

2010-11-9

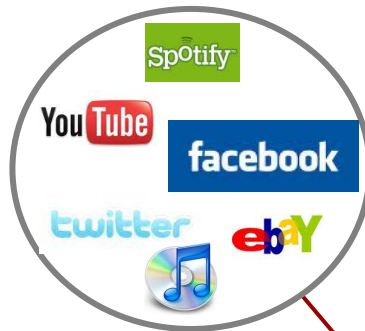
Fibre/Wireless Network Convergence

November 9th 2010

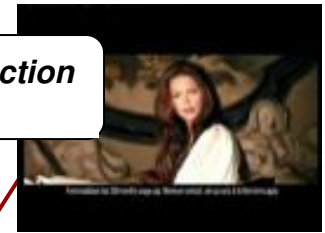
www.huawei.com



Agenda



I need a fast connection to download stuff.



Fibre network architectures are evolving to meet rapidly changing end user expectations of broadband connectivity – what do these changes mean for other network architectures including wireless networks, is technology and engineering convergence a precursor of market and business convergence and what will be the impact on the vendor and operator community.

Convergence is the approach toward a definite value, a definite point, a common view or opinion, or toward a fixed or equilibrium state. In mathematics, it describes limiting behavior, particularly of an infinite sequence series.

Wikipedia

Oh - that's us...



It Might Be Big But It Is Not Clever

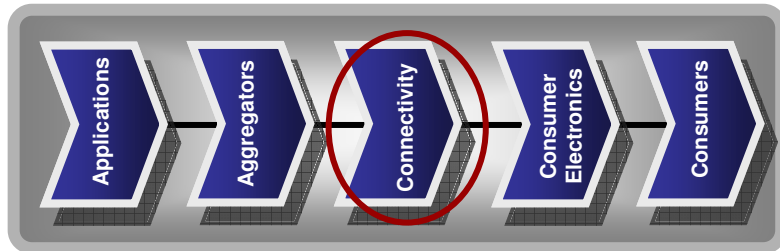
Fibre is nothing more than a lubricant - it just makes bits go faster.



What is interesting is why it is interesting.

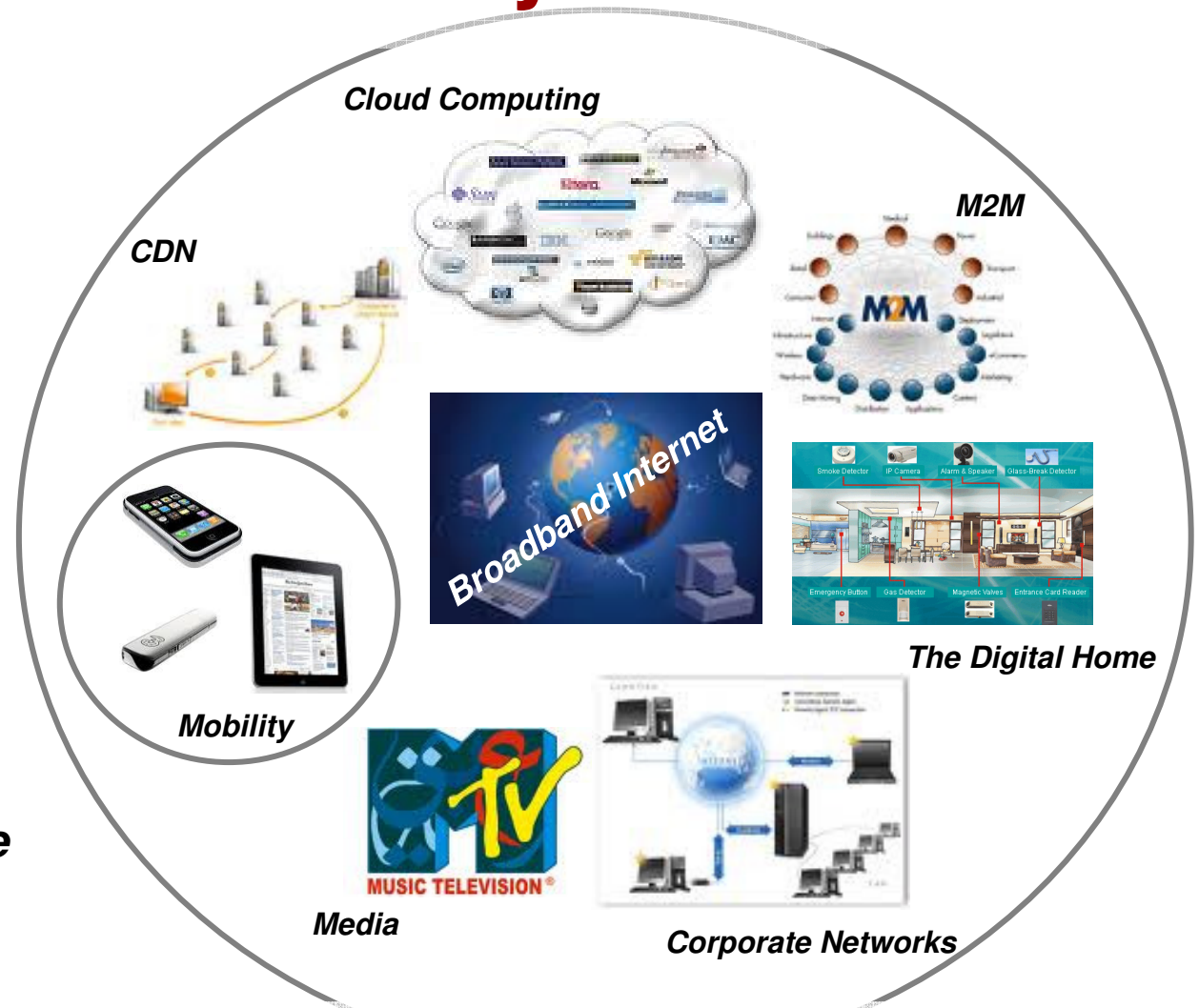
The Broadband Internet Ecosystem

- **Broadband Internet is a key element of the ICT ecosystem.**
- **Central to the value chain.**



- **Almost a Human Right but paradoxically undervalued.**
- **Perceived as fundamental to economic recovery and growth.**
- **It is both fixed and wireless - the user does not care.**

I need a fast connection to download stuff.

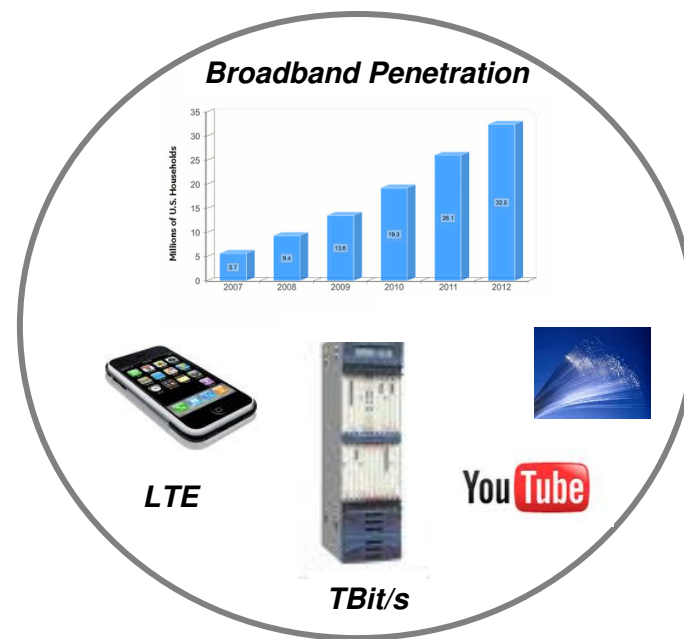
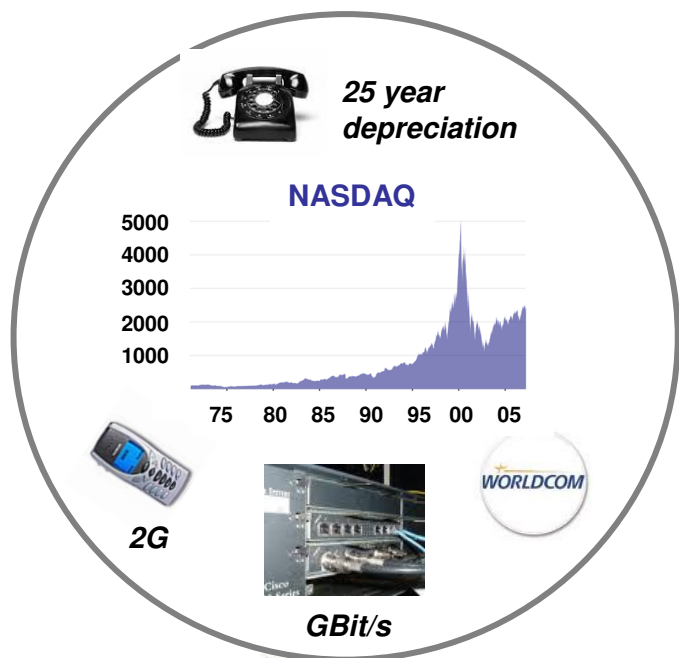


Market development and growth driven and delivered by technology clusters.

The Internet - The State Of The Nation



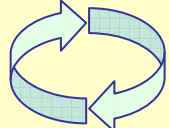
Telecom has progressed a long way in the 10 years since a dotcom era characterised by lagging technology and PSTN accounting practices.



Evolution from simple connectivity through applications to devices.



Industry Evolution

 *A Self Sustaining Ecosystem Where Each Successive Cycle Reinforces Its Predecessors.*

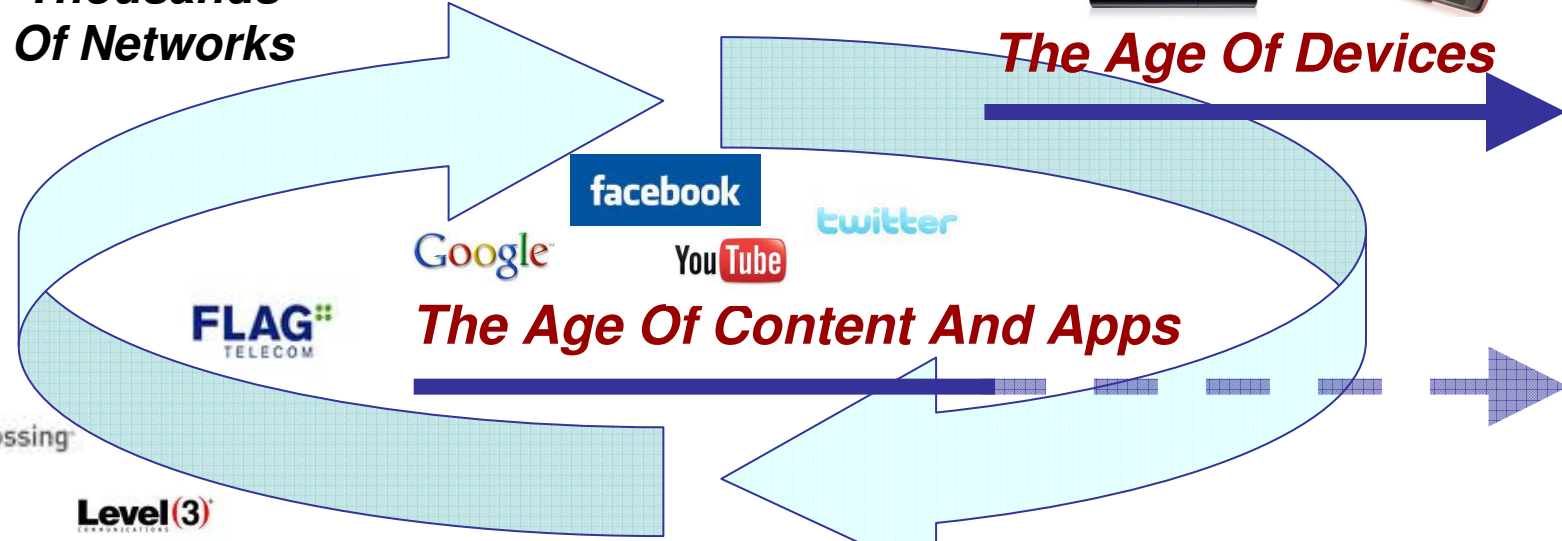
Millions Of Applications

Billions Of Devices



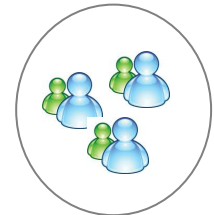
Thousands Of Networks

The Age Of Devices



The Age Of Content And Apps

Billions Of Users



Global Crossing

Level(3)

The Age Of Connectivity

1995



The Means Of Delivery

2000



The Means Of Production

2005



The Means Of Consumption

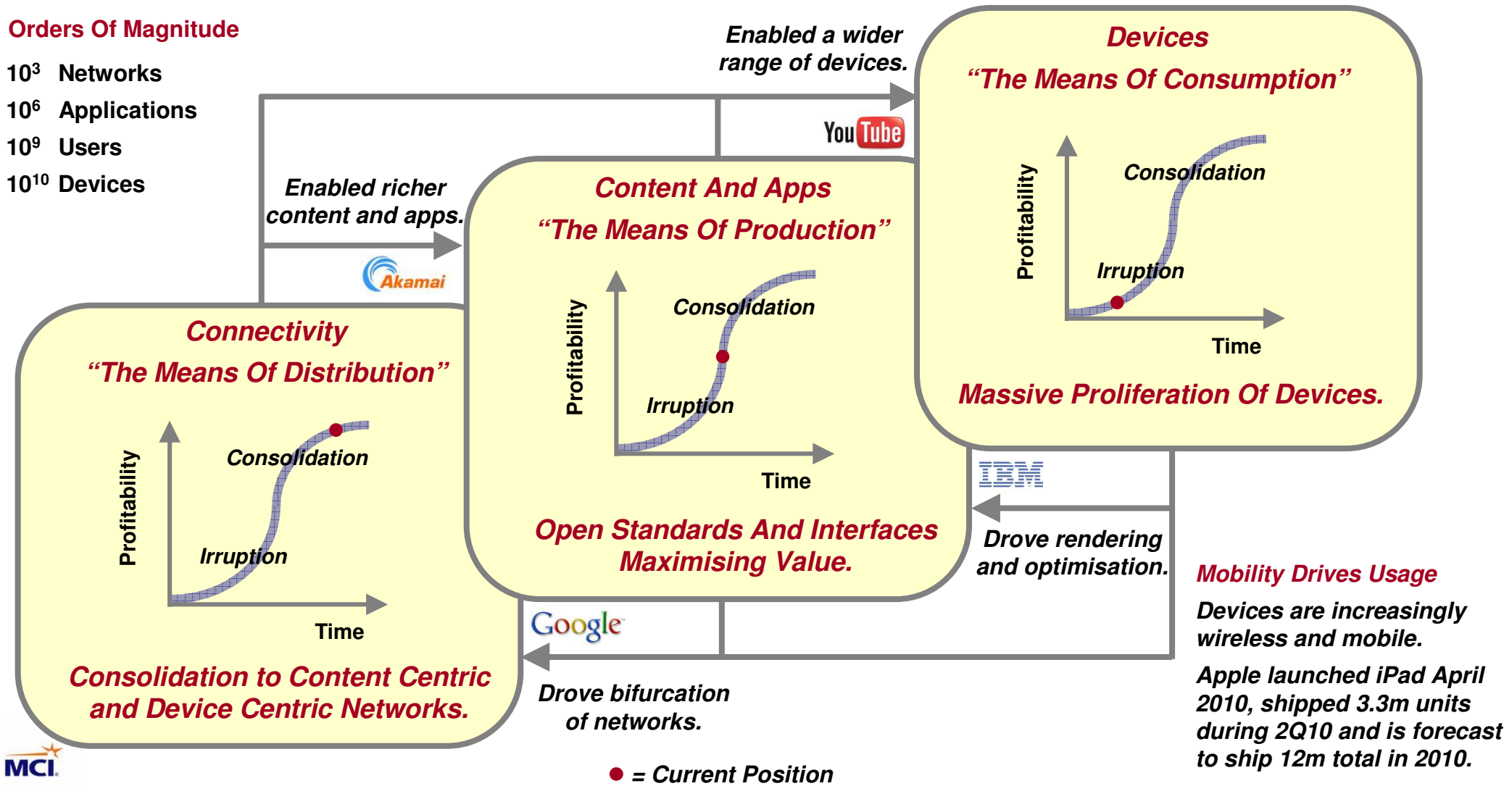
2010

Consecutive Cycles

Self Sustaining Ecosystem Where Each Cycle Reinforces Predecessors. 

Orders Of Magnitude

- 10³ Networks
- 10⁶ Applications
- 10⁹ Users
- 10¹⁰ Devices



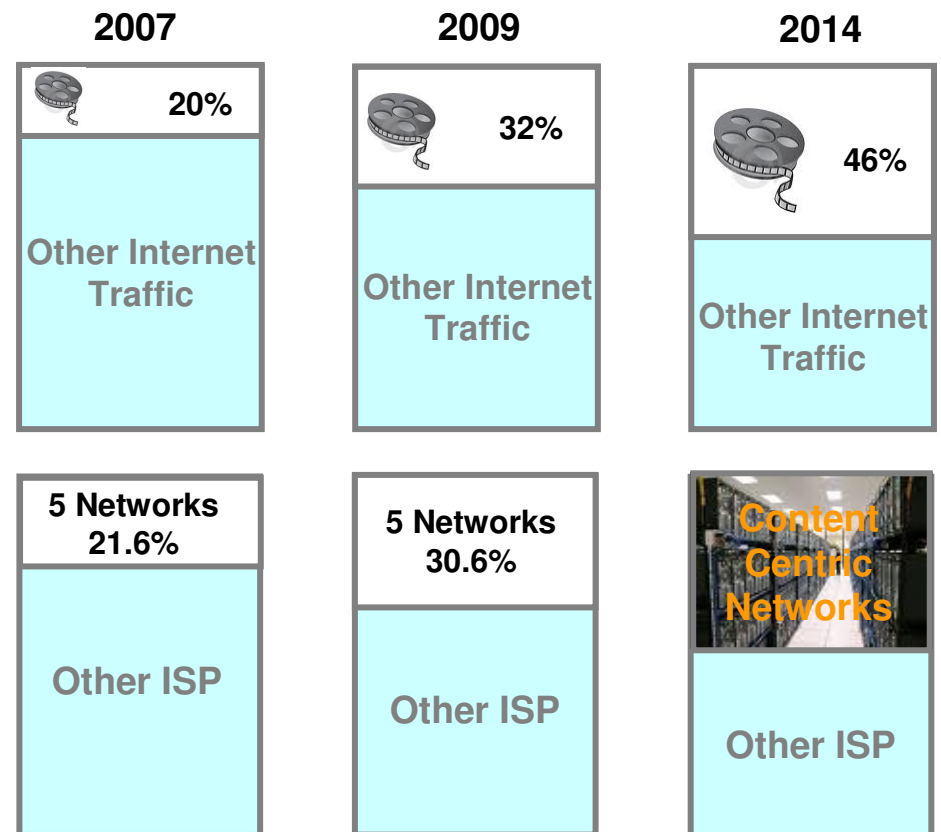
Consolidation Of Supply

Growth of Video Traffic

- Video traffic growing at 52% CAGR.
- Sustained by projects such as YouView, HbbTV and Google TV.

Growth of Content Centric Networks

- A decreasing number of networks originate increasing proportion of traffic.
- Content Centric Networks eg Akamai and Google account for increasing share.
- Expect trend to persist as consumption of video continues to increase.



Respective Traffic Contribution

Company	2007	2009	CAGR
Level(3)	6%	9%	22%
Akamai	3%	7%	52%
Google	2%	6%	73%

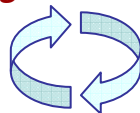
Consolidation Of Demand

Example: UK fixed broadband market development

2007

ISP	Subs m	Share %
NTL	3.77	24.0
BT	3.66	23.3
CW	2.2	14.0
Tiscali	1.45	9.2
Orange	1.1	7.7
Total	12.29	78.2

Organic Growth

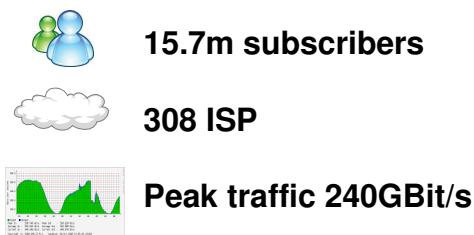


M&A

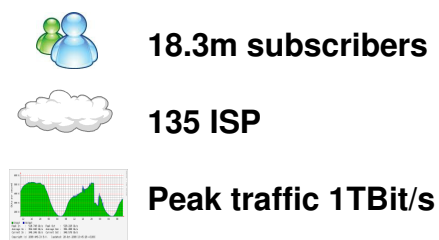
2009

ISP	Subs m	Share %
BT	5.20	28.0
TalkTalk ¹	4.19	22.9
Virgin ²	4.18	22.8
Sky ³	2.60	13.7
Orange	0.82	4.5
Total	16.99	91.9

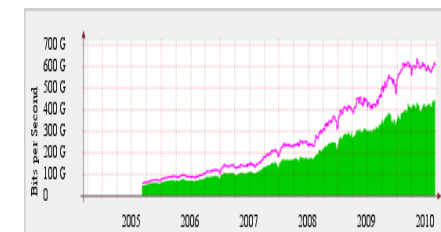
Total Market



Total Market



Robust market growth despite recession.



Notes:

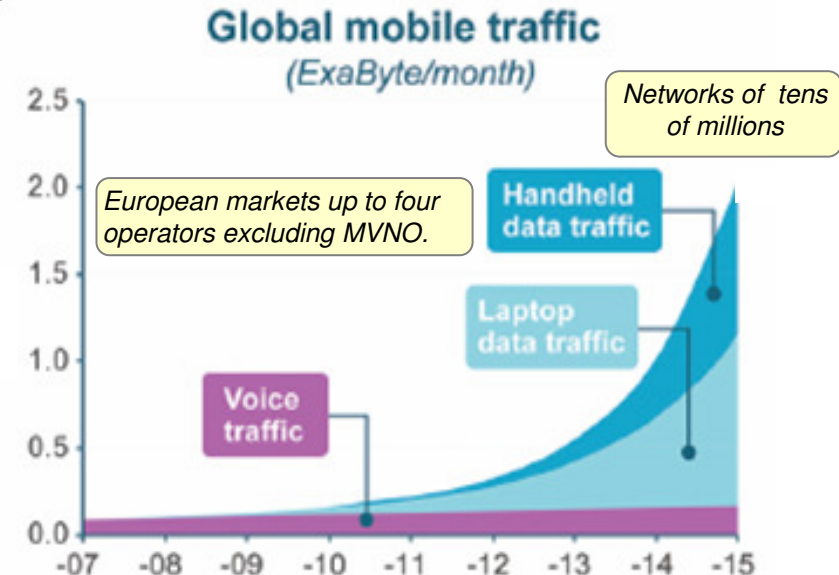
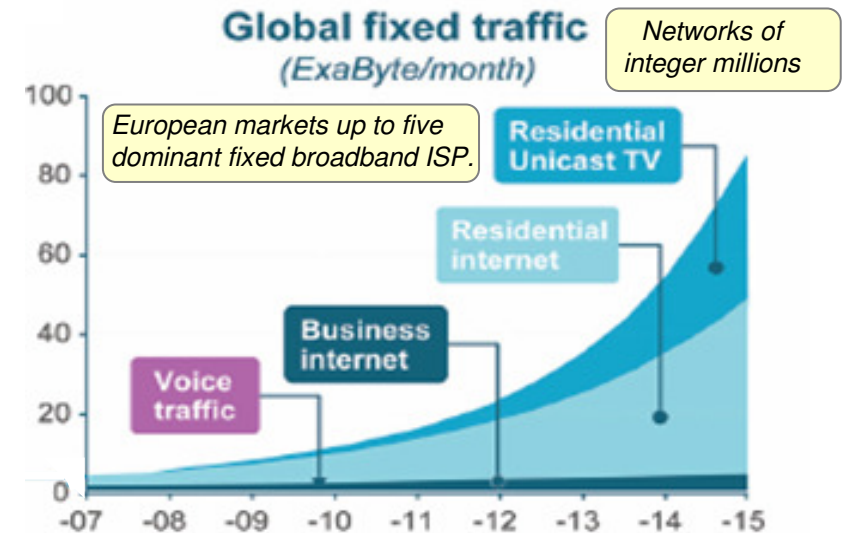
- 1 Talk Talk product of CW acquisition of Tiscali and demerger of broadband.
- 2 Virgin product of NTL merger with Virgin Mobile.
- 3 Sky market entry through acquisition of Easynet in 2005.

Fewer but bigger and better connected broadband networks leverage increasing economies of scale.

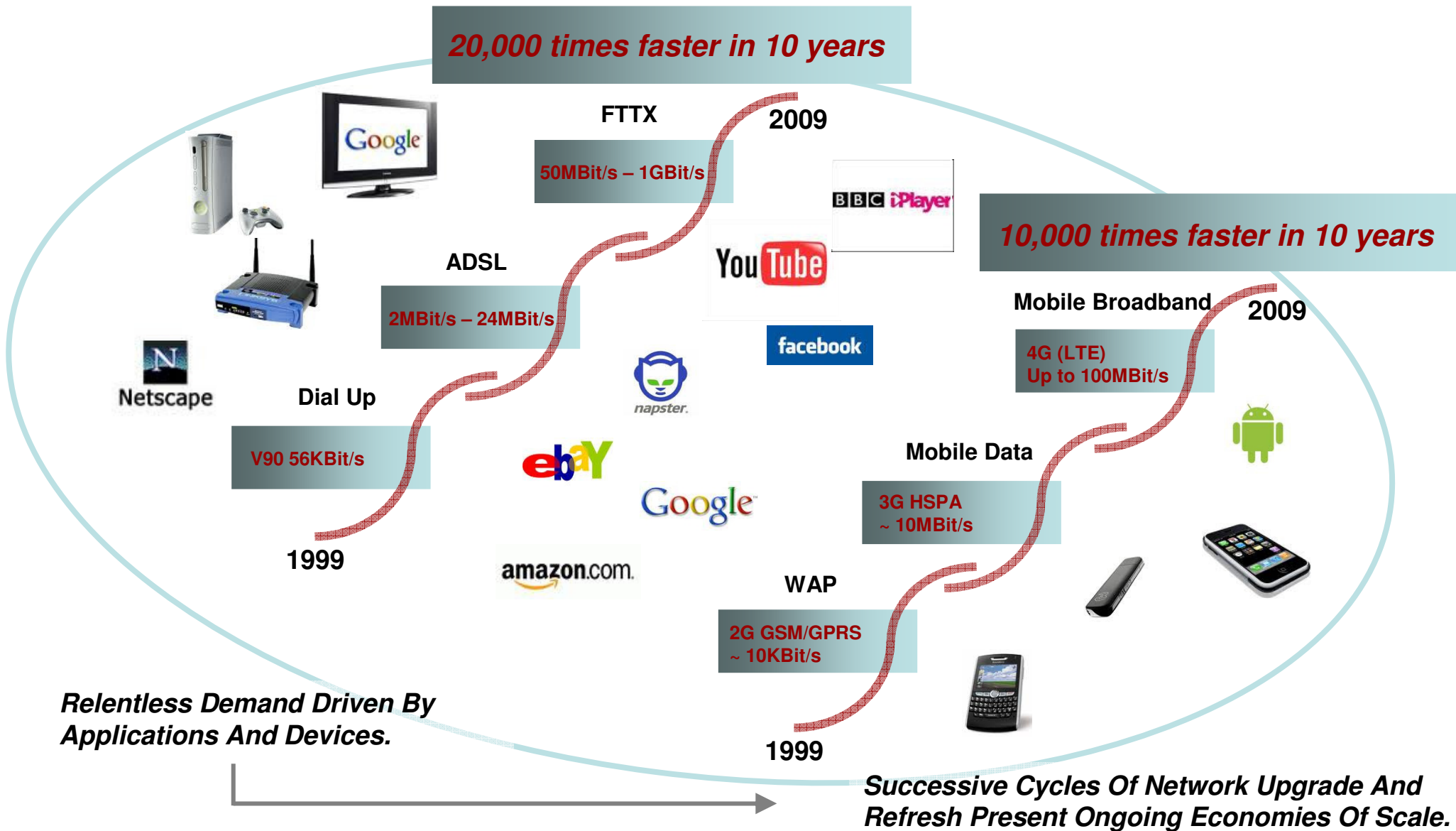
Fixed And Mobile Broadband Traffic Growth

- **UK mobile broadband data traffic grew rapidly to 0.01 EB/month in two years.**
- **Mobile five years behind fixed broadband.**
- **Fixed broadband took ten years to reach the 0.01 EB/month milestone in 2005.**
- **Fixed broadband traffic is currently two orders of magnitude greater at 10EB/month.**
- **This will decrease to one order magnitude by 2015 when mobile will reach 2EB/month.**
- **FTTX is taking fixed broadband from integer digit MBit/s to GBit/s access rates.**
- **LTE will take mobile from integer to treble digit MBit/s access rates.**

Calibration: 1ExaByte (EB) = 10^{18} bytes. Equivalent to 250 million feature length movies.
1 Exabyte/month equates to an average throughput of 3TBit/s.

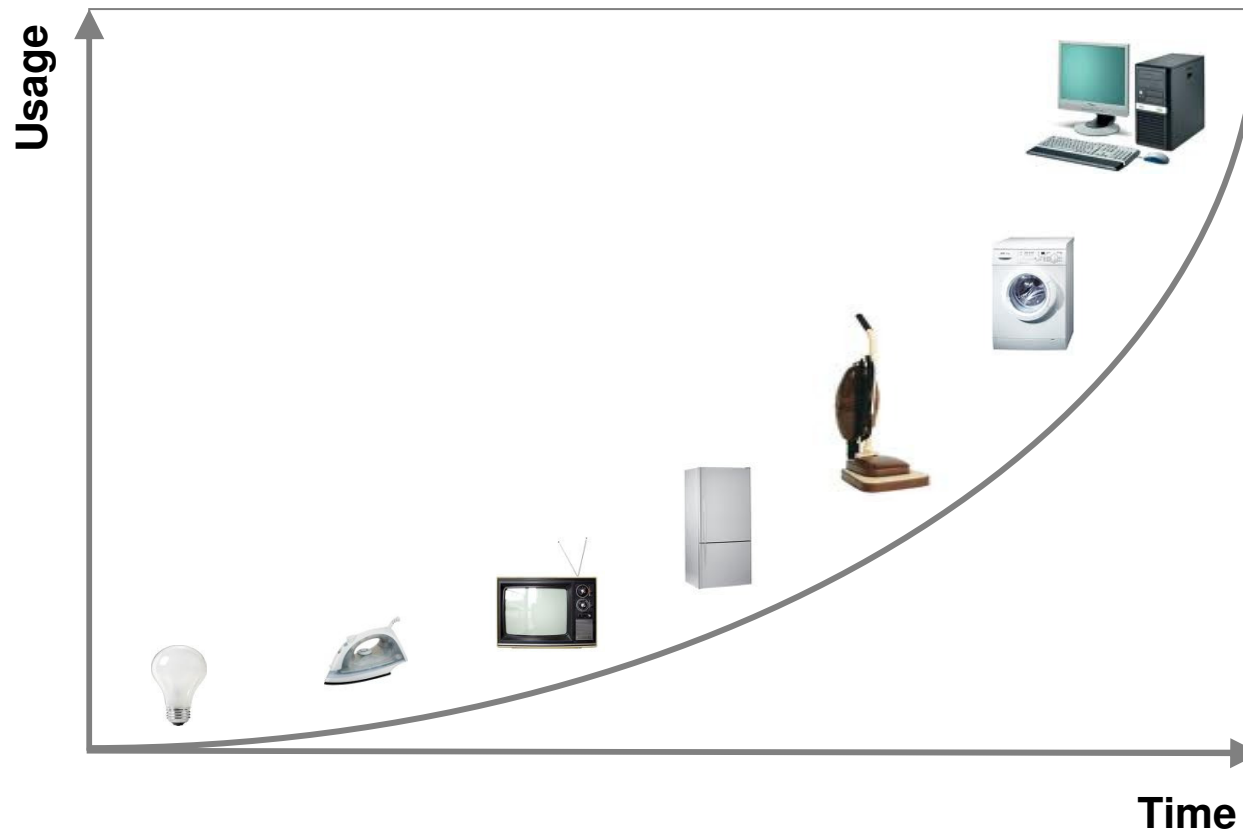


Increasing Access Bandwidth



Fixed Broadband

A utility analogous to the electricity industry.



When Swan invented the first light bulb in 1878 he probably did not foresee the full implications on society.

Mobile Broadband

- **Total UK Internet traffic ~ 6TBit/s peak.**
- **Total UK mobile broadband traffic ~ 66GBit/s.**
- **MNO do not have too much traffic - they do not have enough.**

Operator	Country	Period	Traffic Growth
T-Mobile	Europe	2009	2.80
Elisa	Finland	2009	1.65
TeliaSonera	Nordics	2009	3.75
Tele2	Sweden	2009	2.00
Orange	Europe	2008	5.50
Vodafone	Europe	2009	1.67

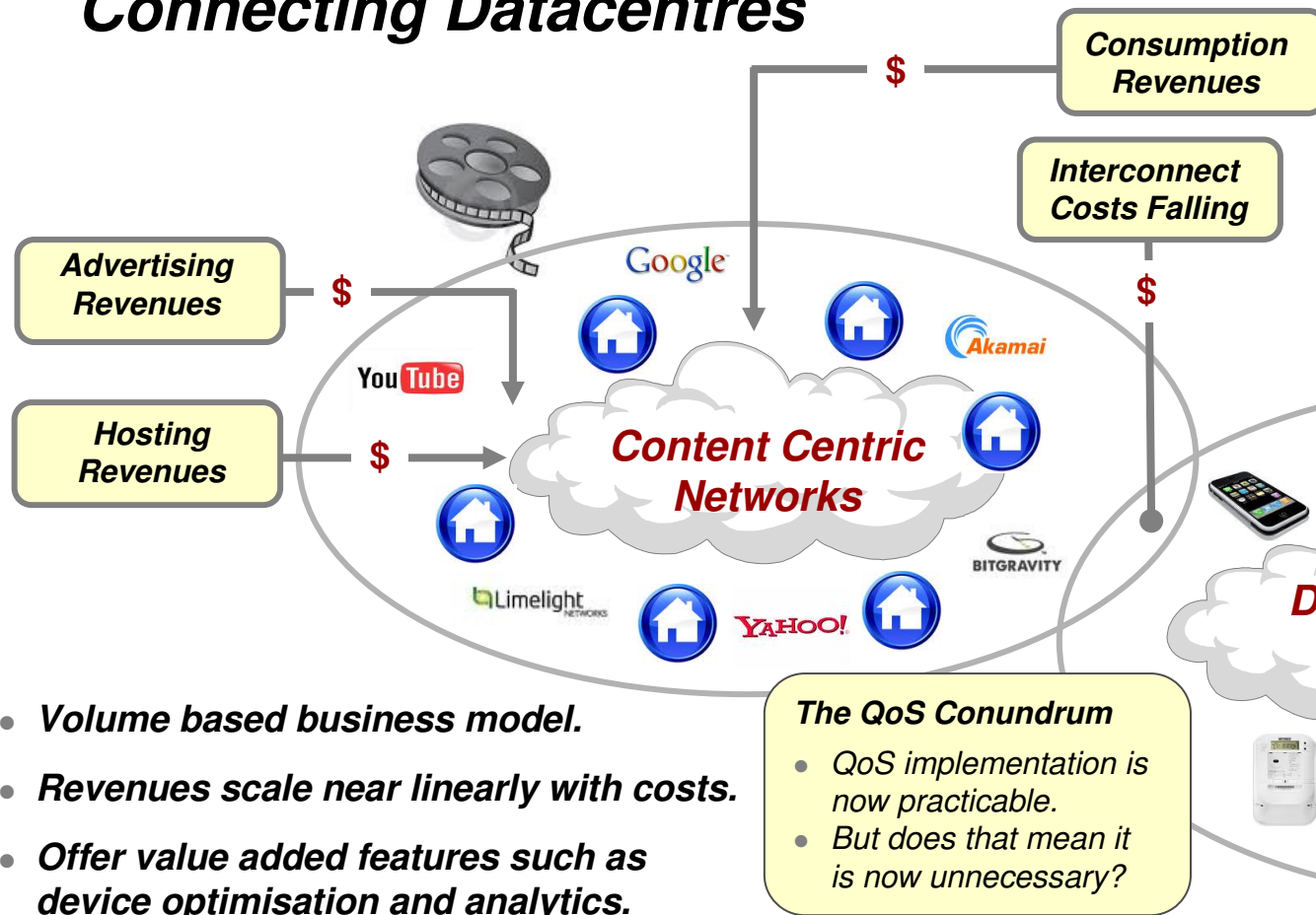
Source: BNP Exane Paribas

- **Fixed broadband is growing at ~ 60% per annum but mobile broadband is growing at > 100% per annum.**
- **MNO have a scale problem now but by 2013 will probably have achieved scale equivalent to today's fixed broadband business.**
- **There is an obvious macro level opportunity to leverage economy of scale through (backhaul) network convergence.**



The Bifurcation Of Networks

Connecting Datacentres

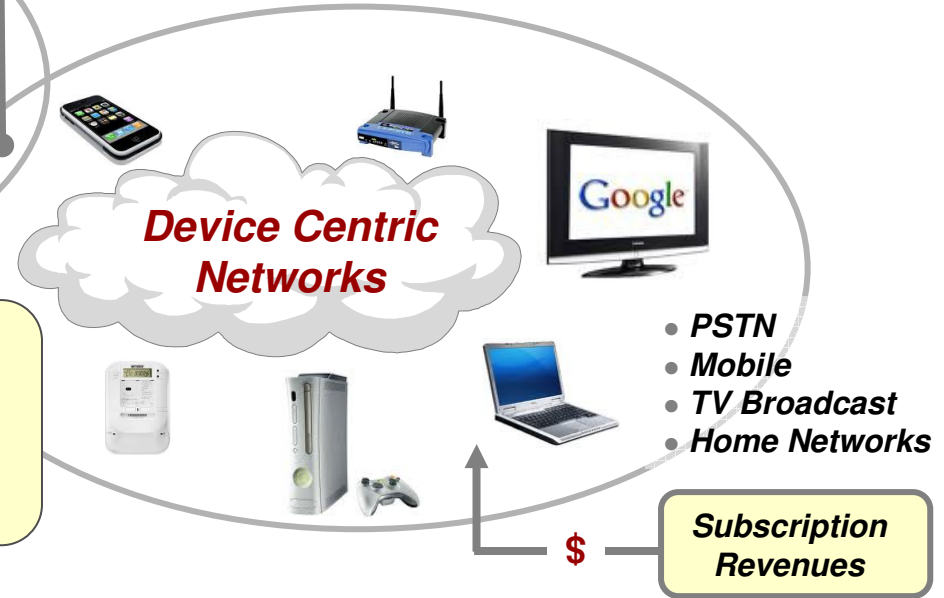


- *Volume based business model.*
- *Revenues scale near linearly with costs.*
- *Offer value added features such as device optimisation and analytics.*

The QoS Conundrum

- *QoS implementation is now practicable.*
- *But does that mean it is now unnecessary?*

Connecting Users



- *Usage agnostic business model.*
- *Operators leverage economy of scale to align revenue/cost.*
- *Support multiple access media.*
- *Mobile networks are device centric.*

- *PSTN*
- *Mobile*
- *TV Broadcast*
- *Home Networks*

Changing business models and increasing scale are establishing economic equilibrium and sustainable growth.

Network Economics

Transmission

Unit Cost Halves As Bandwidth Doubles

"If somebody can give me a cost effective 8TBit/s pipe, I can fill it up."

Bikash Koley Google 19.5.10



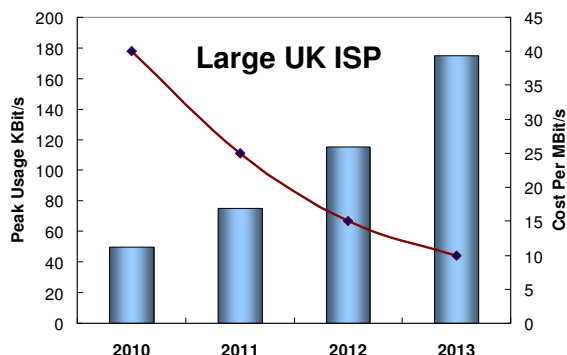
Routing

Cost Per Bit Halves Every Eighteen Months

Industry working to integrate routing, switching and policy management to reduce costs.



Moore's Law Applies



Storage

Cost Per Gigabyte Halves Every Two Years

ISP are evaluating caching which enables significant network cost reductions.



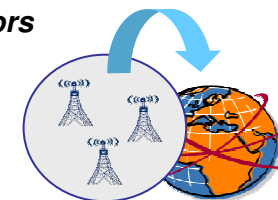
Popular Content



Convergence

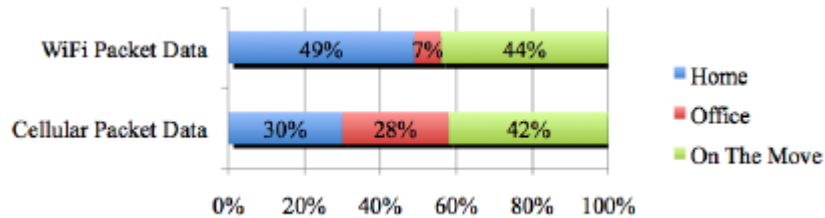
Leverage Economies Of Scale

- Converged Operators
- IP Offload
- WiFi
- MPLS



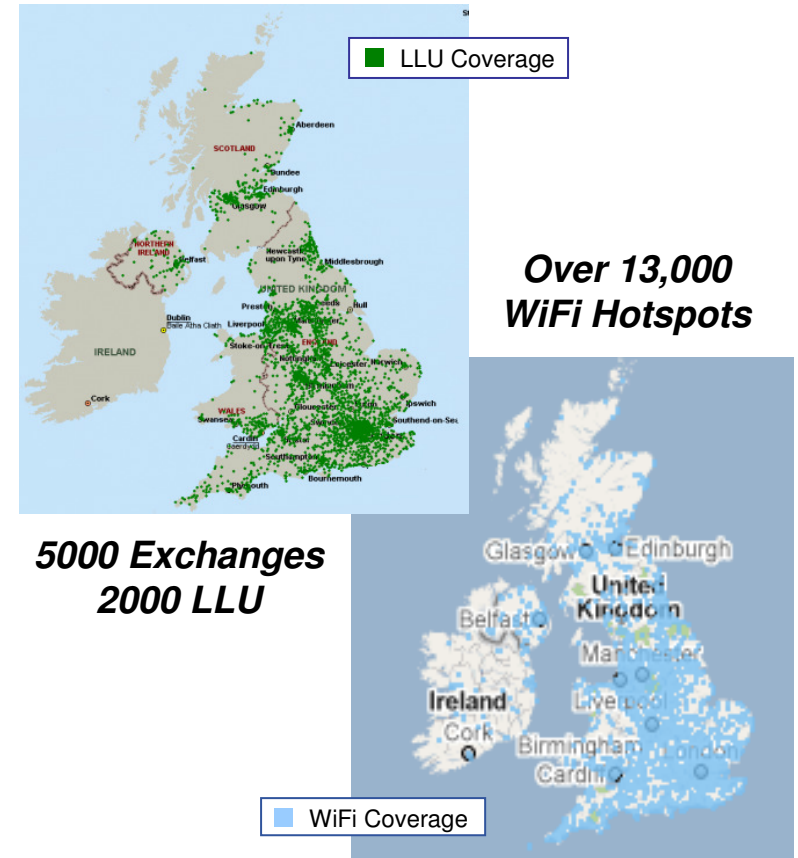
Convergence

- **Devices and users are mobile but mobile broadband usage is less so.**



Source: 3G Network Capacity/Offload Briefing Paper - Exane BNP Paribas 2009

- **Mobile Broadband is not starting from zero.**
- **The fixed broadband operators have already built the infrastructure foundations.**
- **In mature markets mobile operators can leverage next generation technology.**
- **The value (to the user) is in the flexibility of location not the network vehicle.**
- **The mobile service provider does not necessarily have to be the network provider.**



3G connected laptops generate 85% of mobile broadband traffic. Between 5 and 10 times as much per unit as smartphones.

Device Centric Networks

High bandwidth connectivity, content and applications drove the architectural bifurcation to content and device centric networks.

Device Centric networks are consolidating and converging.

- Wholesale backhaul
- IP Offload
- WiFi Offload
- Set Top Boxes

Consolidation driven by mobile broadband and device proliferation.

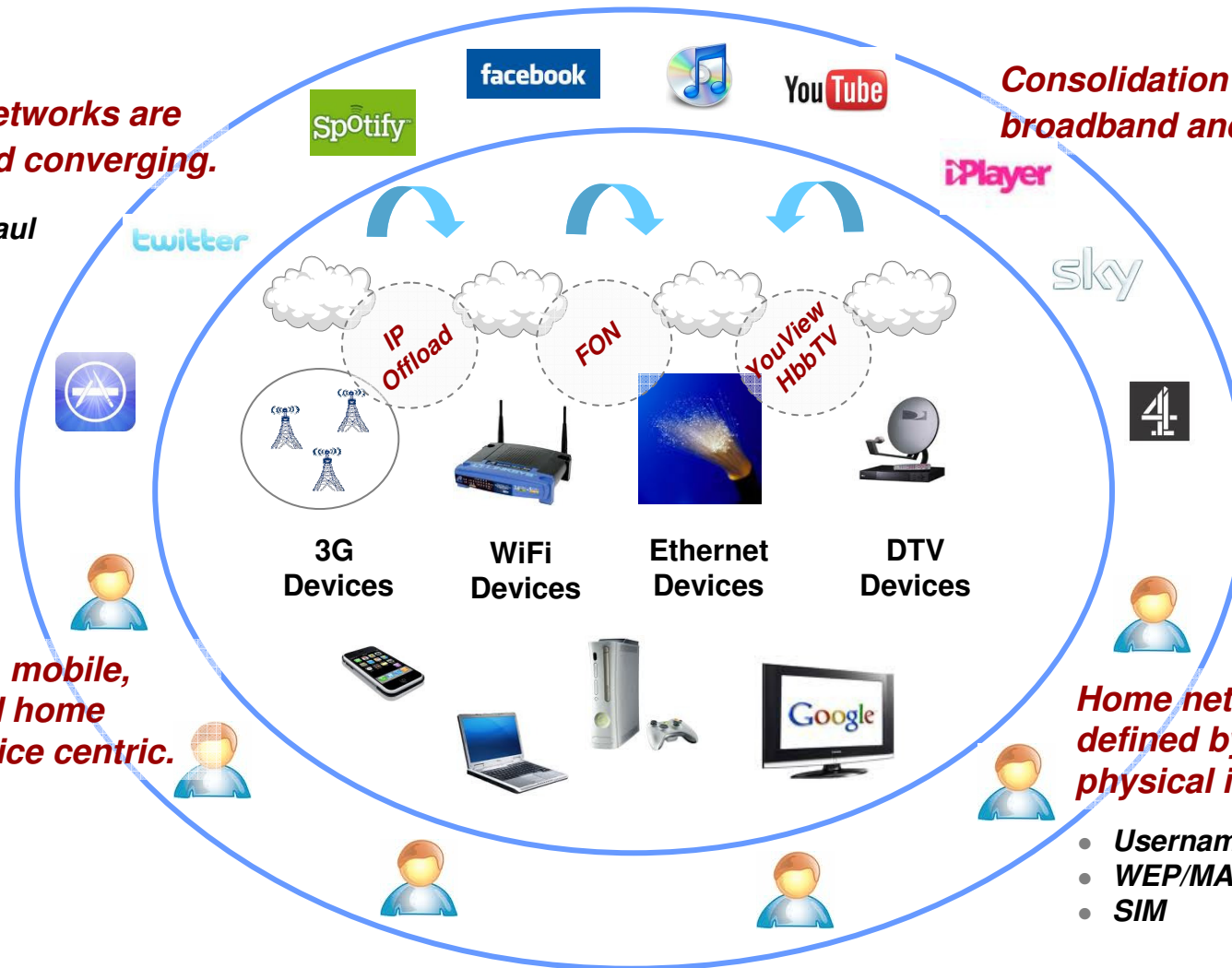
- Smartphones
- Tablets
- Dongles
- WiFi
- Gaming Consoles

Fixed broadband, mobile, broadcast TV and home networks are device centric.

- 2G/3G/LTE
- Ethernet
- Analogue/DTV

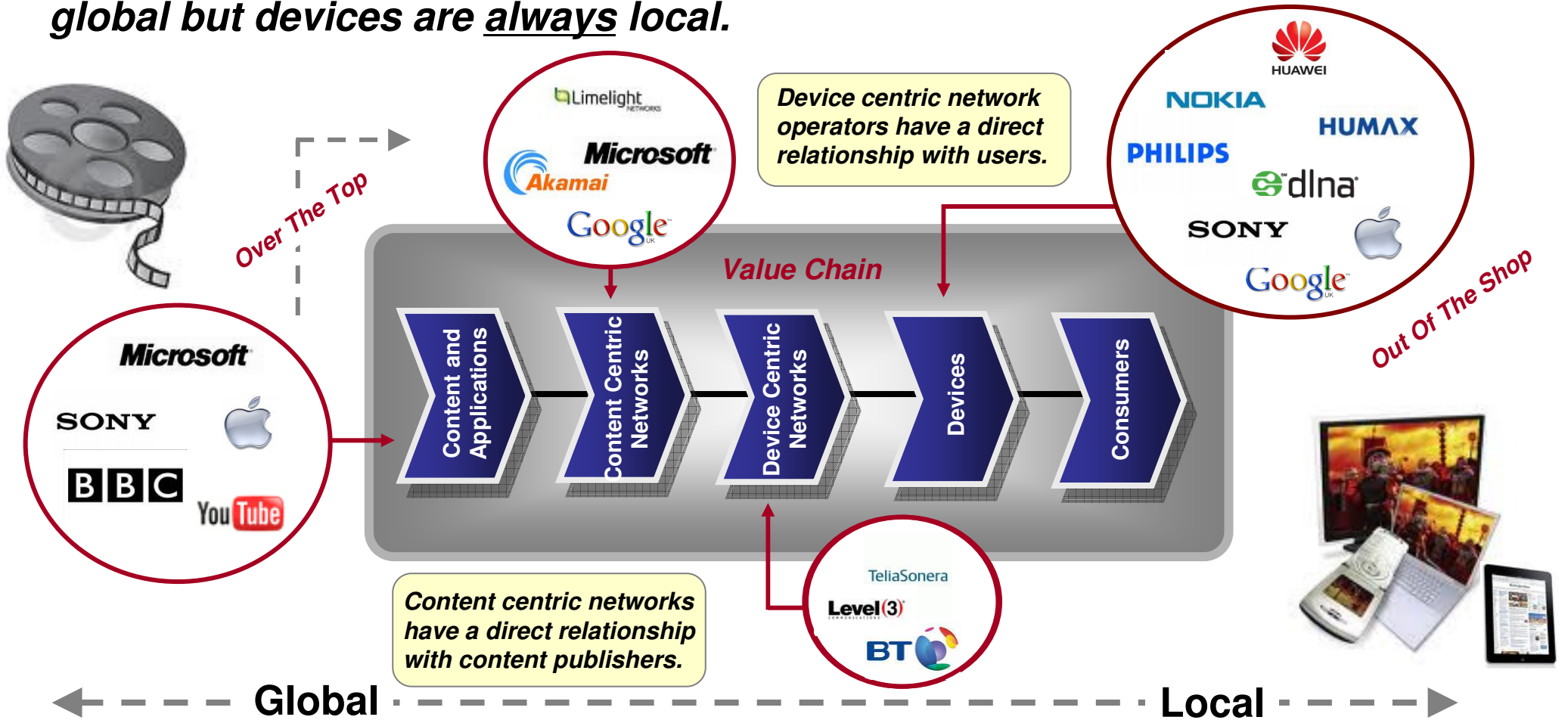
Home network virtualised and defined by user identity not the physical infrastructure.

- Username/password
- WEP/MAC
- SIM



Devices And The Value Chain

- If content drives supply then devices drive demand - content is generally global but devices are always local.*

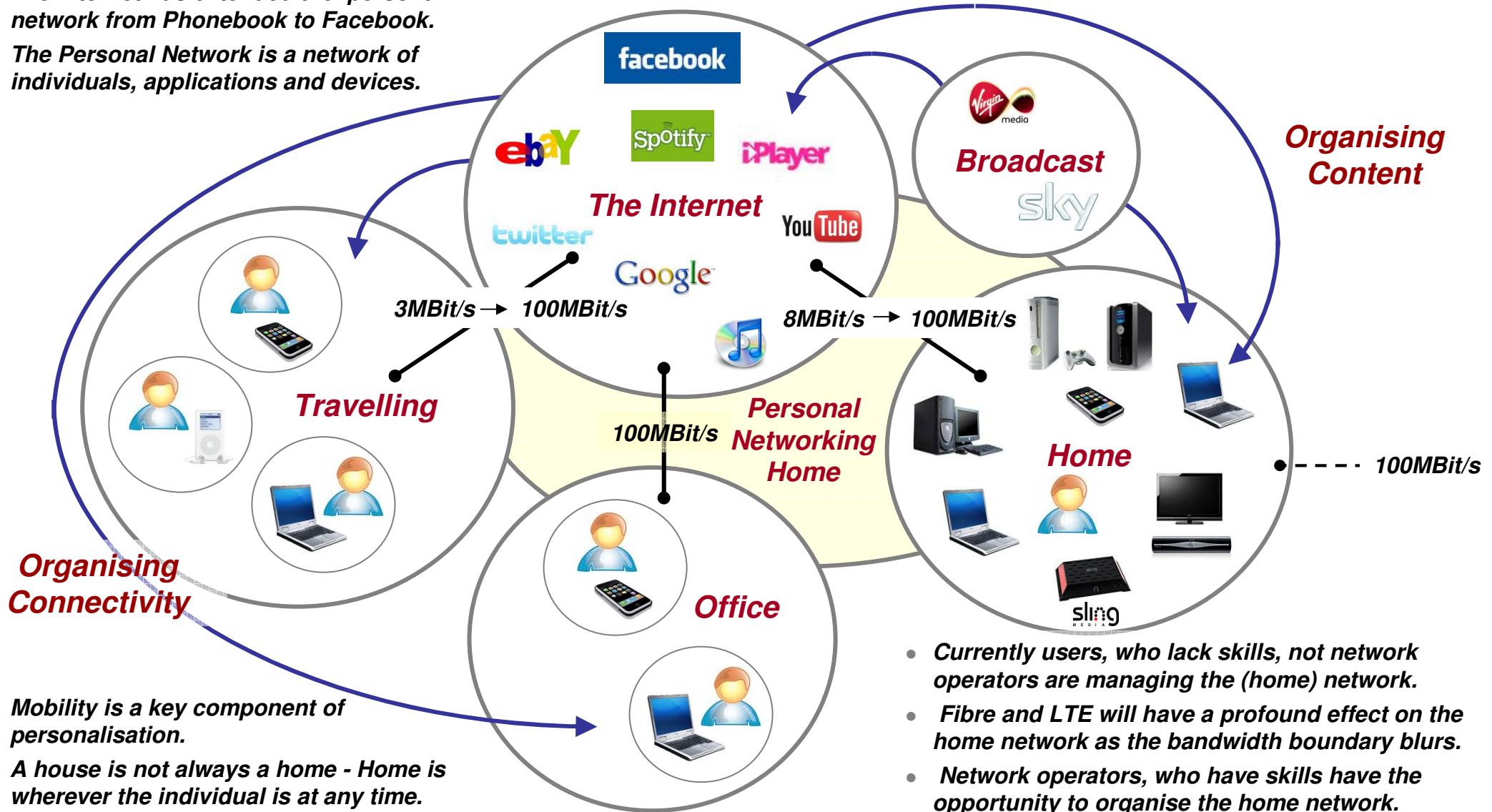


- Devices a natural area for connectivity providers who have direct relationship with users - devices include hardware and software are physical and virtual.*

Personal Networking

- The Internet has extended the personal network from Phonebook to Facebook.
- The Personal Network is a network of individuals, applications and devices.

- The home network is a subset of the Personal network.
- Convergence is happening in the home network.



- Mobility is a key component of personalisation.
- A house is not always a home - Home is wherever the individual is at any time.

- Currently users, who lack skills, not network operators are managing the (home) network.
- Fibre and LTE will have a profound effect on the home network as the bandwidth boundary blurs.
- Network operators, who have skills have the opportunity to organise the home network.

Market Perception



Apps



\$615

Devices



\$304

CDN



\$50

Connectivity



\$2.07



Stock prices as of 2.11.10

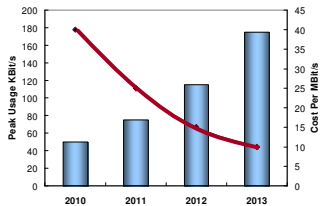
The Markets Seem To Get It.

Summary And Vision

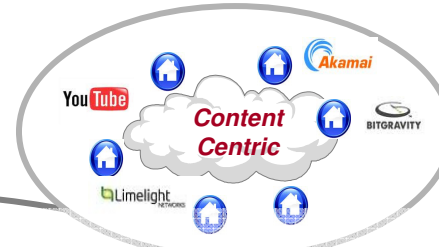
Building Massive Scale And Populating The Value Chain



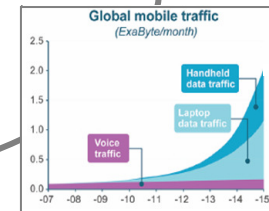
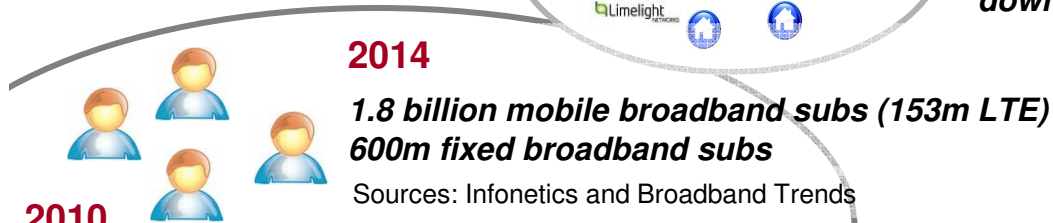
Video continues to fuel supply and will accelerate with proliferation of Internet STB, HDTV and 3D content.



Fixed access ISP with critical mass and scale are taking the industry to the next level with FTTX.



Content Centric Networks improving delivery and user experience driving down costs.



Rapid growth of mobile broadband and LTE roll out brings further scope for consolidation and scale.



Devices are proliferating, becoming increasingly network agnostic and agile driving growth in wide area and home networks.



Device Centric Networks consolidating, converging improving performance and reducing costs.

Economic consolidation and equilibrium across the value chain are establishing the necessary conditions for sustainable wealth generation in network industry.

Fibre

- It is just optical oil - it keeps the online engine running smoothly - wireless is just electromagnetic oil. But without oil the engine seizes up.
- The engine is more interesting - has potential for generation of great wealth.
- Fibre and wireless network convergence is interesting in engineering terms.
- But the combination of fibre and wireless to lubricate converged personal networks is much more interesting.
- Technology and engineering are not necessarily precursors of market and business convergence but do accelerate and lubricate that convergence.
- Fibre does not have the spectrum and interference limitations of wireless and offers almost infinite capacity.
- In the limit when fibre access is ubiquitous wireless may be limited to within premises and truly mobile applications – but that is some way off.

Thank You