Cable Access Migration to Converged Cable Access Platform (CCAP)

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Agenda

- CCAP Introduction
- What's Driving CCAP and Convergence
- The “Cable Operator Challenge”
- Operation Efficiencies Example
- Next Generation Access – DOCSIS 3.1
CCAP

Comcast. Converged Multiservice Access Platform CMAP

Component Suppliers

Vendors

Time Warner Converged Edge Services Access Router CESAR

Worldwide MSO’s

Cable Labs merge of the two requirements
CCAP Converged Cable Access Platform
CCAP Fundamentals

- The Converged Cable Access Platform (CCAP) is intended to provide a new equipment architecture option for manufacturers to achieve the Edge QAM and CMTS densities that MSOs require in order to address the costs and operational challenges resulting from the success of narrowcast services.

- CCAP leverages existing technologies, DOCSIS3.0, MHA and can also include new technologies such as EoC/EPOC and integrated optics.
Key Points CCAP – Goals

- **Convergence:** Flexible use of QAMs between video and data services through a single point of configuration improves densities and OPEX

- **Operational Simplification:**
  - Dedicated QAM channels to narrowcast Service Groups: specific HSi/Voice service group, VOD Service Group and SDV service group
  - QAM Replication: Implementation of separate sets of QAM channels for NC and BC so the NC (inc DOCSIS) can be configured on a unique basis and Broadcast Channels shared across ports in the Downstream line card DLC
  - Simplification of the RF combining to enable all digital services from a single port
  - An option to add content scrambling for both standards based and proprietary without any additional HW – as to aid “interoperability” between platform vendors and to minimise platform complexity
What’s Driving CCAP and Convergence?
Massive Video Growth
- Rapid growth in HD and VoD services
- Video expected to be 90% of consumer internet traffic by 2013
- Content owners looking for new outlets with piracy protection

Personalization and Interactivity
- Consumers want to watch what they want, when and where they want
- Consumers want custom applications & user interfaces
- 36 bn apps will be downloaded in 2012 with 83% from Android and iOS devices
- 1 billion apps downloaded per month from Apple iTune store alone

Multi-Screen Entertainment and Information
- Internet video increasing in quantity
- Broadband speeds & streaming technology improving
- Consumers looking at new viewing options (Over-the-Top Video)
Today’s Cable Access Network

Upward Pressure on Rack Space and Power

Connected Home

IP Services
- Data
- VoIP
- IP Video

Digital Video Services
- Linear
- VoD
- NPVR

SDV EQAM
VOCEQAM
Doc EQAM
Bcast EQAM
DOC EQAM
Optics
RF Combiners
DOCSIS 3.0 Data Modem
DOCSIS 3.0 eMTA
DOCSIS 3.0 Residential Gateway
Cable Operator Challenges to Meet the Video Traffic Growth

More Video + More Devices = More Traffic

- More Video
- More Devices

- More Personal
- More Interactive

Keep up with unprecedented bandwidth growth
Pressure to reduce rack space
Migrate to a converged network with existing infrastructure
A Phased Approach to Meet Today’s Challenges with Scale and Convergence

**Phase 1**
Reduce OPEX
Scaling DOCSIS downstream capacity and converging into a high density UEQAM

**Phase 2**
Maximize ROI
Maximizing and scaling downstream capacity with the existing platform

**Phase 3**
Unprecedented Scale
Optimizing OPEX savings with a high density, next generation cable access platform, beyond 1Gbps/SG
Cable Access Migration Execution Strategy
Cable MSO Blueprint: Optimize and Monetize Existing Infrastructure

Phase 1 – Reduce OPEX

Phase 2 – Maximize ROI

Phase 3 – Unprecedented Scale
Step 1: Scale DOCSIS Downstream/SG on a High-density UEQAM

- Establish foundation for modular CCAP with uBR10012 & RFGW-10
- Increase DOCSIS downstream bandwidth-per-sub by 100%

<table>
<thead>
<tr>
<th>Total Rack Space</th>
<th>Total Power</th>
<th>BW per Sub</th>
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<tbody>
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*Note: Calculation is based on 35K HHP / hub and 54 SGs, 1 RU = 1.75"
Step 2: Converge VoD & SDV QAMs on a High-Density UEQAM

- Converge legacy VoD & SDV QAMs into modular CCAP on RFGW-10
- Decrease rack space by 35% and power by 45%
**Step 3: Scale CMTS Downstream Capacity**

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<tr>
<th></th>
<th>Total Rack Space</th>
<th>Total Power</th>
<th>BW per Sub</th>
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<tbody>
<tr>
<td></td>
<td>(-40%)</td>
<td>(-43%)</td>
<td>(+100%)</td>
</tr>
</tbody>
</table>

*Note: Calculation is based on 35K HHP / hub and 54 SGs, 1 RU = 1.75"*

- Double the downstream capacity of uBR10012 with PRE5 & 3G-SPA
- Reduce Prisma rack space by 33% with double-density TX modules
Step 4: Converge Broadcast Video on a High-Density UEQAM

- Converge broadcast QAMs into modular CCAP on RFGW-10
- Decrease rack space by 8% and power by 9%

*Note: Calculation is based on 35K HHP / hub and 54 SGs, 1 RU = 1.75"
### Step 5: Scale DOCSIS to >1 Gbps per SG with NG Edge

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<thead>
<tr>
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<th>Total Rack Space</th>
<th>Total Power</th>
<th>BW per Sub</th>
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<tbody>
<tr>
<td></td>
<td>(-79%)</td>
<td>(-56%)</td>
<td>(+300%)</td>
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</table>

- **Increase bandwidth-per-sub by another 100%**
- **Decrease rack space by 63% and power by 16%**

*Note: Calculation is based on 35K HHP / hub and 54 SGs, 1 RU = 1.75"*
Meeting the Bandwidth Growth

Downstream Channel Demand versus Capacity Availability

- Additional capacity is available well before it's required
- Maximize efficiency and minimize cost by upgrading incrementally when and where needed
Meeting the Cost Reduction Challenge
While Delivering Greater Capacity and Density

- Reduce downstream costs & OPEX while migrating towards an all-IP network
- Maximize efficiency and minimize cost by upgrading incrementally when and where needed
Migration to CCAP is more than an equipment upgrade

Multi-service convergence for DOCSIS and video networks requires significant operational preparation and readiness

Cisco’s modular CCAP solution, uBR10012 and RFGW-10 offers an incremental deployment approach and meets key CCAP objectives today

Cisco’s integrated CCAP solution, NG Edge, reduces the footprint up to 75% and provides 80 to 240 Gbps of initial capacity, with a path to scale to over 1 Tbps
Operational Efficiencies Examples
SG Combining – Today’s Approach

Converged QAM Network

RFGW-10

- DS384/1-1: 48 Broadcast VIDEO QAMs
- DS384/1-2: 20 DOCSIS QAMs
- DS384/1-3: 20 Narrowcast Video QAMs
- DS384/1-4: 20 DOCSIS QAMs
- DS384/1-5: 20 DOCSIS QAMs
- DS384/1-6: 20 Narrowcast Video QAMs
- DS384/1-7: 20 DOCSIS QAMs
- DS384/1-8: 20 DOCSIS QAMs

External RF Combining Network

SG1
- 20 DOCSIS QAMs
- 20 Narrowcast Video QAMs
- 48 BC VIDEO QAMs

SG10
- 20 DOCSIS QAMs
- 20 Narrowcast Video QAMs
- 48 BC VIDEO QAMs

SG20
- 20 DOCSIS QAMs
- 20 Narrowcast Video QAMs
- 48 BC VIDEO QAMs

SG30
- 20 DOCSIS QAMs
- 20 Narrowcast Video QAMs
- 48 BC VIDEO QAMs

DOCSIS and Digital Video Downstream Channels
SG Combining – Today’s Approach

Converged QAM Network

Broadcast Channels
Split/Combined Across All Service Groups

NC DOCSIS QAMs
Unique per Service Groups

NC Video QAMs
Split/Combined Across DOCSIS Service Groups

DOCSIS and Digital Video Downstream Channels
Converged QAM Network

RFGW-10

| DS384/1-1 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-2 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-3 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-4 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-5 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-6 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-7 | 48 BC, 20 NC Video, 20 DOCSIS |
| DS384/1-8 | 48 BC, 20 NC Video, 20 DOCSIS |

QAMs are Replicated Across Ports to Reduce / Eliminate External Combining
Total QAM Capacity:
- 288 Unique QAMs
- 480 Replicated QAMs
Converged QAM Network

- RFGW-10

*QAMs are Replicated Across Ports to Reduce / Eliminate External Combining*

*Total QAM Capacity:*
- 288 Unique QAMs
- 480 Replicated QAMs

Broadcast Channels are Spanned Across All Ports

**Downstream Channels**

- DS384/1-1
- DS384/1-2
- DS384/1-3
- DS384/1-4
- DS384/1-5
- DS384/1-6
- DS384/1-7
- DS384/1-8

- EuroDOCSIS and Digital Video

- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
- 48 BC, 20 NC Video, 20 DOCSIS
SG Combining Using RF Spanning

Converged QAM Network

RFGW-10

DS384/1-1: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-2: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-3: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-4: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-5: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-6: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-7: 4 BC Video, 20 NC Video, 20 DOCSIS
DS384/1-8: 4 BC Video, 20 NC Video, 20 DOCSIS

• QAMs are Replicated Across Ports to Reduce / Eliminate External Combining
• Total QAM Capacity:
  - 288 Unique QAMs
  - 480 Replicated QAMs

EuroDOCSIS and Digital Video Downstream Channels

NC VIDEO QAMs Can in fact Span Across DOCSIS Service Groups for Alignment. But can be Unique
Converged QAM Network

- QAMs are Replicated Across Ports to Reduce / Eliminate External Combining
- Total QAM Capacity:
  - 288 Unique QAMs
  - 480 Replicated QAMs

EuroDOCSIS and Digital Video
Downstream Channels

- DS384/1-1: 48 BC, 20 NC Video, 20 DOCSIS
- DS384/1-2: 48 BC, 20 NC Video, 20 DOCSIS
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- DS384/1-6: 48 BC, 20 NC Video, 20 DOCSIS
- DS384/1-7: 48 BC, 20 NC Video, 20 DOCSIS
- DS384/1-8: 48 BC, 20 NC Video, 20 DOCSIS
Converged QAM Network

- RFGW-10
  - DS384/1-1: 48 BC, 20 NC Video, 20 DOCSIS
  - DS384/1-2: 48 BC, 20 NC Video, 20 DOCSIS
  - DS384/1-3: 48 BC, 20 NC Video, 20 DOCSIS
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  - DS384/1-5: 48 BC, 20 NC Video, 20 DOCSIS
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  - DS384/1-8: 48 BC, 20 NC Video, 20 DOCSIS

- EuroDOCSIS and Digital Video
  - Downstream Channels

- QAMs are Replicated Across Ports to Reduce / Eliminate External Combining
- Total QAM Capacity:
  - 288 Unique QAMs
  - 480 Replicated QAMs
SG Combining Using RF Spanning

Converged QAM Network

RF Spanning Benefits:
- Optimal Port Utilization
- Increased Density
- Downstream RF Combining is Greatly Reduced / Eliminated

RFGW-10

DS384/1-1
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-2
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-3
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-4
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-5
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-6
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-7
- 48 BC, 20 NC Video, 20 DOCSIS

DS384/1-8
- 48 BC, 20 NC Video, 20 DOCSIS

DOCSIS QAMs Span Across DOCSIS Service Groups

Unique DOCSIS QAMs

Spanned DOCSIS QAMs

NC DOCSIS

BC Video

NC Video

• QAMs are Replicated Across Ports to Reduce / Eliminate External Combining
• Total QAM Capacity:
  - 288 Unique QAMs
  - 480 Replicated QAMs
• RF Spanning Benefits:
  - Optimal Port Utilization
  - Increased Density
  - Downstream RF Combining is Greatly Reduced / Eliminated
DOCSIS 3.1 Overview
**DOCSIS 3.1 Objectives**

DOCSIS 3.1 Goals:

1. Downstream progressing beyond 1Ghz to allow 1G migrating to 10G DS speeds
2. Upstream mid split in the region of 238Mhz to allow 300mb migrating to 2G US speeds
3. Spectrum efficiency gains with the use of OFDM in US and DS
4. LDPC/FEC potential 3db gain giving rise to 1024QAM

The cost/HP to implement DOCSIS 3.1 is less than 1/10 to 1/20 of the cost to implement PON while the services are competitive.
## Technology Potential of DOCSIS 3.1

<table>
<thead>
<tr>
<th></th>
<th>DOCSIS 3.0</th>
<th>DOCSIS 3.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Now</td>
<td>Phase 1</td>
</tr>
<tr>
<td><strong>DS Range (MHz)</strong></td>
<td>54 - 1002</td>
<td>108 - 1002</td>
</tr>
<tr>
<td><strong>DS QAM Level</strong></td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td><strong># DS Channels</strong></td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td><strong>DS Capacity (bps)</strong></td>
<td><strong>300M</strong></td>
<td>1G</td>
</tr>
<tr>
<td><strong>US Range (MHz)</strong></td>
<td>5 - 42</td>
<td>5 - 85</td>
</tr>
<tr>
<td><strong>US QAM Level</strong></td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td><strong># US Channels</strong></td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td><strong>US Capacity (bps)</strong></td>
<td>100M</td>
<td>300M</td>
</tr>
</tbody>
</table>

Note: **TBD** values are underlined. Channels in quotes = Equivalent # of SC-QAMs
**In Summary**

- CCAP objectives provide the roadmap to:
  - Convergence of Voice, Video and Data onto a single platform
  - Unprecedented densities to eliminate rack space, power and cooling
  - Continued reduction in $/DS for unprecedented growth in narrowcast services
  - RF Spanning allows optimal QAM utilization and minimizes RF combining
  - DOCSIS 3.1 is the most cost effective way to provide competitive data and IP Video services
Disclaimer

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