The Challenges of Delivering and Distributing CATV in a K-12 Environment

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70 schools
49,192 students
4658 teachers
2760 classrooms
49,192 laptops
Terms and Terminology

Alphabet soup of digital communications

- DTV
- OTA
- NTSC
- CATV
- ATSC
- 8-VSB
- QAM
- HDTV
- DTA
• Display sets = LCD, Plasma, Digital Projector System, LED

• TV signal transmitted using digital technologies rather than as an analog or waveform signal
• Over the Air
• Broadcast Television
• OTA Broadcast standard
• National Television Systems Committee (NTSC)
• 1941, 1953, 1984
• Analog
• 6 MHz Channel (e.g. 180.31)
• Impetus – OTA unavailable or OTA weak.
• Mountainous areas and populous cities with tall buildings
American Television Systems Committee (ATSC)
- Digital Broadcast Standard for OTA
- 6 MHz Channel
- 19.39 Mbps throughput
- MPEG-2 encoded video
- AC3 encoded audio
- Program and System Information Protocol (PSIP) and Terrestrial Virtual Channel Table (TVCT)
8-VSB

• 8-level vestigial sideband modulation
• 8-VSB is the RF modulation format utilized by the DTV (ATSC) digital television standard to transmit digital bits over the air to the home consumer
• 8-VSB is the modulation format and MPEG-2 – the video compression/packetization format used in DTV
Quadrature Amplitude Modulation (QAM)

- Uses two carrier waves of identical frequencies, shifted 90 degrees apart
- QAM 256 and QAM 64 more common in US
- Major and minor channels
- QAM 256 yields a 38.8 Mbps bit stream
• Accommodates
• 1xHD (1080i) channel at 36.5 Mbps
• 2xHD (720p) channels each at 17.6 Mbps
• 4xSD channels (480i) each at 8.8 Mbps
• 1xHD (720p) channel at 17.6 Mbps + 2xSD (480i) channels at 8.8 Mbps
Digital transmission offers digital broadcasts of both standard definition and HDTV.

- **HDTV** capable of displaying at least 720 vertical lines of resolution.
- Aspect ratio of 16:9
- **SDTV** capable of displaying 480 vertical lines of resolution.
- Typical display aspect ratio of 4:3
• Digital terminal adapter
• Digital transport adapter
• Each channel was a 6Mhz frequency
• CH2 = 54Mhz to 60Mhz
• Transmission was analog
• No channel mapping
Legacy CATV at HCPS

- Classroom analog TV’s
- Local School headends
- Content modulated insertion
- Negative traps
Legacy CATV at HCPS

- FILTERS HBO, CINEMAX
- ANALOG CABLE
- LOCAL CONTENT
- MODULATOR
- COMBINER
- CLASSROOM ANALOG TV's

CH3VCR
- FILTER CH 2-6

Bicsi
FCC required all full power TV broadcast stations to switch from analog to digital format.
• Analog broadcasts scheduled to end on this date

• FCC extended transition deadline to June 12, 2009

• Reception of OTA broadcasts required digital (ATSC) tuners
• Pre-Winter 2010 mix of analog and digital channels
• February 11, 2010 - 15 channels converted to digital.
• March 10, 2010 - 33 channels converted to digital
• Spring, 2012 – Basic tier channels converted to digital (N=16)
• Why?
• Analog reclamation aka Project Calvary
• 79 Analog
• 59 digital, 20 analog
• Reclaim 354Mhz
• 590 Programs
Spring, 2012

Comcast
Elimination of Analog
DTV transition Did NOT require Cable systems to switch to digital
• Consumer approach of one converter per TV impractical

• Classroom analog sets became useless

• 2760 converters

One Can Never Have Too Many Cats
• Expanded head ends
• Deployment of Projectors
• DVD/VCR’s with analog tuners
Pending Impediments to Initial Solutions

• Availability of tuners and DTA’s
• FCC decision
• Local Broadcasts
• Notch Filter Availability
• Analog Sunset
Initially we paired inexpensive **VCR’s** with NTSC tuners with projectors & **Promethean Boards**

- Post digital transition, analog tuners eliminated from VCR’s
- Short time tuners available on DVD/VCR’s
- Today NTSC/ATSC/QAM only available in DVR’s
- Expensive tuner set top boxes
October 12, 2012 decision

FCC amended rules to allow cable operators to encrypt the basic service tier in all-digital cable systems.

Basic tier channels usually include national affiliate stations, PBS and PEG channels.
FCC delineated benefits of decision: no waiting at home for cable guy, less truck rolls, fuel savings, reduce service theft, establish regulatory parity. (100 pages)

Critics of rulings suggested free-device consumer protections to institutional (read school) subscribers.
FCC Decision

• FCC disagreed saying conflagrates encryption with digitization.
• FCC expects MSO’s to work with local institution to minimize disruption (unrealistic)
Increasingly schools wanted local broadcast ability

Morning announcements and/or scrolling bulletin board.

Simplistic modulation

Remote broadcast cart.
Local Broadcasts

Challenge of specifying local insertion channel
• Component video high definition outputs no longer included on BluRay players manufactured after 2013.
• FCC has allowed this to extend to cable boxes for premiers.
• Should restriction be extended to remove component video from cable boxes, HD modulation efforts will be impeded.
• **HDMI encoder input**
Notch Filter Availability

- Notch filter channel deletion or brick wall deletion filters **needed**
- Attenuates the entire channel from video to audio while preserving the adjacent channel carriers
- Allows reinsertion of a new channel without interference from the original signal
- HCPS traditional use of ch 2-6
- $40 vs. custom-made
• RF Equipment
• IPTV
• RF & IP Encoders
RF Equipment:
QAM set top boxes / tuners

Features:
- ATSC/QAM/NTSC RF input
- 480p/720p/1080i/1080p output (HDMI) or 480i output (CVBS)
- Stereo audio output
- Digital audio optical output
RF Equipment: MDTA

Clear and Encrypted QAM input

• Clear QAM Output
  • Analog Output

Passes through Clear QAM
RF Equipment: MDTA continued

**Features**

- Multichannel QAM to analog RF converter (**MSO**)  
- Demodulated MPEG-2 transport streams from multiple QAMs are decrypted, decoded to analog then converted to correct RF channel
- Demodulates up to 8 QAM channels and decrypts up to 36 single program streams.
- Support 6 cable cards
- Connects up to 46 single programs to analog channels.
RF Equipment:
QAM to QAM transcryptor

- Demodulated MPEG transport streams are decrypted by Cable card then re-encrypted using Pro: Idiom
- Encrypted MPEG transport streams are re-modulated and delivered to select RF channels
RF Equipment: Q to Q transcripotor

**Features**

- Combines QAM demodulation, decryption, demultiplexing, encryption, multiplexing, QAM modulation and upconversion in single chassis.
- Demodulates up to 80 QAM channels
- Supports up to 10 multi-channel Cable Cards.
- Decrypt up to 60 programs
- Both SD and HD in same chassis.
- Supports delivery of local broadcast
RF Equipment: QAM Encoder

(Single to a few inputs)

Composite Video
L/R audio input

QAM Output Channel

Bicsi
RF Equipment: QAM Encoder

(Single to a few inputs)

**Features:**

- Blank QAM from headend, locally deleted QAM & underutilized QAM (add/drop) from headend.
- QAM demodulation card
- Integrated QAM channel deletion filter.
RF Equipment: QAM Encoder

(Single to a few inputs)

Example Application:

• EIA CH 16
• 10 SD programs
• Insert local origination on program #5
• Delete Programs 6-10
• Retain original programs 1-4 (e.g. 16.1)
RF Equipment: QAM Encoder

(Multiple inputs)

- **Composite** Video x8
- Stereo Analog Audio x8
- Video Encoding Data Rates: 2-12 Mbps per channel
- QAM 256 modulation
- HDMI
Composite video (SD or HDMI input)
Features:

• 5Mbs to 2Mbs HD
• 2Mbs to 10Mbs SD
• H.264 encoding
• Multicast vs. Unicast
• 1:1 ratio of encoders & programs
• Chassis based
• Program guide
• Mobile cart
RF and IP Encoders

Composite Video (SD) or HDMI Input

QAM output (multiple channels) + IP output (multiple channels)
RF and IP Encoders

Features:

• Program Encoder (IP)
• QAM modulation
• Multiplex all programs on one QAM (e.g. 2.1-2.8)
• Frequency Agile QAM channel from Channel 2 to channel 135
• Virtual Channel Numbering
• Short Program Name
• Compression codec MPEG-2 or H.264
Enhanced solution #1: MDTA

VHS

- Filter
- Digital cable (Clear & encrypted QAM)
- MDTA
- Clear QAM
- Analog Channels
- Local Broadcast Modulator
- Analog TV’s
- DVR’s
- Projector
Enhanced solution #1: MDTA

- Passing through digital clear QAM
- Decrypting encrypted QAM
- Outputs Analog channels.
- Analog local broadcast
Enhanced solutions #2:

Digital pass through and Analog broadcast

Diagram:
- **Local Broadcast Modulator (Analog)**
- **QAM pass through**
- **DVR**
- **Projector**
- **Promethean Board**
- **Combiner**
Enhanced solutions #2:

Digital pass through and Analog broadcast

• Passing through digital QAM (e.g. 102.24)
• DVR’s with NTSC/ATSC/QAM tuners (clear?)
• Analog local broadcast
Enhanced solutions #3:

Digital pass through and digital local broadcast
Enhanced solutions #3:

Digital pass through and digital local broadcast

• Passing through digital QAM
• DVR’s with NTSC/ATSC/QAM tuner
• Digital (QAM) local broadcast
  (e.g. 16.970 - .979)
Enhanced solutions #4: Digital Q to Q and digital local

- Encrypted QAM
- Local Content
- Q to Q Multiplexer
- Combiner
- Clear QAM
- Digital Flat Screens w/QAM Tuners
- DVR
- Set Top Box
- Projector
- Legacy Digital Flat Screens
- VCU
- Bicsi
Enhanced solutions #4:

Digital Q to Q and digital local

- Decrypting digital QAM
- Inclusion of local broadcast
- **Mapping** of channel line up
- Receiving sets: Flat screens, DVR’s, set top boxes equipped with **QAM tuners**
Enhanced solutions #5:
Digital QAM & IP Local

Diagram showing the flow of signals from DTA's, QAM Modulator, Analog pass-through, QAM, Decoder, IP Network, Combiner, and devices like DVR, Projector, and Laptop equipped with VLC player.

Bicsi logo at the bottom right.
Enhanced solutions #5:

Digital QAM & IP Local

• Passing through digital clear QAM
• DVR’s with NTSC/ATSC/QAM tuners
• Modulating encrypted via QAM
• IP Local Broadcast (laptops)
Enhanced solutions #6:

Digital QAM and IP local & OTA

• Passing through digital clear QAM
• DVR’s with NTSC/ATSC/QAM tuners
• Modulating encrypted via QAM
• IP Local Broadcast
• OTA local Stations
Enhanced solutions #7: IPTV
Enhanced solutions #7: IPTV

- WAN & LAN speeds
- Multicasting
- IPTV VLAN
- IGMP routing
- Wireless cautiously
- Codec decision?
• Trunk and Tap
• Star Typology
• Campus Schools
Classroom HDMI Links

- Distance between projector and teacher station >30 Feet
- HDMI Laptop connection
- Solution: HDMI adapters with 2 Cat 6e cables
RF over UTP

RF Classroom Connection (Unused Pairs)

Laptop is receiving DATA only NOT IPTV

PROJECTOR

IP Network

CATV HEADEND

CAT 6e

Balun

RF Patch Panel

UTP Patch Panel

Proprietary Patch Panel

Combiner

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Recommendations

- Build into the short-term franchise agreement needed equipment
- Hospitality and MDU
- Lease any and all equipment
- Adopt a headend approach
  * Centralized if WAN permits
  * Distributed
Recommendations

• Do not invest in analog
• Consider cable infrastructure
• Don’t throw out COAX
• Consider RF over UTP
• Adopt a mix of QAM & IP
• Consider inclusion of OTA
Questions

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Thank you

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