UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
Wireline Access Network

IT "HERTZ" NOT TO BE ABLE TO MEASURE DOCSIS 3.1 & 4.0 CAPACITY

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Comcast Cable
Measuring DOCSIS 4.0 Capacity

Agenda

• The Evolution of Coaxial Cable
• Speed Tier Contribution during Peak Hours
• Current Upstream Toolbox
• Multi-Gig Services
• HFC Spectrum allocation
• Metrics to Measure D4.0 utilization
The Evolution of Coaxial Cable

How the Cable Network Changed

Over 70 years of success and innovation, the cable industry has proven to be incredibly effective, supporting all the new technologies and applications.

Getting closer to delivering Multi-Gig Bandwidth with DOCSIS 4.0 to support new services.
**Speed Tier Contribution during Peak Hours**

**DS and US consumption by Speed Tier**

**Give me More, I’ll consume More!**

DS and US average consumption during Peak hours increases proportionally based on Speed Tier.

Business Services consumes more than Residential subscribers during Peak hours on the US.
Upstream BW enhancements

In addition to expanding the Spectrum for Mid-Split and High-Split to double available BW, Profile Management Application (PMA) has its benefits:

- PMA optimizes DOCSIS network to maximize Capacity
- Using the PMA will achieve a maximum theoretical gain of ~25%
- PMA proven enhancement of ~16%

More “Hertz” needed!
Multi-Gig Services

More Devices ... More Demand!

- Increase in Concurrent Devices
- Online Education
- Video Conferencing
- Cloud Gaming and Streaming
- Internet of Things (IoT) with Automation
- Virtual Reality (VR) & Augmented Reality (AR)
- Autonomous Vehicles (AV) & 5G towers
- High-Resolution Video Quality
- Virtual Medical Services
HFC Spectrum allocation

Increase the spectrum to 1.2 GHz and 1.8 GHz

How “Hertz” helped “Multi-Gig”!

- To achieve the Multi-Gig services Spectrum expansion is crucial with DOCSIS 4.0
- Mid-Split and High-Split are a great start to increase Upstream Bandwidth.
- Full Duplex DOCSIS (FDX) and Extended Spectrum DOCSIS (ESD) will give us 10 Gbps
- Spectrum should expand to 1.2 GHz or 1.8 GHz
- Swapping Modems to D4.0 to utilize the full Spectrum

<table>
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<th>Modem Type</th>
<th>Max Speed</th>
<th>SC-QAM Bonding</th>
<th>OFDM/A Capable?</th>
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<tr>
<td>D2.0</td>
<td>40 Mbps DS 30 Mbps US</td>
<td>1 DS 1 US</td>
<td>NO</td>
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<tr>
<td>D3.0</td>
<td>1 Gbps DS 100 Mbps US</td>
<td>8 DS 4 US</td>
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<td>D3.1</td>
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<td>YES</td>
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<tr>
<td>D4.0</td>
<td>10 Gbps DS 6 Gbps US</td>
<td>44 DS 8 US</td>
<td>YES</td>
</tr>
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</table>
Metrics to Measure DOCSIS 4.0 Utilization

Essential Metrics

CMTS Pollers:
- In-bps, out-bps converted into percent utilization
- Up-channel utilization
- OFDM percent utilization & Profiles
- OFDMA percent utilization & Profiles
- FDX metrics
- PMA profiles and capacity
- Interfaces’ speeds
- Latency

Cable modem Pollers:
- Cable Modem type
- Boot-file specifications
- CMTS mapping
- SNR, MER

Additional metrics collected:
- HHP per Node per Zipcode
- Node to CMTS mapping

**Full “Hertz” view of “Multi-Gig” behavior**
Thank You Co-authors!

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Thank You!

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