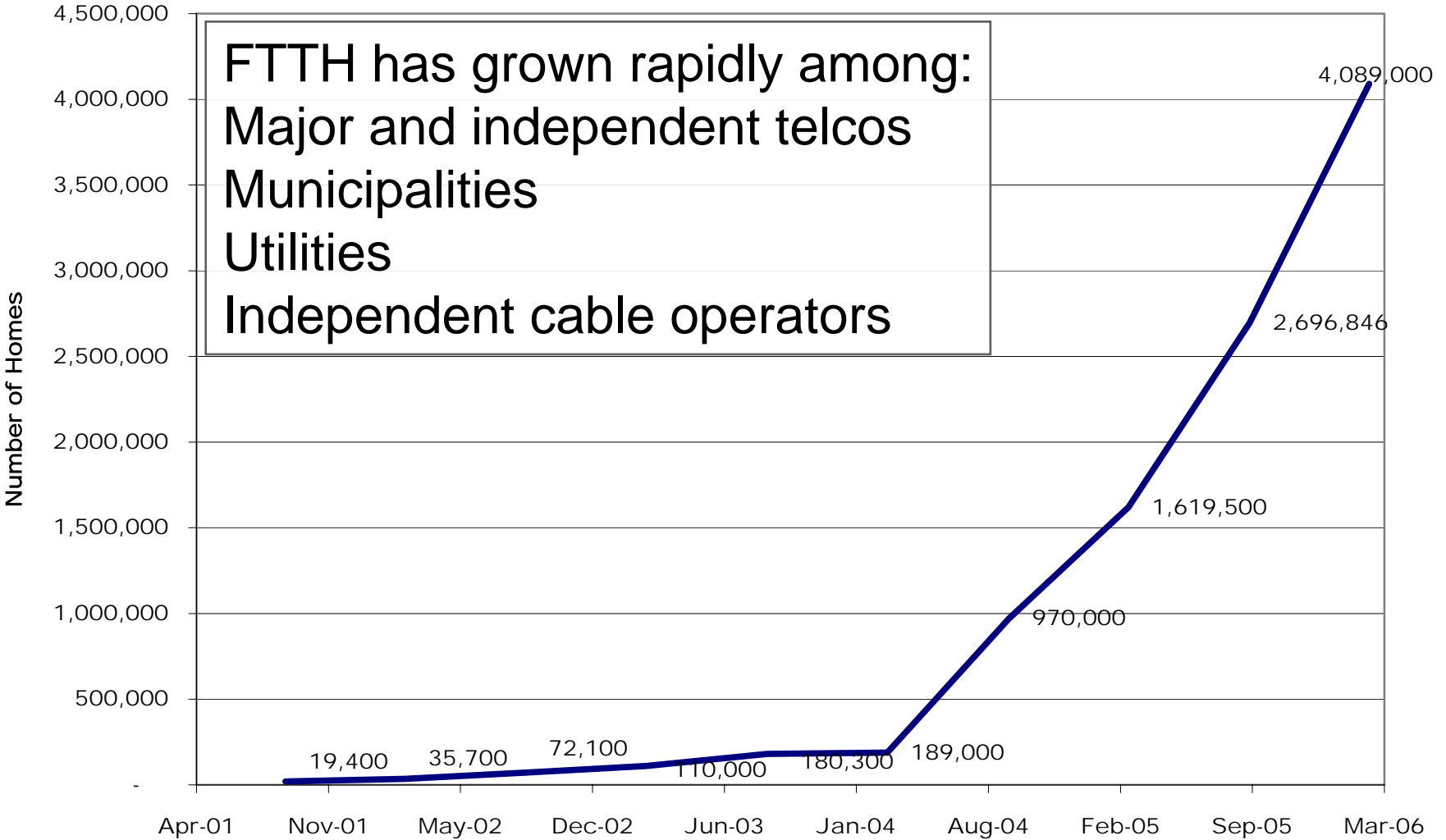


# Video Options for FTTH Networks

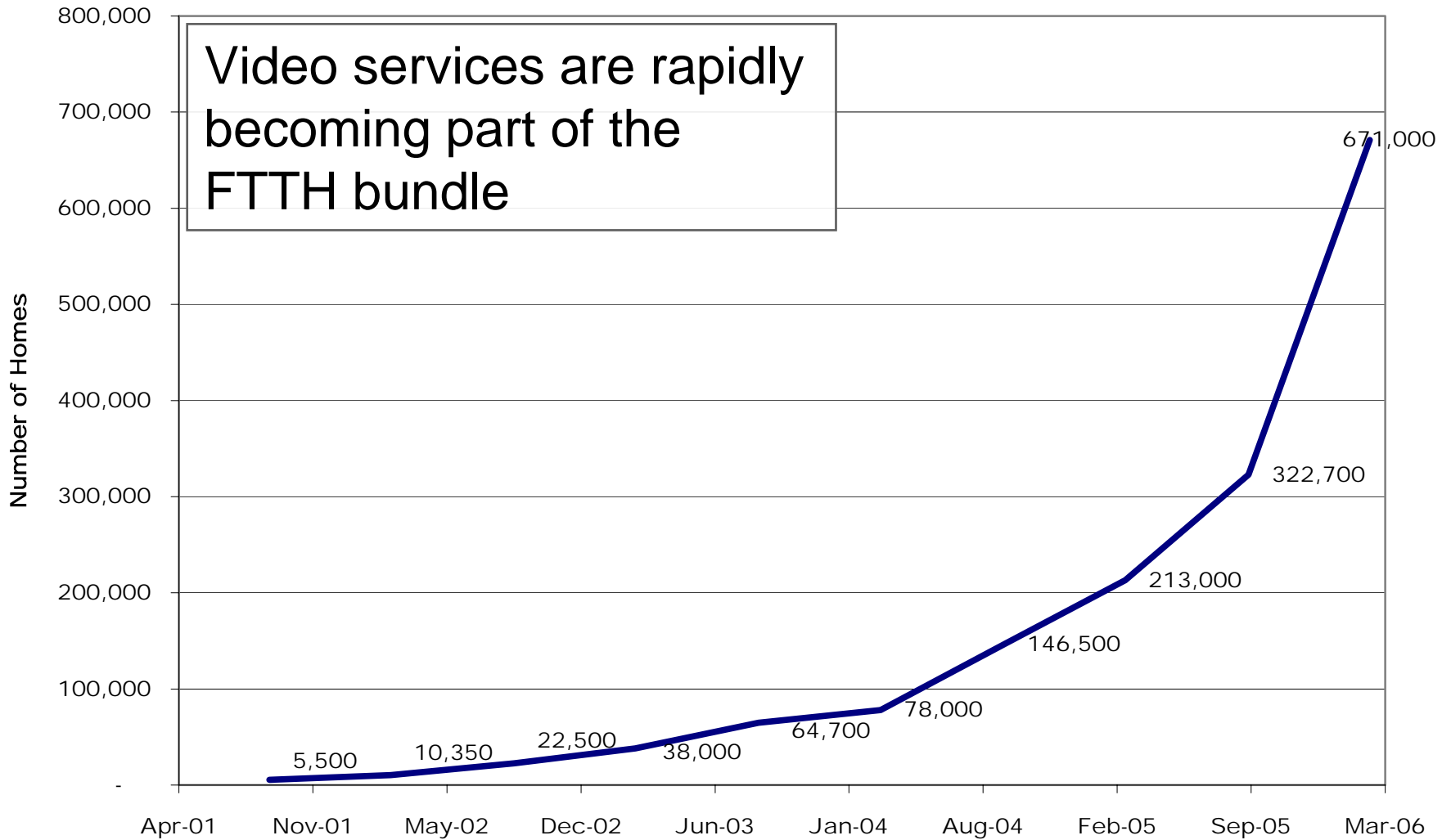
Andy Woodfin  
Corning Optical Fiber  
UTC Telecom 2006

# FTTH Homes Passed

FTTH has grown rapidly among:  
Major and independent telcos  
Municipalities  
Utilities  
Independent cable operators

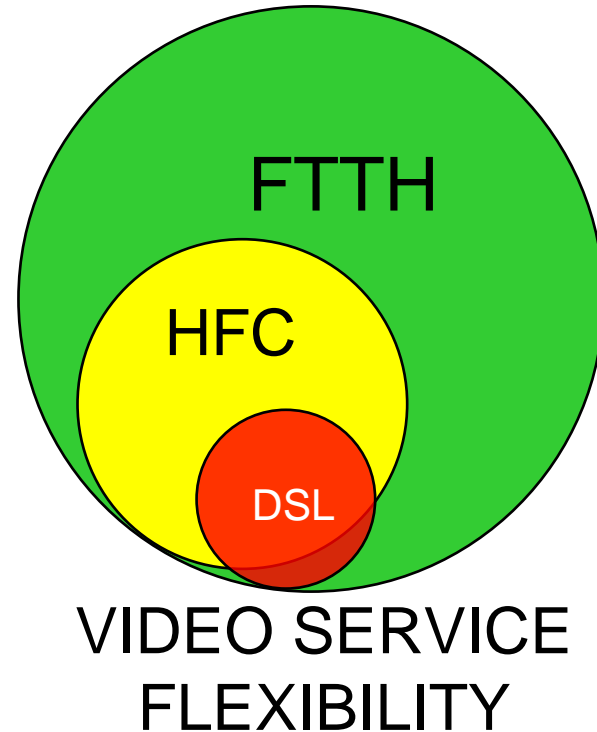
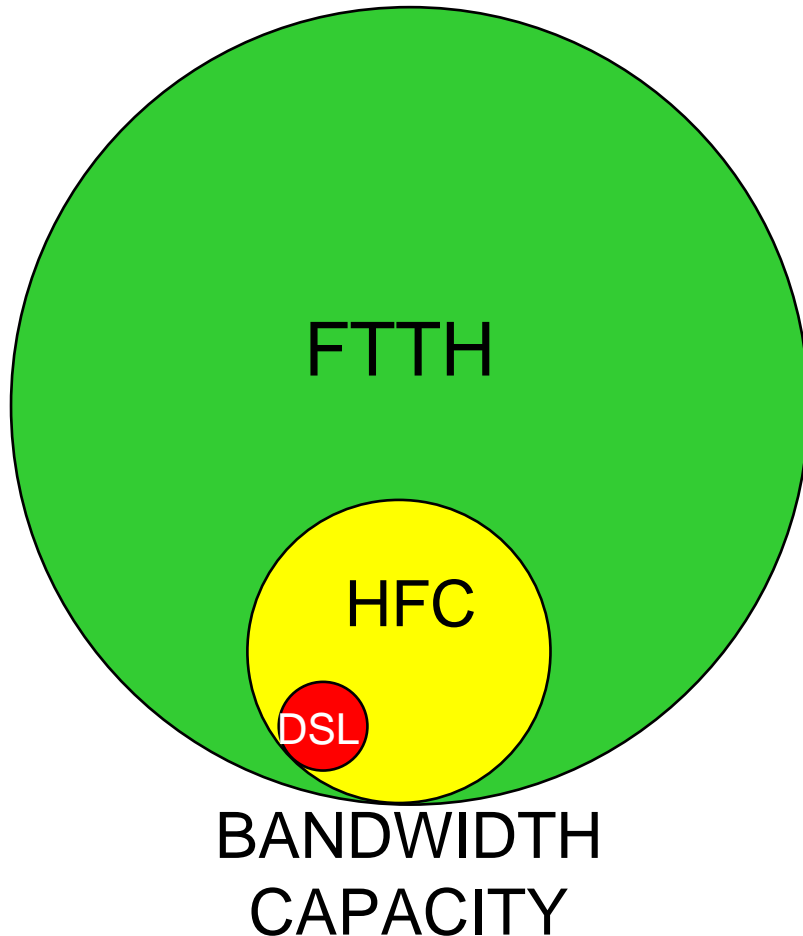


# FTTH Homes Connected

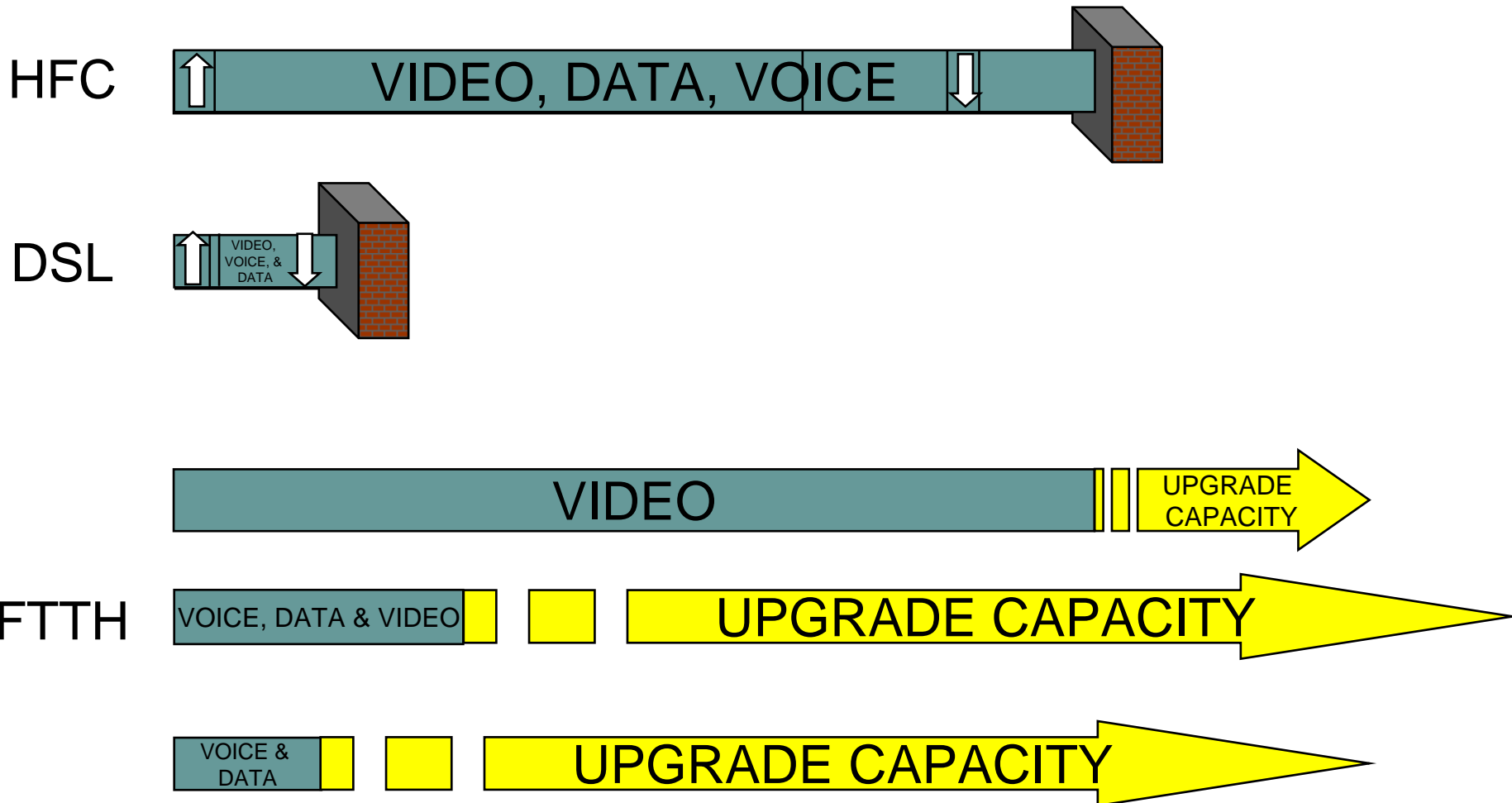


# How FTTH Stacks Up

How does FTTH compare with other broadband options?



# Architecture Comparisons



# Video Service Options

- RF video is well suited to conventional broadcast video, both analog and digital. It is the dominant distribution technique worldwide.
- IPTV allows more integration between voice, video, and data, and is purpose-built for VOD.

	HFC	DSL	FTTH
RF Video	✓	✗	✓ +
IP Video	✓ -	✓	✓ +
Hybrid RF+IP Video	✓ -	✗	✓ +

# RF Video – Not Dead Yet

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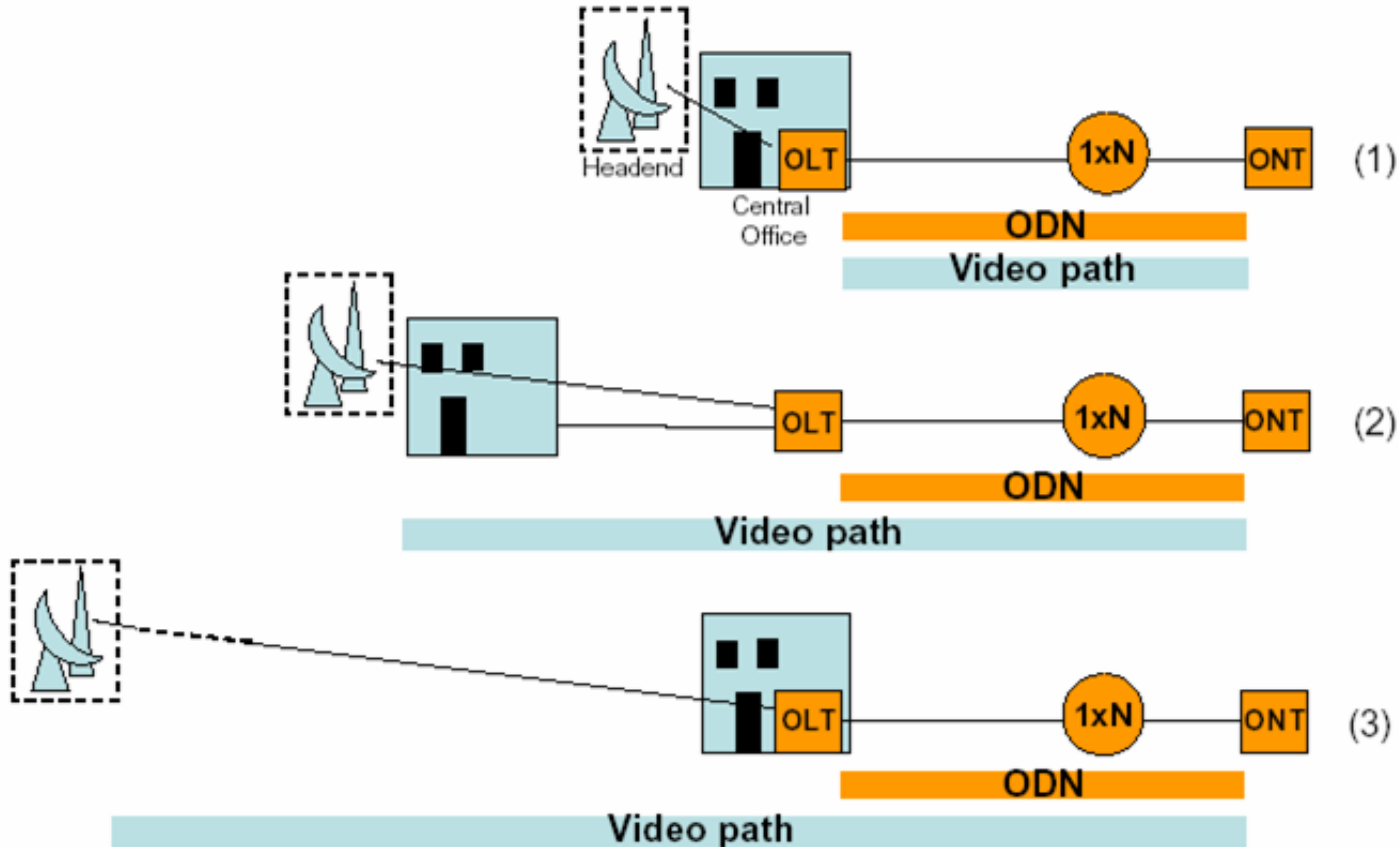
- No surprise that nearly all HFC networks are RF-based. Very mature and reliable technology, and the majority of video subscribers are still basic-only
- DSL networks are limited to *only* switched digital video, so IPTV growth is no surprise as telcos enter the video market
- FTTH can support anything, or EVERYthing... New independent FTTH builds are still split 50/50 between RF and IPTV. Some are even opting for both to get the best of both worlds

# FTTH Video Architecture Options

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- The BPON architecture with RF video overlay remains the most widely deployed FTTH option for video service delivery
- The BPON RF overlay can pose challenges to the overall FTTH network because of optical limitations.
- RF optical signal ranges, with standard single-mode fiber:
  - Maximum launch power: 16-22 dBm, depending on distance, transmitter type, passive element location, etc.
  - Minimum received power: -6 to -3 dBm

# FTTH Video Architecture Options



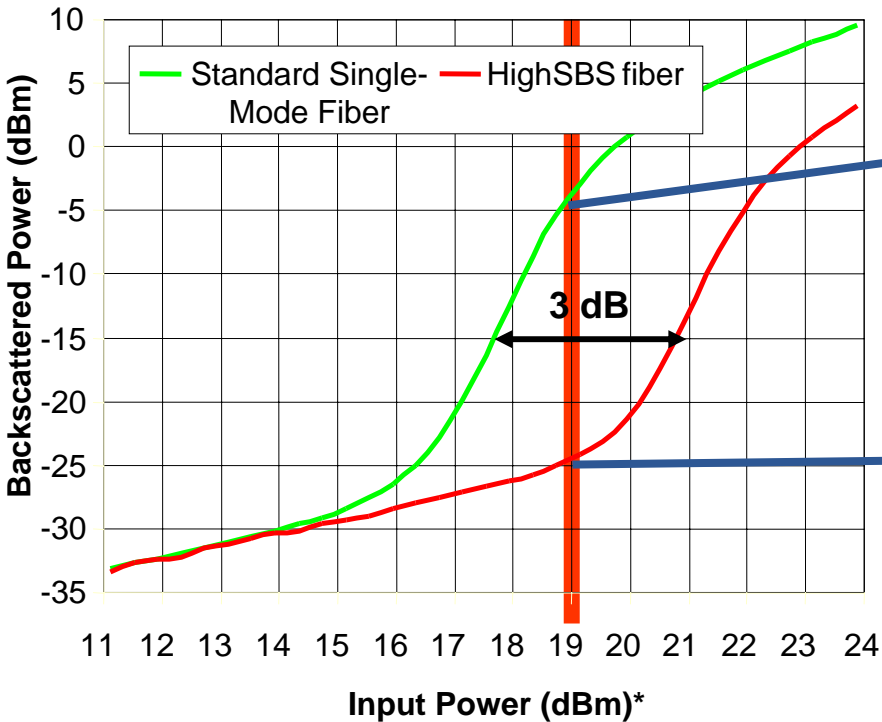
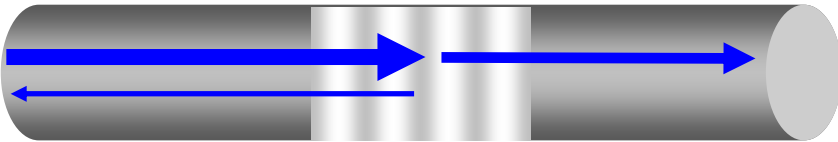
Three configurations for RF video overlay transport and distribution (1) collocated HE/CO with collocated OLT and video Tx, (2) collocated HE/CO with remote OLT , and (3) regional HE with RF transport. Length of the RF video signal path (blue bar) clearly varies depending on configuration, and can be much longer than the PON ODN (orange bar). Optical amplifiers and video/data WDM are not shown.

# Video Architecture Implications

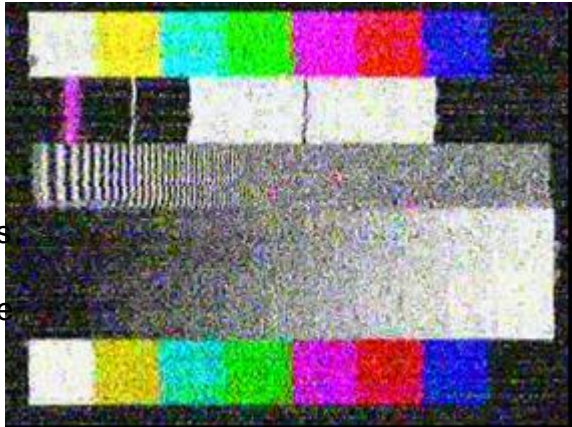
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- Simplistic analyses typically address only configuration 1, although this is not the most common FTTP implementation of video. Still, optical limitations can be encountered here.
- For large FTTP deployments, configuration 3 is the most logical, and common, choice. Distances from HE to ONT can exceed 100km.
- Common in all 3 configurations is the potential limitation of stimulated Brillouin scattering (SBS)
  - Impact of other limitations varies – self phase modulation, stimulated Raman scattering, etc.

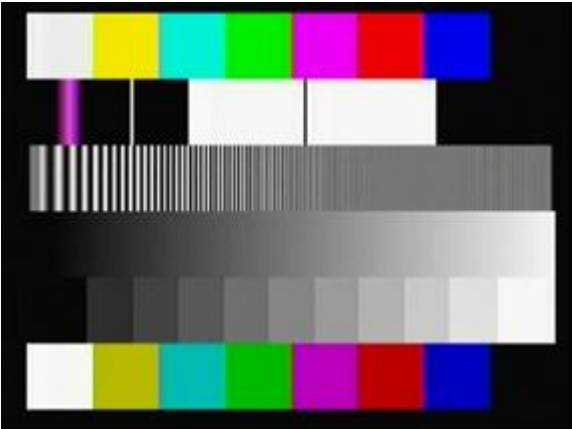
# SBS Effect Limitation – What Is It?



Picture quickly degrades above SBS threshold on standard single-mode fiber



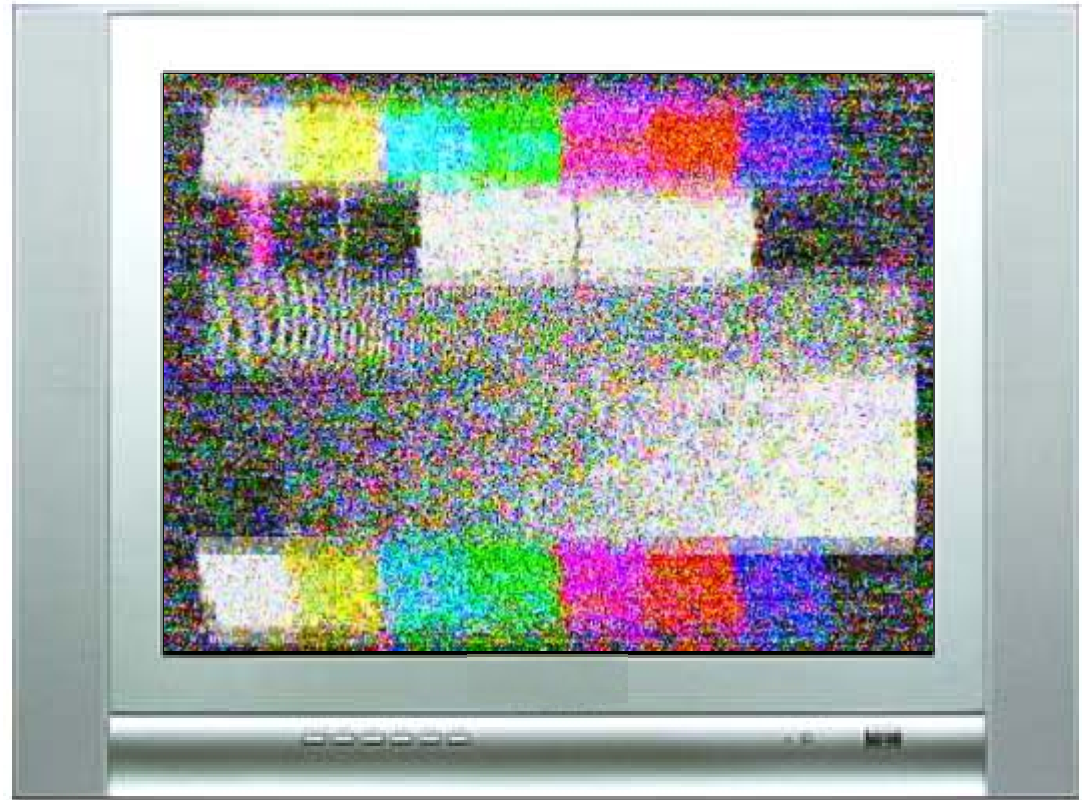
High threshold fiber allows the same optical power with no degradation in picture quality



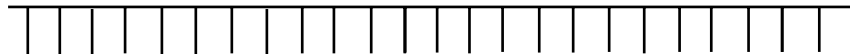
\*Impact of SBS will vary with distance, so higher powers may be supported at shorter distances. Values here are measured at 50km.

# Impact of SBS

- NTSC Channel 2 monitored over 20 km of standard single mode fiber, with additional loss equivalent to 1x32 splitter and two mated connector pairs. Transmitter used is nominally rated for 17 dBm SBS threshold over 50 km of standard single-mode fiber.



Optical Signal Power



# Optical Fiber Development

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- Recent understanding around the fundamental physics of SBS now enables optical fibers with parameters equivalent to standard single-mode fibers, but with elevated SBS threshold. Some examples have demonstrated increases of >4dB relative to standard commercially available single-mode fibers.
- By relaxing SBS constraint, network flexibility is increased:
  - Higher powers can enable longer spans
  - Higher powers can enable lossy and/or lower cost passive components
  - Transmitter SBS mitigation can be reduced to operate at typical power levels but with improved signal quality

