SDV and the Universal Edge QAM

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Program Management
Agenda

- Video Services Today
- What is SDV and Why do I care?
- What is a Universal Edge QAM?
- What is the role of the U-EQAM in SDV?
- How does SDV Work?
- U-EQAM Deployment Configurations
- Future U-EQAM Technology Evolution
Video Services Today
Evolution of Video Services

1. Video services historically started with analog broadcast services
2. Various forms of near-video-on-demand and true video-on-demand services began to emerge
3. Digital video and technology has moved into these services today for both Broadcast and VOD (Annexes A, B and C)
4. Historically services, such as VOD, were provided by single-purpose Edge QAM devices
Evolution of Video Services

1. Today’s services offerings now add Switched Digital Video to the puzzle

2. In the future U-EQAMs will also function as a Multi-Service M-CMTS / Multimedia Forwarding QAM (DS PHY) for DOCSIS 3.0

3. Introduction of Universal Edge QAM devices allow all of these applications to be delivered simultaneously through a single Edge QAM device (see later discussion on QAM sharing)

4. Converged service offerings include Voice, Data and Video
What is SDV and Why Do I Care?
Traditional Broadcast System

BEFORE: 20 QAM channels used to deliver 200 Standard Definition TV channels

Note: HD requires ~5 times more bandwidth per program

Traditional Broadcast Video

"Long tail" Broadcast Services

Traditional Broadcast System

Plant Bandwidth

Every channel is “All Multicast All The Time”

Of the 200 TV channels being transmitted, only 5 are being viewed
Switched Digital Video System

AFTER: 10 QAM channels used to deliver “watched” TV channels
SAVING: 10 QAM channels freed up for “other” services

Switched Digital Video

“long tail” Broadcast Services

Switched Digital Video System (QAM)

30 New HD Channels

Requested channels are “Multicast On Demand”

Freed up QAM channels available for HD or other services
Broadcast compared to SDV System

Conventional Broadcast System
All programs are broadcast to all subscribers all the time

Switched Digital Video
Programs are transmitted to a service group only when a subscriber in that group is watching them
Switched Digital Video
Leveraging the ‘Long Tail’

- Niche Content
- Speciality TV
- Multi Angle Camera Feeds
- Narrowcast
- Off Net TV Channels
- Subscriber generated content
- Education

Most often watched TV Channels

Time of day dependent pattern

Long Tail or infrequently watched Channels
Switched Digital Video Requirements

- Content delivered only when requested
- Content not delivered when unwatched
- Requires Flow Management System
- Must be fast (sub-second for joins and leaves)
- OOB channel must support real-time usage reporting
- Edge device must be able to process usage requests in real-time
- Requires robust Traffic, Policy, and Session Management System
- All clients must comply, must have MW support in legacy.
- Must handle multiple clients in a subscriber premise.
- Solution must be able to scale

- SDV does not necessarily launch a new subscriber service, but rather a new methodology for delivering broadcast channels
  
  - Today, every broadcast channel is always available, but with SDV, channels that are less frequently viewed can be designated as “switched”
    
    - Switched channels are not broadcast throughout the cable network, instead, they are placed into a Serving Group only if one or more set-top box is tuned to that channel
    
    - Whether a channel is “always-on” broadcast or switched should be transparent to subscribers

20% of the channels are watched by 80% of the customers

Significant portion of an 200 program lineup goes unwatched, therefore, wastes BW!
Switched Digital Video Primary Benefits

▪ Cost-effective bandwidth management tool
  - Reducing HFC bandwidth requirements compared to existing linear broadcast content
  - Allows bandwidth usage to be scaled as a function of viewer-ship rather than as a function of TV programs offered
  - Therefore it helps extend the life of existing network capacities by making more efficient use of currently available bandwidth
  - Gives the MSO an opportunity to increase niche programming

▪ Enables capture of detailed viewer-ship data
  - Enables optimization of system performance, program offering, line-ups, etc
  - Provides exact data on viewer demographics to enable better directed advertising to be deployed
  - New directed advertising can be done at the node level to different demographic groups
What is a Universal Edge QAM?
Basic Edge QAM

IP-based, Digital Stream Data

Video Stream Handling, Signal De-jitter, PCR Correction

▪ Downstream “Phy”

QAM Modulated RF

MPEG2 Transport
Opportunities Exist for a New Edge Device

Operators:
- Bandwidth “Crunch” created by new services must be resolved
- Low-cost, all-digital, all-IP architectures must be deployed to reach operational & ROI goals
- “Open” and higher security Conditional Access systems must be deployed

Subscribers:
- Demanding Choice & Control of services
- Desire communications, data, and entertainment service convergence

Technologies:
- Moore’s Law - advanced signal processing reaches low cost platforms
- Media storage costs decline continues to exceed Moore’s Law
- Advanced video compression

Content:
- Vertical integration of content providers and distributors improve profits
- Multi-modal distribution will drive higher revenues

The “Perfect” Storm
So what is a Next Generation (Universal) Edge Device?

It is a device that allows MSOs a future direction for cost-competitive, all-digital migration and creates a common converged platform for an assortment of new services mostly based on video, data and voice.
# The Video EdgeQAM – Today & Tomorrow

<table>
<thead>
<tr>
<th>Legacy</th>
<th>Universal</th>
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<tbody>
<tr>
<td>Low Density Edge QAM - 8,16 QAM channels</td>
<td>High Density Edge QAM - 24, 48, 72 and more QAM Channels</td>
</tr>
<tr>
<td>DHEI, ASI, Single GbE input</td>
<td>Multiple GbE inputs</td>
</tr>
<tr>
<td>Proprietary or no Encryption/Scrambling support</td>
<td>Open Standards Compliance</td>
</tr>
<tr>
<td>Only VOD, Standard Def, CBR support</td>
<td>QAM Sharing for HD/SD/CBR/VBR</td>
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<tr>
<td>Primitive Layer 3 TCP/UDP/IP support</td>
<td>Sophisticated Layer 2/3 TCP/UDP/IP support</td>
</tr>
<tr>
<td>Limited to / No Redundancy features</td>
<td>Modular / Hot-Swappable / Redundant</td>
</tr>
<tr>
<td>Limited management features</td>
<td>Remote Operations via GUI / Telnet / SNMP</td>
</tr>
<tr>
<td>No M-CMTS Compliance &amp; QAM sharing</td>
<td>Evolution to M-CMTS, Data Bypass, Wideband Data</td>
</tr>
<tr>
<td>High cost per QAM channel</td>
<td>Reduced per QAM channel cost</td>
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</table>
Next Generation Edge QAM must:

✓ High density, multi-service Edge QAM
  ✓ Increased # of QAM channels
  ✓ Decreased Rack space

✓ Modular architecture allows flexible configurations
  ✓ Cost effective for a variety of applications
  ✓ Software only field upgrades for future IP multimedia processing requirements
    • DPI, SDV, Wideband Data, etc

✓ Redundancy features for all single points of failure modes

✓ Extensible for M-CMTS Compliance & QAM sharing
- Superior Jitter Tolerance
- Multiple, flexible modes of UDP port mapping for VOD and SDV support (static and dynamic mapping)
- Multiple RF configurations per unit (QAM card level)
- Channel muting (e.g. 1, 2, 4 active channels per bond)
- Superior RF specifications (e.g. M-CMTS/DOCSIS 3.0 specs DRFI compliance)
- Stream Replication (e.g. directed or all channels)
- Full Spectral Range Support
- Simultaneous Multi-feature support (e.g. VOD, SDV, passthrough, M-CMTS data)
# Value-added Next Gen Edge QAM Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 3 intelligence</td>
<td>IGMPv3 – Source Specific Multicast -- ARP reply etc</td>
<td>Simplify IP Video transport network design</td>
</tr>
<tr>
<td>Improved Density per RU</td>
<td>More QAM channels per F-connector</td>
<td>Reduce cost and powering</td>
</tr>
<tr>
<td>Redundancy</td>
<td>Power, Modules, (QAM and GIGE), Input ports, Source Video</td>
<td>Reduce likelihood of customer visible network outages</td>
</tr>
<tr>
<td>Modularity</td>
<td>Rack “once” mentality and “slide in” new capacity easily</td>
<td>Pay as you grow and reduce fork lifting of equipment</td>
</tr>
<tr>
<td>DOCSIS Timing Interface (DTI)</td>
<td>Required for DOCSIS M-CMTS TDMA upstream / downstream synchronization</td>
<td>Future proof network and allow for sharing of DOCSIS services over U-EQAM</td>
</tr>
<tr>
<td>Open Standards interfaces</td>
<td>Product supports open standards (SDV, SNMP, IP, DOCSIS M-CMTS, DOCSIS/DRFI etc)</td>
<td>Guarantee choice, competition and best of breed products</td>
</tr>
</tbody>
</table>
What is the role of the U-EQAM in SDV?
What is a Universal Edge QAM?

In simple terms, the U-EQAM acts as a “services cross connect” to route requested services from the headend to the STBs by mapping the streams into multicast IP groups assigned to service groups.
How Does SDV Work?
HFC Digital Video Hub

Analog & Digital Broadcast

DWDM or Muxed Baseband transport

Local IRTs

Statistical Mux/Transcoder/Transrater

HE

Metro Net

Local Encoder & Transrater

On-demand Streaming Servers

Element Management Systems

U-EQAM

CMTS

Analog & QAM Modulators (if needed)

DSG messaging

RF Combine to HFC
Comcast NGOD Architecture VOD/SDV
RPC-based, Open-SDV Architecture (SA)
U-EQAM Deployment Configurations
U-EQAM Deployment Configurations

Lots of Design Scenarios to Consider:

- Do you want to QAM Share SDV, VOD, and/or Linear Broadcast on a U-EQAM?
- Do you want to QAM Share SDV, VOD, and/or Linear Broadcast on an RF output?
- Do you want to stripe U-EQAM’s within a Serving Group? If so, which services?
- What are your redundancy requirements for the GbE for each service?
- What are your RF wiring requirements during migration to higher capacities?
- Will VOD or SDV be your initial service?
- Will Dual or Quad bonding be your initial deployment?
- What is the SDV/VOD northbound arch? (e.g. RPC/DNCS, R6/D6, Seachange VOD)
4 QAM SDV deployment – No Striping

**Quad-Mode SDV U-EQAM Chassis**

- aMHz, bMHz, cMHz and dMHz are Contiguous
- 4 Frequencies for SDV per Serving Group

*Based on a model of 4 QAMs available per F-connector*
6 QAM SDV deployment – No Striping

- aMHz, bMHz, cMHz, dMHz, eMHz and fMHz are Contiguous
- 6 Frequencies for SDV per Serving Group

Based on a model of 6 QAMs available per F-connector
No Striping - Chassis Deployment

- QAM 1,1: Fa Fb Fc Fd
- QAM 1,2: Fa Fb Fc Fd
- QAM 2,1: Fa Fb Fc Fd
- QAM 2,2: Fa Fb Fc Fd
- QAM 3,1: Fa Fb Fc Fd
- QAM 3,2: Fa Fb Fc Fd
- QAM 4,1: Fa Fb Fc Fd
- QAM 4,2: Fa Fb Fc Fd
- QAM 5,1: Fa Fb Fc Fd
- QAM 5,2: Fa Fb Fc Fd
- QAM 6,1: Fa Fb Fc Fd
- QAM 6,2: Fa Fb Fc Fd
Striping Configurations
Common VOD deployment - Striping

Dual-Mode VOD U-QAM Chassis Striping

- wMHz and xMHz are Contiguous
- yMHz and zMHz are Contiguous
- 4 Frequencies for VOD per Serving Group

Based on a model of 2 QAMs available per F-connector
**Example Dual Mode VOD Deployment**

Dual-Mode VOD U-EQAM Chassis Striping

- wMHz and xMHz are Contiguous
- yMHz and zMHz are Contiguous
- 4 Frequencies for VOD per Serving Group
Quad Mode Chassis Striping

Based on a model of 4 QAMs available per F-connector
Example VOD QAM Striping

VOD

- QAM 1/1
- QAM 1/2
- QAM 2/1
- QAM 2/2
- QAM 3/1
- QAM 3/2
- QAM 4/1
- QAM 4/2
- QAM 5/1
- QAM 5/2
- QAM 6/1
- QAM 6/2

SG

Fa Fb Fc Fd Fw Fx Fy Fz
8 QAM SDV deployment – Chassis Striping

Quad-Mode SDV U-EQAM Chassis Striping

- aMHz, bMHz, cMHz and dMHz are Contiguous
- eMHz, fMHz, gMHz, and hMHz are Contiguous
- 8 Frequencies for SDV per Serving Group
‘Striping’ Trade-Offs

**Advantages:**

- Protects against a single point of failure completely taking out a given service type to a service group.
- Can choose the level of protection at either the QAM striping level or the chassis striping level
- Allows maintenance window to run in a degraded bandwidth mode without causing a complete service outage

**Disadvantages:**

- Not reasonable to stripe broadcast services (could allocate a range of QAMs to broadcast on one chassis or split broadcast services across chassis with half of the services on each chassis)
- More complicated operational model, network wiring, and provisioning model
# 8 QAM SDV & 4 QAM VOD Sharing

## Hex-Mode SDV/VOD U-EQAM Sharing with Chassis Striping

<table>
<thead>
<tr>
<th>VOD Frequencies</th>
<th>SDV Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>a, b, k, l</td>
<td>c, d, e, f, g, h, i, j</td>
</tr>
</tbody>
</table>

- aMHz, bMHz, cMHz, dMHz, eMHz and fMHz are Contiguous
- gMHz, hMHz, iMHz, jMHz, kMHz and lMHz are Contiguous
- 8 Frequencies for SDV, 4 for VOD per Serving Group
4 QAM SDV & 8 QAM Broadcast Sharing

Hex-Mode SDV/B’cast U-EQAM Sharing with Chassis Stripping

SDV Frequencies
a,b,k,l

Broadcast Frequencies
c,d,e,f,g,h, i, j
(e.g. 42 SD, 10 HD)

• aMHz, bMHz, cMHz, dMHz, eMHz and fMHz are Contiguous
• gMHz, hMHz, iMHz, jMHz, kMHz and IMHz are Contiguous
• 4 Frequencies for SDV, 8 for Linear B’cast / Serving Group
QAM Sharing - 4 QAM SDV & 4 QAM VOD
SDV/VOD QAM Sharing with Chassis Striping

Based on a model of 4 QAMs available per F-connector
‘Sharing’ Trade-Offs

Advantages:

• Allows for combining with striping topologies for added protection

• Expands real time edge resource management from common, industry-standard, remote tools

• Cost savings over single purpose edge QAM devices by filling chassis with all available services

• Simplifies operational and provisioning models due to reduced number of network components

Disadvantages:

• Depending on BW allocations, it may require mixing services on an F-connector

• If used without striping, a single QAM card failure can cause a service group outage

• Mixing services may complicate network troubleshooting
Future U-EQAM Technical Evolution
QAM Channel Capacity Growth

Adding 2 more Adjacent 6MHz frequencies to get to HEX

Note: Legacy edge QAM devices have 2 bonded channels
U-EQAM Technical Evolution

- Elimination of channel bonding within an F-connector
- Higher densities of QAM channels per F-connector
- Higher densities of F-connectors per QAM Card
- These lead to higher densities of QAM channels per chassis
- Scaling to higher bandwidth per subscriber
- Increased frequency range support (up to 1 Ghz)
- Increased ability for targeted ad insertion on a per service group basis
- Improved user management tools
  - Web-based application managers to manage multiple U-EQAMs
  - Real time performance monitoring and metrics
  - Multiple interfaces (GUI, CLI, SNMP, Telnet)
- Support for end to end digital transport
- Improved diagnostics
  - Device
  - Network troubleshooting
Review

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Questions?
Thank You