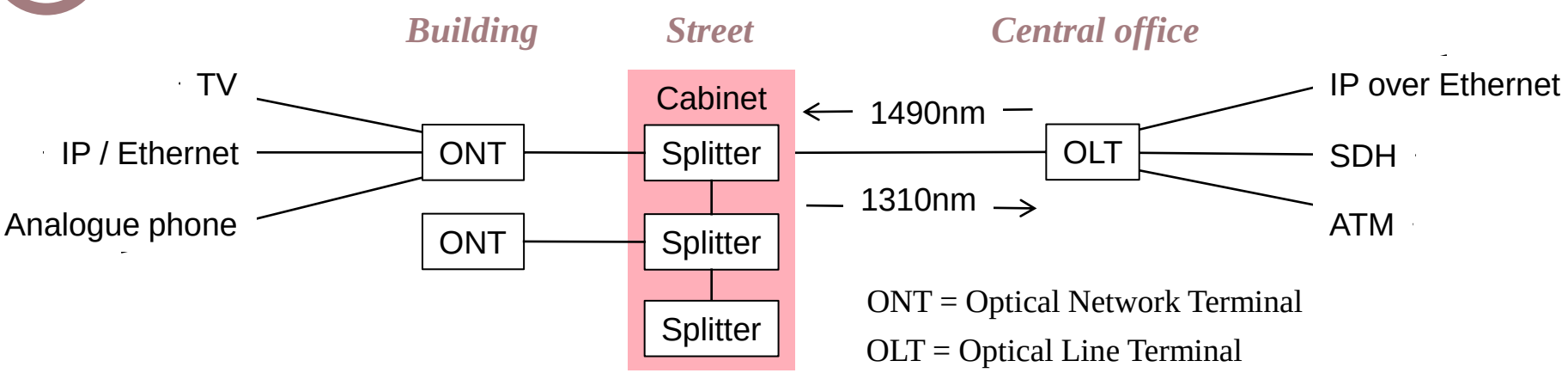
VM= VDSL2 Modem

MPLS = Multi-protocol Label Switching



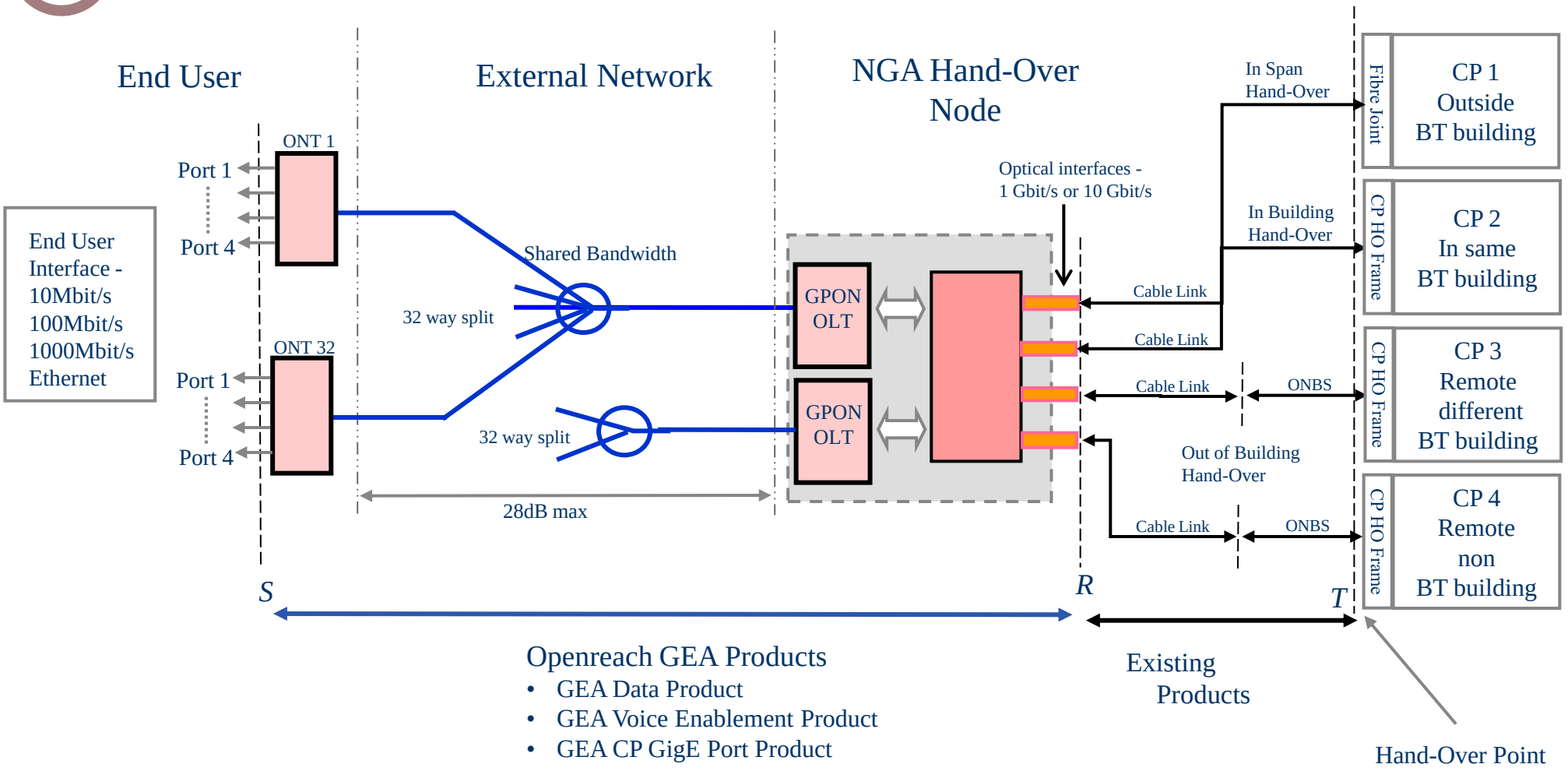
- Performance varies with distance from the DSLAM and VDSL channel dimensions
- Frequency plan for the local loop has to take account of new VDSL and existing ADSL usage
- Significant use in Belgium, Switzerland, Finland and Germany
- UK hybrid implementation in conjunction with FTTH

Fibre to the home – Point to Multipoint Passive Optical Network



- Various PON standards BPON, EPON (1Gbps / 10Gbps), GPON
- Single fibre runs through up to 128 splitters (GPON)
- Single stream of downstream traffic
  - All traffic delivered to all ONTs
  - ONT reads only traffic addressed to it and multicast traffic
  - Privacy provided by encryption
- Upstream traffic built from each ONT's upstream traffic
  - Timing issues resolved by the OLT – the OLT provides a 'grant' to each ONT
  - A grant is a defined interval of time over which the ONT can transmit
  - Upstream traffic can be guaranteed for applications like telephony
- GPON implemented by Verizon, BT, STC, Etisalat and AT&T

BT's Generic Ethernet Access Product



Source: www.openreach.co.uk/orpg/products/nga/nga.do

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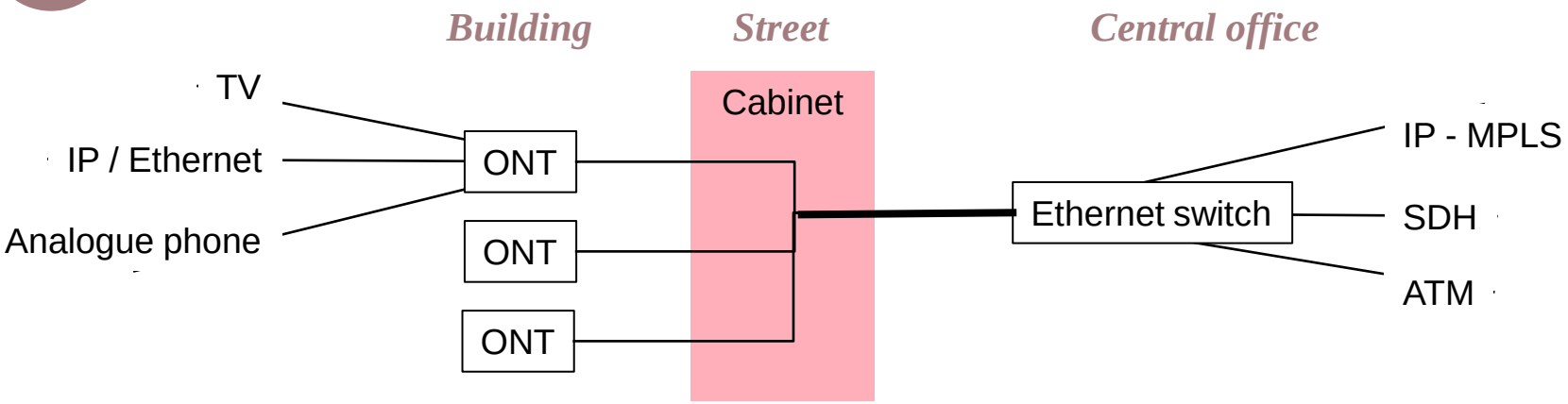
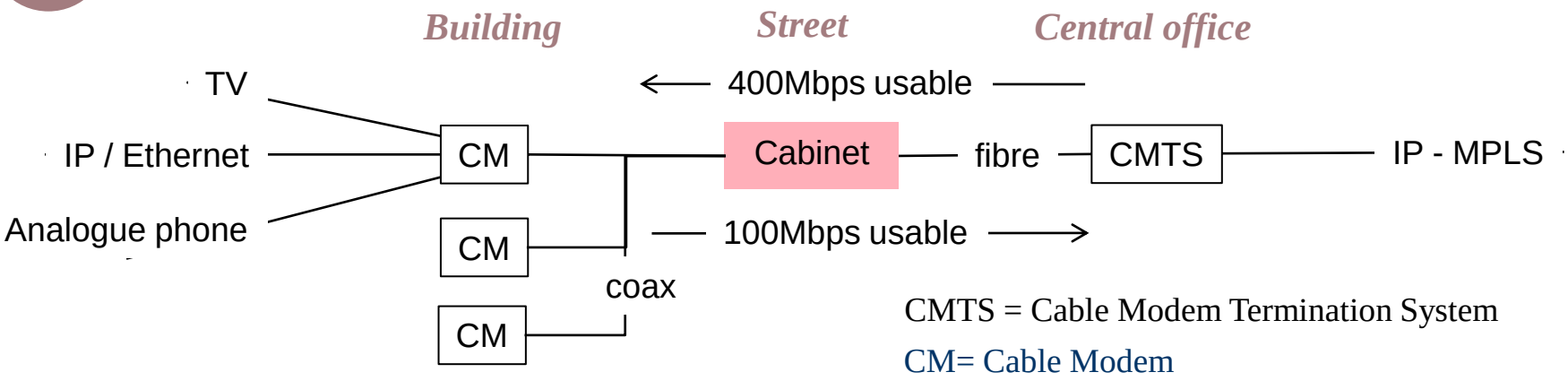
Fibre to the home – Point to Point



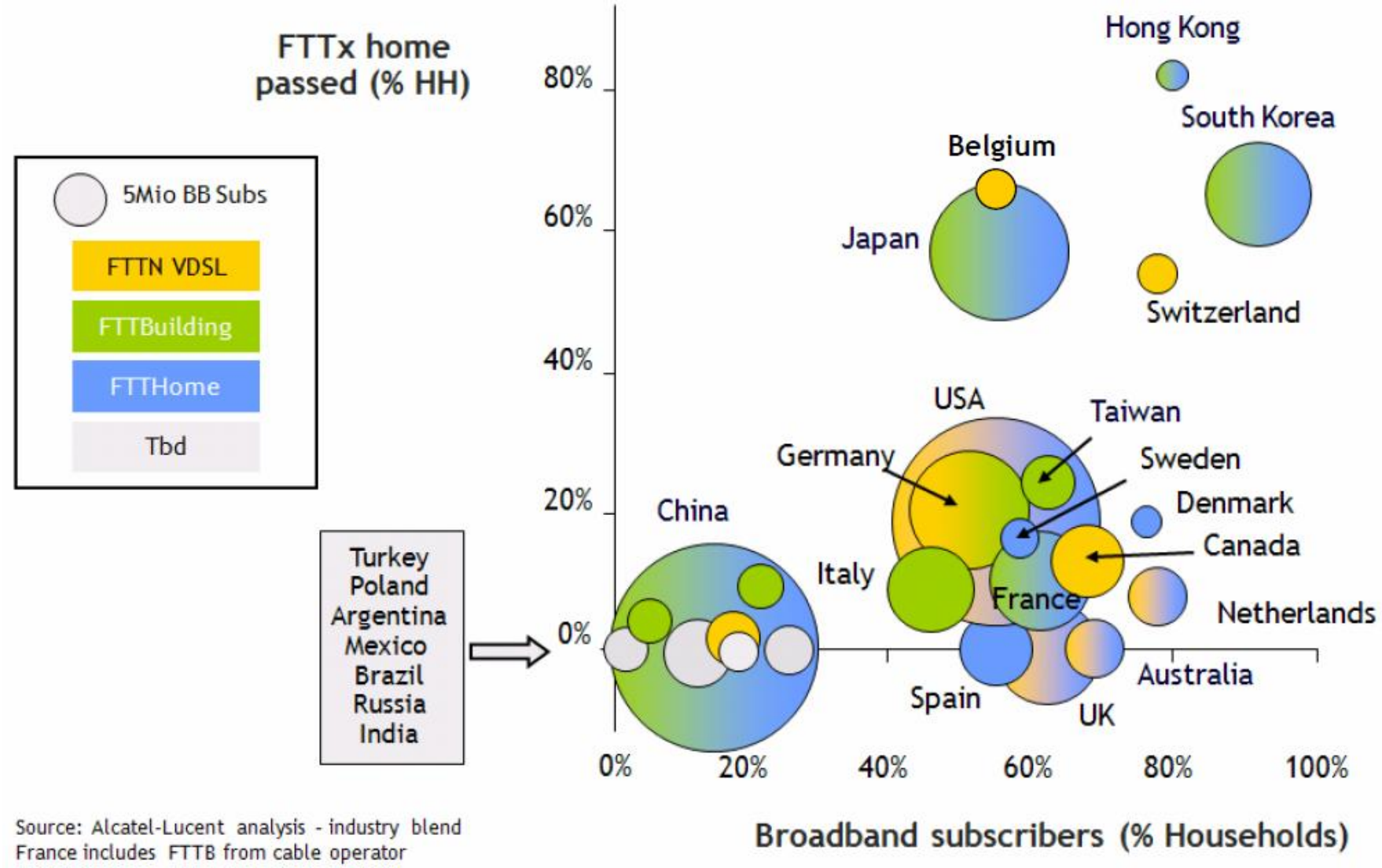
- Generally Ethernet over fibre at 100, 1000 or 10,000Mbs
- Point to point fibre between central office and premises
- Street cabinets installed for patching fibre bundles with different numbers of fibres and for drop fibres
- P2P fibre implementation mainly by municipalities rather than operators
  - More suitable for ‘open access’ networks
  - European state aid rules require open access networks
  - Examples include Stokab in Stokholm

Cable – DOCSIS 3.0



- Data Over Cable Service Interface Specification (DOCSIS)
- Reserves one or more channels for data communications
  - 6.4MHz channels; European DOCSIS
    - Downstream - 55.62Mbps nominal, 50Mbps usable per channel downstream
    - 30.72Mbps nominal, 27Mbps usable upstream
  - Up to 8 channels downstream; 4 channels upstream (DOCSIS 3.0)
- Media access uses TDMA or S-CDMA (DOCSIS 2 and 3) and QoS features
- Requires a Hybrid Fibre Coaxial network to provide a back channel
- Downstream IP traffic is encapsulated in MPEG transport packets
- Upstream IP traffic is carried as Ethernet traffic in the T-bands (sub-bands) which were specified to send TV signals back to the head end
- Implementation expected by all Hybrid Fibre Coax cable networks

Broadband penetration and FTTx availability



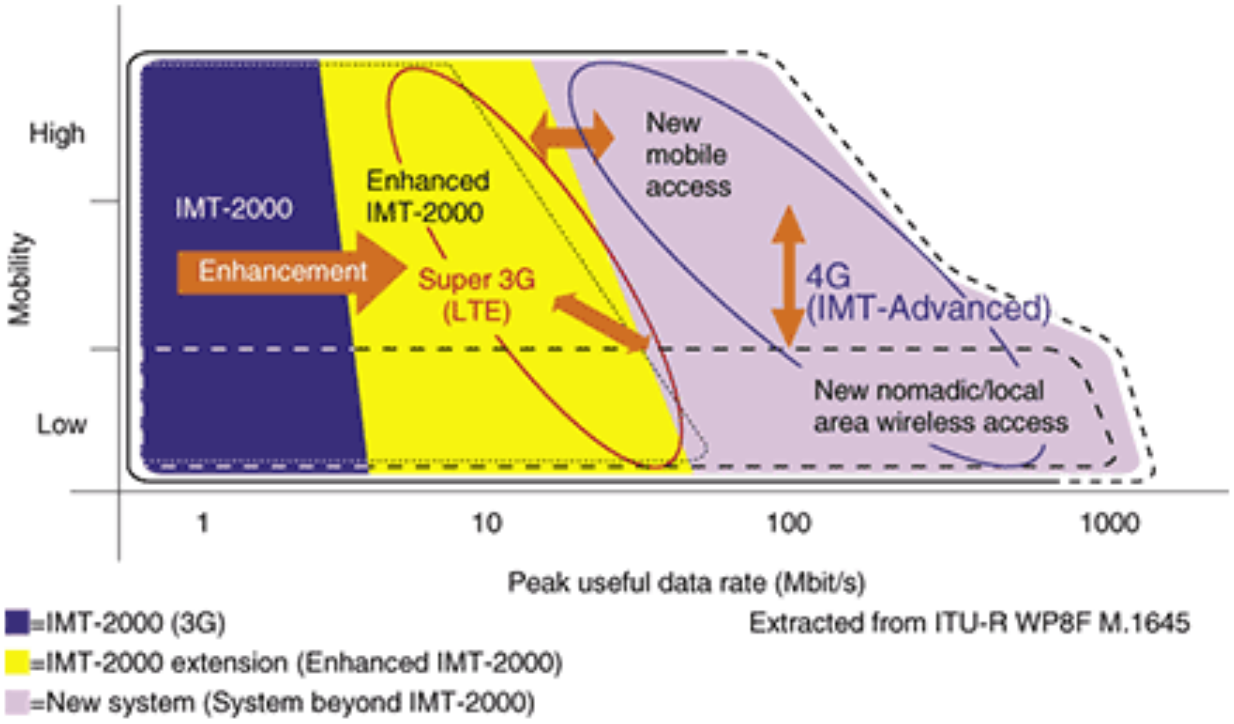
Source: Alcatel-Lucent analysis - industry blend
France includes FTTB from cable operator

Broadband Wireless Access – current contenders

Standard	Family	Primary Use	Radio Tech	Downlink (Mbit/s)	Uplink (Mbit/s)	Notes
WiMAX	802.16	Mobile Internet	MIMO-SOFDMA	144	35	WiMAX update to offer up to 1 Gbit/s fixed speeds.
UMTS W-CDMA	UMTS/3G SM	General 3G	CDMA/FDD	0.384	0.384	HSDPA widely deployed. Typical downlink rates today 2 Mbit/s, ~200 kbit/s uplink; HSPA+ downlink up to 42 Mbit/s.
HSDPA+ HSUPA				14.4	5.76	
HSPA+			CDMA/FDD/MIMO	42	11.5	
LTE	UMTS/4G SM	General 4G	OFDMA/MIMO/SC-FDMA	326	84	LTE-Advanced update to offer up to 1 Gbit/s fixed speeds.
Flash-OFDM	Flash-OFDM	Mobile Internet mobility up to 200mph (350km/h)	Flash-OFDM	5.3	1.8	Mobile range 18miles (30km)
				10.6	3.6	extended range 34 miles (55km)
				15.9	5.4	

Source: http://en.wikipedia.org/wiki/WiMAX

Anticipated performance development



LTE – Who's doing it?

- Global Mobile Suppliers Association (GSA) claims:
  - 42 LTE network commitments in 21 countries
  - 15 LTE networks in service by end 2010
  - 33 LTE networks in service by end 2012

NTT DoCoMo, Japan	Will be the first to offer LTE services in the Asia Pac region; Commercial availability expected December 2010 using 2100MHz band; Insufficient spectrum in this band to support a full LTE deployment; Will use newly allocated spectrum in the 1.5GHz band from 2012.
Verizon, USA	On track to launch LTE in 25 to 30 markets in 2010; expects to cover almost all current 3G footprint by the end of 2013; Will reach about 95 percent of the U.S. population; Will support 60Mbps service in the 700MHz band.
Zain, Bahrain	Announced network upgrade to LTE by NSN in Nov 2009; Will introduce Internet High Speed Packet Access (I-HSPA) initially; Followed by Middle East region's first LTE technology.

BWA - Issues

- Many current issues equally apply to different access technologies
- IMT-Advanced – the ITU 4G standard
  - Specifies 1Gbit/s for stationary users
    - » Not met by LTE or WiMAX – hence proposed “updates”
- Radio Spectrum
  - Current allocations in use for 2G & 3G
    - » Possible for some migration to 4G, but legacy users require parallel running
    - » Higher bandwidth services needed wider channels
  - New allocations needed
    - » Digital dividend provides sub 1GHz spectrum in USA, Europe & ME
    - » Sub 1GHz provides better rural coverage and improved indoor penetration
    - » Physical bandwidth limitations at lower frequencies reduce service bandwidth
    - » Probably require a combination of sub-1GHz (for coverage) and higher frequencies (for capacity)

Key issues

Inhibitors

- Regulatory uncertainty
- Demand uncertainty and consumer price expectations
- Uncertain returns on NGA assets
- Resistance by investors given uncertain returns

Drivers

- Government policy
- Consumer demand
- Service innovation
- Assumptions by application developers
- Competition from mobile operators

End

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