SCTE ISBE CABLE-TEC EXPO '16

SEPTEMBER 26-29 PHILADELPHIA

INFINITE DOCSIS

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SCTE Society of Cable Telecommunications Engineers

ISBE International Society of Broadband Experts

#CableTecExpo

Essential Knowledge for Cable Professionals™

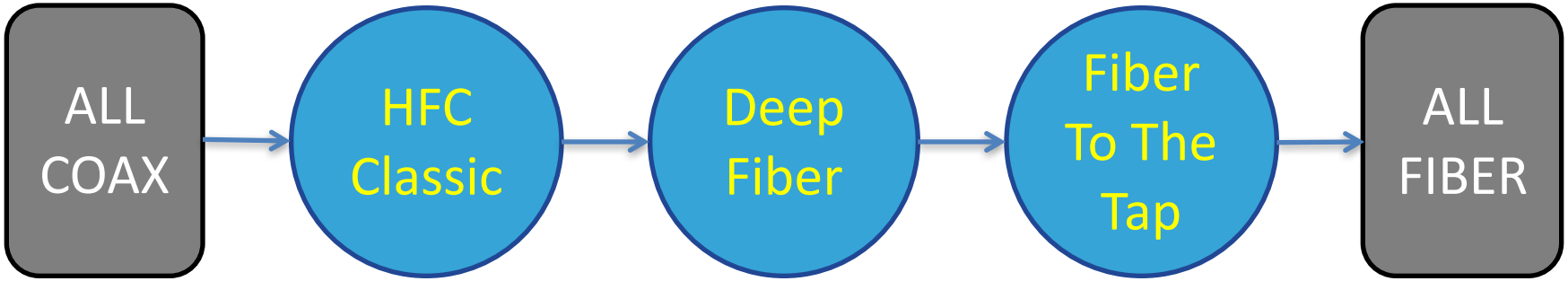
Infinite DOCSIS

To Infinity and Beyond

- How far has DOCSIS and the HFC plant come in the last 20 years?
- How far will they go in the next 20 years?
- What is possible?
- What is the technology roadmap?

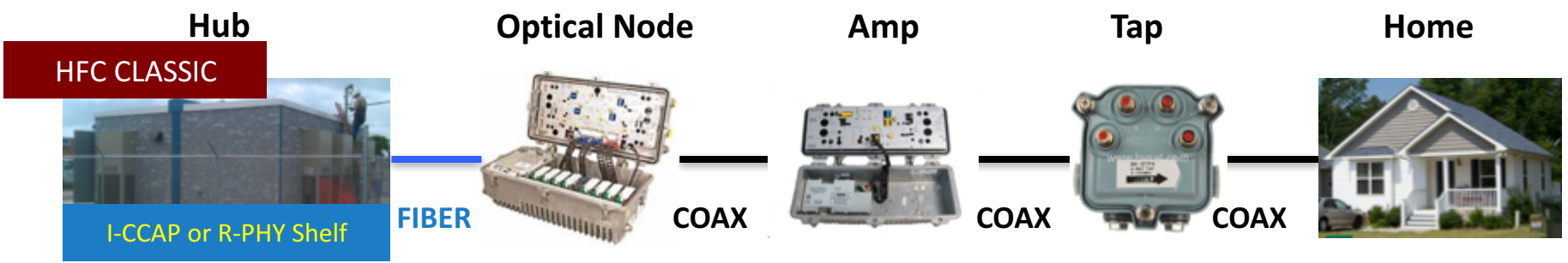
These are the questions we will answer today.

Three Phases of the HFC Plant



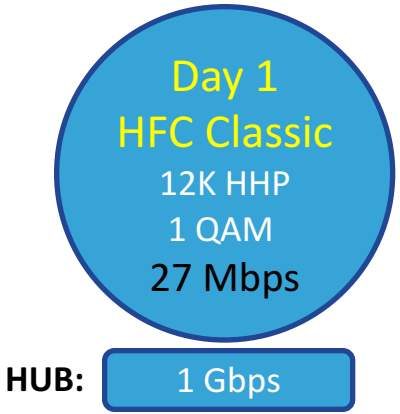
- This white paper presents the theorem that there are three stages of life to the HFC plant

Phase 1: HFC Classic



- CCAP at Hub
- Analog Optics to Optical Node. 500 HHP per Node.
- Design goal of a five amplifier cascade, 42 MHz return path.
- Tap connects to a drop cable

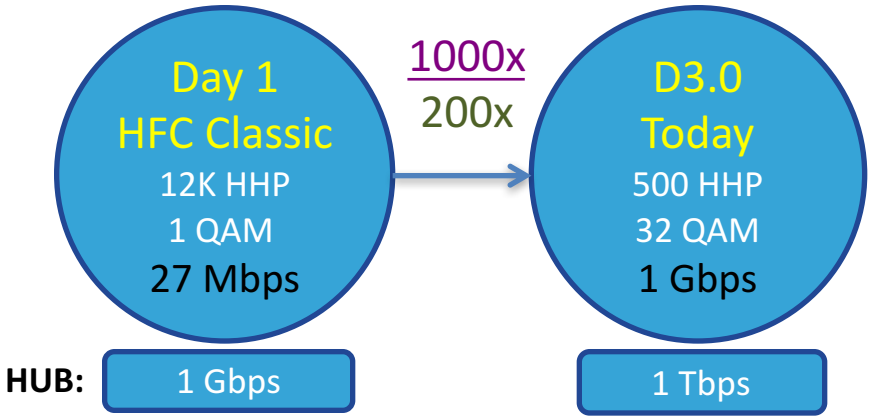
In The Beginning …



- DOCSIS 1.0 shipped in 1997, almost 20 years ago.
- Study baseline starts with 1x6 port line card, 64-QAM DS, QPSK, 1.6 MHz US, 2000K HHP per US port.
  - 27 Mbps x 2.2 Mbps
- Reference hub site capacity for study is 400K HHP

uBR7246

Phase 1: Classic HFC



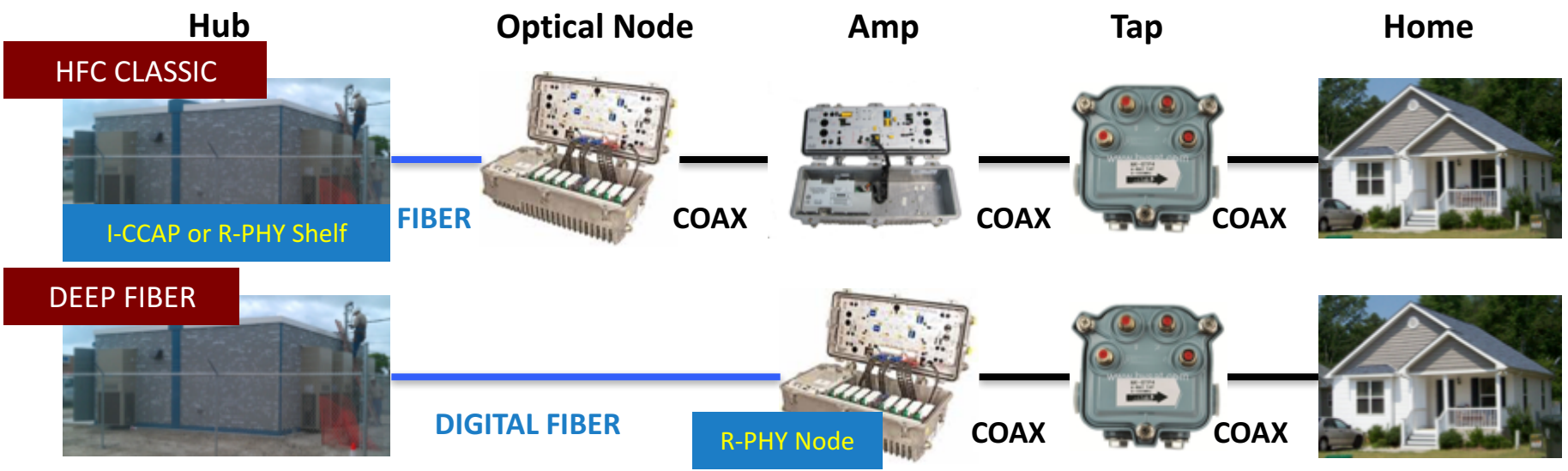
Over the last 20 years:

- HFC plant segmentation
- DOCSIS 1.0, 1.1, 2.0, 3.0

Over 20 years, DOCSIS capacity has grown 1000x

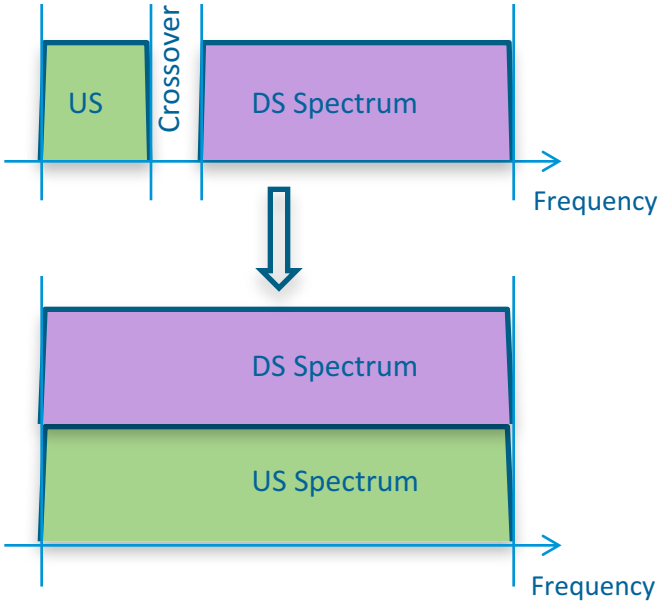
- This matches Ethernet's growth of 10x every 7 years.
- This is very impressive.

Phase 2: Deep Fiber



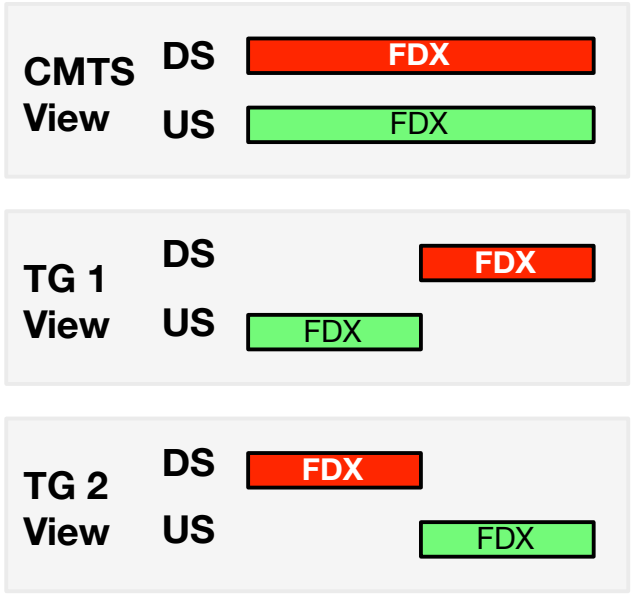
- 10x to 20x the node count. 60 HHP
- D3.1, 1.2 GHz, 6 OFDM, 10 Gbps
- RPD can segment to 4 SG. 15 HHP
- RPD increases SNR, ~+1 bps/Hz

FDX DOCSIS – Continued Innovation



- Symmetrical service offerings.
  - 10 Gbps x 10 Gbps theoretically possible.
  - 10 Gbps x 4 Gbps more likely
- Optimized for R-PHY Node and N+0 deep fiber.
- Not standardized yet.
  - Calculations for study are done using Cisco's FDX scheme.

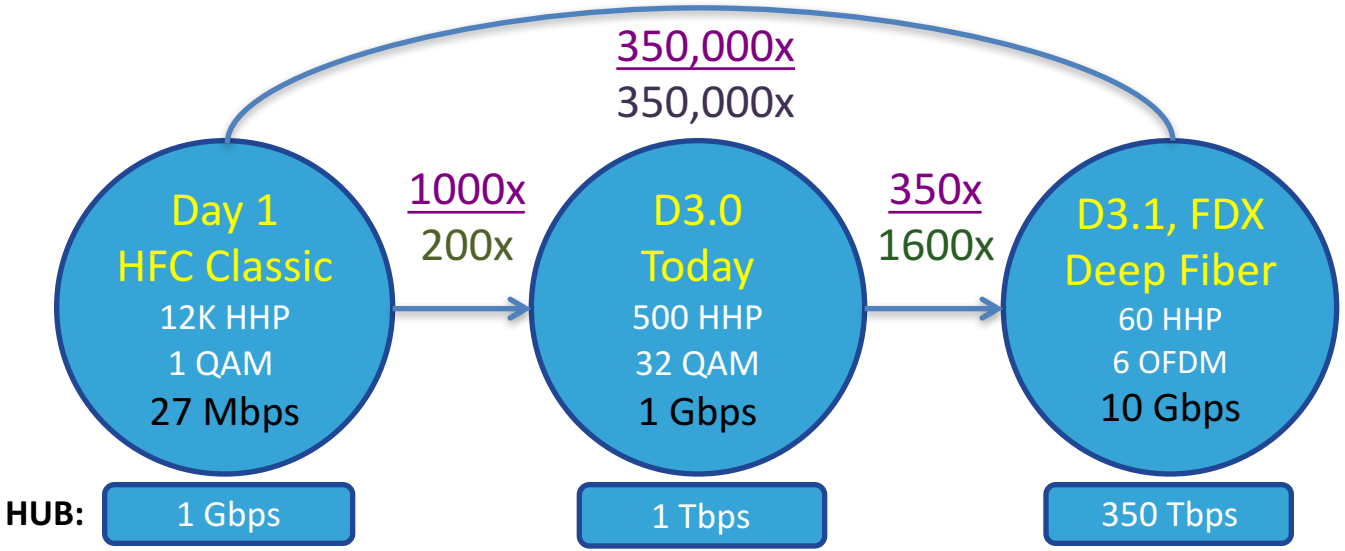
Making FDX Work



Here is what we do.

1. We echo cancel at the CMTS PHY.
2. We measure and sort CMs into interference groups (IG) and IGs into transmission groups (TG).
3. We use FDD (and/or TDD) within a TG so that those CMs do not interfere with each other. All broadcast is handled separately.
4. We overlap TGs in frequency and time so that 100% of the spectrum and 100% of the timeline are used for both DS and US.

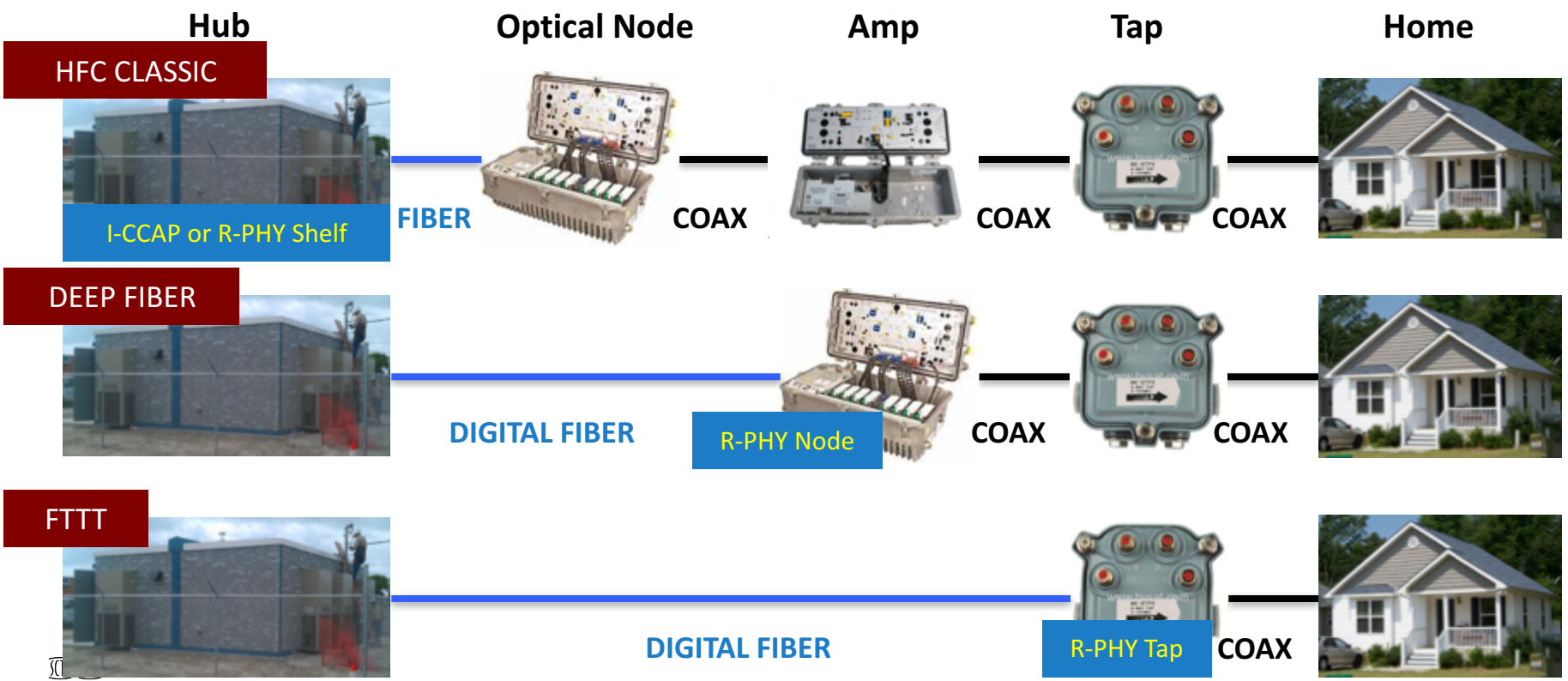
Phase 2: Deep Fiber



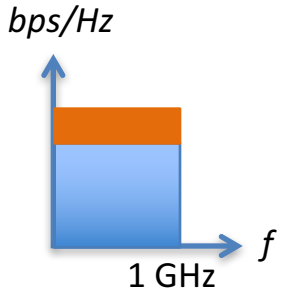
Massive Scale

- ≥10x nodes
- 4x within node segmentation
- 8x with D3.1 6 ch OFDM
- 1.5 bps/Hz from R-PHY
- D3.1 US & FDX US = 40x

Phase 3: Fiber to the Tap (FTTT)



Extended Spectrum (ES) DOCSIS



6 dB of headroom can be use for:

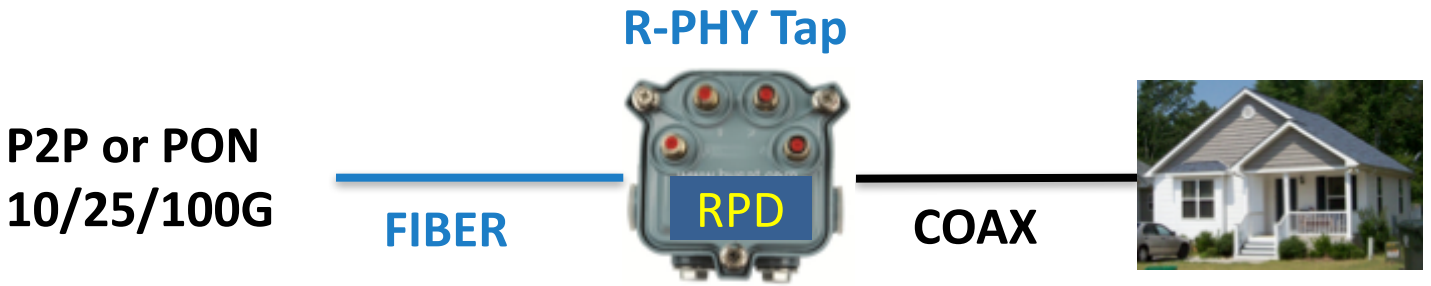
+2 bits/Hz
~= +20% bps

– or –

400% more spectrum but with attenuation.
>> +20% bps

- DAC and ADC will soon be multi-GHz.
- As SNR decreases at higher frequencies, use lower modulation.
- Potential Specs:
  - 100 Gbps, 10 GHz, 50 OFDM ch equiv.
  - Matched to fiber.
- Near FDX possible.

Fiber to the Tap - DOCSIS to the Door



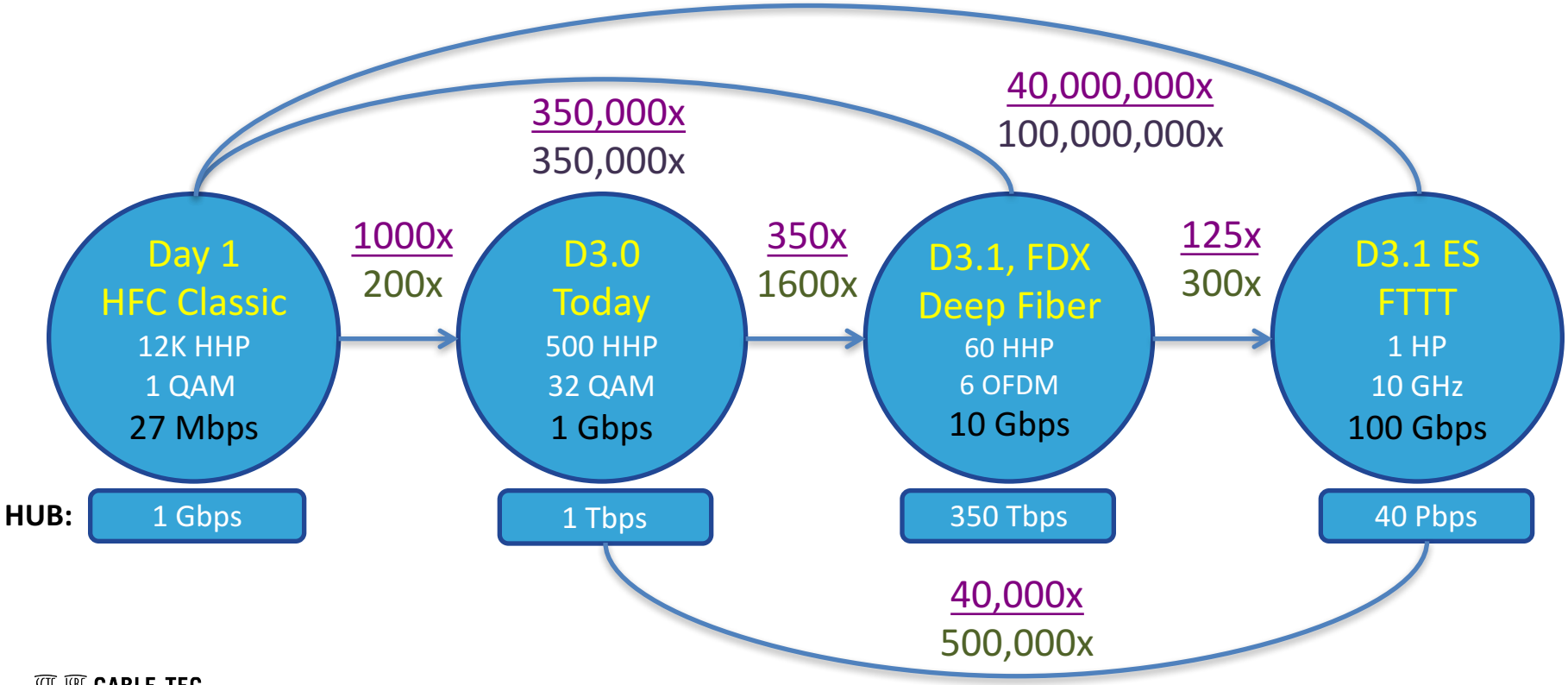
Goals

- Ultimately one spectrum per home
- 100 Gbps FDX/ESF over coax per home

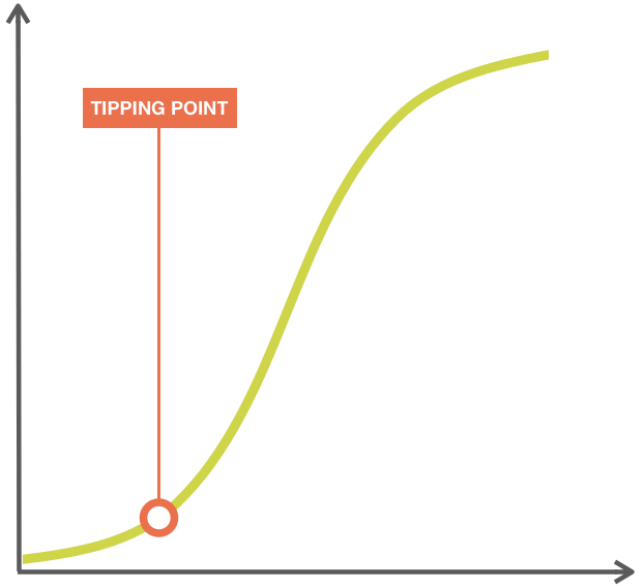
Why FTTT instead of FTTH?

1. Cost of fiber drop vs cable tap upgrade.
2. Quicker to upgrade plant than customers
3. Support of legacy equipment in the home.

Phase 3: Fiber-to-the-Tap (FTTT)



Conclusions



- Remote PHY is a tipping point
  - Thinking “Outside the Box”
  - Deep Fiber and Remote PHY are a once in 20 year change
  - FDX is a once in a lifetime change.
- Timeframes (@10x per 7 years)
  - Deep Fiber: 350x ➔ 10 to 20 years
  - FTTT: 40,000x ➔ 30 years
- Infinite DOCSIS → Infinite Opportunity
  - 25 to 100 Gbps per HHP
  - Connect everybody and everything

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