

A large, white, sans-serif '10G' is centered on a rectangular background. The background features a vibrant, abstract design with horizontal streaks of light in shades of red, orange, yellow, and purple, creating a sense of motion and energy.

# 10G

## The Path to 10G at Comcast

IETF-114  
Philadelphia  
July 2022



Welcome Back to Philadelphia!!

*IETF is back in Philadelphia for the first time since 2008!*

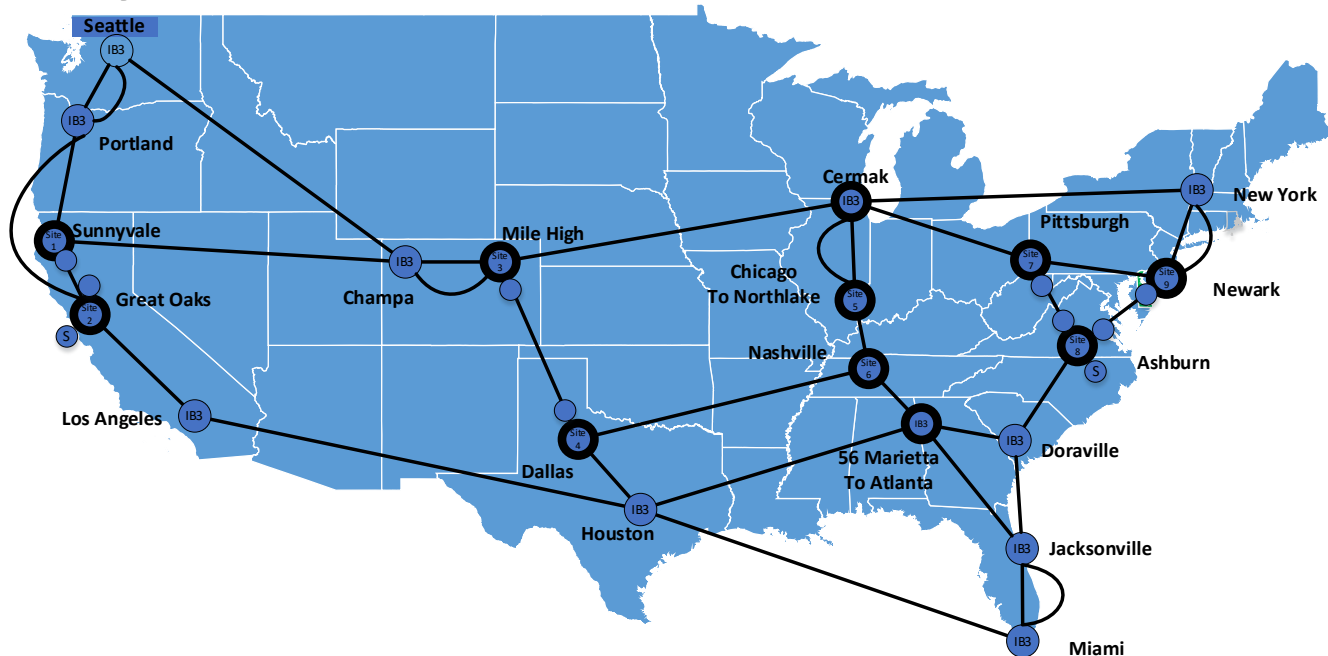


- 20+ years of engagement at the IETF
- Sponsoring IETF since 2008
  - SIP
  - IPv6
  - DNSSEC
  - DoH
  - Low Latency, Low Loss, Scalable Throughput (L4S)
- Future of the TV Experiences (HTTP adaptive streaming)
- And lots more – from layer 3 to 7



*Thanks to the foundational work of the IETF, the world has been able to make an unprecedented shift to remote work, school, healthcare, and scientific collaboration due to the power of broadband and the Internet during a global pandemic.*

## Our Network Today



Size	Scale	Capacity	Investment	Gig Speed
~ <b>1.08M</b> Network miles covering 39 States & DC	~1.3 trillion DNS lookups each day	<b>Doubled</b> every 2.5 years	<b>\$20B</b> since 2017; <b>\$4.2 Billion</b> in 2021	<b>60M</b> Homes and Businesses

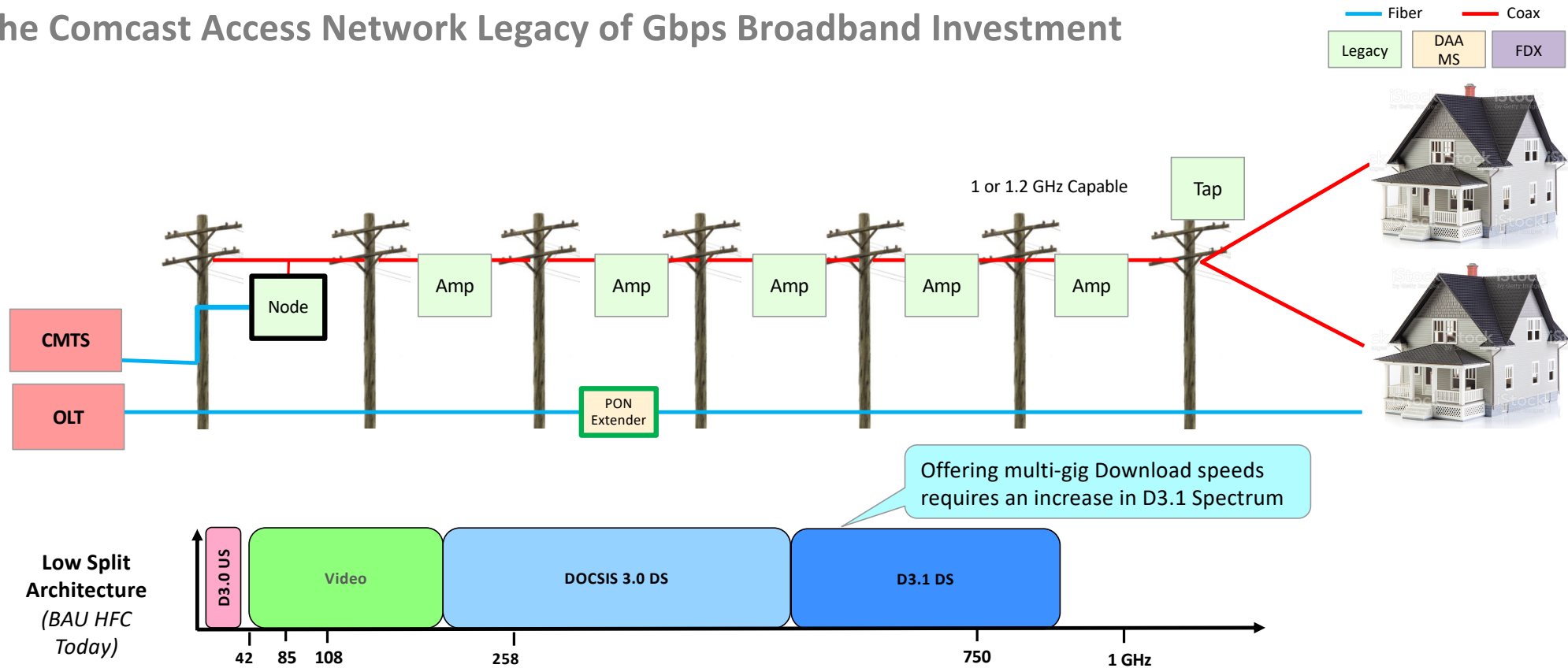
*We are continuing our investments with cutting edge R & D for:  
Bi-Di Coherent Transceivers, Hollow-Core Fiber & ML based optimization*

## 2021 in Review On The Network

- Continued Consumption Growth on top of an unprecedented 2020:
  - Peak downstream traffic increased 11%
  - Peak upstream traffic increased 5%.
- Network traffic continued to be highly asymmetrical
  - Network asymmetry increased throughout the year, with total downstream traffic volumes 12.4x higher than upstream for the first 6 months of the year, and 14.5x higher for the last six months
- Octave network AI platform improved capacity by ~45%
  - Automatically optimizes the performance of 50 million devices across the Comcast network every 20 minutes
- Entertainment activities dominated peak network traffic, with video streaming accounting for 71% of downstream
- Videoconferencing as a share of peak network traffic decreased slightly in 2021, remaining less than 5 percent
- XB8 gateway with WiFi 6E, mesh networking, 2.5GigE



# The Comcast Access Network Legacy of Gbps Broadband Investment

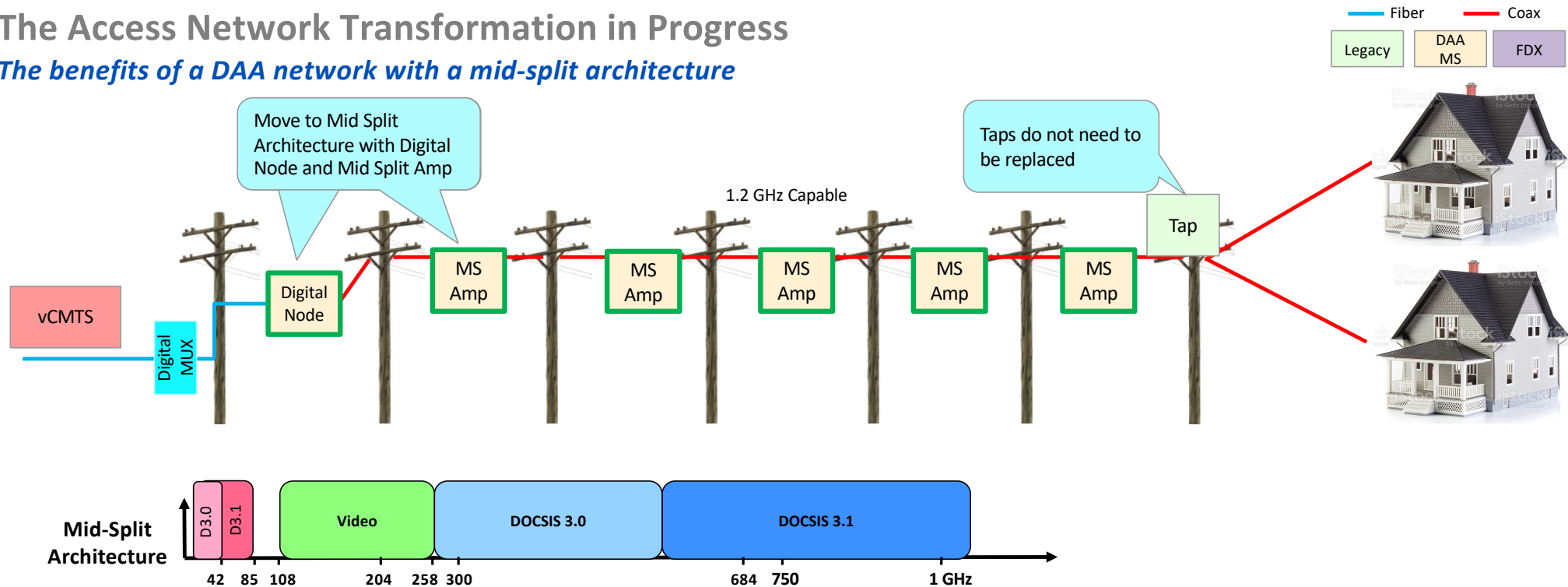


## Key Callouts:

- First nationwide Gbps consumer broadband network
- Prior network spectrum was limited to 42 MHz upstream and varied from 750 MHz to 1 GHz Downstream
- DOCSIS 3.1 is ~40% more efficient than DOCSIS 3.0, enabling higher capacity and speeds both downstream and upstream
- Optimized with AI/ML to achieve ~45% more capacity
- Continue to support legacy Video channel carriage

# The Access Network Transformation in Progress

## The benefits of a DAA network with a mid-split architecture



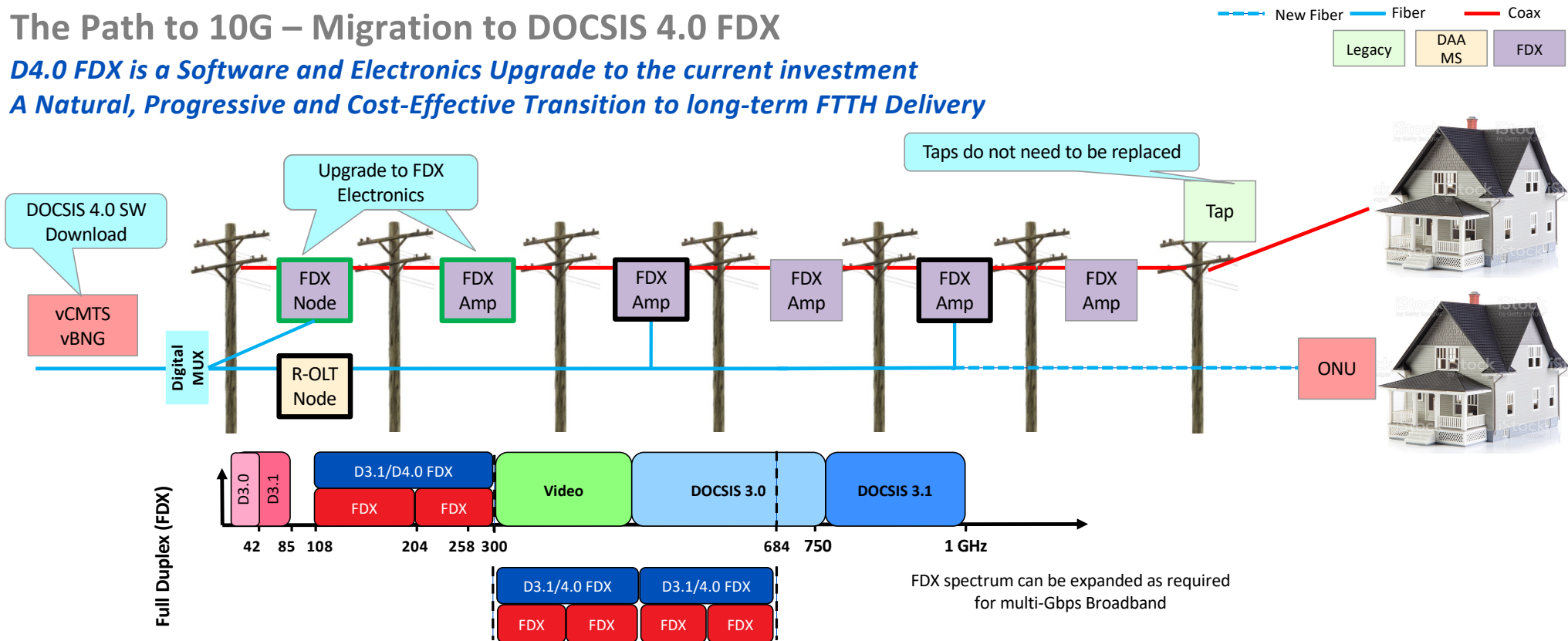
### Key Callouts:

- **Upstream** expanded using DOCSIS3.1, increasing capacity by >4x and enabling speeds up to **300 Mbps**
- The overall network spectrum is extended to 1Ghz with 1.2 Ghz capability
- **Video customers unimpacted**; Legacy and IP Video devices will continue to function
- Extending digital fiber connection to the node and virtualizing the access network
- Transformational real-time reliability with virtualization and automation

# The Path to 10G – Migration to DOCSIS 4.0 FDX

*D4.0 FDX is a Software and Electronics Upgrade to the current investment*

*A Natural, Progressive and Cost-Effective Transition to long-term FTTH Delivery*

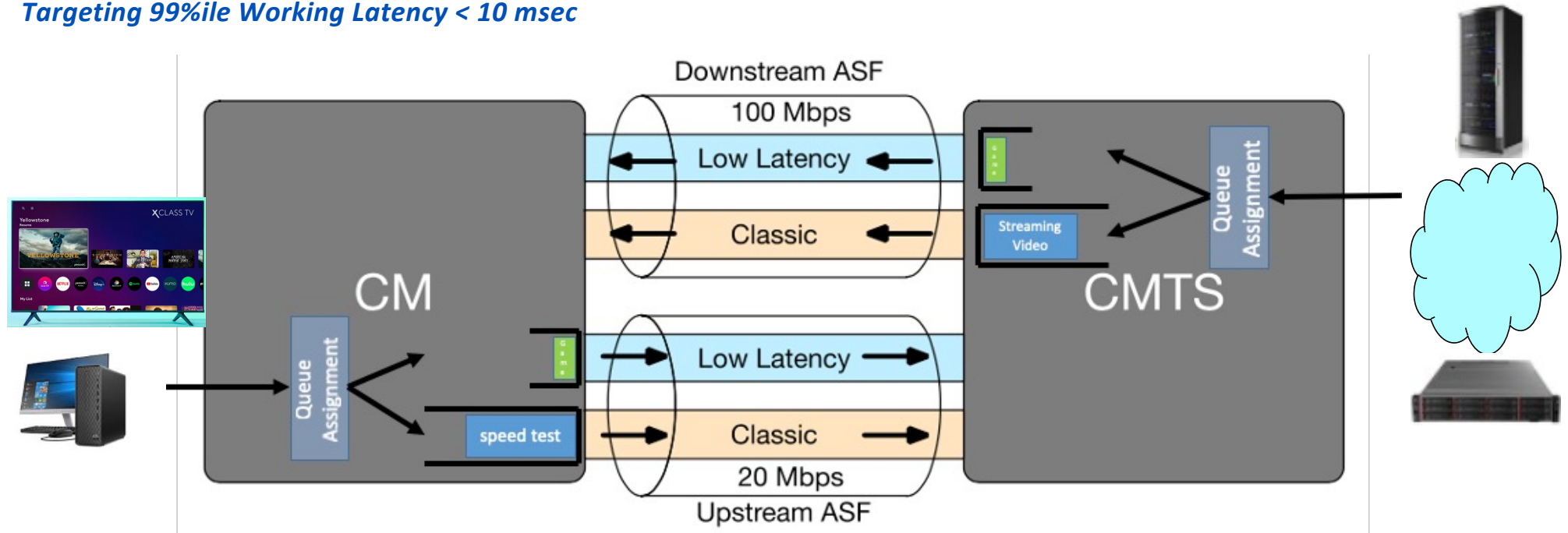


## Key Callouts:

- Upgrade path to DOCSIS 4.0 FDX
  - vCMTS DOCSIS 4.0 FDX software upgrade
  - Electronic Swap on Digital nodes and amps to DOCSIS 4.0 FDX
  - FTTH Remote OLT supported from within same node
- Multi-Gig Upstream / Multi-Gig Symmetrical - ~8 Gbps/5 Gbps End to End
- IP Video continues to expand as legacy QAM video is upgraded

## Low Latency DOCSIS and L4S

*Targeting 99%ile Working Latency < 10 msec*



- User controls low latency treatment
- Application marks traffic
- GW passes ECN & DSCP marking DS & US

### Key Highlights:

- Leverages the vCMTS architecture for optimal results
- SW driven service provisioning for speeds & packet classification
- Larger ecosystem support with application/server-based marking with partners
- Flexibility in product offerings and application with partners
- In active trials with partners, all application L4S support welcome and encouraged

- Edge application server marks traffic
- ECN & DSCP passed unbleached through core network
- Low latency treatment across core and access



COMCAST