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A Study on Video Over IP and the Effects on FTTx Architectures

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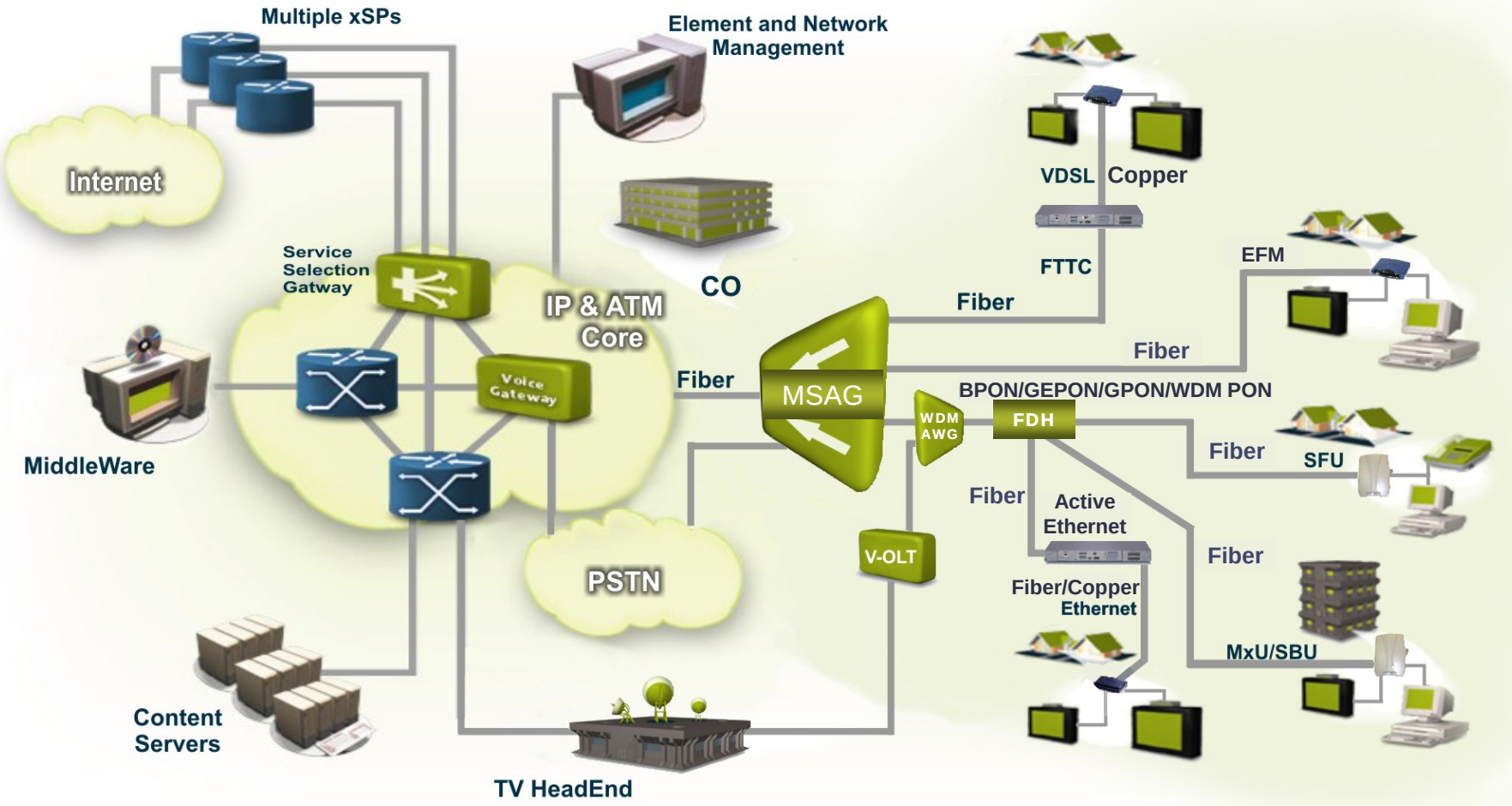
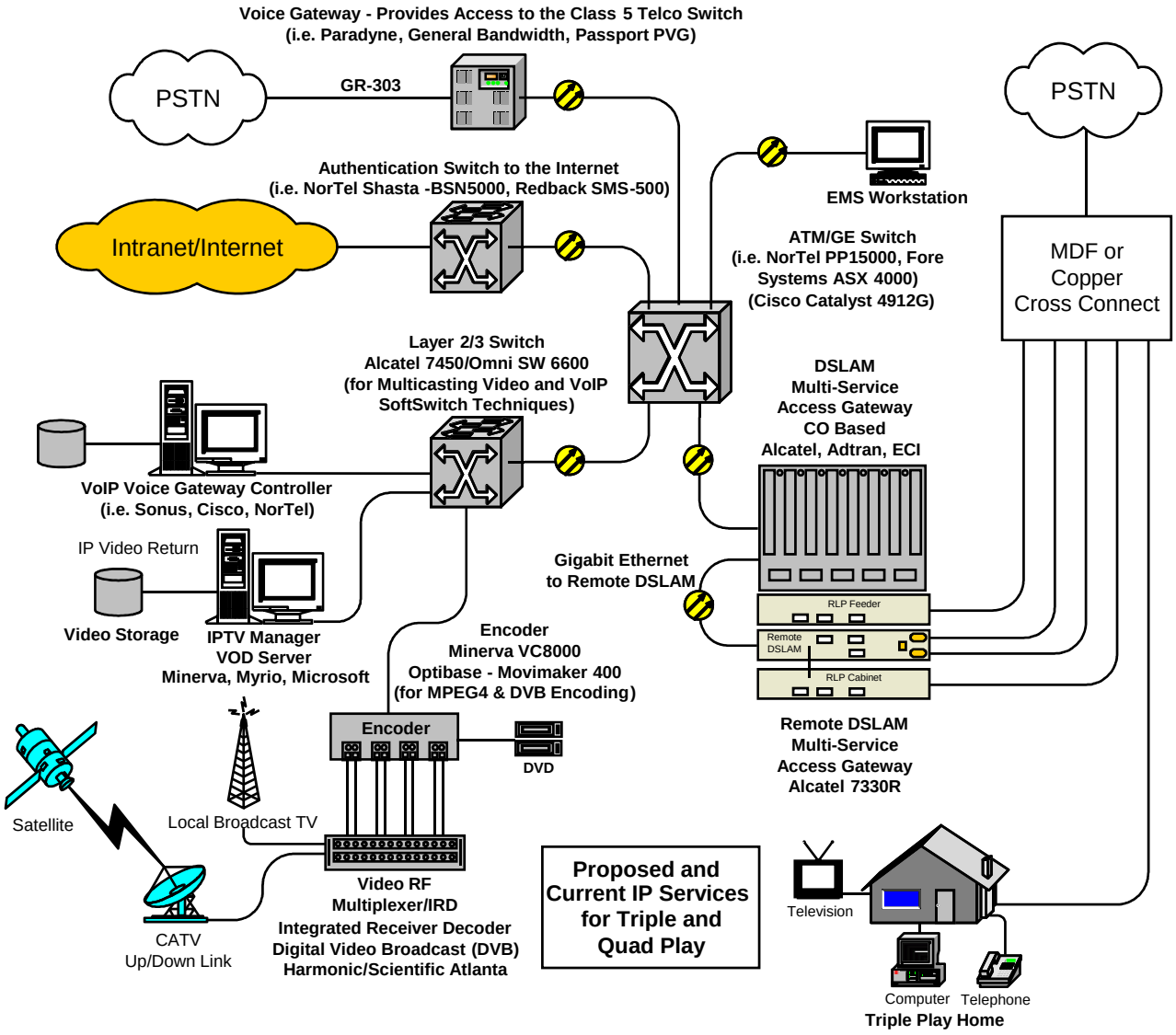
Principal Engineer

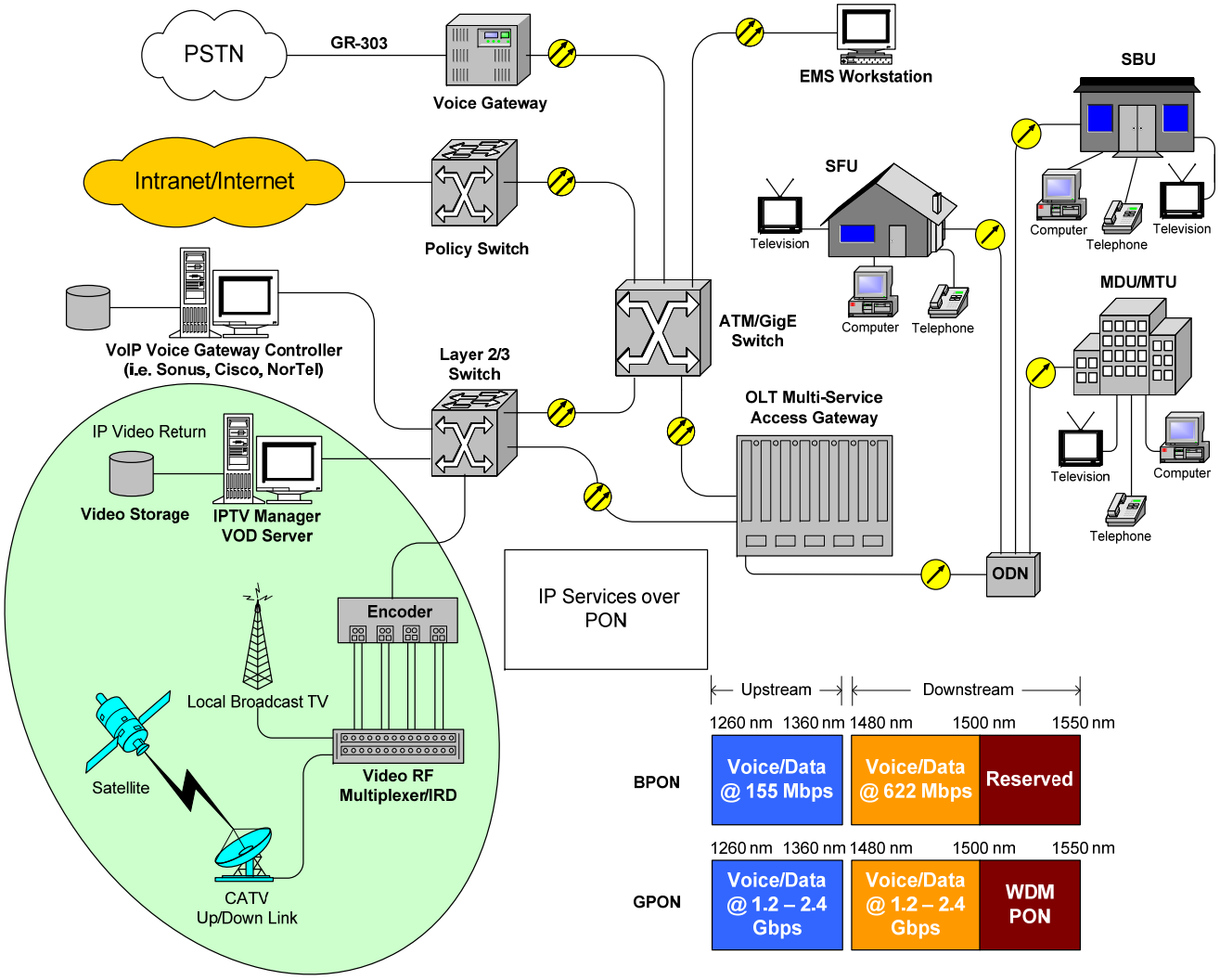
Beginning the FTTx Services Architecture



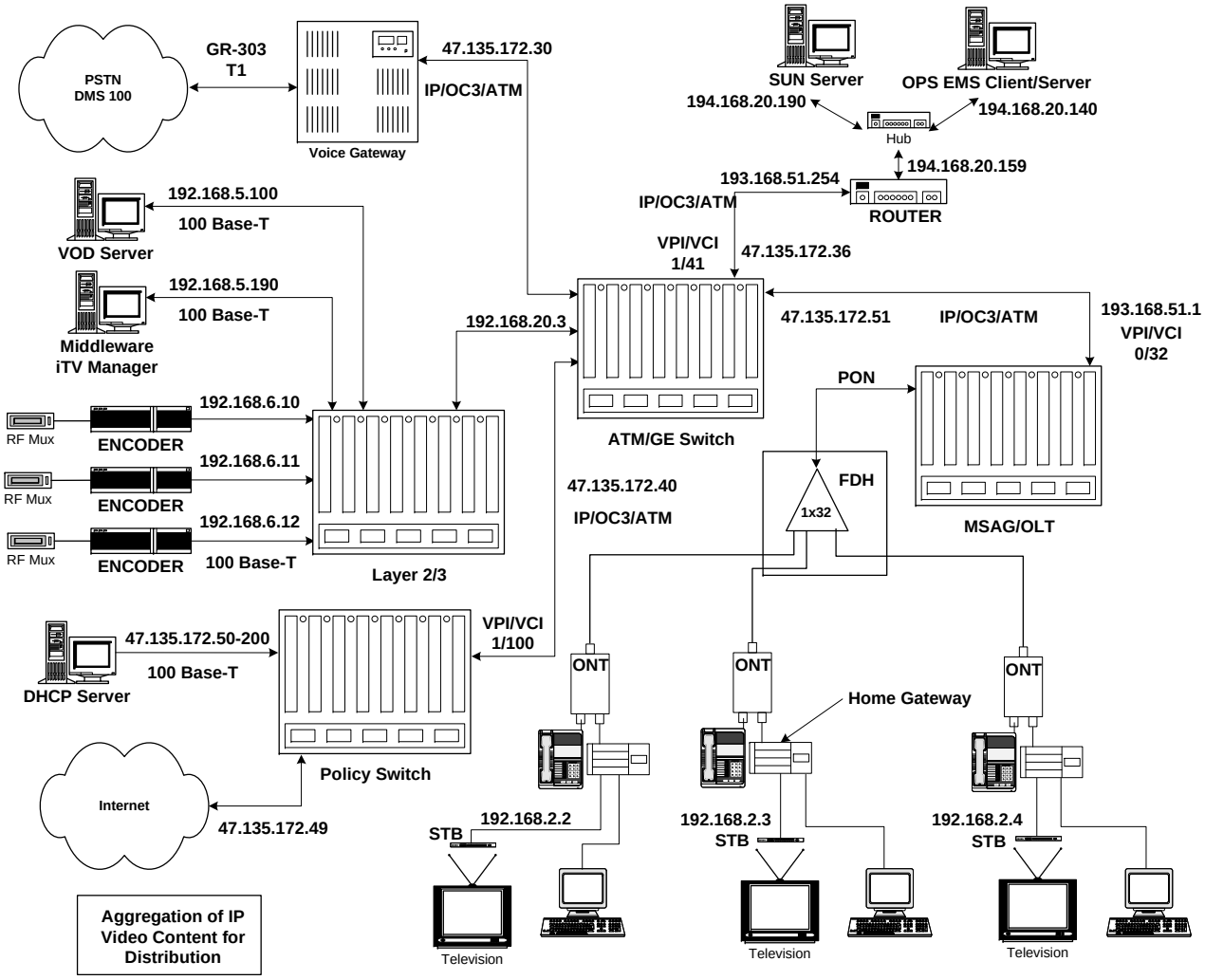
What We Know Today - *IP Services over xDSL*



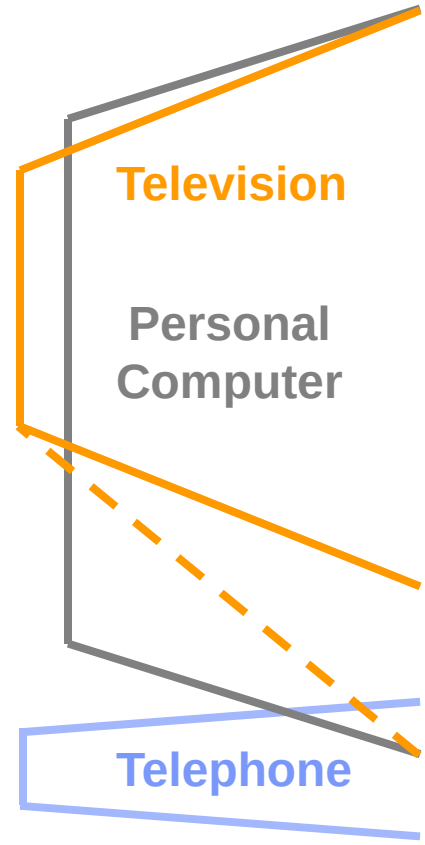
What We Know Today - *IP Services over PON*



What We Know Today - *IP Services Complexity*



Defining Converged Services – *Multi-Media Convergence*



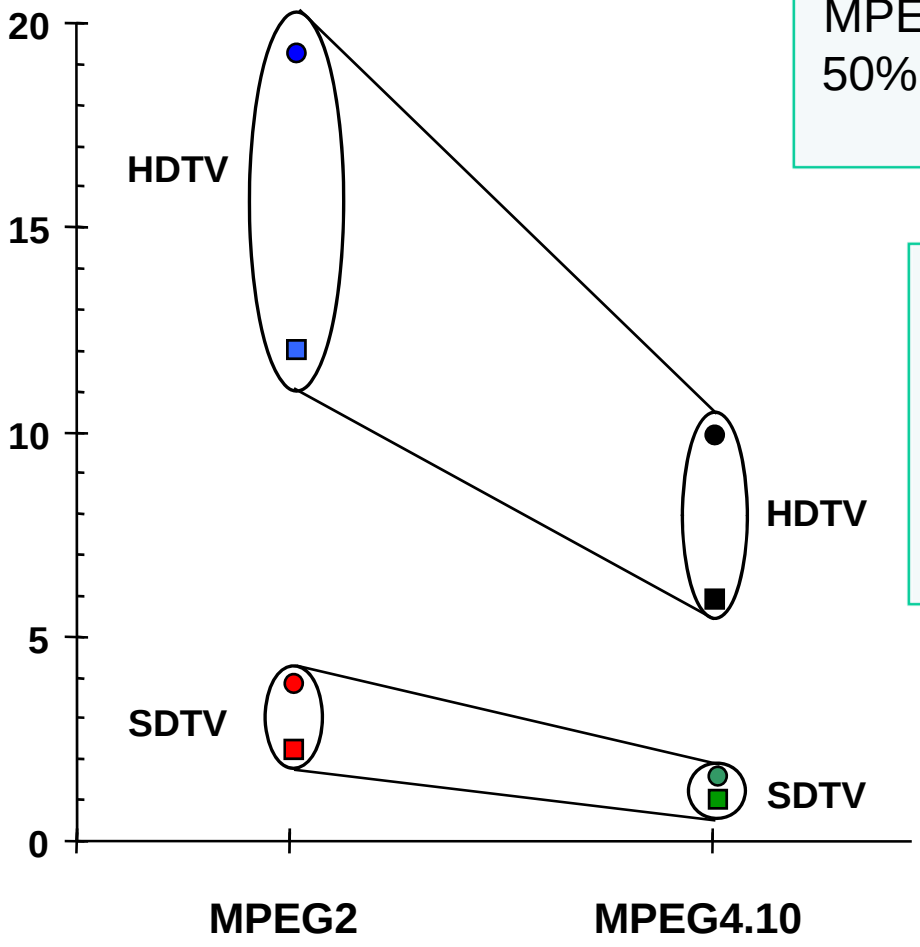
Appliance	Service	Bandwidth
Television	High Definition TV (MPEG2)	~19 Mbps
Television	Pay TV	3 - 6 Mbps
Television	Standard Definition TV (MPEG2)	3.5 Mbps
Personal Computer	Interactive TV on Internet	1 – 3.5 Mbps
Personal Computer	Video on Demand (VoD)	3 - 6 Mbps
Personal Computer	Personal Video Recorder	Up to 6 Mbps
Personal Computer	High Speed Internet (WEB Surfing)	Up to 2 Mbps
Personal Computer	Interactive Gaming	1 – 5 Mbps
Personal Computer	Video on PC	4 - 12 Mbps
Telephone	Voice over IP (VoIP)	80 kbps - 5 Mbps
Telephone	Voice over DSL (VoDSL)	40-64 kbps/ch

40 – 80 Mbps Needed?

Video Coding Performance Roadmap

Channel Raw Bandwidth

Mbps, Not Stat Muxed over Multiple Channels

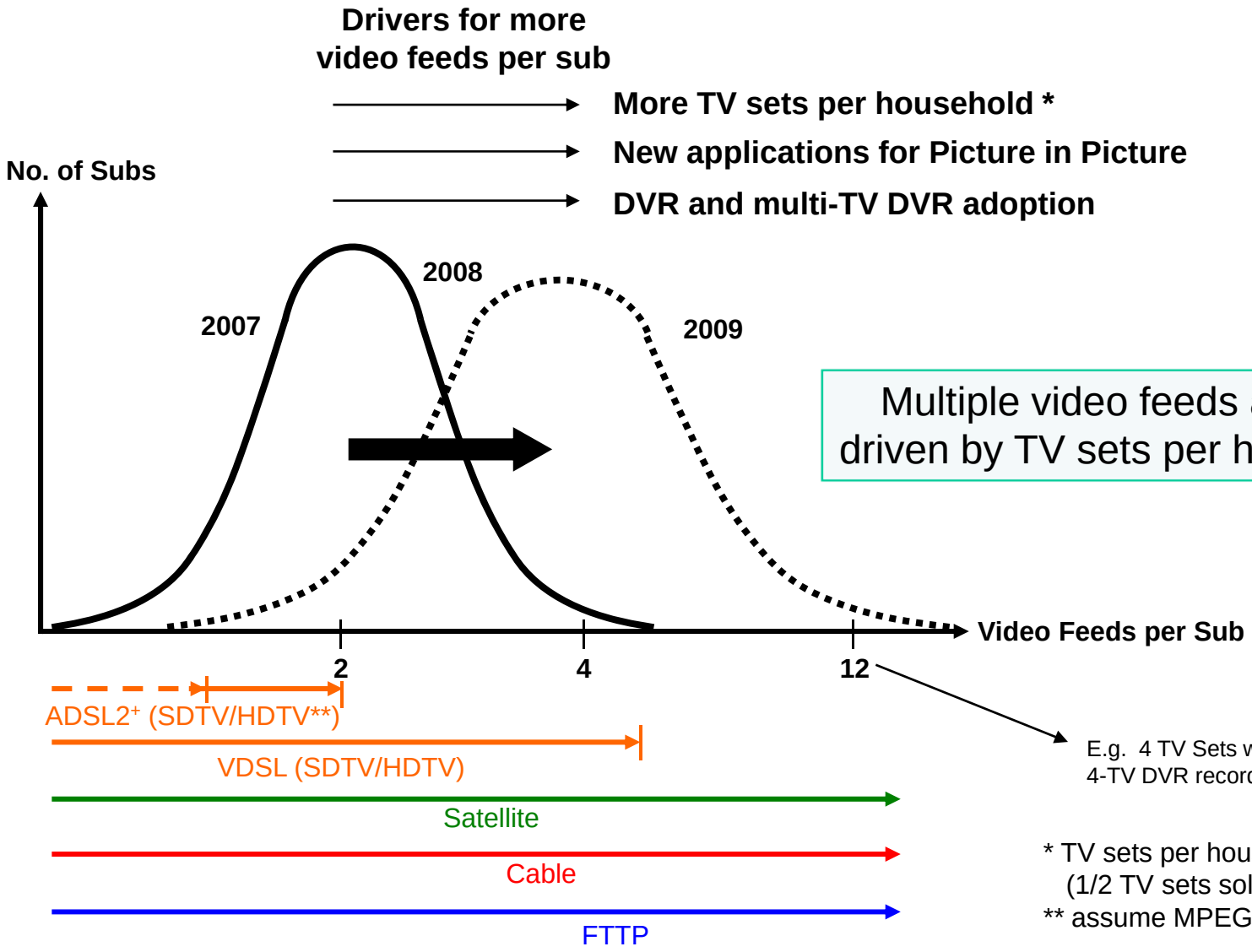


MPEG 4 (H.264) can reduce bandwidth by 50% but at the expense of higher headend costs and more expensive STBs.

Current HD FPS set at 30. Full HD (1080p, 4-million pixels) set at 60 FPS. Content providers making “BlueRay” HD (1080p compatible). BW for Full HD to be set at 50 Mbps. Future 3D HD set at 100 – 200 Mbps

- Full motion video quality with action or sport sequences
- Video with lower fps or less motion and scene changing

Requirements for Multiple Video Feeds



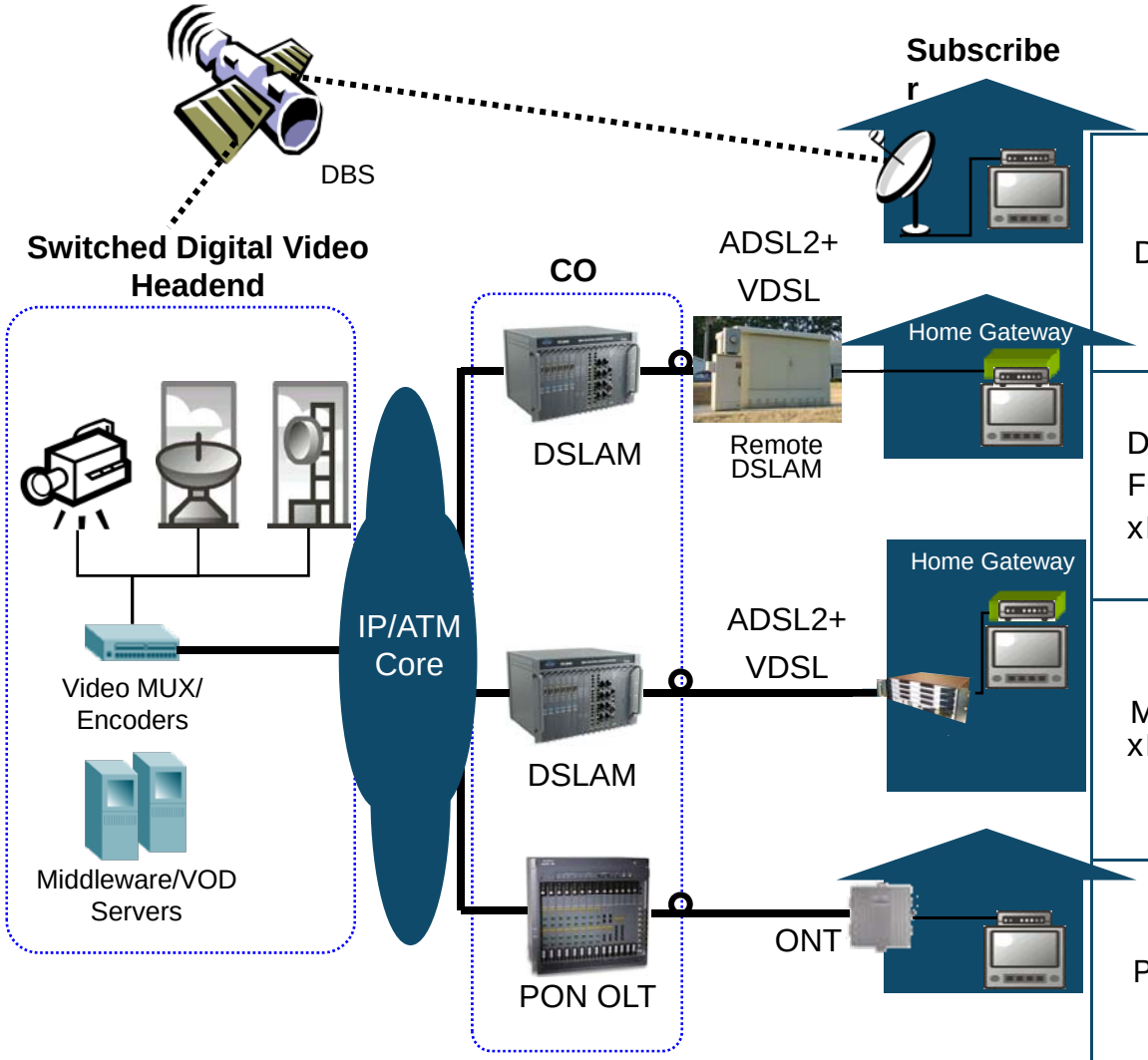
Multiple video feeds are no longer driven by TV sets per household alone

E.g. 4 TV Sets with PIP viewing and 4-TV DVR recording other channels

* TV sets per household average 2.60 (1/2 TV sets sold today are HDTV)

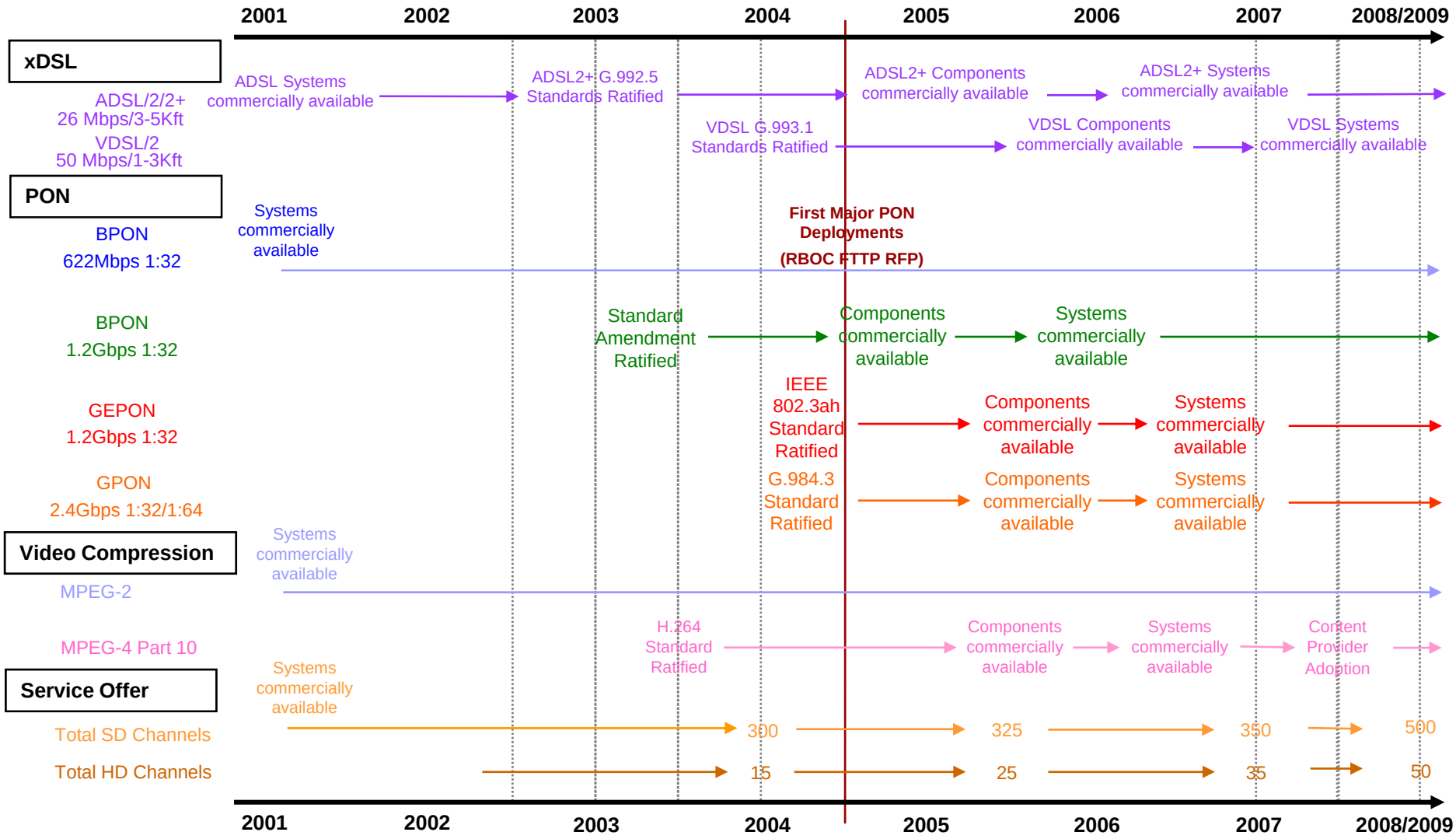
** assume MPEG-2 1-Channel each.

Broadband Video Options – *For Telephony Providers*



	Strengths	Risks
DBS	•Available World Wide •Local Area Coverage •Many Video Feeds per Sub •HD supported	•Limited VOD support •Limited US Data support
Deep Fiber xDSL	•Reuse Existing Copper Plant •VOD Supported •HD supported	•Limited bandwidth to meet medium to long term service demand •Remote Electronics
MDU xDSL	•Reuse Existing Copper Plant •VOD Supported •HD supported	•Limited bandwidth to meet medium to long term service demand •Electronics in MDU
PON	•Enough bandwidth to provide multiple IP Apps w/Video over IP •VOD supported •HD supported	•Greenfield initially •Rehab existing plant may take time

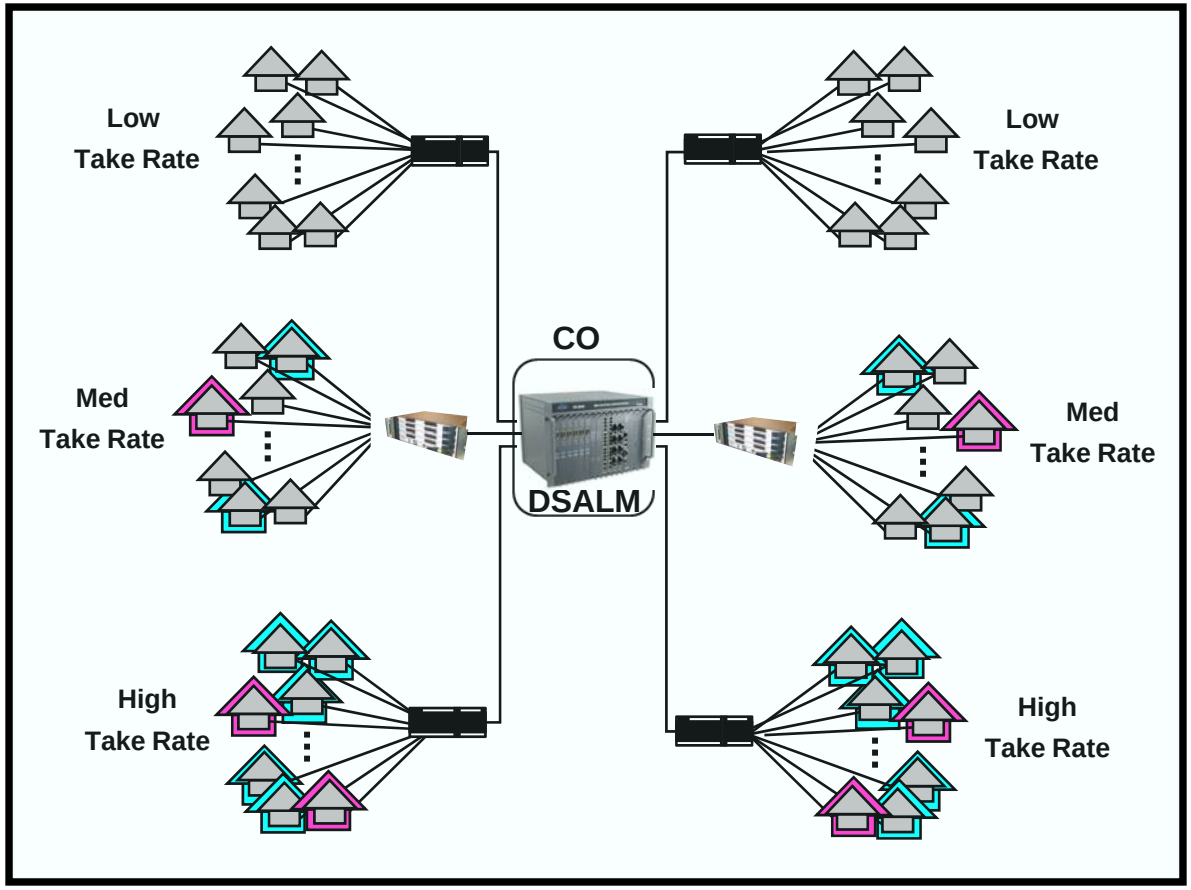
Timeline – *Broadband Deployments*



Serving Area Reference Model – *for xDSL*

A Serving Area (SA) deployment will consist of Networks with varying degrees of triple play service take rates.

SA *(100 -2000 Homes Passed. Remote DSLAM Supports 24-96 Subscribers each.)*



Overbuild Deployment

- SA Take Rates will be mixed:
  - HSI 2-10 Mbps
  - Voice: POTs/VOIP
  - Video: MPEG2/4 SD/HD

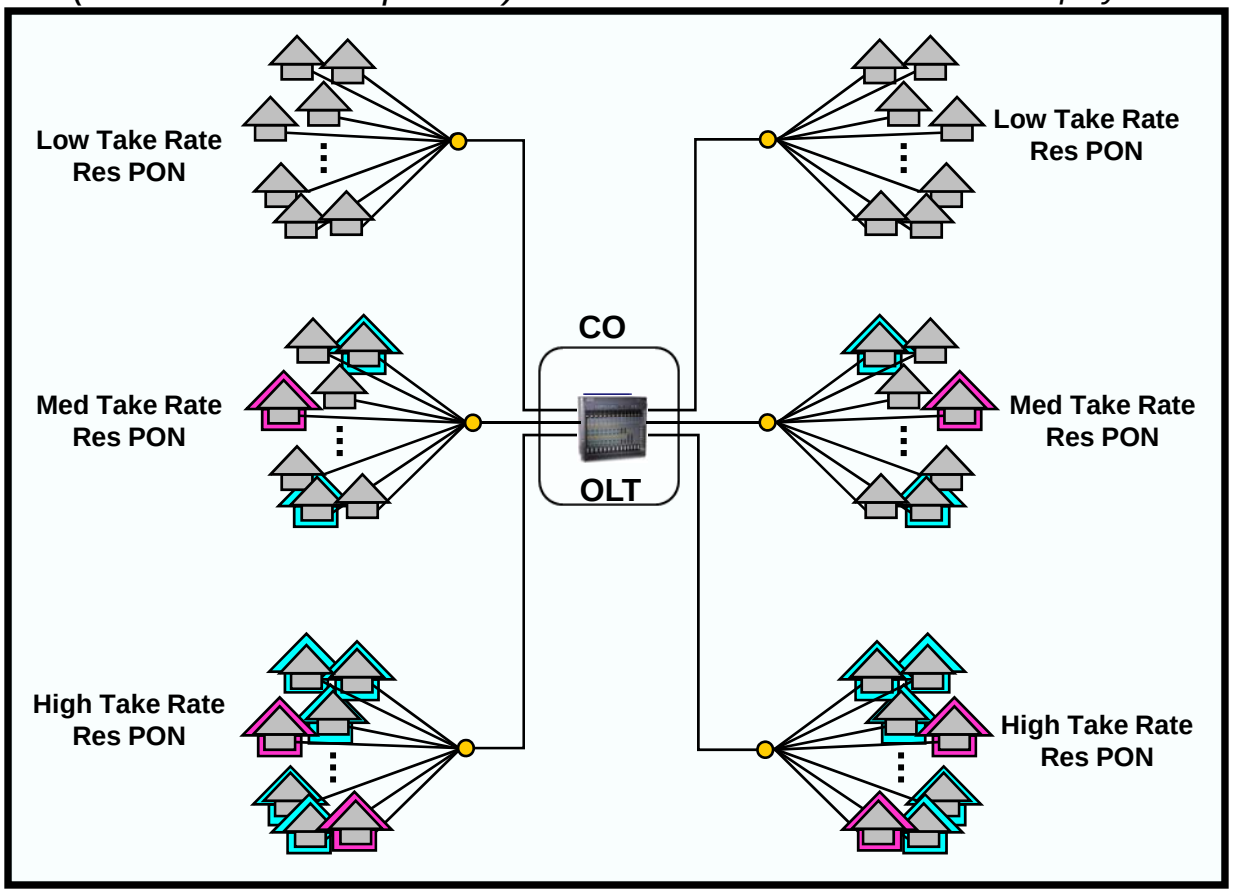
- Copper X-Connect

- Remote DSLAM

Serving Area Reference Model – *for PON*

A SA deployment may consist of PONs with varying degrees of triple play service take rates and different PON techniques and technologies.

SA *(1152 -2040 home passed)* *Greenfield and Overbuild Deployments*

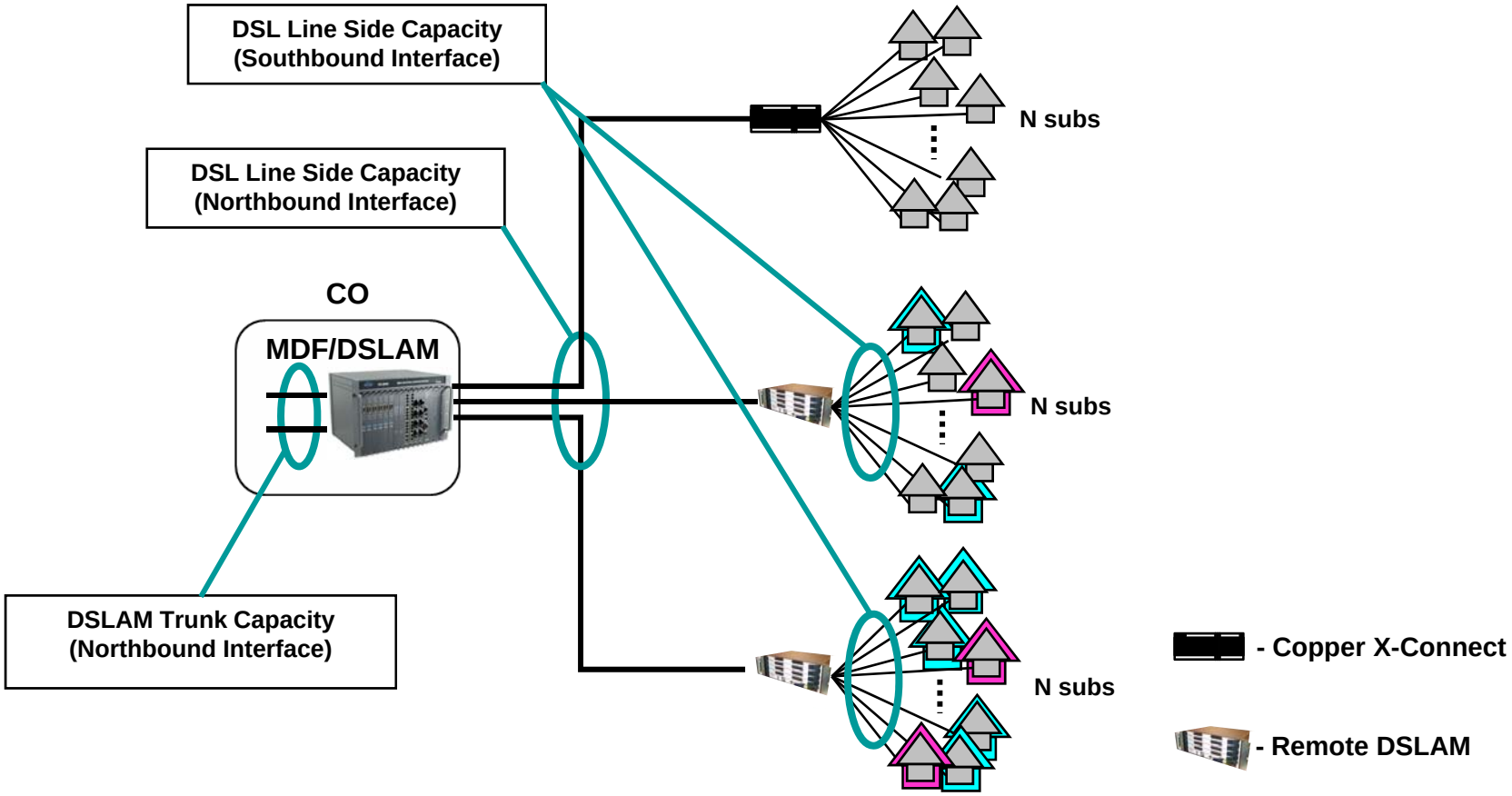


Avg Home Passed per SA
= 120 BPON x 16 Homes/PON
= 60 BPON/GEPON x 32 Homes/PON
= 60 GPON x 32 Homes/PON

- SA Take Rates will be mixed:
  - HSI 5 -30 Mbps
  - Voice: POTs/VOIP
  - Video: MPEG2/4 SD/HD

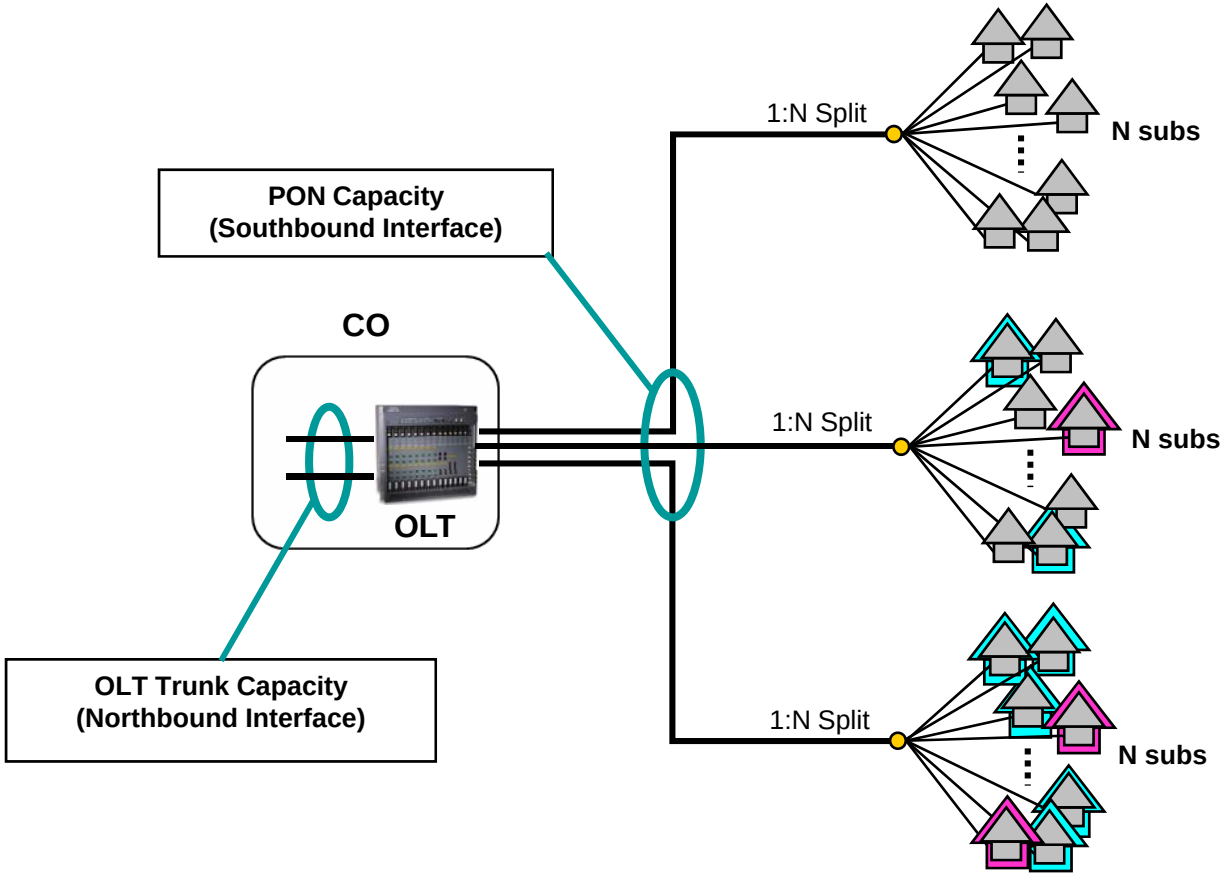
xDSL Capacity Analysis

The objective is to determine whether a particular DSL implementation can meet a given service bandwidth requirement

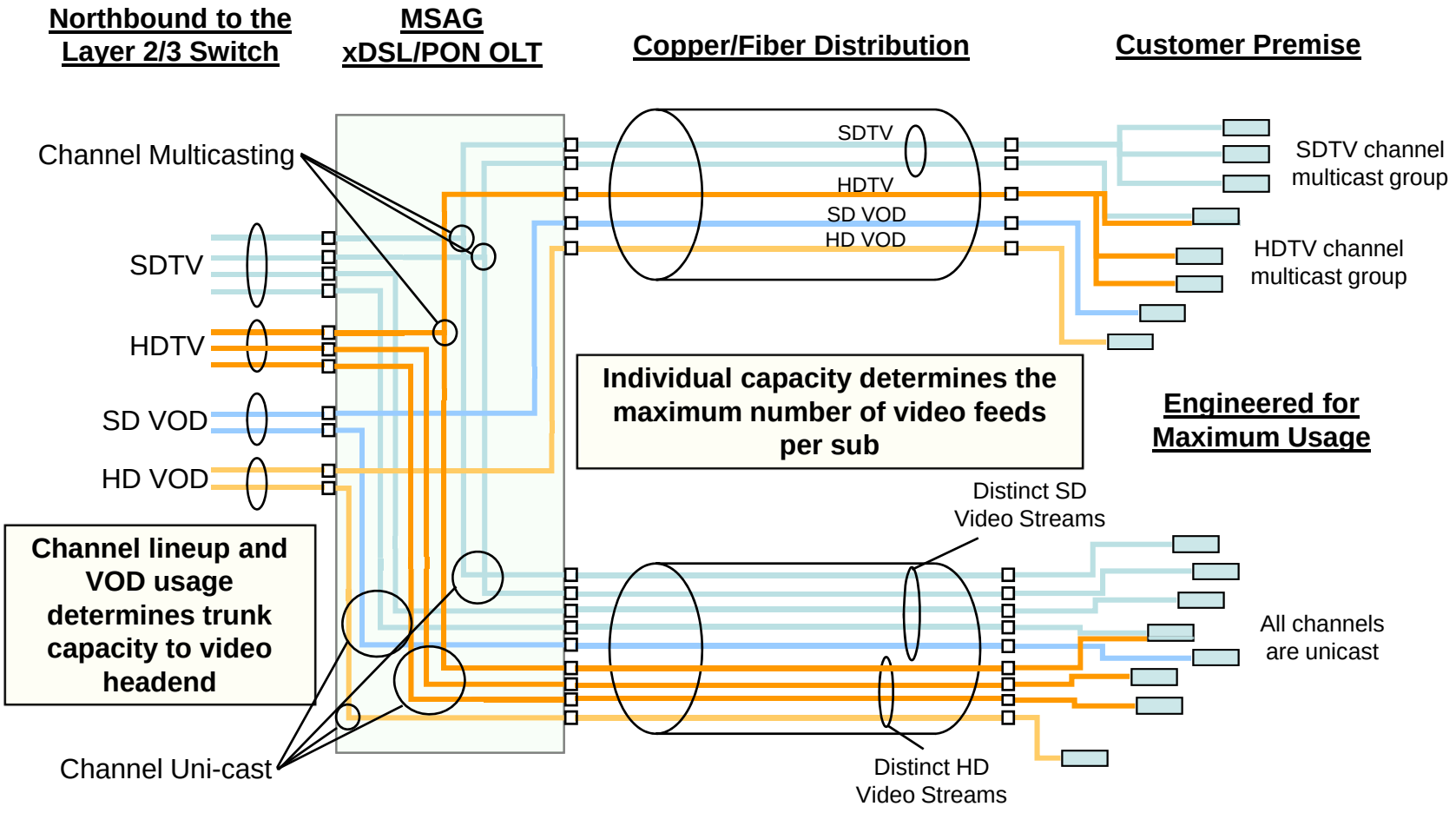


PON Capacity Analysis

The objective is to determine whether a particular PON implementation can meet a given service bandwidth requirement



Video Distribution over IP



Capacity must meet maximum usage without video blocking for any given take rate.

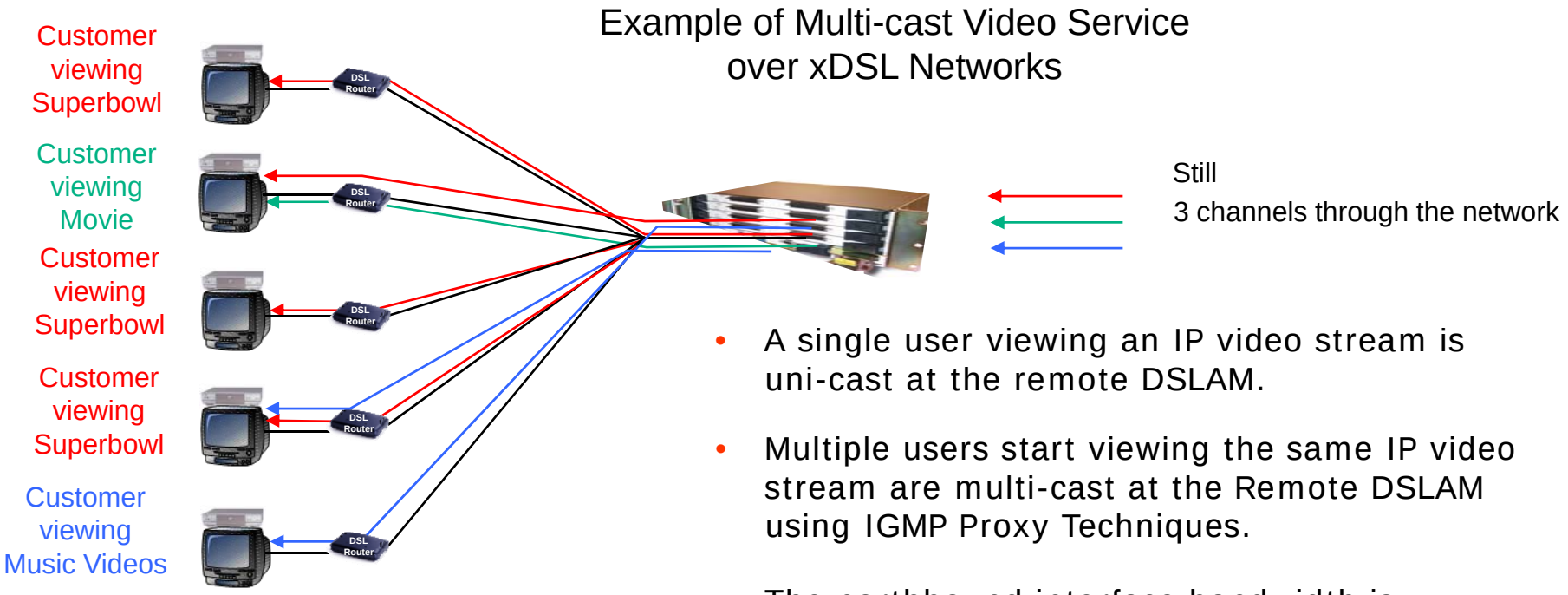
How Does Multi-Cast Video Work?

Integrated multi-casting to be supported at the Core and the Edge.

- Multiple users viewing the same IP video stream are multi-cast at the **Core** via IGMP Proxy.
- Multiple users viewing the same IP video stream are multi-cast at the **Edge** via IGMP Snooping.

- Significantly reduces the network load
- Benefits increase as the number of users is increased
- Benefits increase as higher bandwidth services are enabled (HDTV)

How Does Multi-Cast Video Work – *Over ADSL2+ and VDSL*

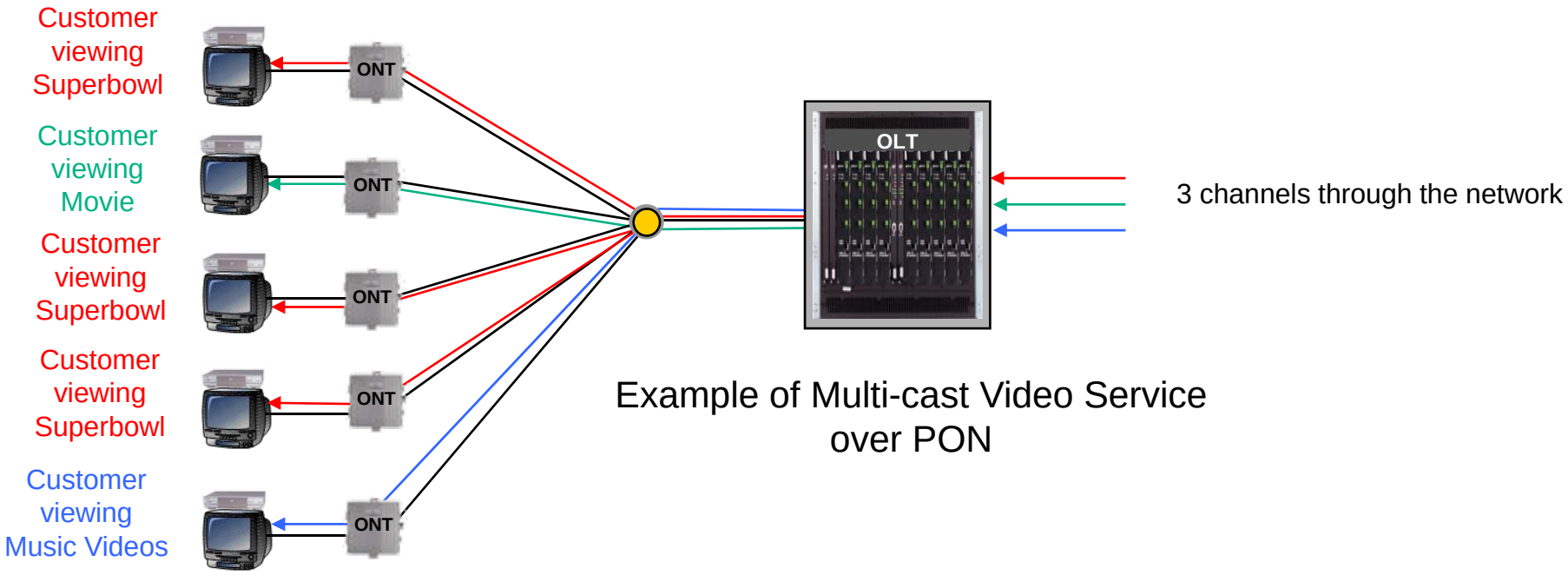


- A single user viewing an IP video stream is uni-cast at the remote DSLAM.
- Multiple users start viewing the same IP video stream are multi-cast at the Remote DSLAM using IGMP Proxy Techniques.
- The northbound interface bandwidth is maintained as a single video stream.
- The southbound interface bandwidth is determined upon the DSL service provided, i.e. ADSL2+/VDSL.

Integrated multi-casting to be supported in the CO and the Remote DSLAMs

How Does Multi-Cast Video Work – *Over PON Systems*

- Multiple users viewing the same IP video stream are multi-cast at the OLT on each PON Port where the OLT is using IGMP Proxy Techniques.
- The PON Splitters are passive and allow all of the ONTs on that particular PON Port to view the same video stream where the ONT is using IGMP Snooping Techniques.
- As additional users start to view the same IP video stream on different PON Ports, the bandwidth at the northbound interface through the network remains the same.



Example of Multi-cast Video Service over PON

Integrated multi-casting to be supported at the OLT and the ONT.

Key Findings

- Competition in offering voice and data services as well as a diverse video service portfolio are forcing Service Providers to re-think Video over IP.
  - » VOD and HD Content is on the Rise
- Multiple video feeds are no longer driven by TV sets per household alone.
  - » VDSL alone may not have the BW for video services to compete
  - » PON offers enough BW for competitive video services with or without MPEG-4
- Multiple bandwidth tiers are determined by line rates, video compression technologies, and multi-cast techniques; not PON (BPON, GEPON, GPON, WDMPON or EFM) vs. DSL.
- MPEG2 and MPEG4 as well as IGMP Snooping and Multicast Techniques need to be reviewed where the requirements imposed on various FTTx and Broadband architectures require precise engineering in the CO/HE.
- Significant opportunity cost for inaction or delayed action to capture revenues from a quad-play offer that has a competitive video services.

Summary

- Architectural and Topological Choices Driven By…
  - Initial and target take rates
  - Overbuild, Greenfield or Migration Focus
  - Active Electronic Requirements
- Network Efficiency and Growth Strategy
  - Critical underpinnings for the design
  - Key to cost-effective use of intelligent electronics
- Design must take a System Approach
  - To coordinate all elements
- Understand the impact of all the techniques that offer the best solutions while ensuring network stability

Questions?

Thank You

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