Cable Network Overview

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Introduction

- This slide deck is intended to provide an overview of the following:
  - How cable networks have evolved over time
  - The components of an HFC network
  - Main sources of impairments in HFC networks and their impact on operations
  - How the cable network's spectrum is divided up into different services, and how that may change over time
- Please note that these slides are merely representative, and do not necessarily depict actual cable systems

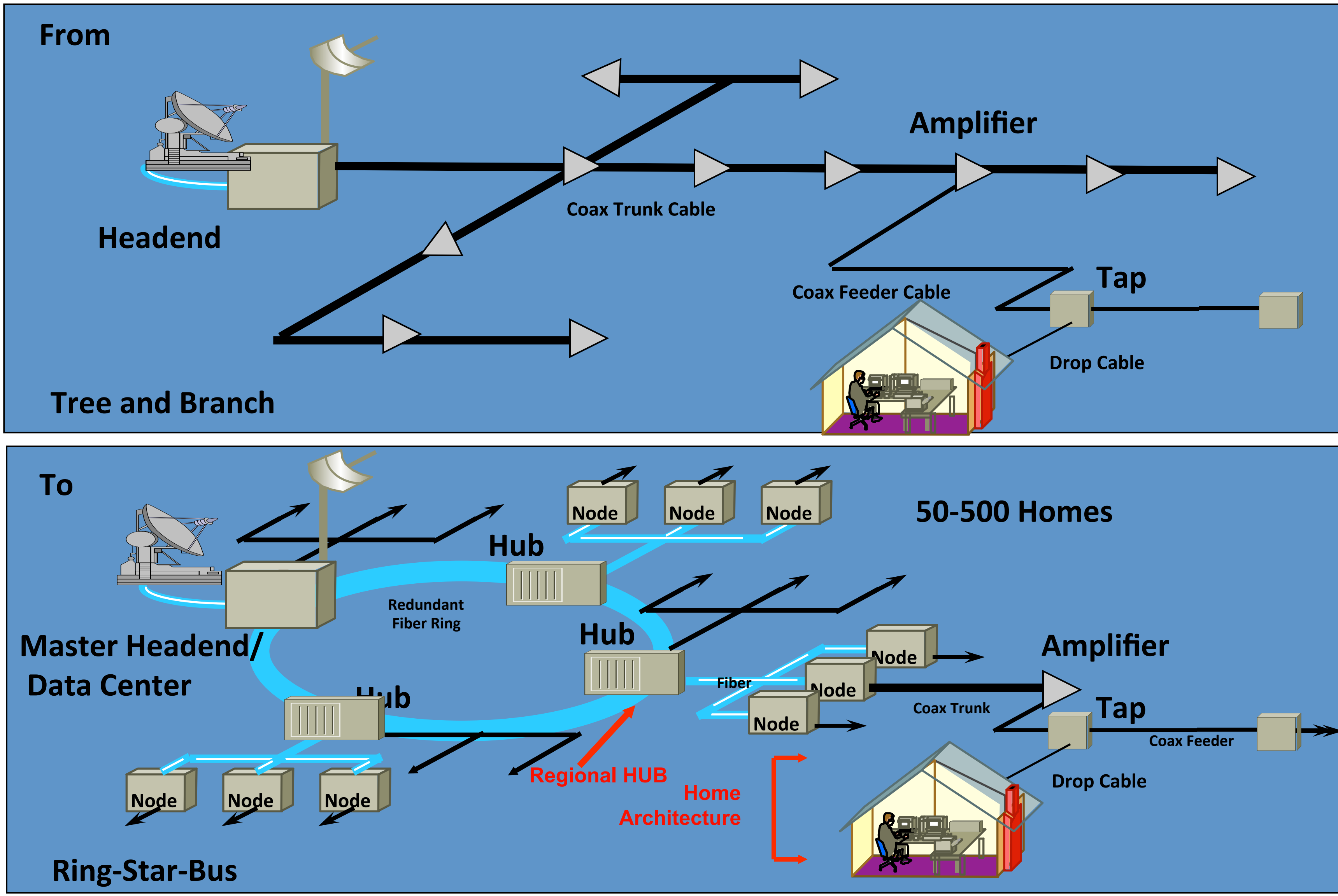
United States Cable Statistics

- 114 million households, 131.7 million housing units
- 129.3* million homes passed by cable video service (~98%)
- 124.3* million homes passed by cable high speed data service (~93%)

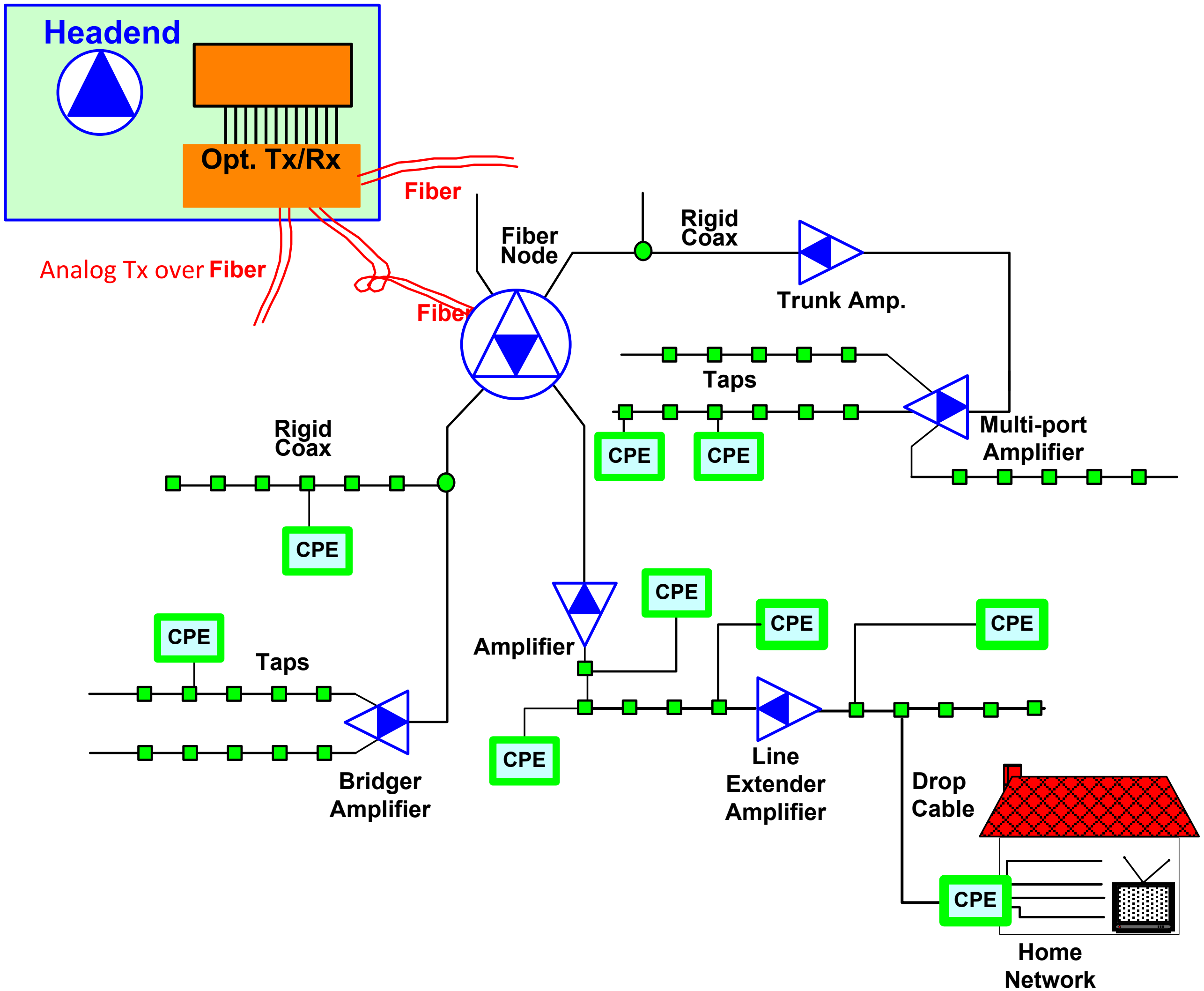
- Ubiquitous coverage of high speed data services

* Statistics by NCTA June 2011

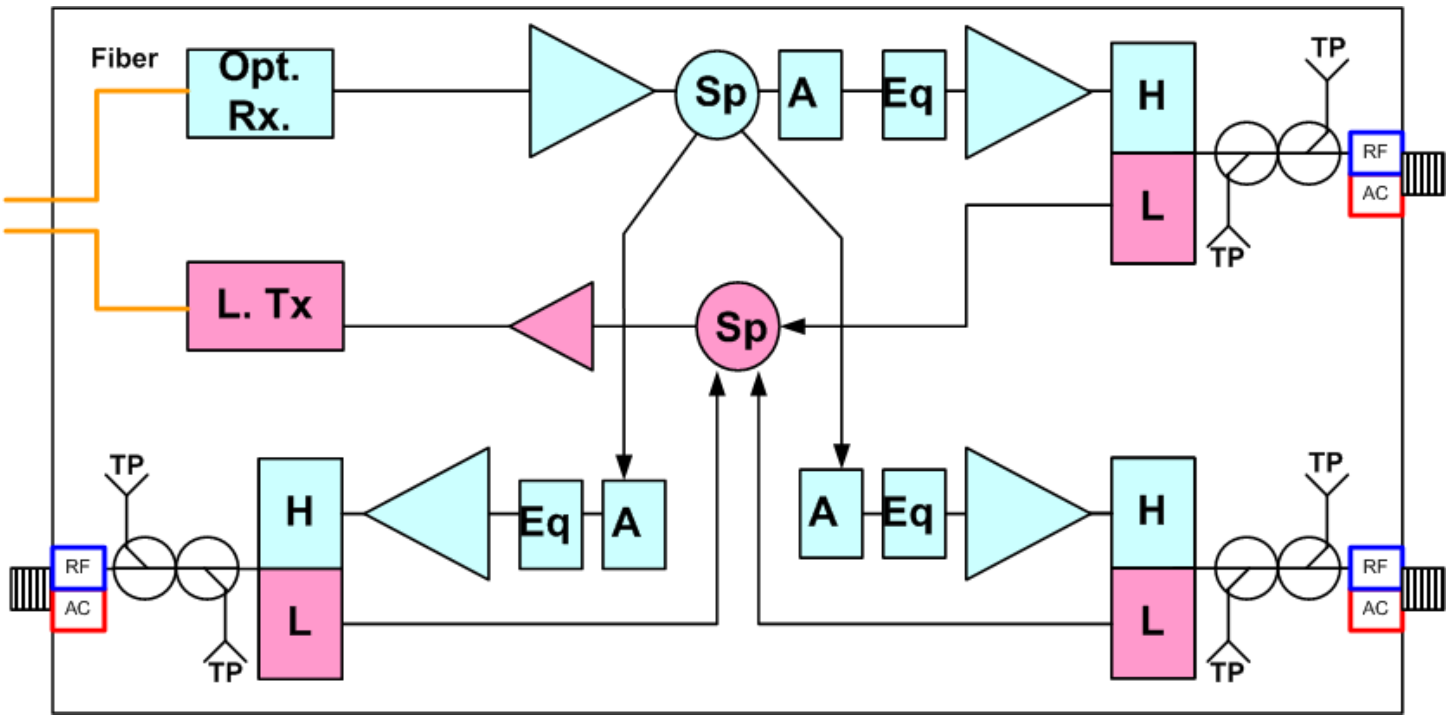
Cable Networks: Then and Now



Node + N Generic Implementation



Optical Node

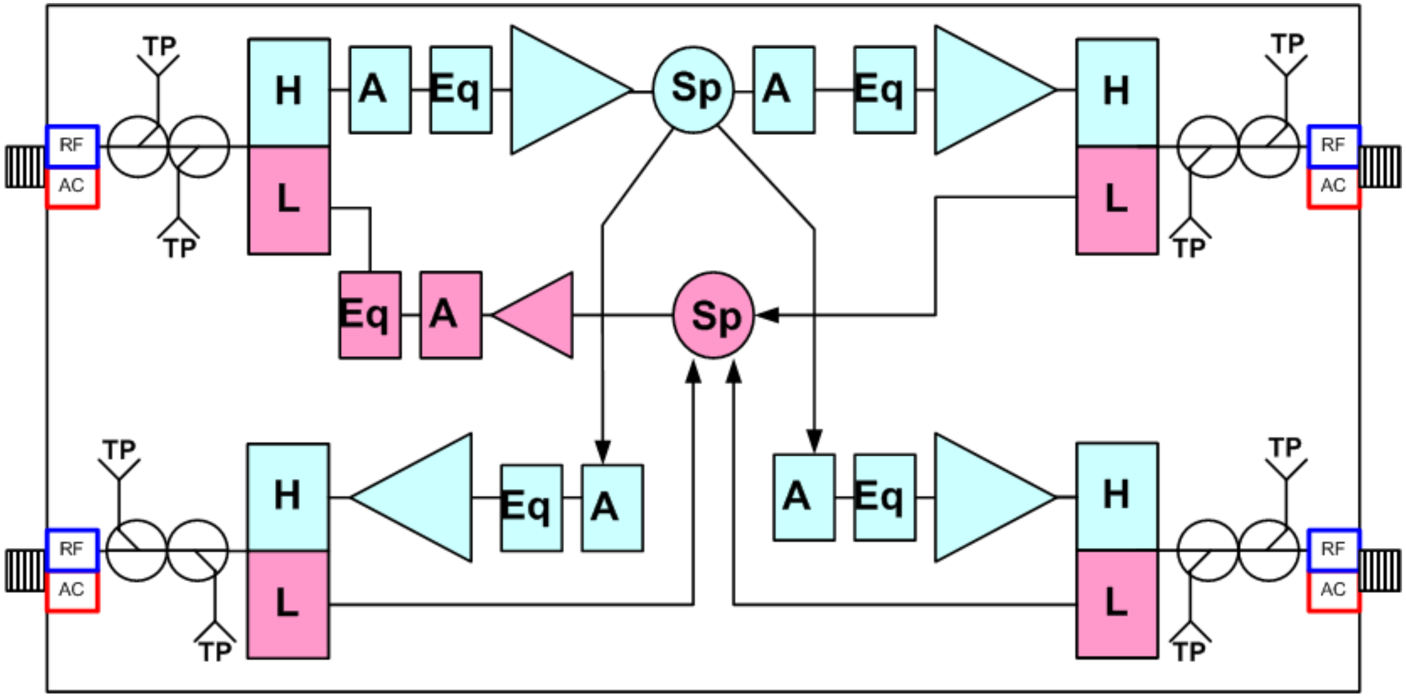


Downstream Blue

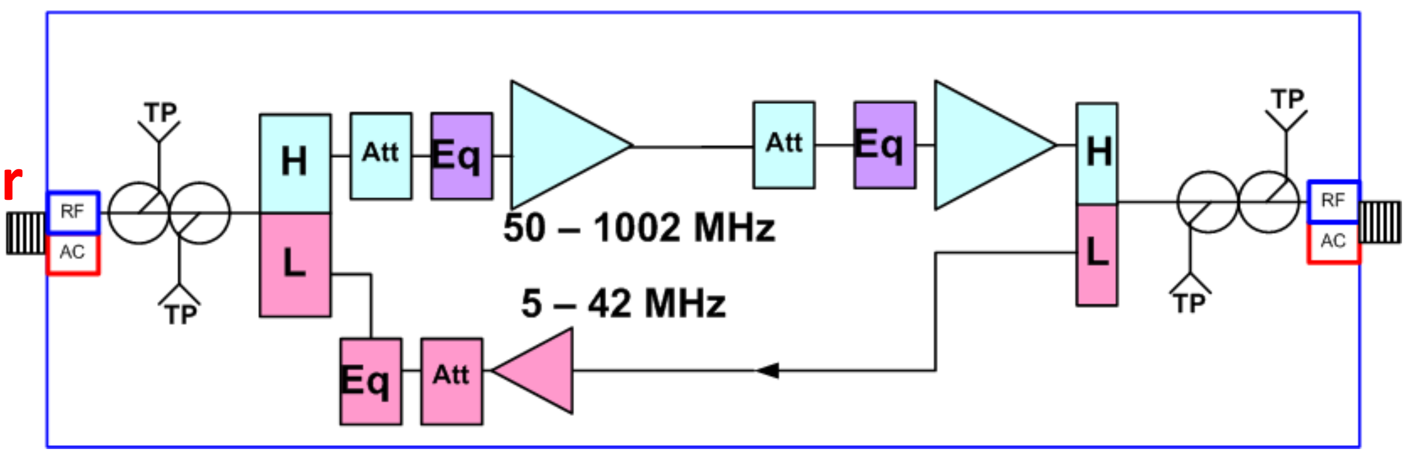
Upstream Red

Multiport and Line Extender Amplifier Structure

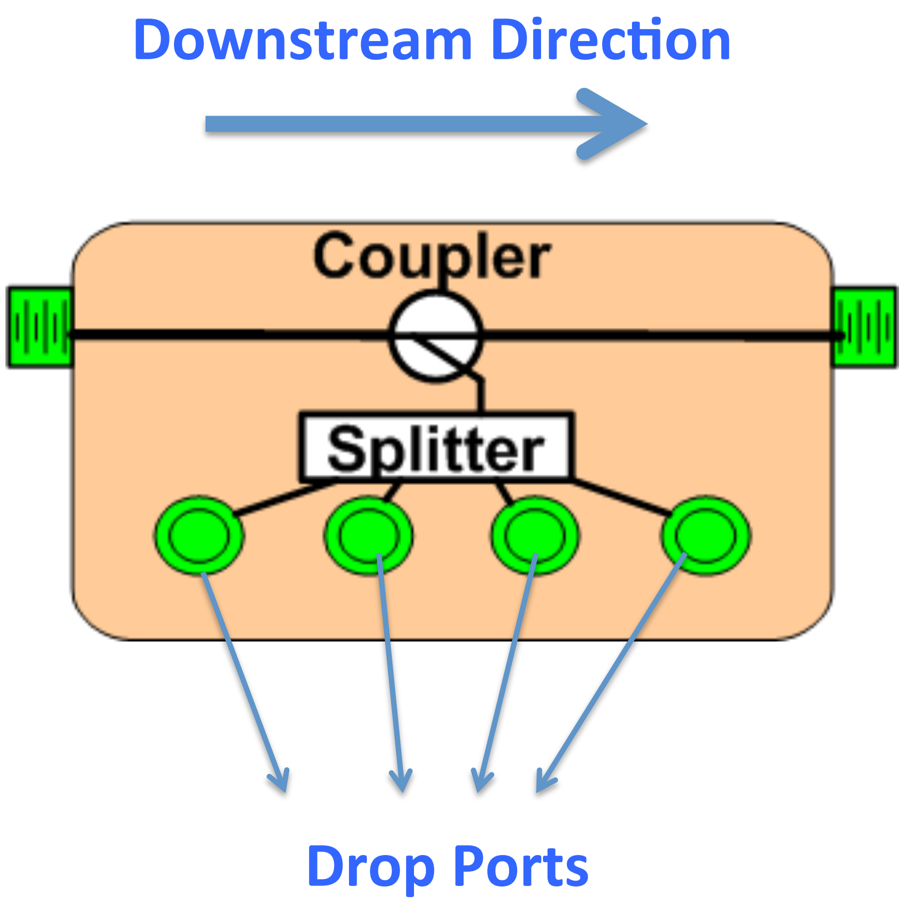
Multiport Amplifier



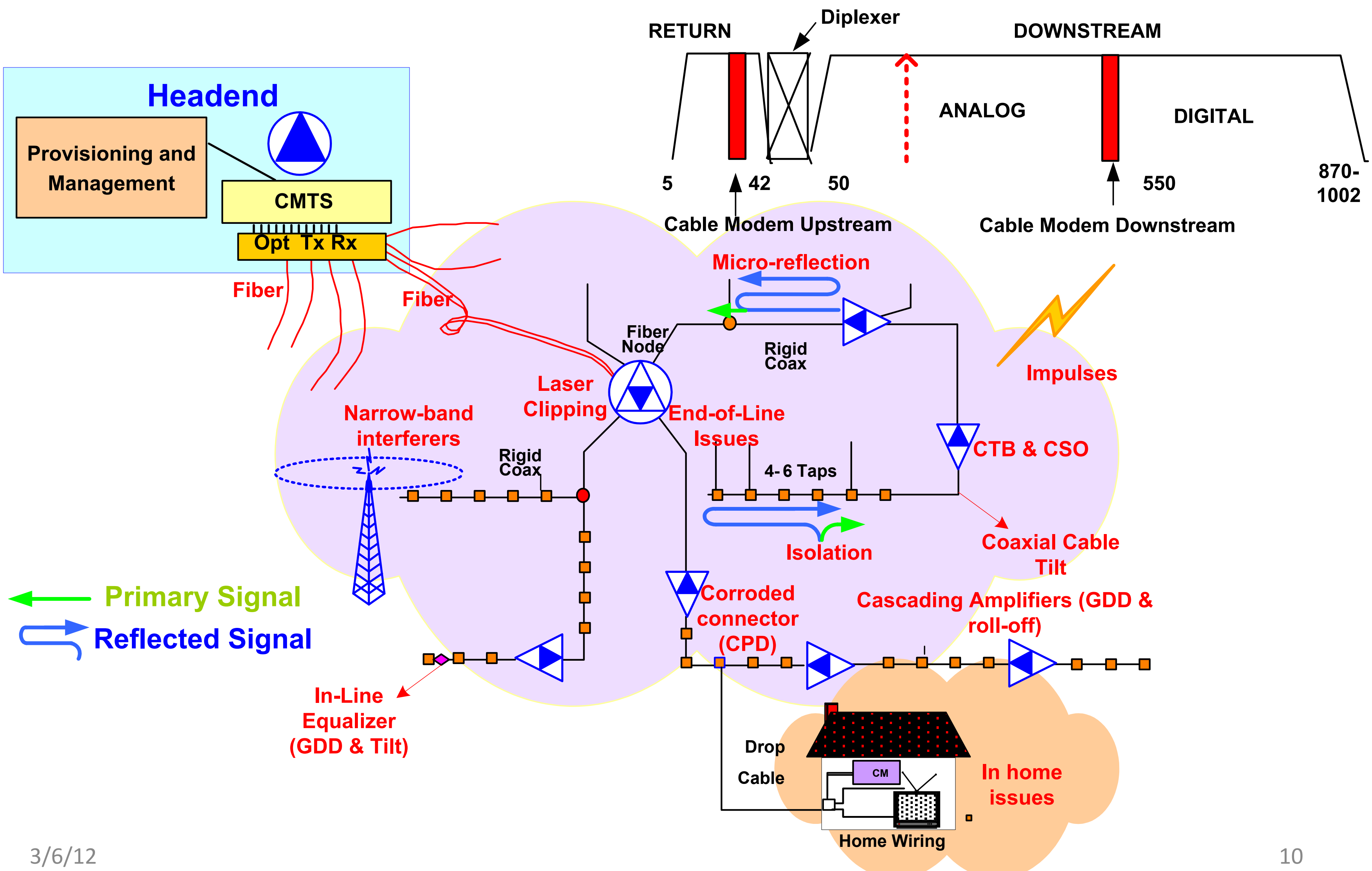
Line Extender Amplifier



Distribution Tap

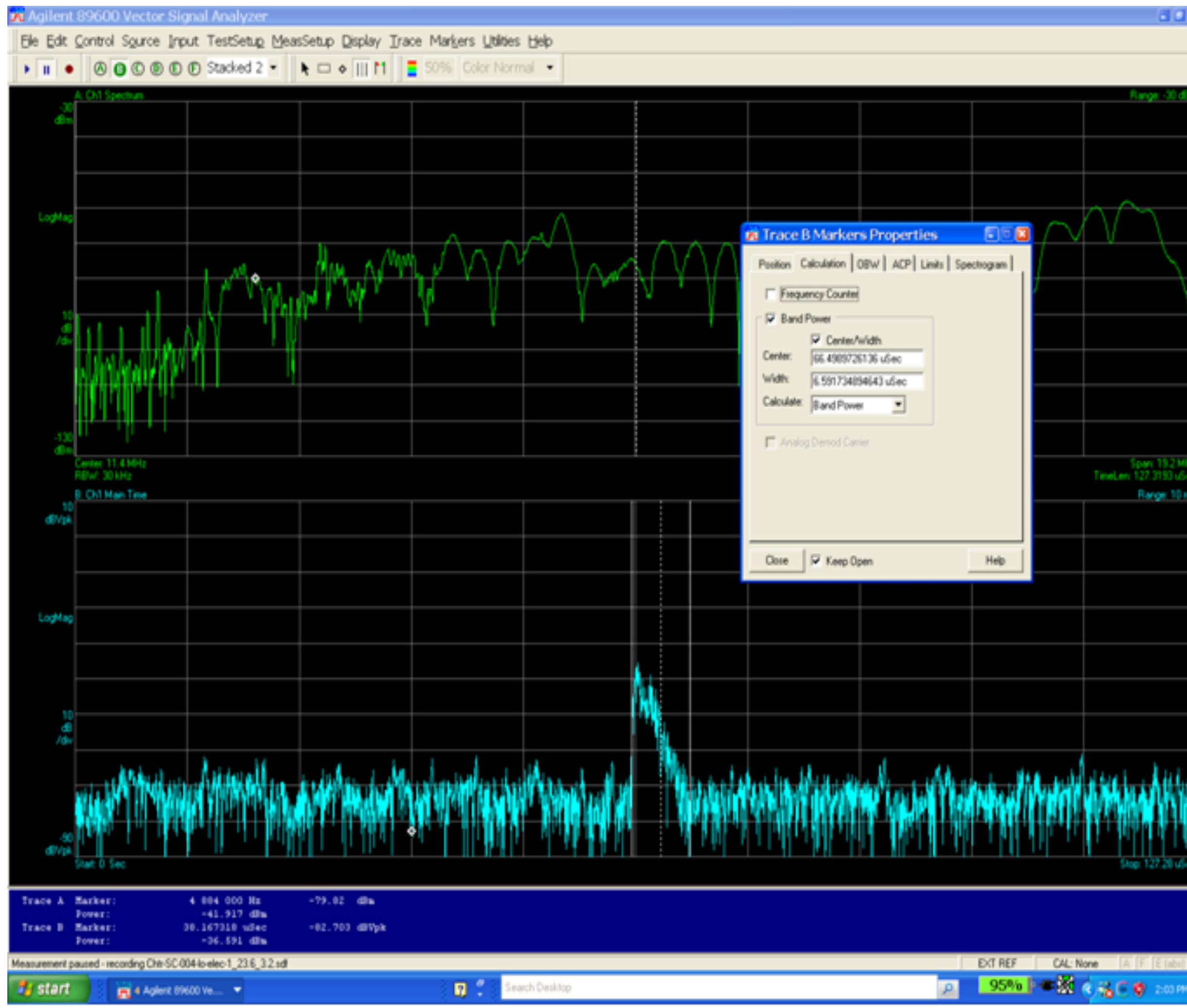


Plant Impairments



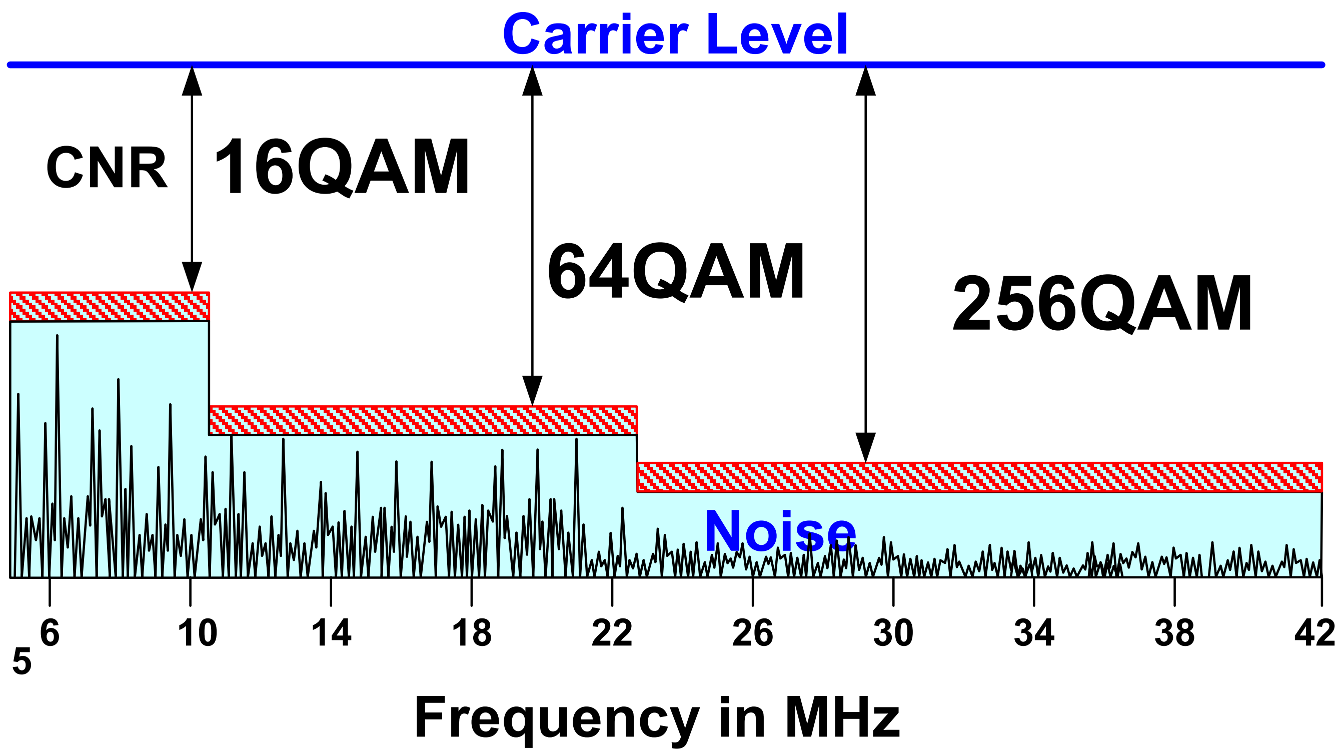
Impulse /Burst Noise

- Generated mostly from external sources entering via ingress
- Arise through cable defects in proximity of noise sources such as electric motors, appliances, thermostats, arc welders, light fixtures, power lines, static from lightning etc.
- Typically last a few microseconds and covers a good portion of spectrum
- Burst noise related to laser clipping and overdriving amplifiers can have durations a long as a data burst.

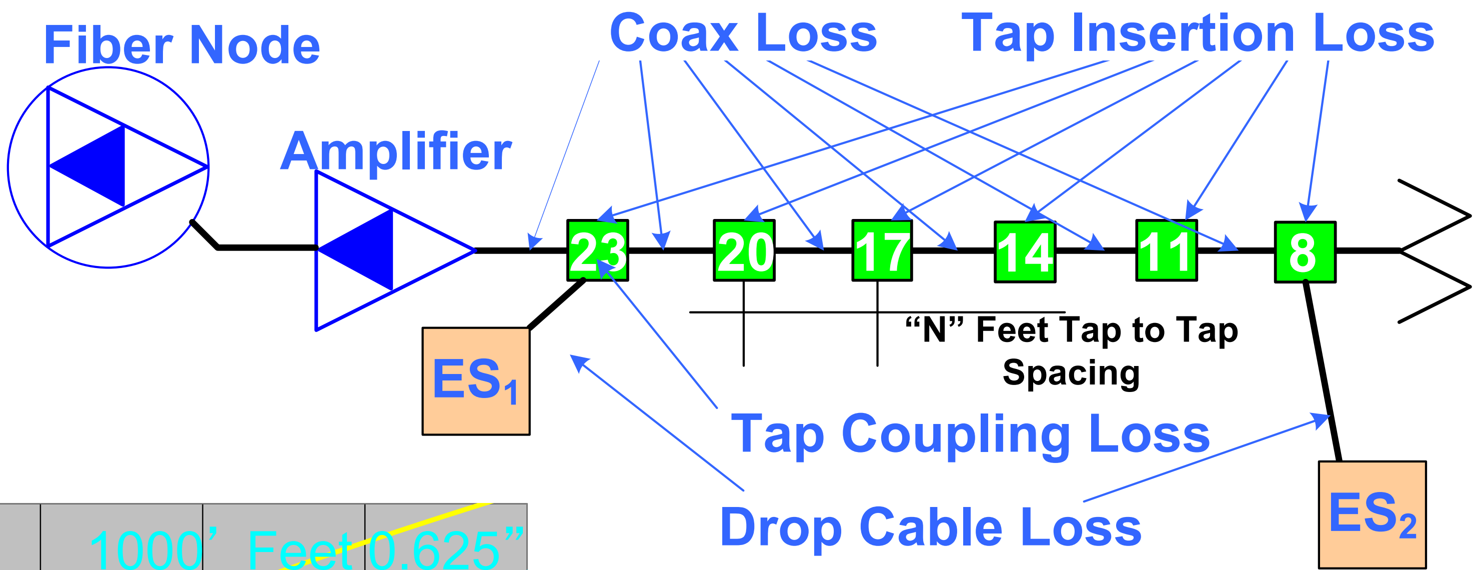


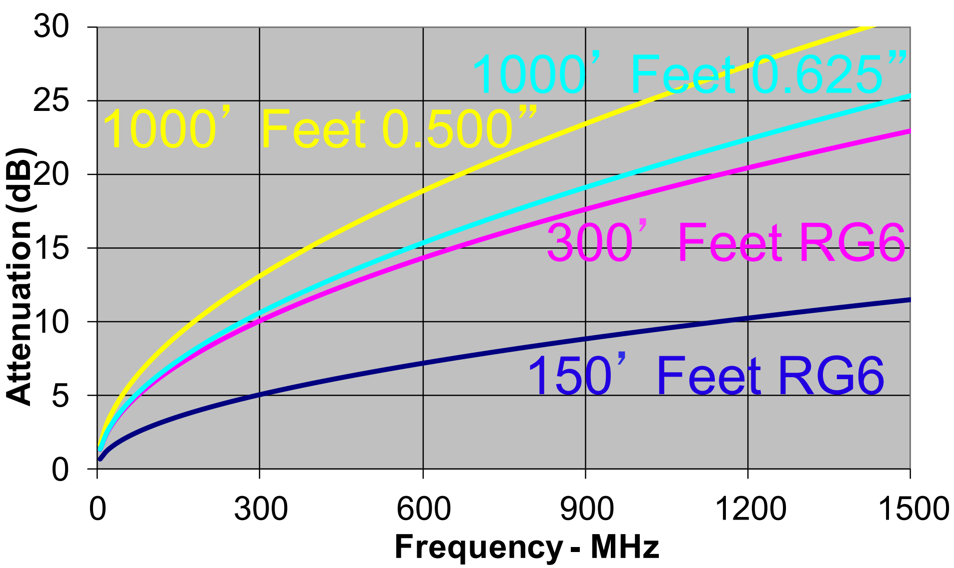
Narrowband Interferers in Upstream Spectrum

- Narrowband interferers and wideband noise determines possible modulation efficiencies



Loss Comparison

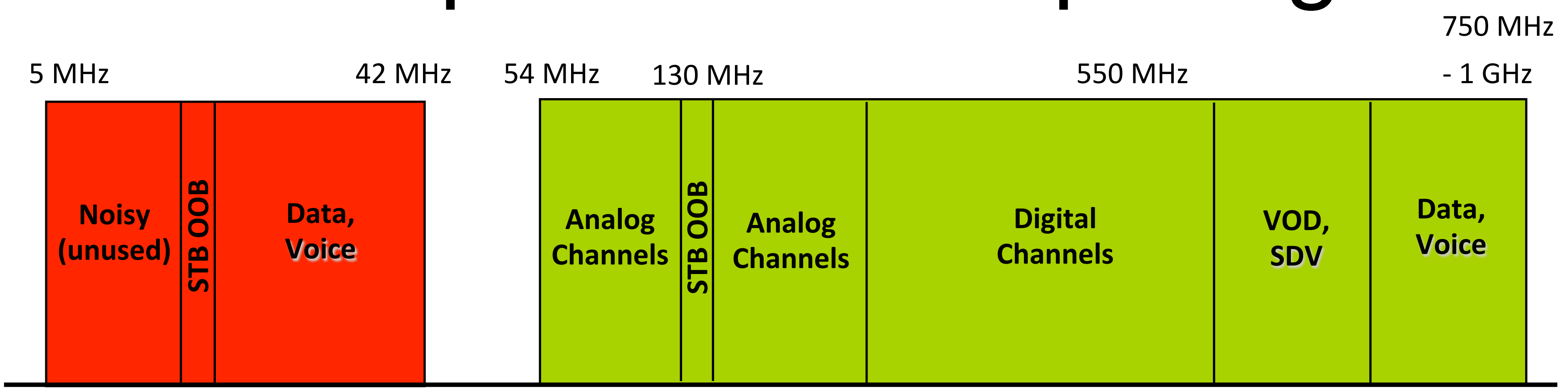


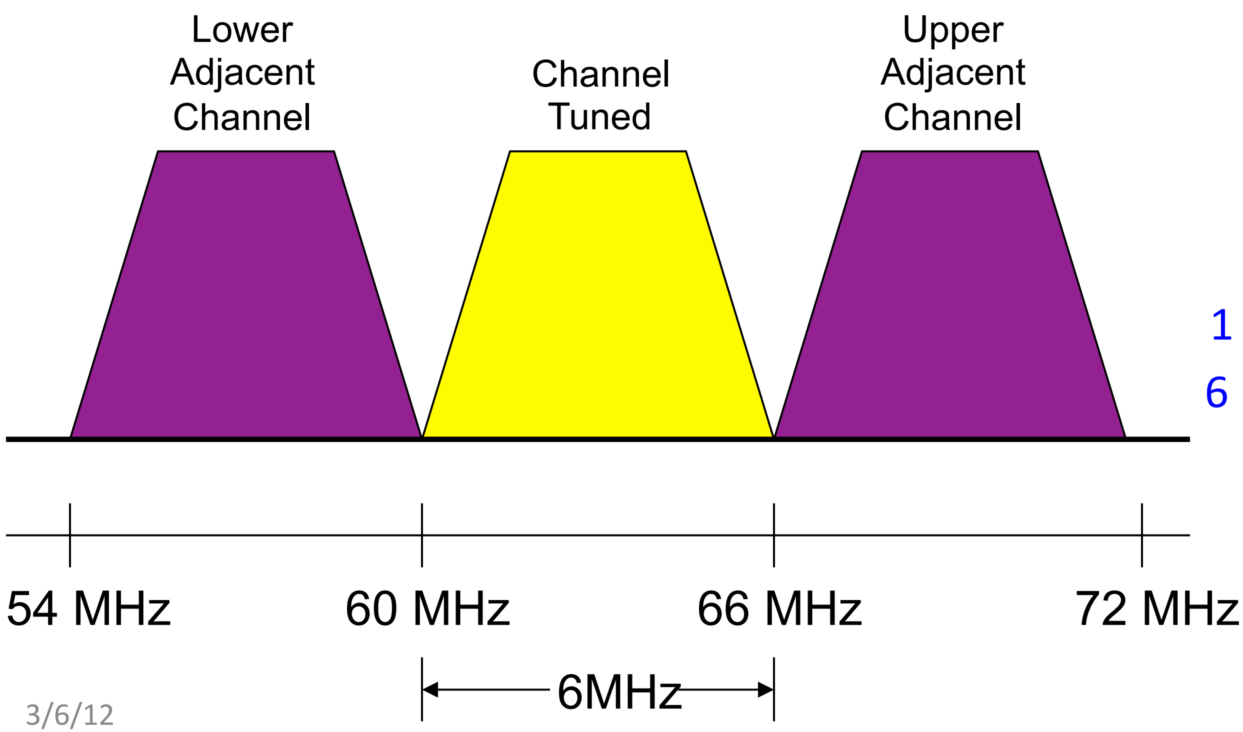


ES = End Station or CPE

Decreasing tap values give each ES approximately same performance

Example Channel Spacing



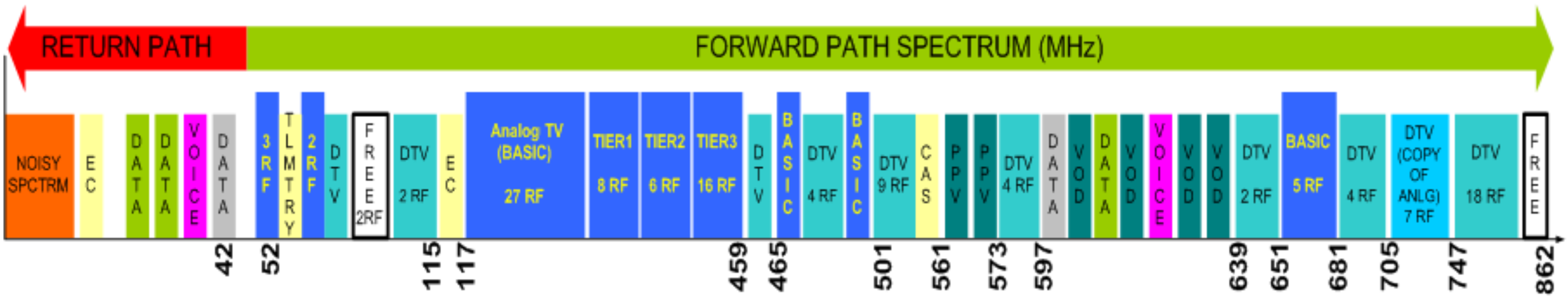


One 256 QAM Downstream
6 MHz Digital Channel
carries ~40 Mbps

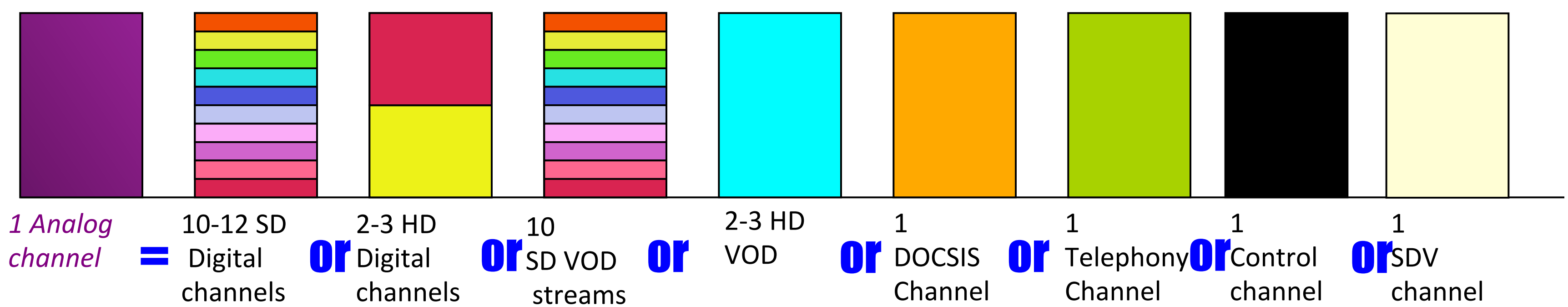
1 GHz System contains ~ 158
6 MHz Downstream channels

One 64 QAM Upstream
6.4 MHz Digital Channel
carries ~30 Mbps

2008 Example Frequency Allocation



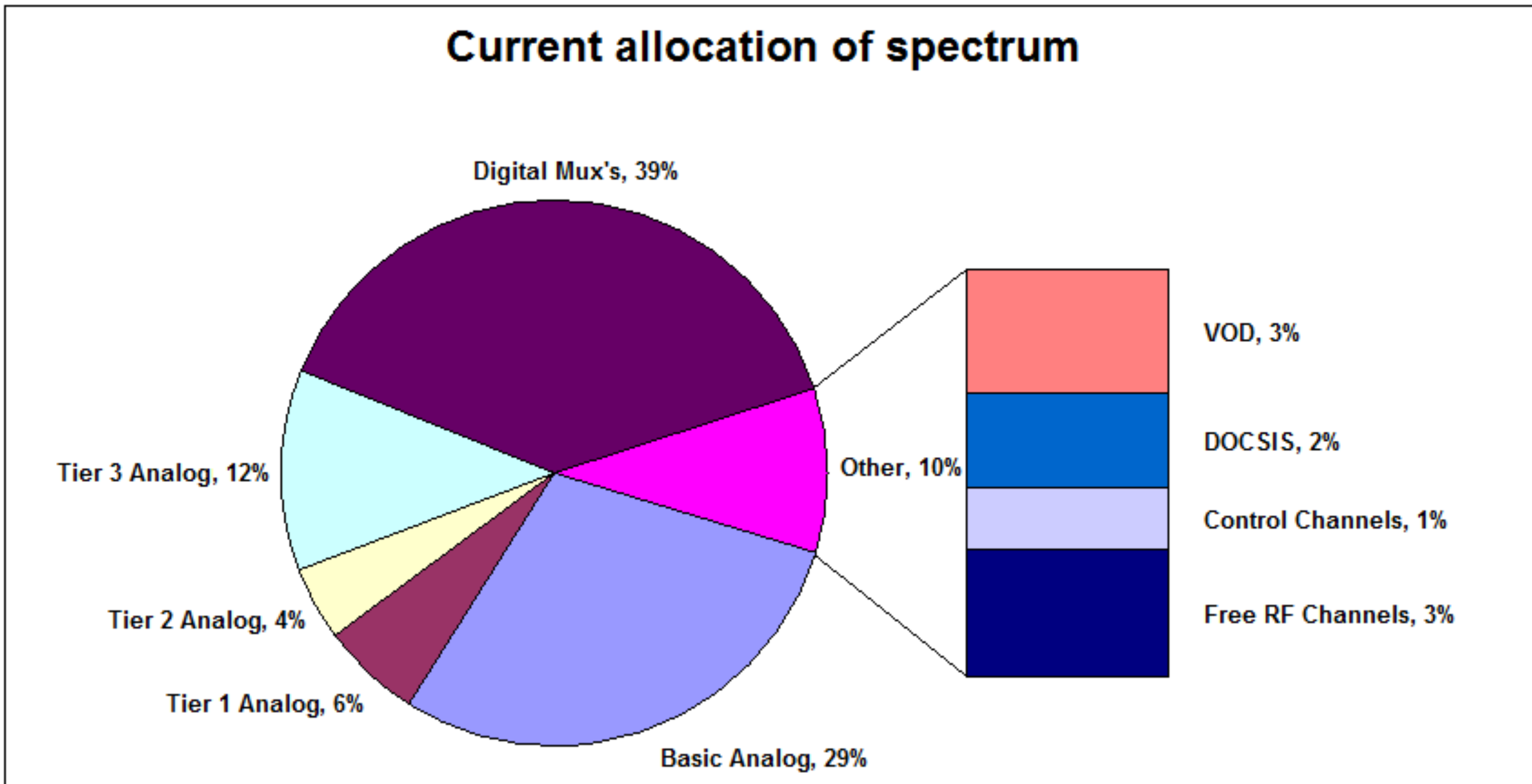
Example frequency allocation circa 2008; free channels typically do not exist today



Equivalent channel capacity

2008 Example Channel Allocation

Service	Analog TV	Digital Mux's	VOD	DOCSIS	Control Channels	Free RF Channels	Total
Allocated EIA Channels	69	52	4	3	2	4	134

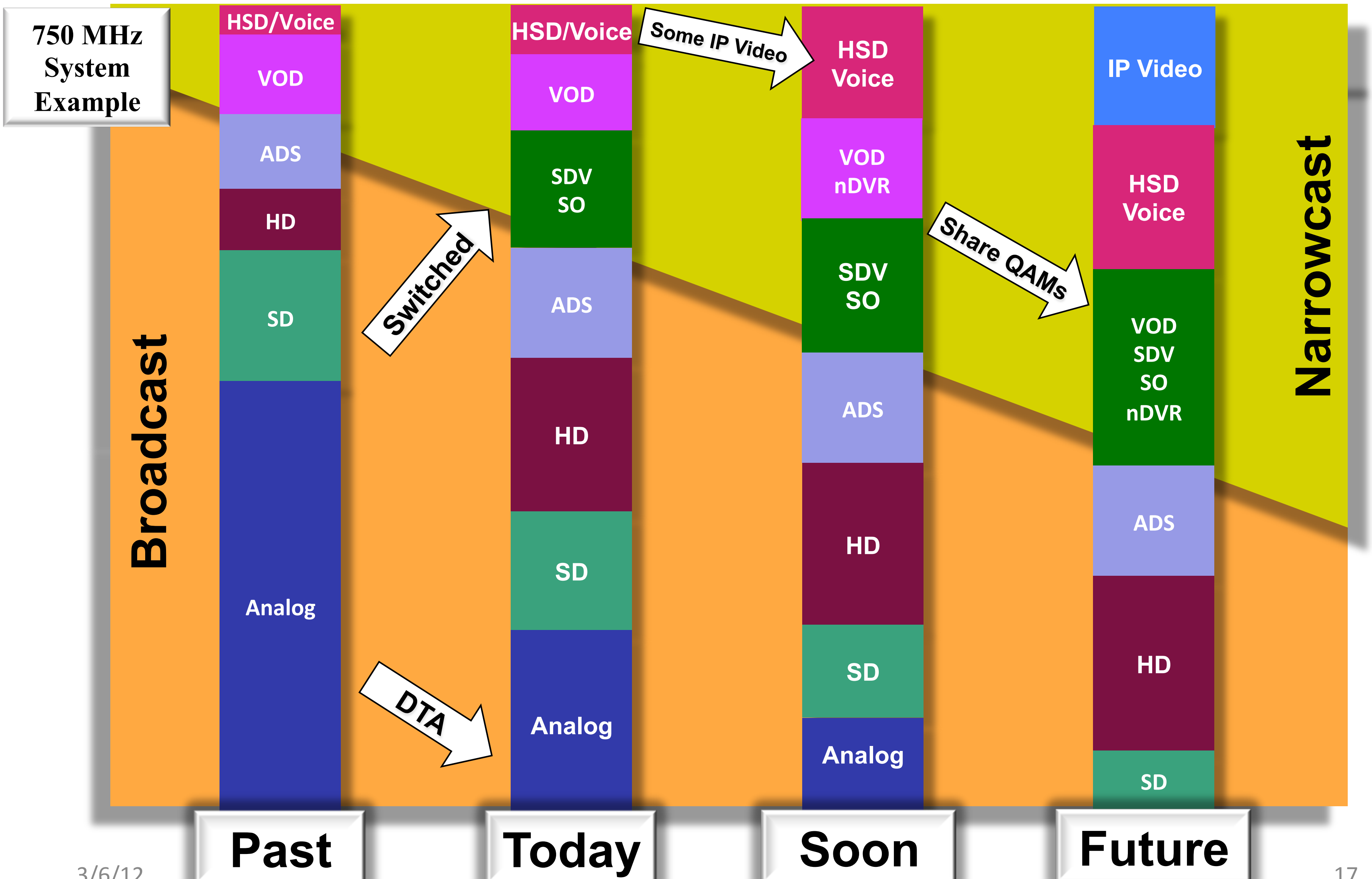


Figures rounded up

Spectrum Usage Over Time

(not to scale)

Where are we going with spectrum?



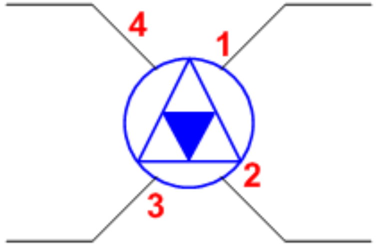
Additional Notes/Information

- STBs receive information and communicate to the network in one of two ways
  - Older STBs transmit on a proprietary channel, and receive guide data on a Forward Data Channel tunable up to 130 MHz (see SCTE 55 for details)
  - Newer STBs support both SCTE 55 and the use of DOCSIS channels for signaling
- Most receivers (in STBs, TVs with QAM tuners, etc.) use wideband Automatic Gain Control equipment
  - As a result, they receive signals across the entire spectrum, and may be sensitive to nearby high power transmissions

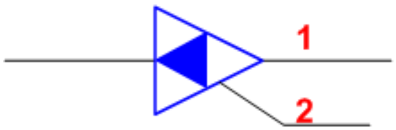
Questions?

Background Material

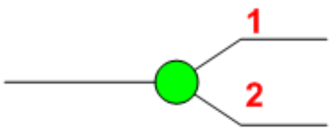
Symbol Legend



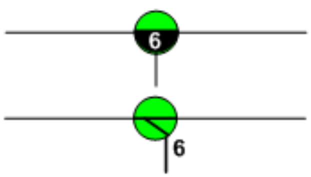
Fiber Node with Branch number in red



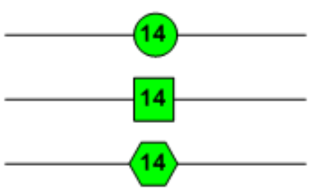
Amplifier with Branch number in red



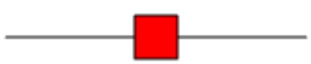
Splitter with Branch number in red, # indicates number of branches



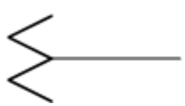
Directional coupler – coupling loss applied to branch connected to black semicircle or through diagonal line, 6 dB coupling loss example



Taps (circle= 2-port tap, square = 4-port tap, hexagon = 8-port tap). Number inside TAP indicates coupling loss at drop port. 14 dB value tap example shown



Power inserters or power blocks



Termination – End of Line

Node Topology Example