

Integrating ATSC M/H Mobile DTV into a Broadcast Transmission System

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Incospec “Content to its Distribution 2010 Tour”

March 9th & 11th , 2010



the **rf** experts

Overview

- What is ATSC M/H?
- Terminology
- Major components of DTV system
 - Existing and Mobile DTV
- Transmitter system design options
 - Single- vs. multi-transmitter
- Conclusions

ATSC M/H Mobile DTV – What is it?

- Mobile/Handheld or Mobile DTV
- Backward compatible with legacy ATSC (A/53)
 - Existing TVs and STBs still work, but cannot display M/H content
- Uses existing RF channel, existing DTV transmitter
 - Apportions 19.39 Mbps bitstream between fixed and mobile streams
 - Allows for both “legacy” (A/53) and Mobile DTV (A/153) programs
- Same physical layer as A/53 (8-VSB)
- Additional coding and training signals on mobile streams
 - More robust for mobile
 - Can receive approx. 4 dB C/N vs. 15 dB for standard ATSC
 - Trades spectral efficiency for robustness
 - $\frac{1}{4}$ rate coding – 4 bits out for 1 content bit
 - $\frac{1}{2}$ rate coding – 2 bits out for 1 content bit



ATSC M/H Mobile DTV – What is it?

- IP-based mobile baseband signals
 - Easily supports streaming (real-time) and file-based (non real-time) delivery
 - Common protocol for various file types
- Mobile signals use more efficient encoding/compression than legacy
 - MPEG-4/H.264 for video
 - HE AACv2 for audio
- Service protection capability
 - Based on OMA BCAST DRM profile (Open Mobile Alliance – Mobile Broadcast Services)
- Electronic Service Guide
 - Based on OMA BCAST Service Guide standards



History and Current Status

- Two groups originally proposed compatible mobile technologies
 - A-VSB (Samsung) – started development in 2005
 - MPH (LG/Zenith) – first introduced in 2007
- Extensive lab and field tests were conducted on both systems
- May 2008
 - Broadcast industry group Open Mobile Video Coalition (OMVC) recommended MPH as the most viable technology
 - ATSC accepted recommendation to base M/H standard on MPH
- ATSC appointed subcommittee to develop and codify standard
 - ATSC TSG-S4 subcommittee; A/153 standard
- November 2008
 - A/153 elevated to Candidate Standard
- October 2009
 - A/153 Mobile DTV standard approved by ATSC

ATSC Mobile DTV Consumer Devices



Terminology

- ATSC Legacy, Main or “Fixed” service
 - ATSC A/53
 - ATSC broadcast signal to stationary receivers
- ATSC M/H or ATSC Mobile DTV
 - ATSC A/153
 - Allows a portion of the signal, currently up to 75%, to be used for delivery to portable and mobile devices, with the balance for delivery to existing receivers
 - Bandwidth can be allocated based on individual station requirements



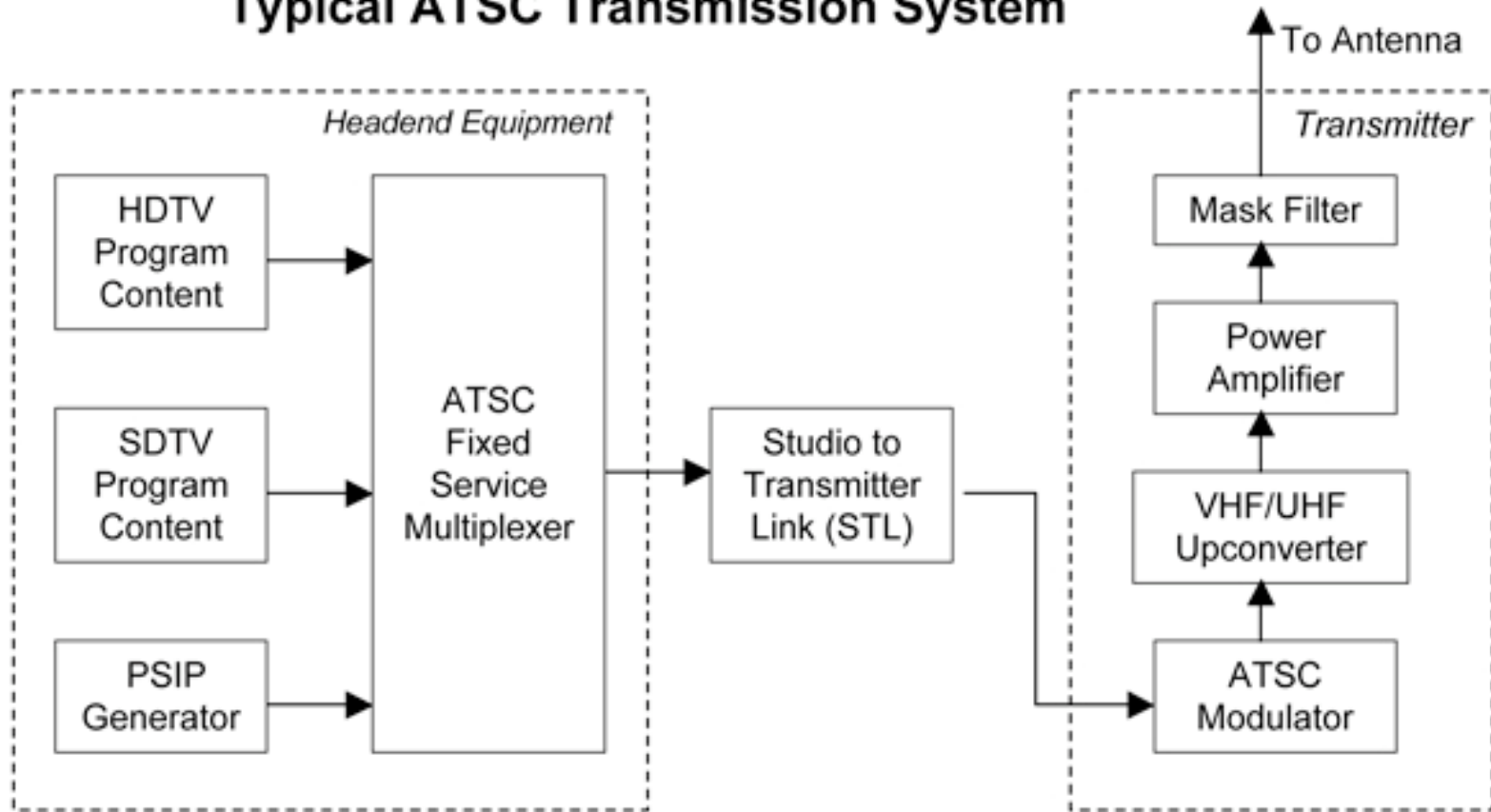
Equipment

Major Components of DTV Transmission Facility

- Three general blocks for ATSC legacy service:
 - Program Headend Equipment
 - Multiplexers, encoders, PSIP generator, etc.
 - Studio to Transmitter Link (STL)
 - Fiber, microwave, satellite, etc.
 - Digital Transmitter
 - Modulator, upconverter, RF power amplifier(s), mask filter, etc.

Major Components of DTV Transmission Facility

Typical ATSC Transmission System



Major Components of DTV Transmission Facility



- Fixed Encoding and PSIP
 - MPEG-2 encoding equipment for fixed HDTV and SDTV programs
 - Static and/or dynamic PSIP generation
 - Can be separate equipment or integrated into service MUX
 - Remains in service after M/H conversion, but only for fixed program content

ATSC Mobile DTV Hardware



- Mobile DTV Encoders
 - One required for each mobile program/channel
 - Provides MPEG-4 (a.k.a. AVC, H.264) encoding for mobile programs
 - Scales resolution to 416 x 240
 - Ideally repurposed for viewing on small screen, but can be simulcast
 - IP output feeds preprocessor/MUX
 - Currently stand-alone equipment

ATSC Mobile DTV hardware



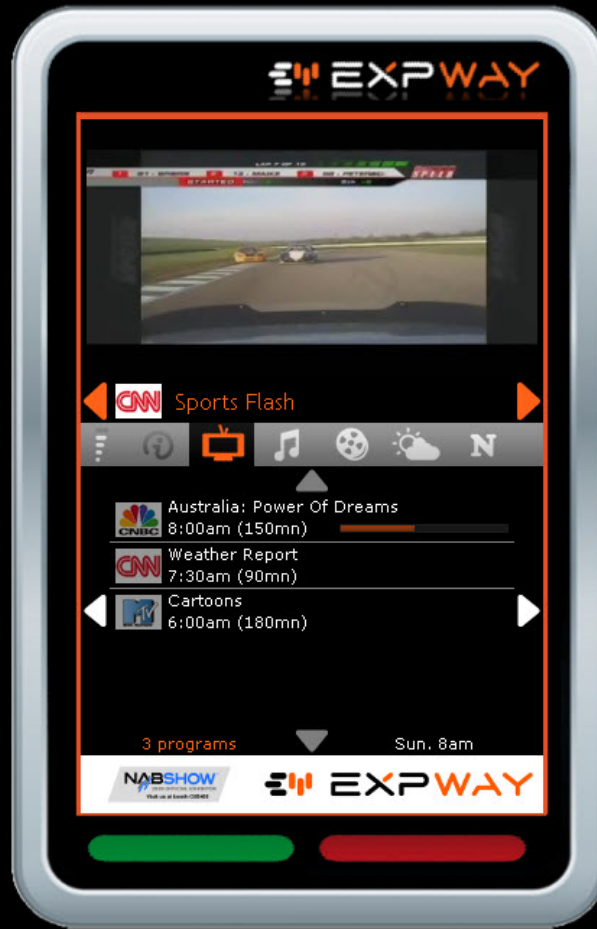
- Mobile DTV Electronic Service Guide (ESG) Generator
 - Provides program guide and overall navigation GUI for mobile device
 - Creates M/H service signaling channel (SSC), providing structure of transmitted services and decoding parameters for video and audio
 - Independent of legacy PSIP generation, but some existing PSIP equipment can be extended
 - IP output
 - Can be stand-alone equipment

ATSC Mobile DTV hardware

Move to Mobile DTV
with



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EXPWAY

*Service Guide Solutions for
ATSC-MH Mobile DTV*

TV
Zapping ads

Program Information
TV and Data Services

Channel Logos
Program Guide
Video and Music files
Weather Report
Sport Statistics

Banner Ads



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Major Components of DTV Transmission Facility

Legacy Service Multiplexer

- Various options
 - SDTV and/or HDTV capability
 - Number of program streams
 - Static or dynamic multiplexing
 - Other features...
- Remains in service after M/H conversion, but only for fixed program content



ATSC Mobile DTV hardware



- ATSC Mobile DTV Multiplexer (Pre-processor)
 - Combines Mobile DTV content with legacy ATSC transport stream
 - Placed downstream of the service MUX; Accepts inputs from service MUX, M/H encoders and ESG generator
 - Preprocessor provides M/H data structure, adds additional FEC and training processes, and encapsulates the data into MHE (M/H ensemble) transport stream packets
 - MUX allocates bandwidth between mobile content and main (fixed) service data
 - Typically includes ASI and/or SMPTE 310 input for fixed content, IP input for M/H content; Output can be ASI or SMPTE 310
 - Supports both internally generated and external service signaling

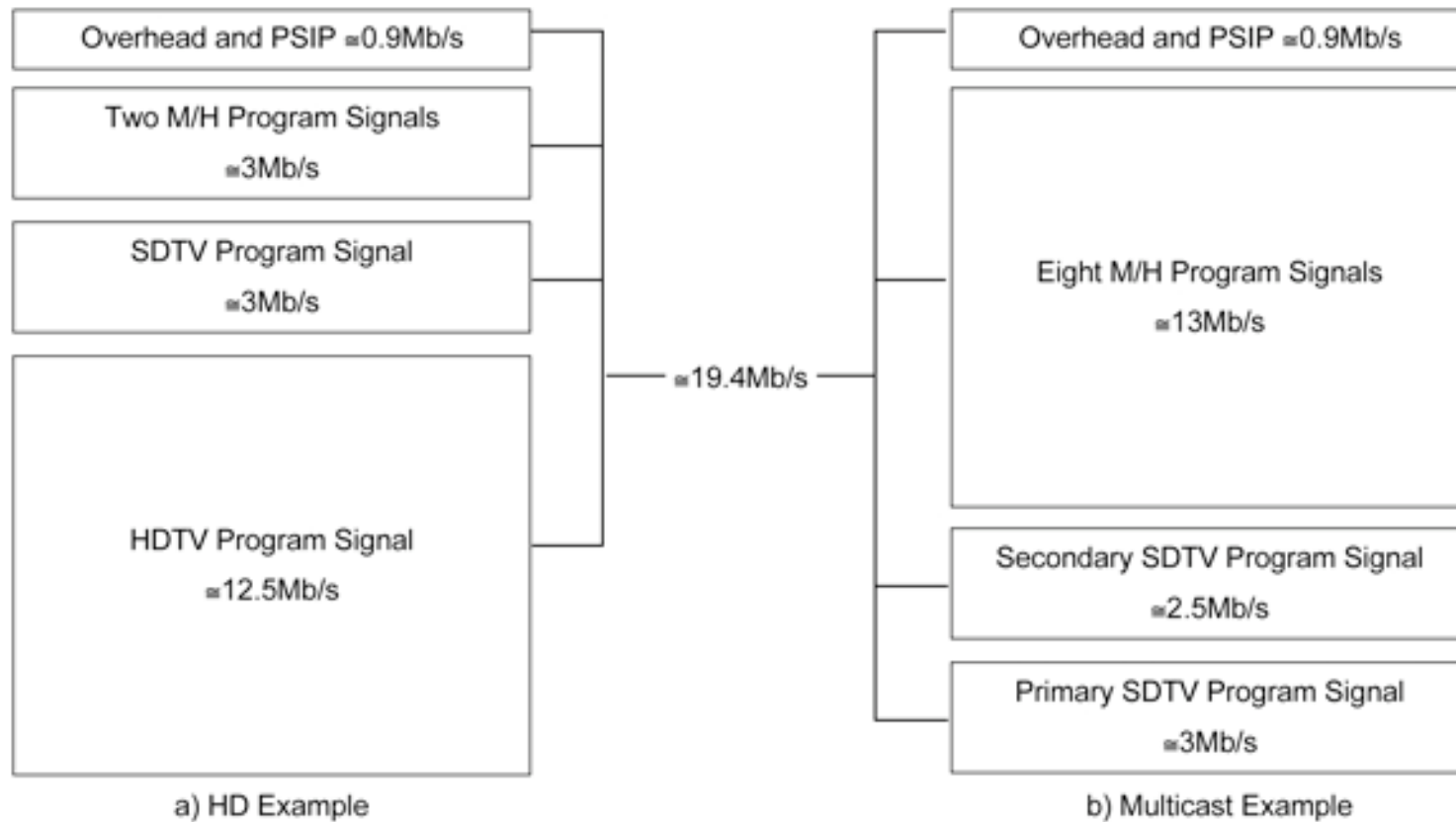
ATSC Mobile DTV hardware

- Total capacity for all streams remains at 19.39 Mbps
- HD stream consumes ~10-14 Mbps
- SD stream consumes ~3-4 Mbps
- PSIP consumes ~ 0.5 Mbps
- Each Mobile DTV program consumes approx. 1-2 Mbps (assume 500kbps payload, $\frac{1}{4}$ rate or $\frac{1}{2}$ rate coding)



ATSC Mobile DTV hardware

Fixed / Mobile Bandwidth Examples



Major Components of DTV Transmission Facility

- Studio to Transmitter Link (STL)
 - Typically point-to-point microwave or fiber, but can be satellite or even IP
 - Addition of M/H does not increase bandwidth requirements, so existing digital STLs should continue to work
 - Choosing to deploy M/H in a multi-transmitter network may require additional STLs, depending upon technology selected



Major Components of DTV Transmission Facility



- Existing ATSC Exciter

- ATSC and RF signal generation section of transmitter, includes...

- ATSC Modulator – Accepts ATSC-compliant ASI or SMPTE310M bitstream and typically modulates to an intermediate frequency (IF)
 - Upconverter – Converts the IF signal to the desired VHF or UHF channel frequency
 - Downconverter – Required for systems employing adaptive pre-correction

ATSC Mobile DTV hardware

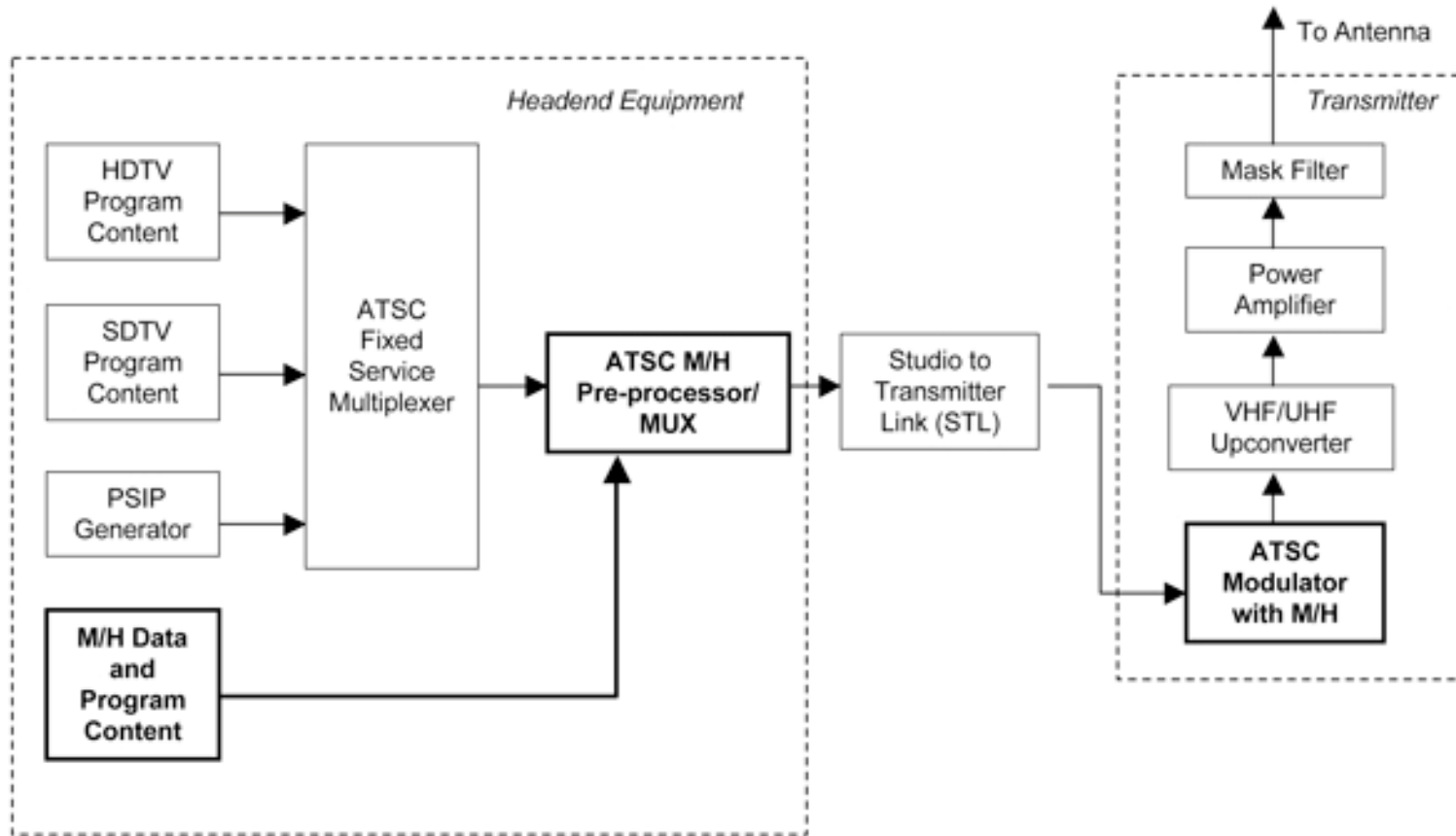
- M/H ATSC Exciter

- ATSC exciter components generally capable of operating with M/H, except modulator
- For M/H operation, modulator requires post-processor to ensure main service data compatibility with legacy receivers
- Depending upon brand and vintage, modulator will be firmware upgradeable to M/H or will require replacement
- M/H exciter retrofits are available



Major Components of ATSC Mobile DTV Transmission Facility

ATSC Transmission System Including M/H





Mobile DTV System Considerations

System Considerations

- UHF is best for Mobile DTV
 - Receive antennas too large/gain too small at VHF
- Circular/elliptical polarization benefits mobile reception
 - Even if transmitter power is not increased – benefit is more than 3 dB
 - Some studies have shown that elliptical polarization with ~33% vertical is optimum
- Coverage requirements differ substantially from broadcasting to fixed receivers

System Considerations

- Terrain Shielding and Mobile DTV
 - Can be better controlled in fixed installations
 - Viewers in shadowed areas expect and compensate for low or no signal (better antenna system or cable)
 - Greater issue for mobile television
 - Transient service
 - Larger number of viewers experience coverage gap
 - Viewers cannot compensate for gap and many times are unable to anticipate gap
 - Will expect Mobile DTV wherever phone service works
 - May cause frustration and suppress desire for service

System Considerations

- Fringe Area Signal Levels and Mobile DTV
 - Can be better controlled in fixed installations
 - Suburban and rural viewers expect and compensate for low signal (better antenna system or cable)
 - Greater issue for mobile television
 - M/H very advantageous in low signal areas, but reception can still be challenging
 - Typically handheld receivers
 - Relatively small antennas only a few feet from ground
 - Can be oriented in any plane, indoors or outdoors
 - May cause frustration and suppress desire for service

Single Transmitter vs. Multi-Transmitter Network

- Single Transmitter Approach
 - Simplest
 - Lowest cost
 - Can cover majority of contour
 - Possibly most attractive for initial mobile DTV deployment
 - Drawbacks include coverage gaps and lower signal levels as distance from transmitter increases



Single Transmitter vs. Multi-Transmitter Network

- Multi-Emitter Approach
 - Multiple emitters provide greater signal strength and transmit diversity to help overcome...
 - Omni, low gain receive antenna on mobile - compared to higher gain outdoor directional
 - Receivers typically only a few feet from the ground – compared to outdoor rooftop
 - Doppler effect of movement increases required C/N
 - Movement behind buildings, obstructions





Equipment

Multi-Transmitter Network

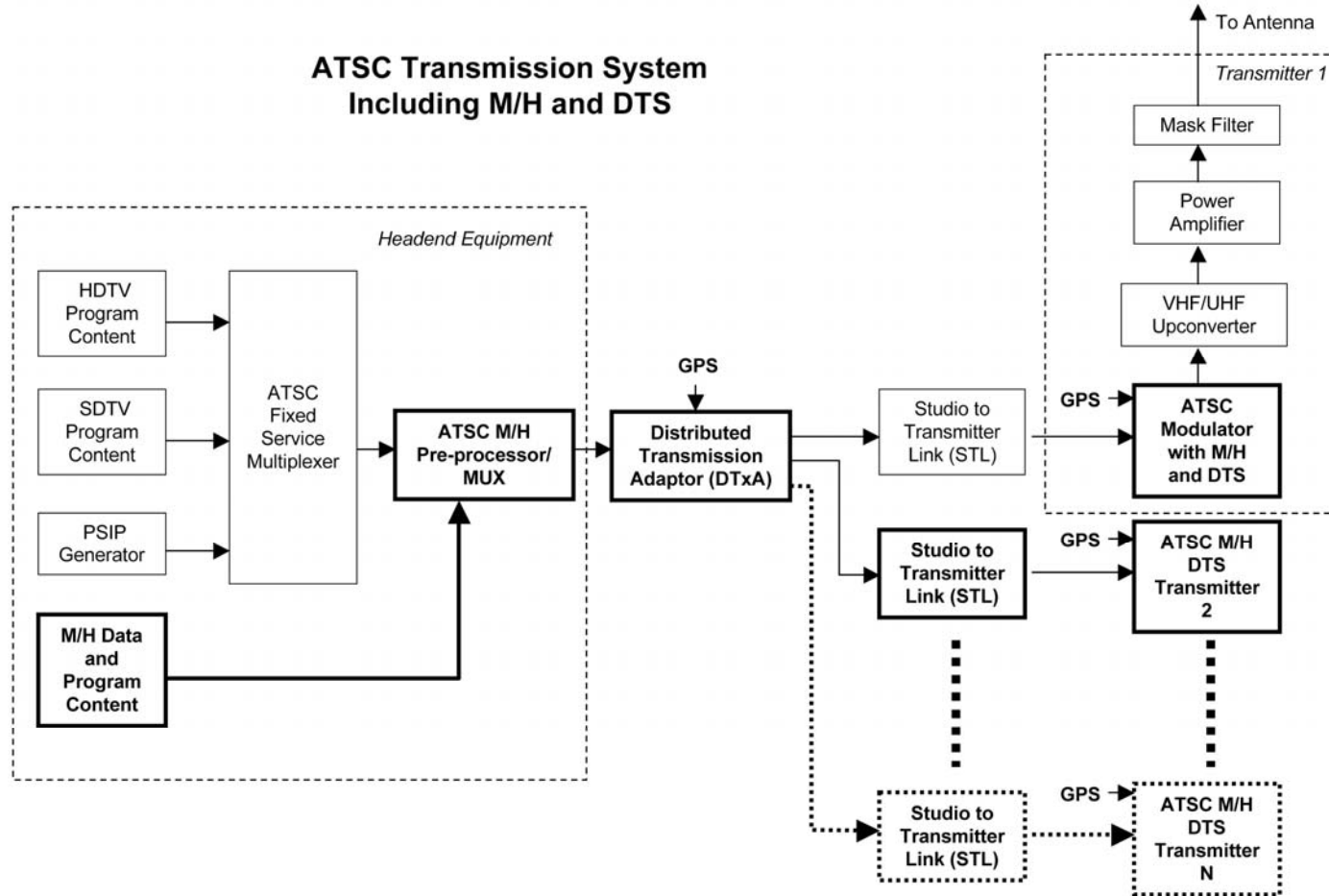
- On-channel “gap fillers”
 - Serial boosters/repeaters receive and rebroadcast main transmitter signal on same channel
 - Can improve coverage in shadowed areas
 - Echo-cancelling versions can ease system design

Multi-Transmitter Network

- Distributed Transmission System (DTS)
 - Identical, originating signal from each transmitter in network
 - Timing/delay adjustment provides control of signal overlap areas
 - Allows lower power transmitters to be used with a high power transmitter to fill coverage gaps
 - Can eliminate need for high power transmitter and optimize signal levels throughout licensed contour

DTS Equipment

**ATSC Transmission System
Including M/H and DTS**



DTS Equipment

- Starting with single transmitter architecture and upgrading to DTS...
 - Prepare by choosing M/H exciter that is firmware upgradeable to A/110B-compliant DTS
 - DTxA can easily be installed in the signal path downstream of the M/H pre-processor/MUX
 - Distribution system and slave transmitters can be added as necessary
 - Some solid-state transmitters can even be broken down for use at multiple sites



DTS Equipment



- Distributed Transmission Adaptor
 - Inserts timing and synchronizing information for multi-transmitter systems operating in a single frequency network (SFN)
 - Used for fixed multi-transmitter networks (DTS or A/110), or fixed/mobile networks (ATSC Mobile DTV or A/153)
 - Software upgradable between modes – can use for DTS, then upgrade to Mobile DTV

Conclusion

- Mobile DTV offers a great new revenue opportunity for broadcasters
- Technical challenges exist, but can be overcome with forethought and planning for successful deployments
- Most any existing ATSC transmission system can be upgraded to incorporate Mobile DTV
- Multi-transmitter technologies can enhance coverage and improve user experience
- Planning can make it possible to efficiently migrate from legacy to M/H to multi-transmitter architectures



Thank You!

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