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How to Build a Network for the Next 25 Years

Next Generation of Fiber Access

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Questions that need to be answered

- **How much bandwidth will be needed in the access networks of the future?**
  - How can we predict the bandwidth requirements?
- **How to physically build or design a network for the next 25 years**
  - Fiber is amortized over 20 years with a life cycle of up to 60 years
  - Fiber is the end goal - what should I consider when I layout my fiber?

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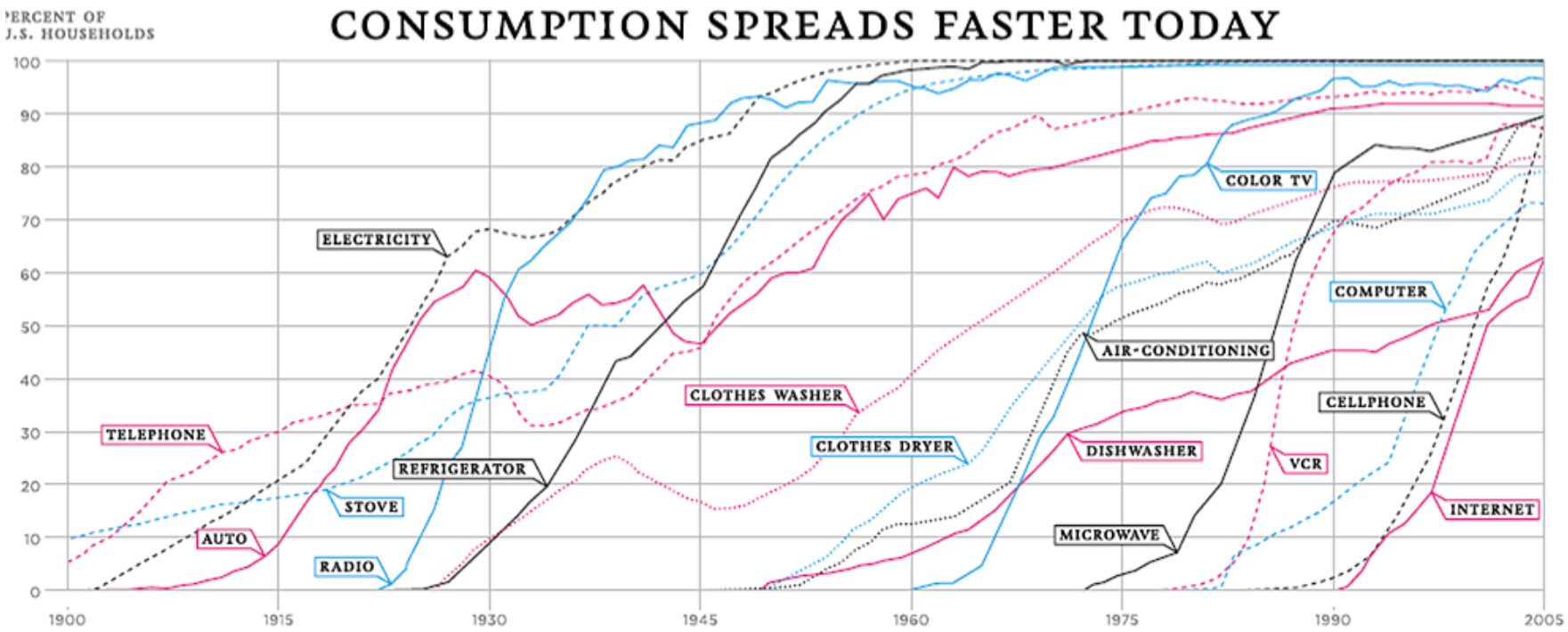
Change in the Industry

- **Adoption slope has increased**
  - IPhone, Facebook, over the top video
- **Consumer usage is based on application, not technology or services**
- **Consumers want bandwidth at a low cost**



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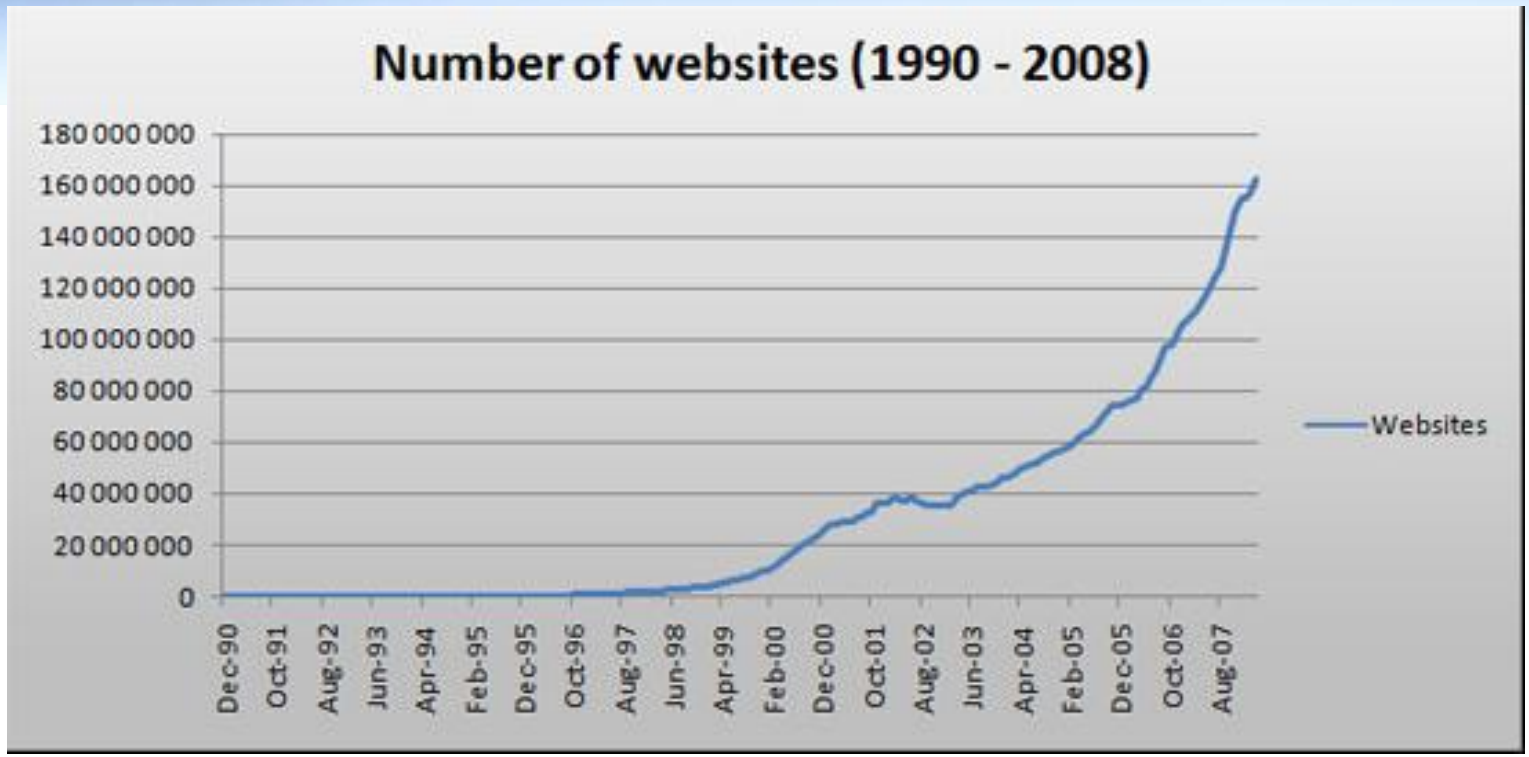
Looking back 20 years ago



- **In December 1992 there were 50 web sites**
- **In the February 2010 survey showed there were 207,316,960 sites**

Source: www.pingdom.com

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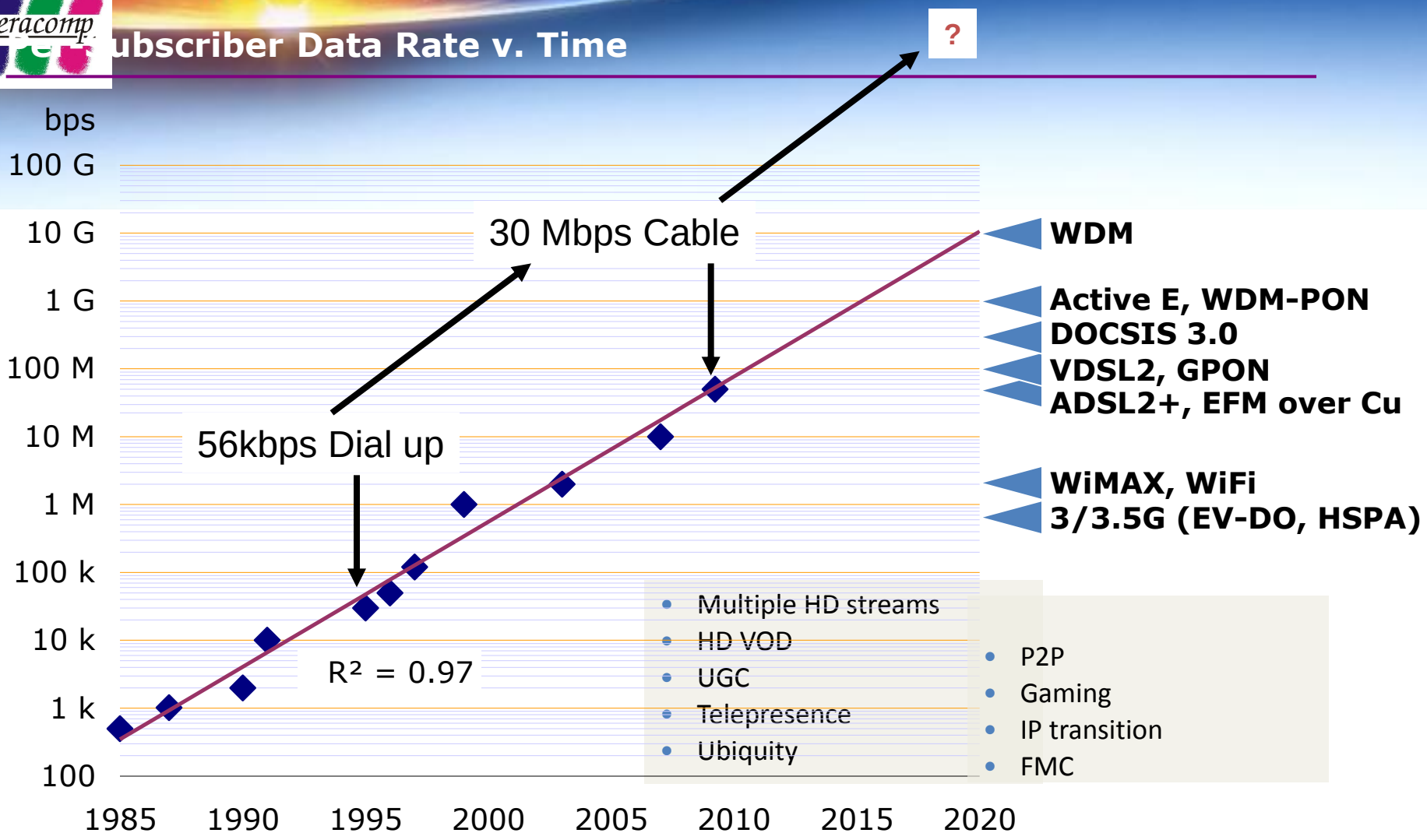
Subscriber demand for bandwidth follows a trend

Subscriber Data Rate v. Time



Source: Jakob Nielsen

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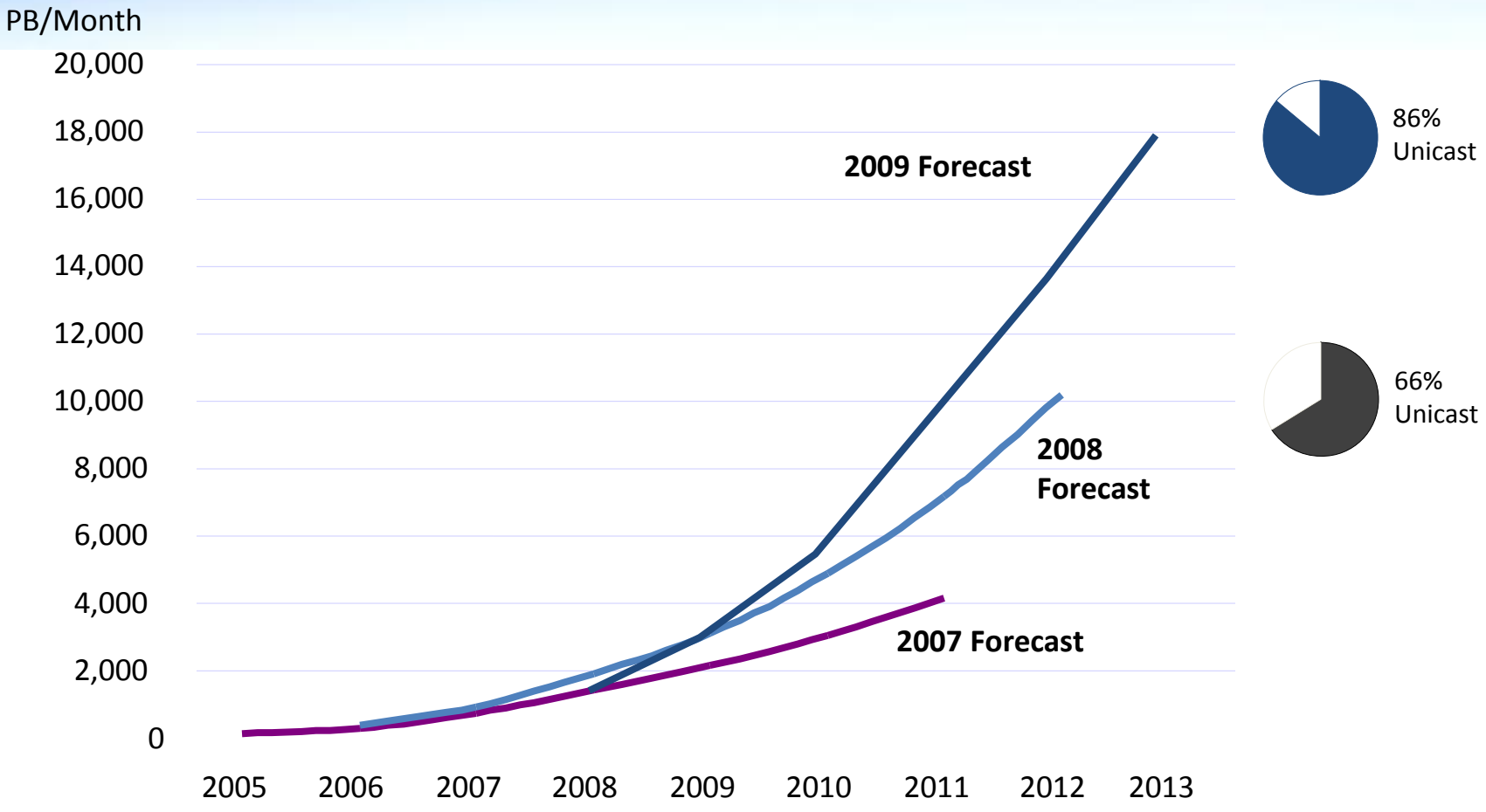
This Change is Accelerating in Magnitude and Impact

er-Year Growth in Internet Video Traffic Forecasts

Global traffic actuals and forecast for internet video to PC, internet video to TV, video communications, and gaming



Source: Cisco Visual Networking Index

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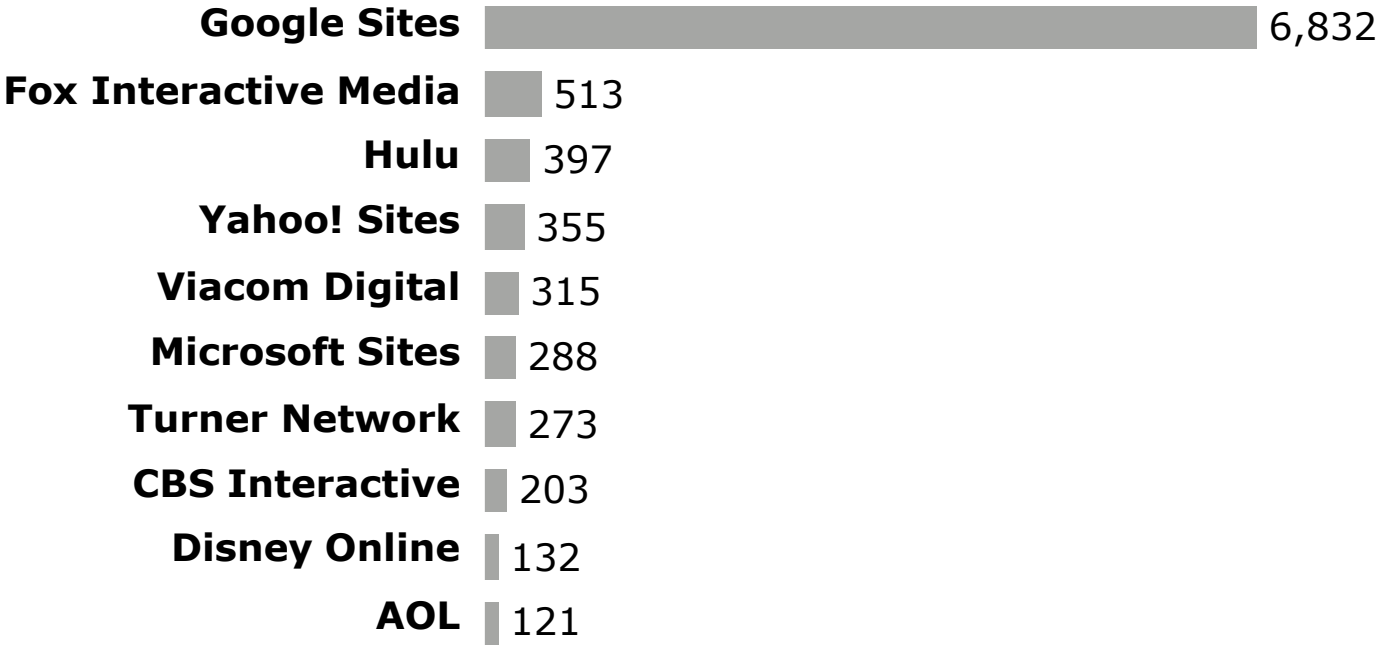
Substantial Changes in Subscriber Behavior - April 2009

Video Streaming from Top 10 Sites in April 2009

Millions of Clips Watched



Source: comScore

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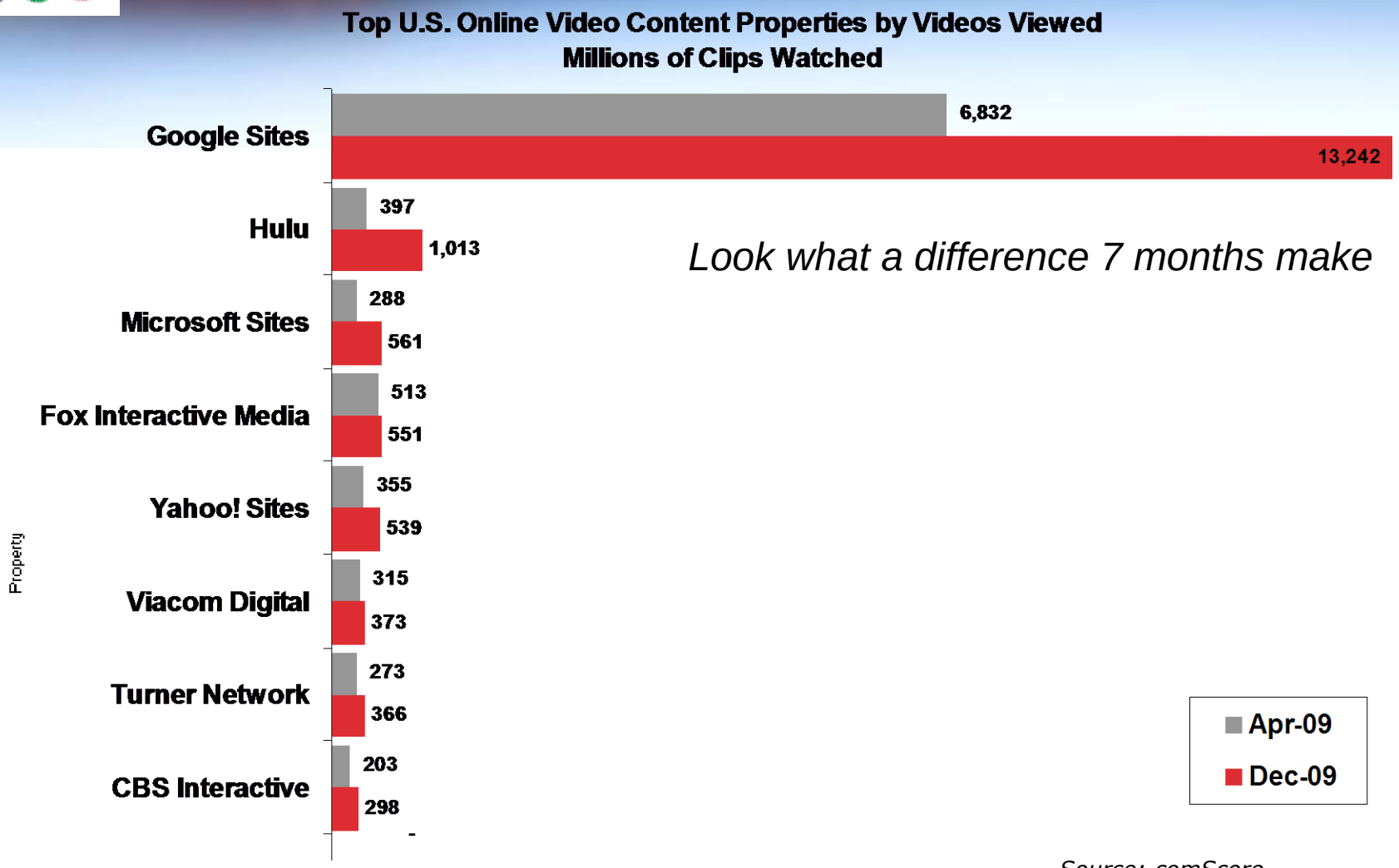
Substantial Changes in Subscriber Behavior – December 09



Look what a difference 7 months make

Source: comScore

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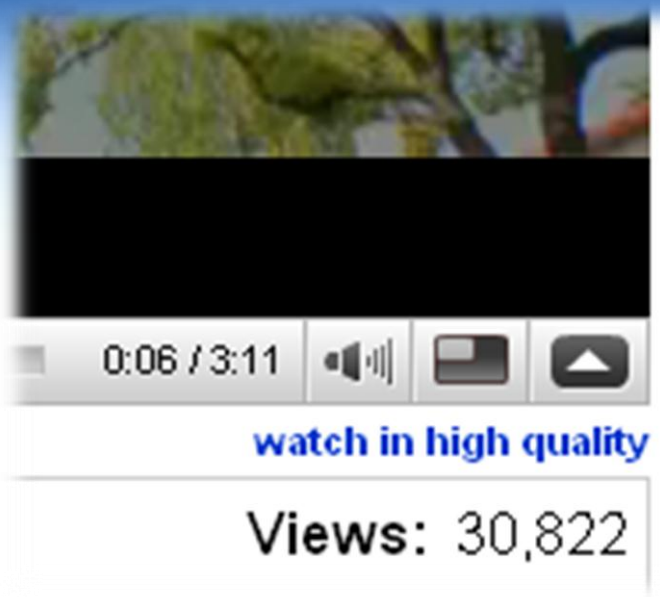
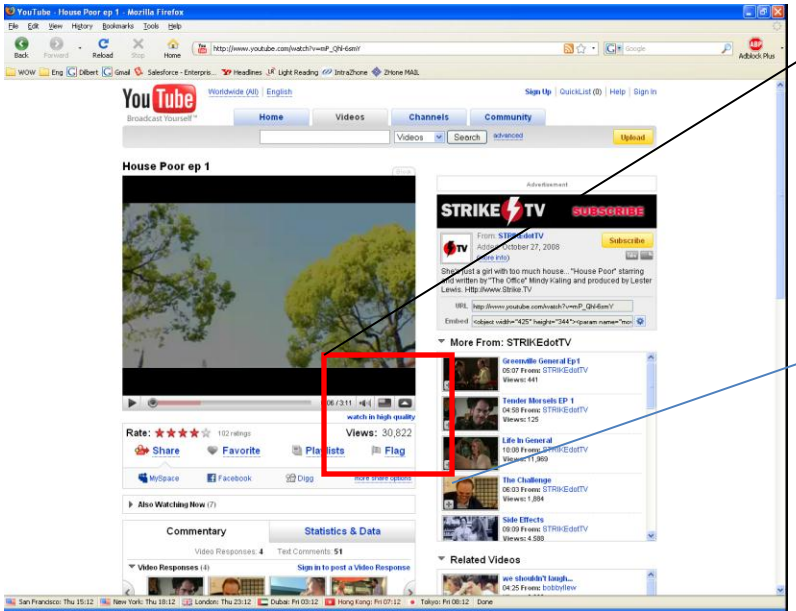
Consider New HD Content like YouTube – November 2009

Comparison of Normal Youtube vs Youtube High Quality		
	Normal Youtube	**High Quality Youtube**
Screen Res.	320 x 240	480 x 360
Bitrate	~200 kbps	~900 kbps
Audio	22KHz 64 kbps Mono ABR	44.1KHz 96 kbps Mono CBR
Frame Rate	30	30
Video Codec	Flash Sorenson	Flash Sorenson
Audio Codec	Mp3	Mp3





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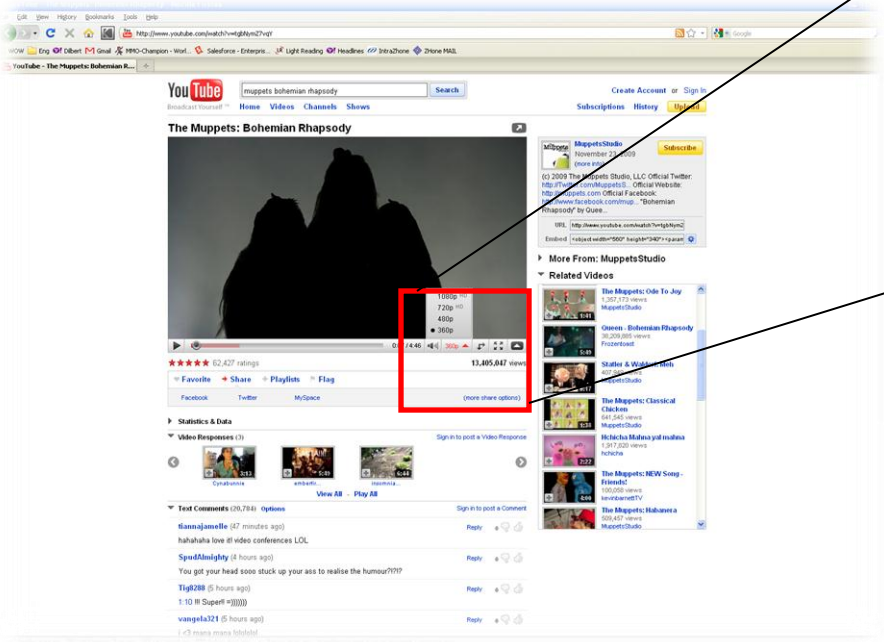
Consider New HD Content like YouTube – Today

Video over HD - 720p = 1.9-3.0 Mbps

Video over HD - 1080p = 2.2-5.0 Mbps



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High Bandwidth Drivers – New Service…Higher Revenues

- **An online world**

  GPON installed base projected to grow to 40 million by 2010 [1]

  - 100 Mbps subscriber data rates by 2015 [2]
- **A multimedia future**
  - Super-sensory - surround sound – high def – 3D
- **Demand for richer entertainment media & video**
  - IPTV and VoD changes the traffic equation
  - HDTV requires 5 times the capacity of SDTV
  - Video calling
  - Peer to Peer growth –
    - Video, photos and music
  - Niche broadcasting
  - Combination of amateur, pro-consumer and licensed video.
  - Tele-medicine
  - 3-D gaming

[1] *Infonetics*

[2] *The Yankee Group*

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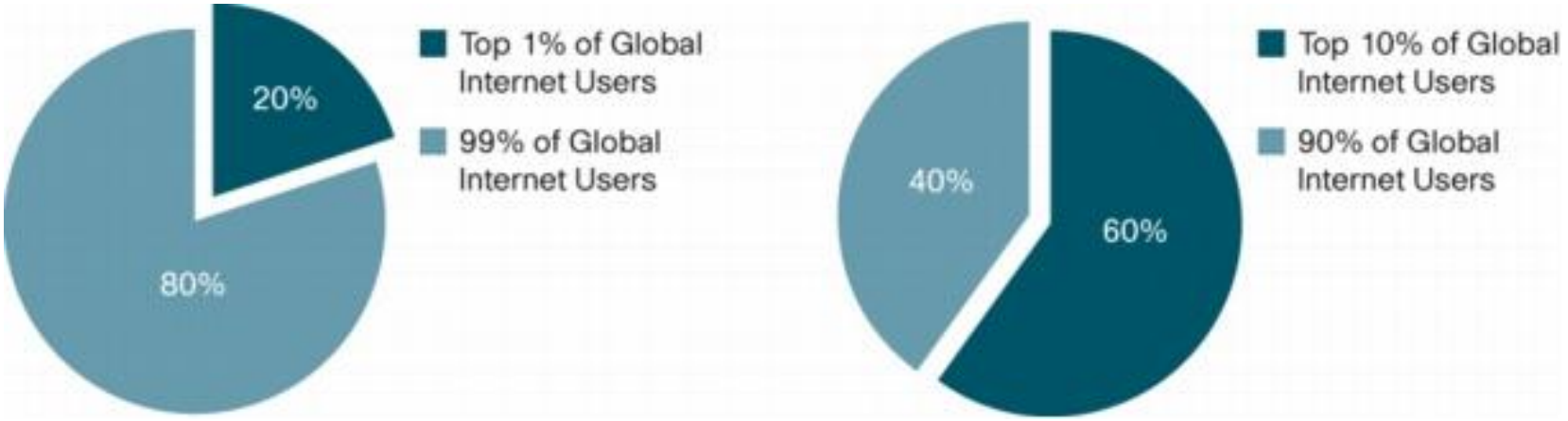
Who Uses How Much…

- **Figure 1. Top 1% and Top 10% of Global Broadband Subscribers Create 20% and 60% of Internet Traffic Respectively**



- **Yankee group estimates the top 5% of users use at least 75% of the bandwidth.**
  - The caveat from several sources in the DPI/policy management world is while the prior statement is generally true, the users making up the top 5% tend to change on a month to month basis.

Cisco Visual Networking Index: Usage Study 2009

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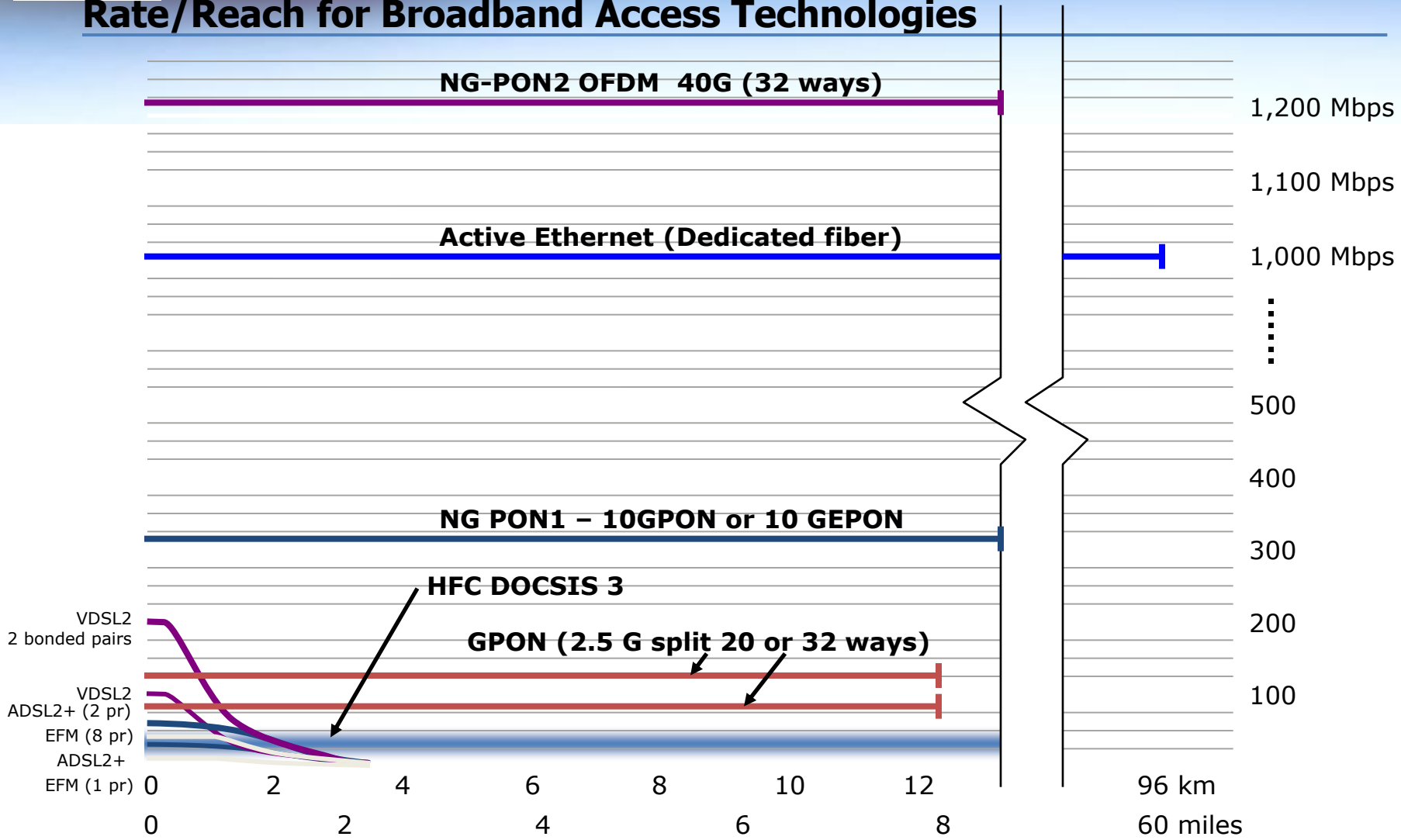
Next Gen FTTx Solutions

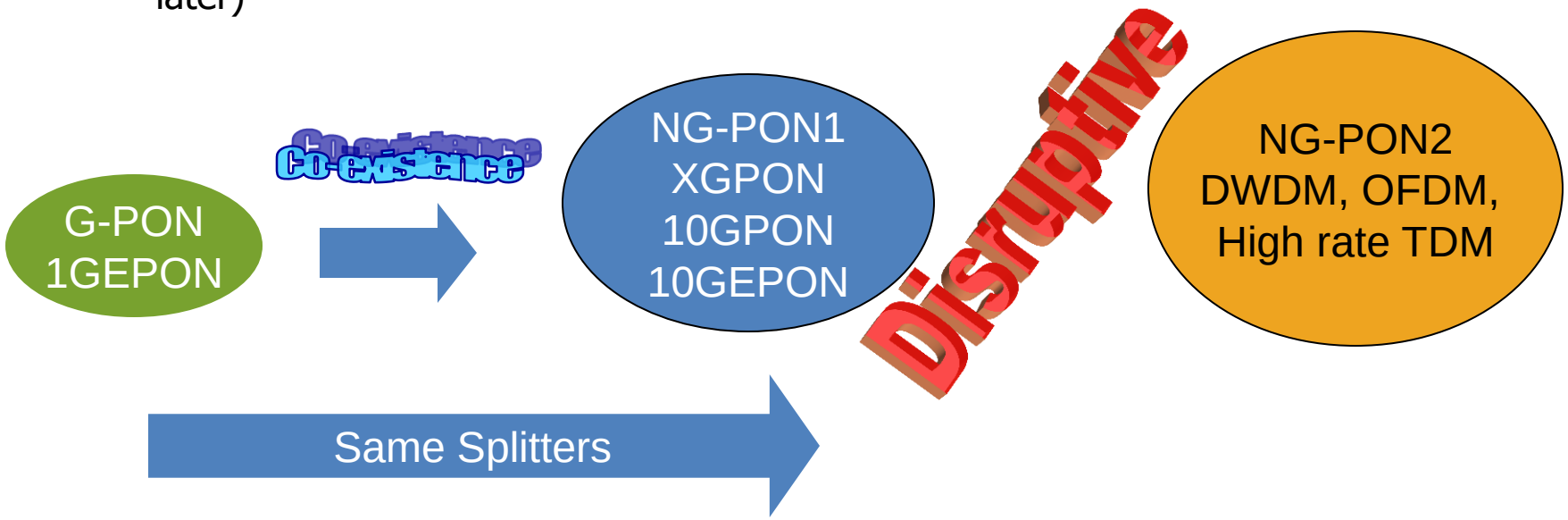
Rate/Reach for Broadband Access Technologies



Sources: DSL Forum; Zhone testing.

What's Next for PON

- **NG–PON1: supports the coexistence with G–PON on the same ODN. The coexistence feature enables seamless upgrade of individual customers to NG-PON on a live ODN without disrupting services of other customers.**
  - Viewed as a Interim solution to get us to 10Gbps
  - XGPON (10Gigiabit capable PON) Based on TDMA is the solution
- **NG–PON2: "Disruptive" NG–PON with no requirement in terms of coexistence with G–PON on the same ODN.**
  - Will be the long term solution for carriers
  - Requirements for new technologies under consideration. (will be addressed later)



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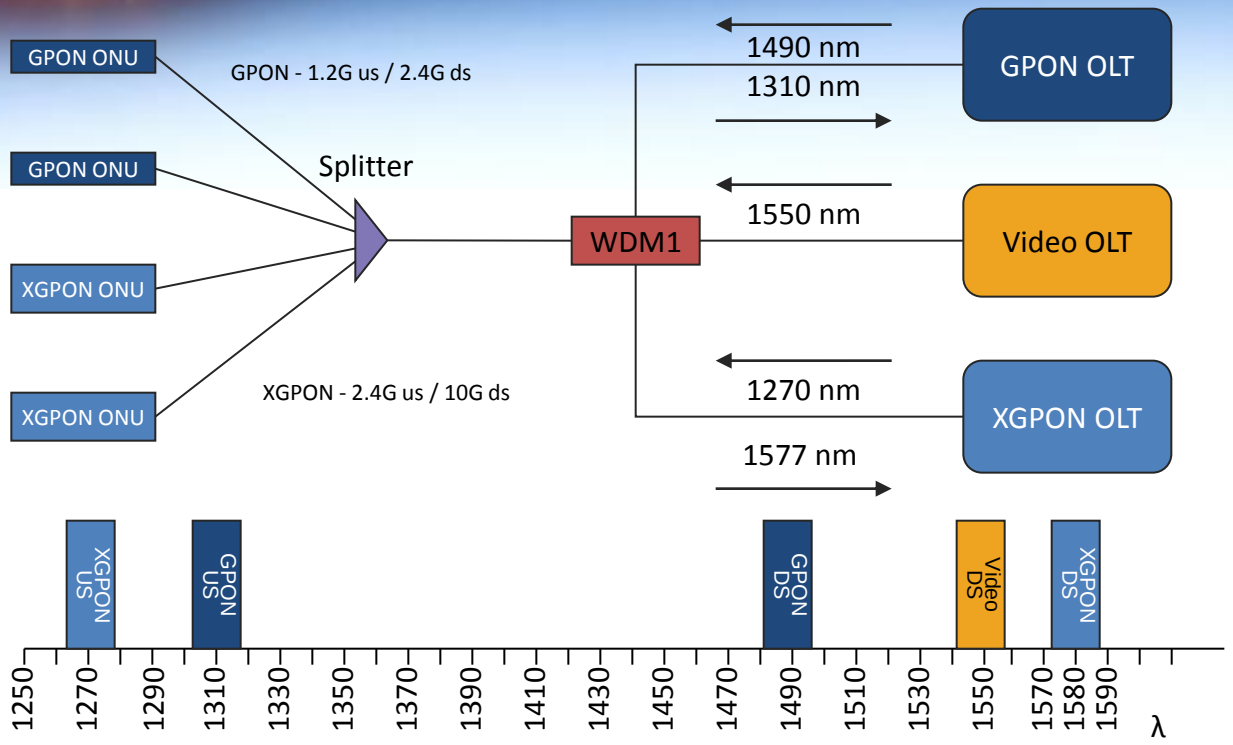
GPON and XGPON Co-existing on the Same ODN



- No overlapping frequencies allow for co-existence
- XPGON can be deployed over existing ODN connected subscribers with the same infrastructure, i.e. fiber, splitter, connectors, etc.

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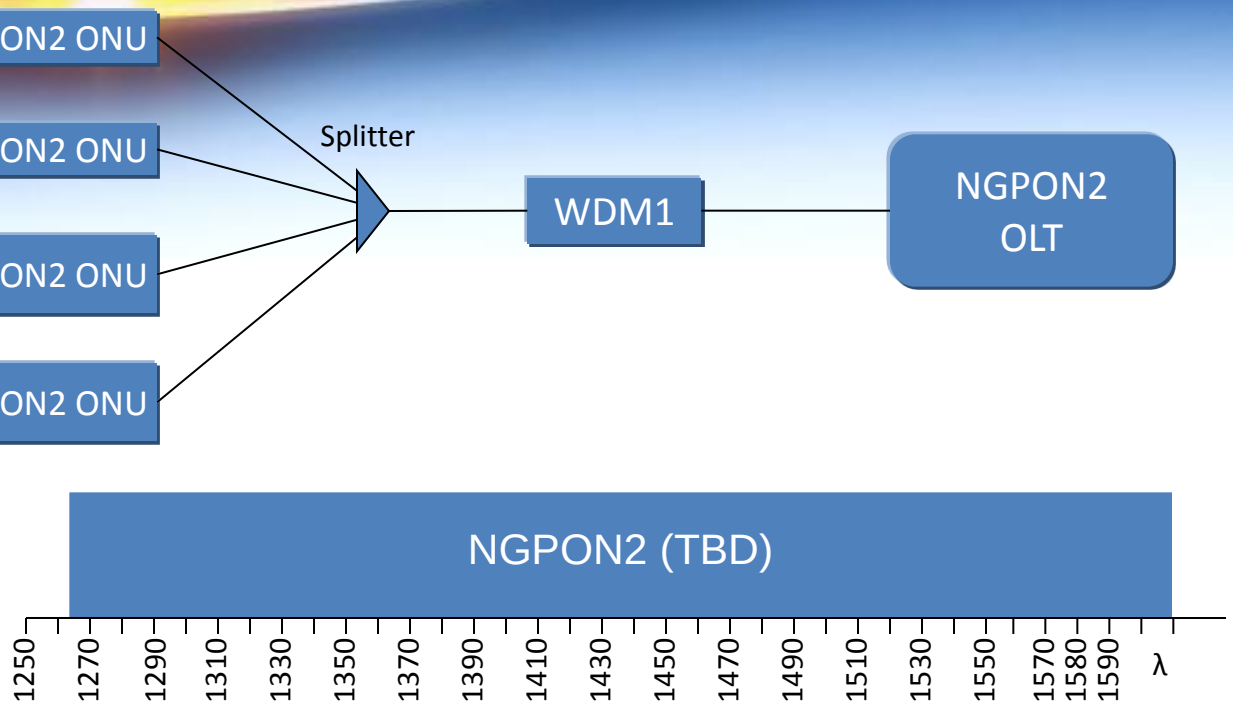
NGPON 2



- No co-existence requires
- Higher bandwidth either 40G or 100G
- Expected to use the same infrastructure (physical ODN)
- Looking at longer reach for Central Office consolidation without an extender box

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NG PON1 – XGPON - Features

- **Single fiber transmission**
- **Bandwidth**
  - Downstream – Nominal – 10Gbps
  - Upstream – Nominal 2.4 Gbps
- **Media Access Control Layer**
  - Upstream – TDM/ Downstream - TDMA
  - Forward Error Correction with Scrambled NRZ Line Encoding
- **Optical Characteristic**
  - For the Upstream "O- Band" Ranging from 1260 to 1280nm
  - For the Downstream "1577nm" Ranging from 1575 to 1580nm
- **Optical Power**
  - "Nominal" Budget is to be Determined Between 28.5 dB to 31 dB
- **Split Ration Support**
  - At Least 64:1 (possibly up to 256)
- **Fiber Distance**
  - At Least 20 km with Logical Distance up to 60 km
  - Extended GPON Under Consideration
- **Supports Authentication, Identification and Encryption**
- **Dynamic Bandwidth Allocation**
- **Full QOS and Traffic Managements**
- **Enhanced Timing and Time of Day Synchronization for Mobile Backhaul Apps**

10 GPON is well defined and expect first products end 2010 to early 2011

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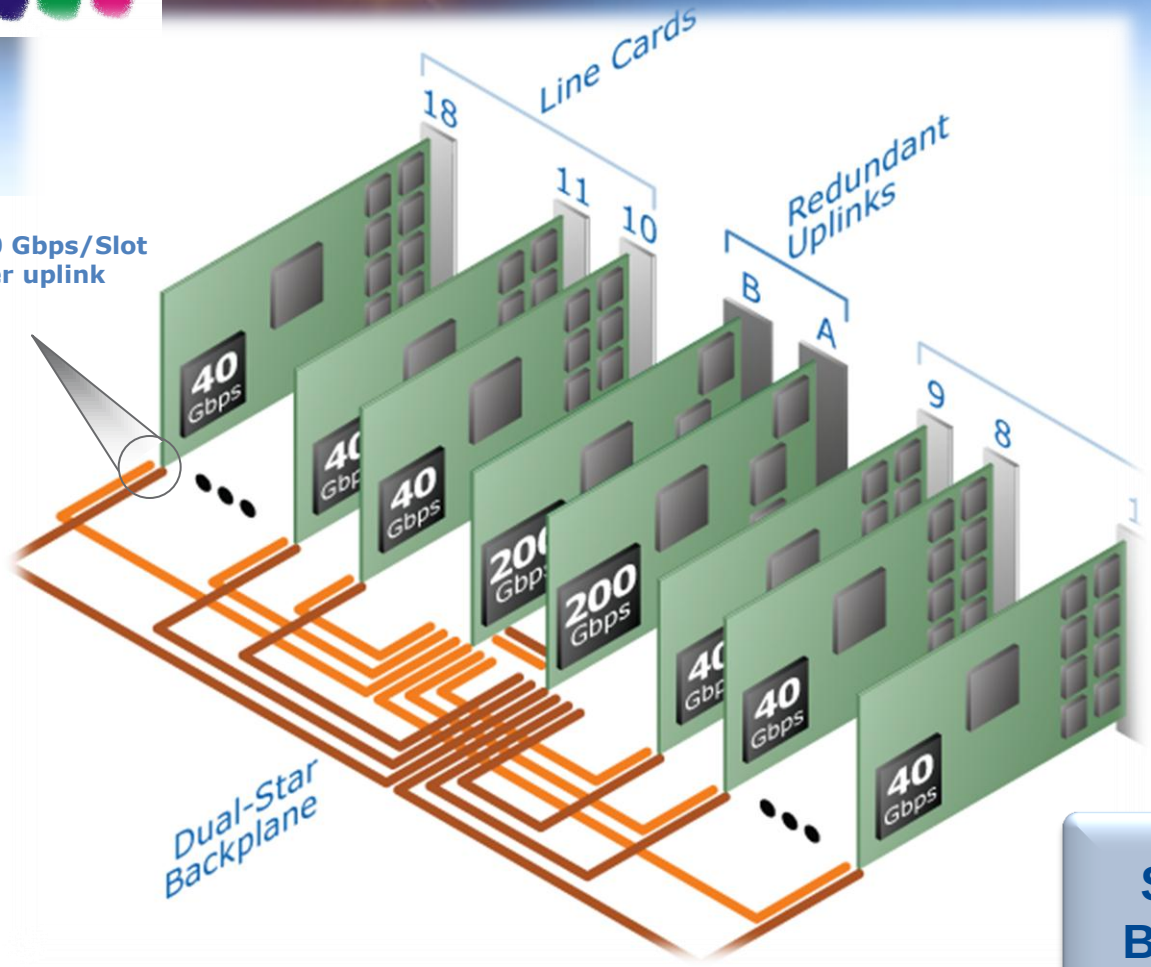
The New MXK – Industry leading Throughput



Investment protection Allowing the existing MxK platform to scale up to support 100G uplinks and NGPON2 Line cards

Scalable Pure IP Terabit Backplane & Architecture

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MXK Support for NGPON2 Uplinks

- **Economic Concerns**
  - Currently, the cost of a 40G Ethernet link on single mode or multimode fibre is about $8,000, or six or seven times that of a 10G link, participants at the Ethernet Technology Summit said
  - A 100G Ethernet link on single mode or multimode fiber can cost $25,000, up to 20 times that of a 10G Ethernet interface, they say.

- **Phase 1**
  - Supporting a 8 x 10G or 2 X 40G interfaces (SFP+ and Fixed Respectively)

- **Phase 2**
  - Supporting 2 X 100G uplinks

MXK Scales with PON access

Subscriber	Network Interface	Time frame
2.5G / 1.2G GPON 1G Active Ethernet		**Today - 2011**
2.5G / 1.2G GPON 10 G / 2.5 G XGPON 1G Active Ethernet		**2011-2014**
2.5G / 1.2G GPON 10 G / 2.5 G XGPON 40G NGPON2 WDM PON 1G Active Ethernet		**2014-2017**

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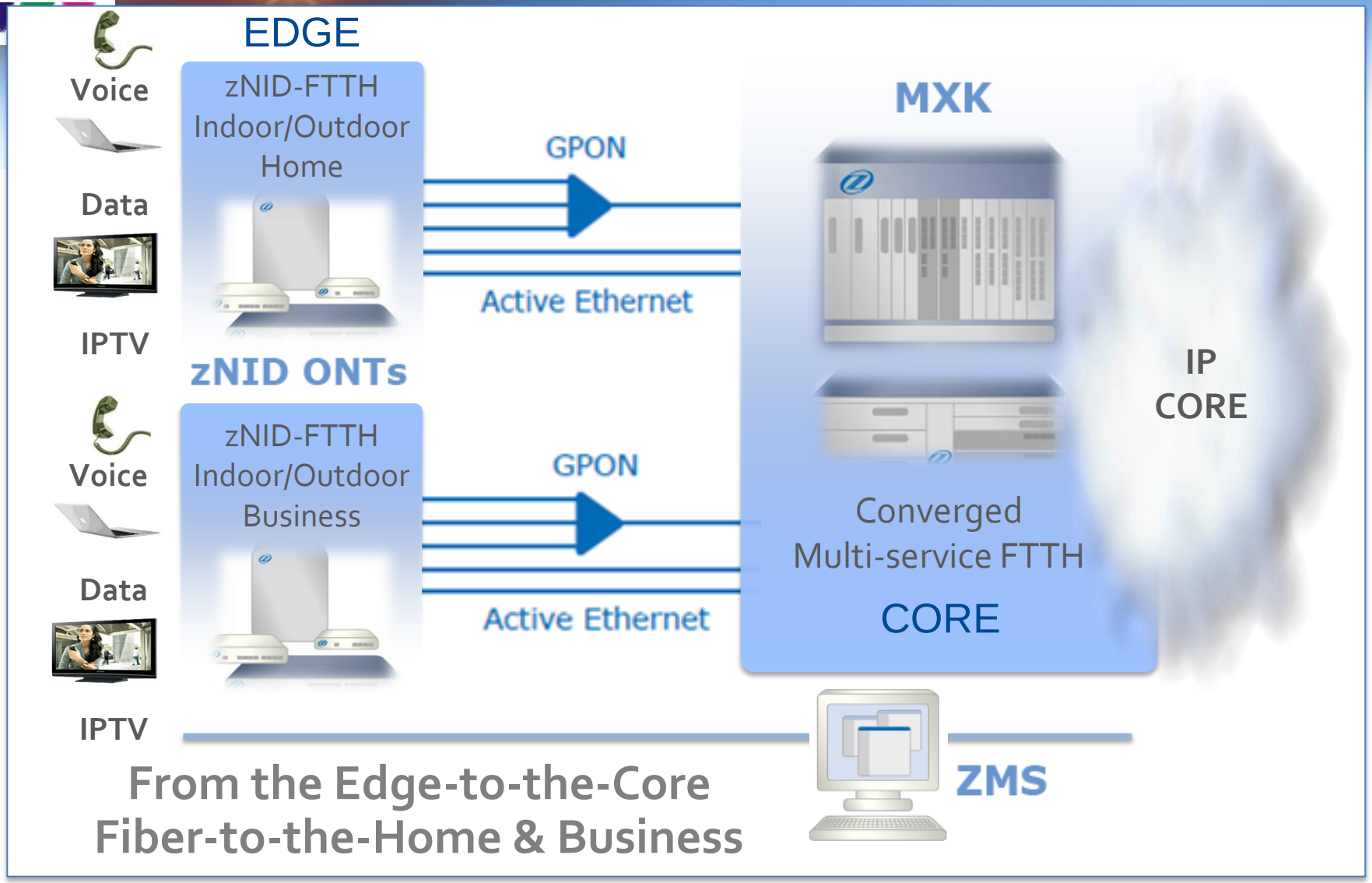
MXK – Converged Multi-Service FTTH Solutions



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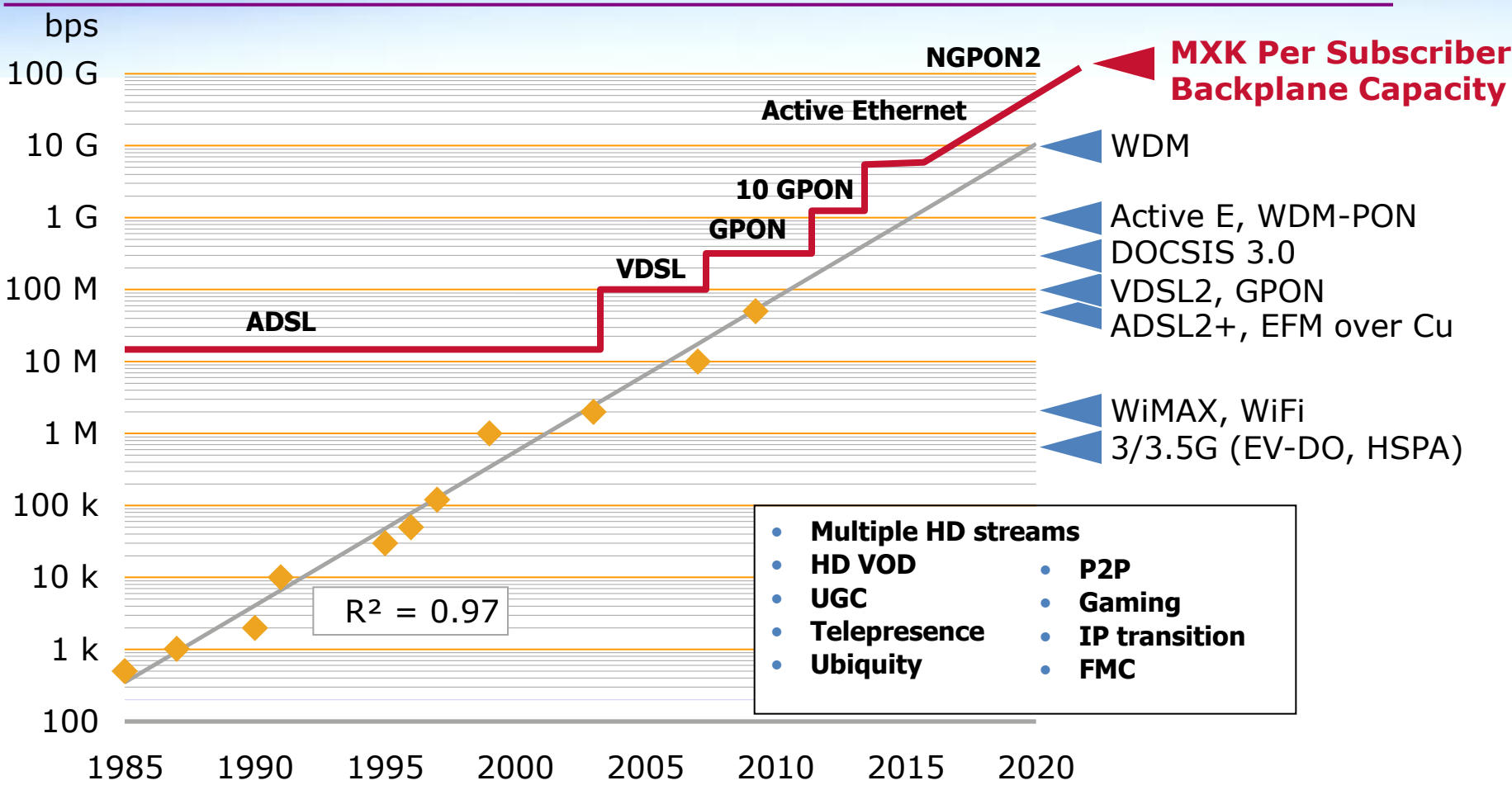
MxK Grows with end user Bandwidth needs

Per-Subscriber Data Rate v. Time



Source: Jakob Nielsen.

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What to Do Today

- **Continue to deploy fiber to the x**
- **CO based splitter gives you the option for AE or GPON depending on bandwidth needs for short term**
  - Or, assume a small % of subscribers will require more bandwidth, so include extra fibers between CO and splitters
  - 10/60 rule – 10% of your subscribers will use 60% of your bandwidth
- **If you want 1G to the home use AE today**
- **Chose an access device that can offer both AE, GPON, with clear upgrades to NGPON1 and NGPON2**
- **Look at operational savings for network equipment selection**
  - Can one device replace 4 or 5?

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Dziękuję za uwagę