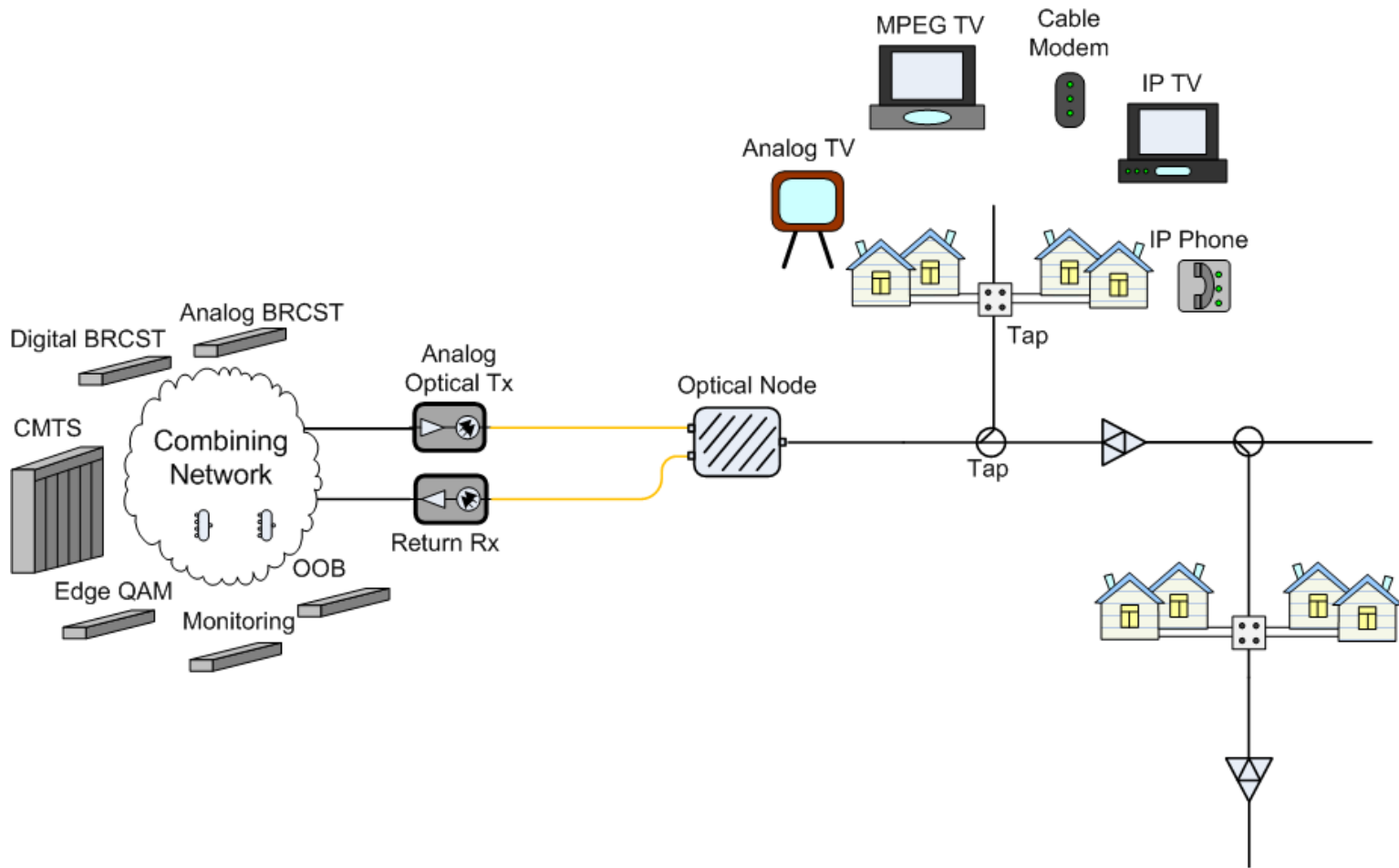


# HFC: New PHY coexistence concerns and network limitations

Boris Brun (Harmonic Inc)

# HFC Network

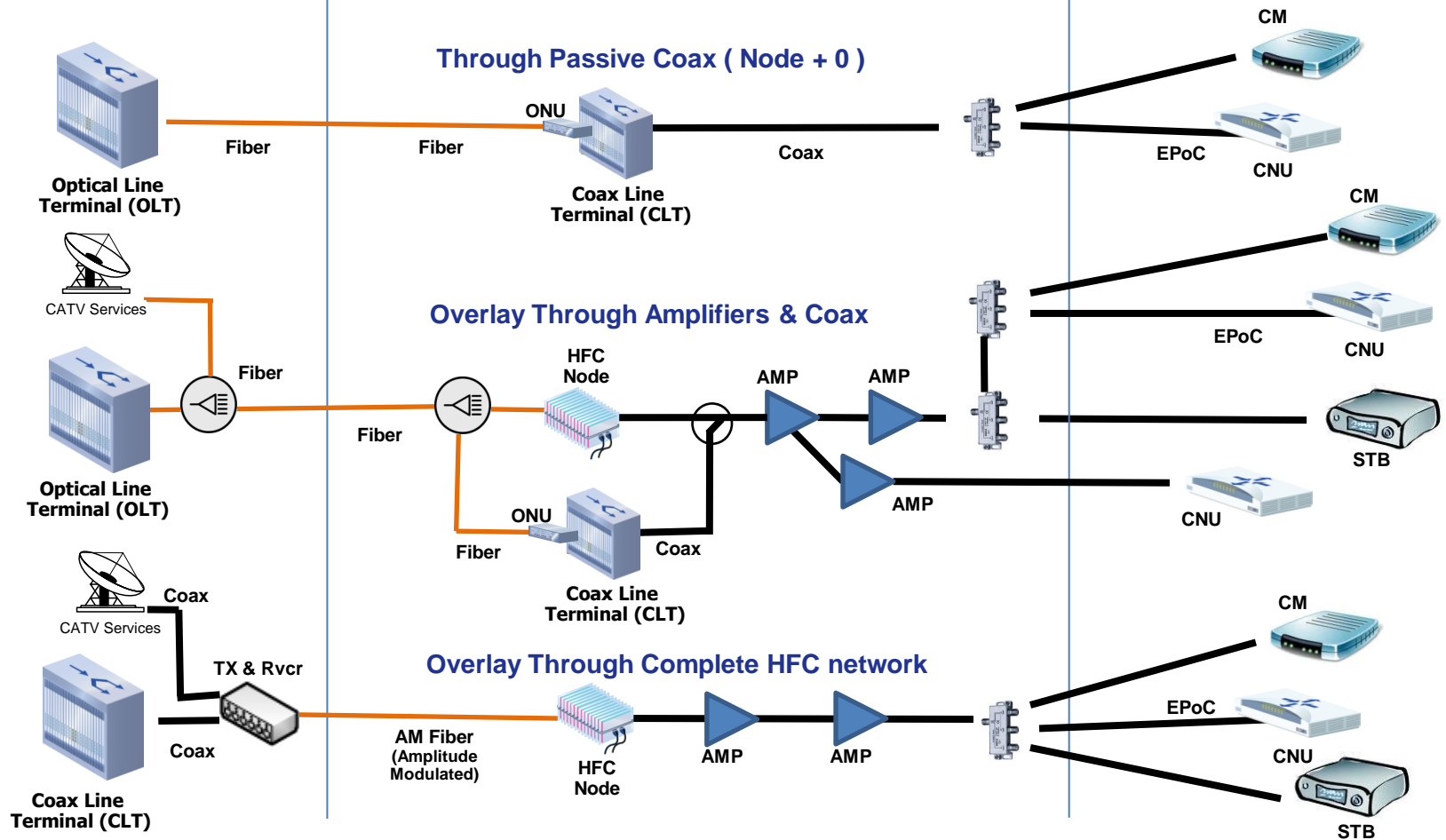


# EPOC Deployment Options

## Hub / CO Facility

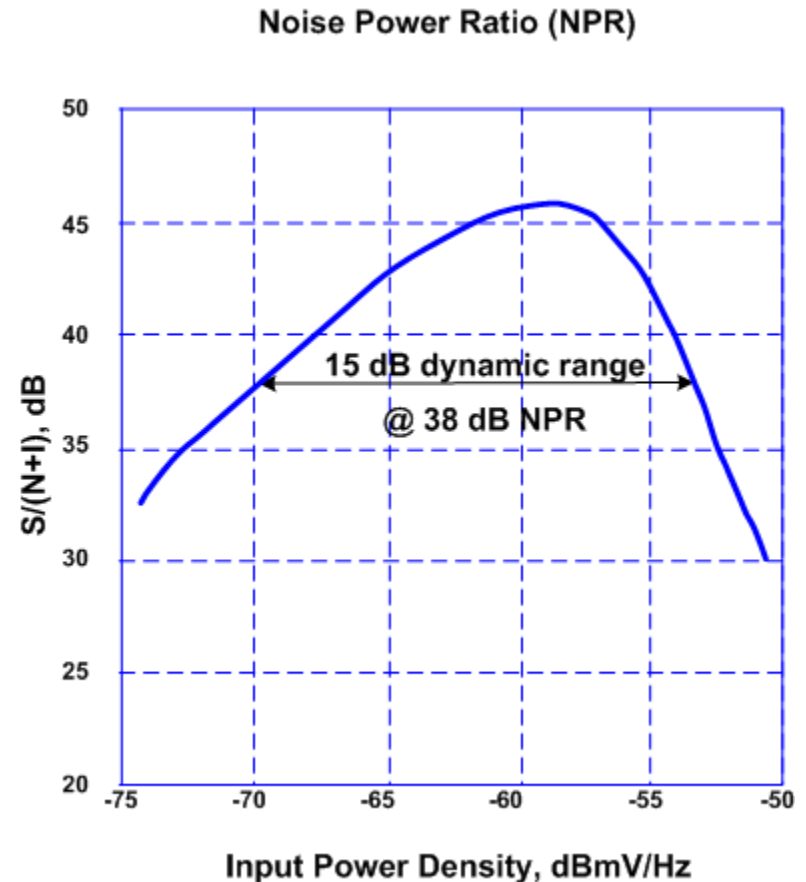
## Outside Plant

## Home Network



# Optical Transmitter Spec

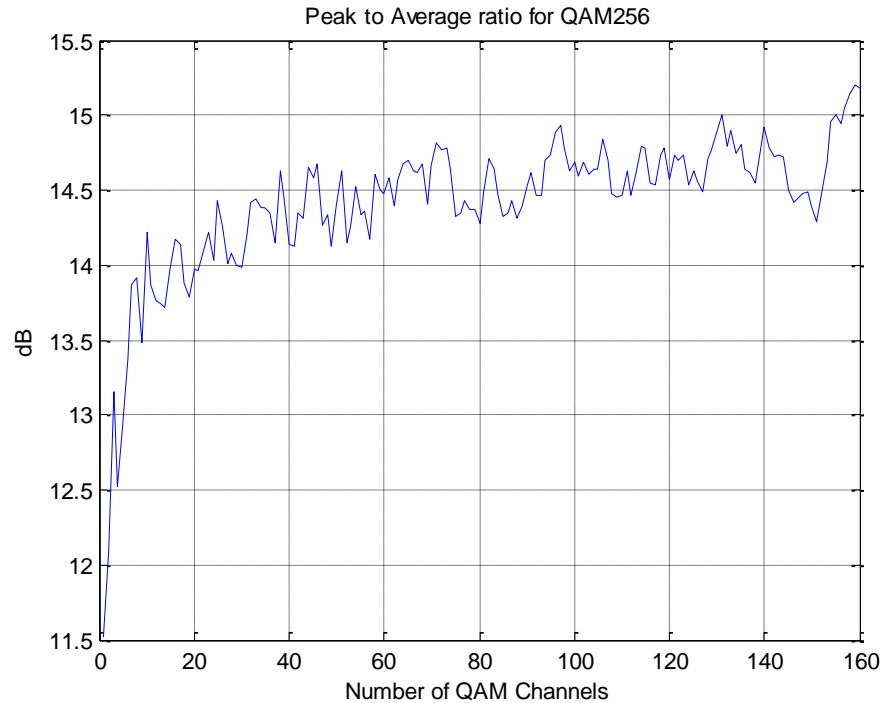
- NPR Dynamic Range
  - Calculated for targeted SNIR
  - Has to be wide enough to pass a high amplitude signals (peaks) and prevent clipping
    - max PAR = 15dB
    - min DR = 15dB
- Nonlinear distortions
  - CSO (composite second order)
  - CTB (composite triple beat)
- High PAR ratio can cause clipping and higher distortion level of the laser



# RF Amplifier

- RF Amplifier Distortions
  - CIN – Carrier to Intermodulation noise
  - CSO – Composite Second Order
  - CTB – Composite Triple Beat
- The high PAR ratio will degrade RF performances

# QAM Peak to Average Ratio



- The simulation was done for up to 160 QAM256 channels, 20K symbols per channel
- The nominal power level of the downstream 256QAM signal is -6dBc relative to analog video carrier level (peak power)

# CNR Performance

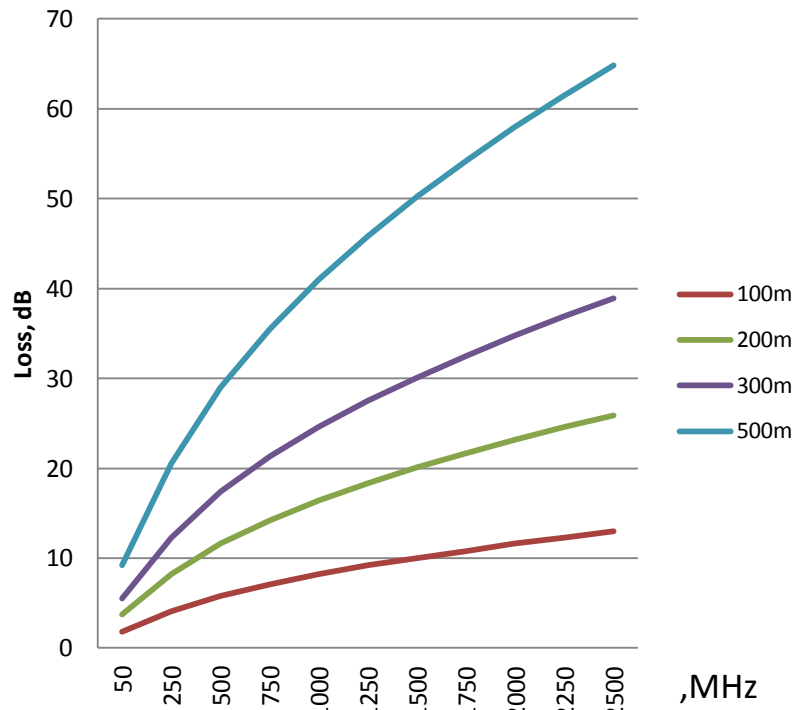
- RF Amplifiers Noise Figure
  - 8-11 dB for forward and return directions
- Optical Link
  - 45-50 dB for downstream link for analog channel, 39-44 dB for QAM
  - 35-40 dB for upstream link
- Typical CNR performance for Node+5, 35 amplifiers per Node RF port:

Upstream 42MHz		Downstream (for analog channel)	
CM	52 dB	Headend	62 dB
Coaxial Link	44 dB	Coaxial Link	54 dB
Optical Link	38 dB	Optical Link	48 dB
<b>TOTAL</b>	<b>37 dB</b>	<b>TOTAL</b>	<b>47dB (41 dB for QAM)</b>

# Cable Attenuation

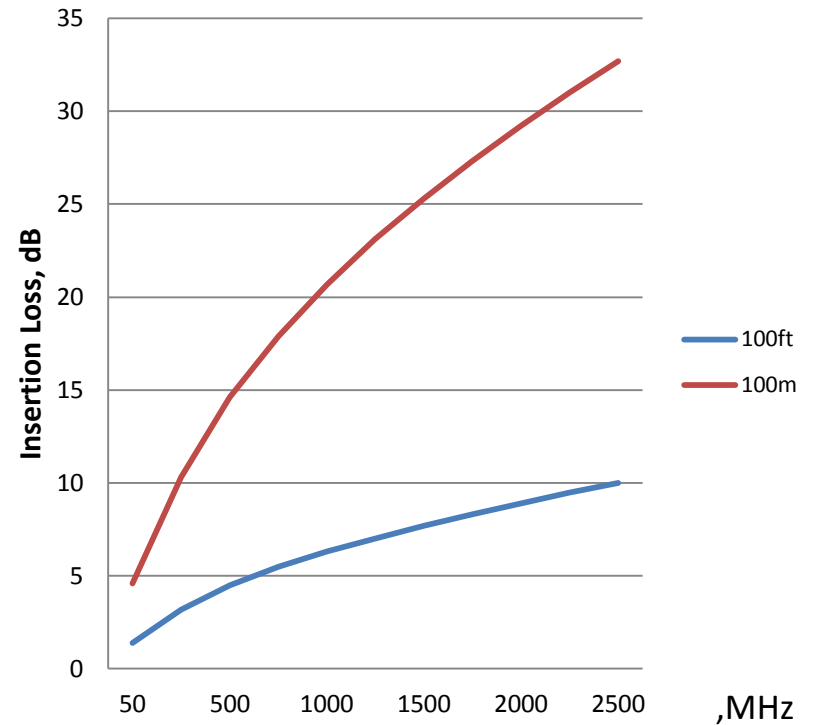
## Distribution Cable

PIII 500



## Drop Cable

RG6





# Linear Distortions

- Group Delay caused by diplexers
  - 10-12ns/MHz close to the edge
- Amplitude and phase distortions caused by microreflections

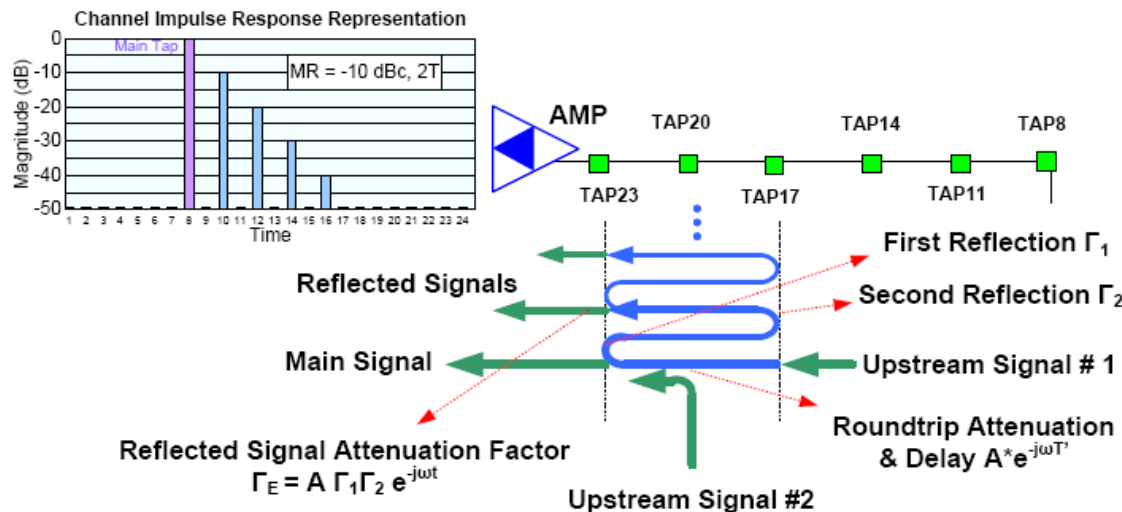


Figure 1 - Micro-reflection with multiple-transit echoes

# Optical Crosstalk

- The digital data stream delivered through the same fiber as RF signal has to be randomized in order to prevent a crosstalk and RF performance degradation.