Digital Television Broadcasting in the United States

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There have been many changes in the industry during the transition to digital television (DTV) broadcasting. This report summarizes some of the more significant developments that have occurred in the current reporting period relating to terrestrial transmission and reception, technical standards, quality issues, regulatory issues, and contains a brief mention of station facilities and broadcasting to handheld and mobile devices.

Terrestrial DTV Transmission

On February 8, 2006, President Bush signed into law the bill that sets February 17, 2009 as the date U.S. broadcasters must cease transmitting analog television signals and move to all-digital broadcasts. This will end the era of NTSC television broadcasting that started in 1941. Broadcasters are preparing for this milestone and, at the end of May 2006, 1,701 digital terrestrial television stations had been granted a license or construction permit and 1,573 stations were on air in 211 markets (FCC figures). This compares with 1,497 DTV stations on air 12 months previously, and a current total of approximately 1,750 analog stations. One or more local DTV station transmissions are now on air in markets serving nearly 100% of U.S. households, with about 90% of households in markets with five or more DTV broadcasters. However, most television translators and boosters or repeaters, which extend the coverage of main station transmitters, have not yet been replicated for DTV.

To help prepare consumers for the transition, the Federal Communications Commission (FCC) has established a DTV information website at www.dtv.gov. The National Telecommunications and Information Administration (NTIA) has also been given responsibility for communicating information on the DTV transition to the public. The Consumer Electronics Association (CEA) and the National Association of Broadcasters (NAB) have both announced that they will work with the NTIA to ensure that consumers will be ready for the change to digital broadcasting.

DTV Programming

The majority of prime time broadcast network programming in the U.S. is now produced in high definition (HD). In addition to scripted drama and sports, HD programming includes documentaries, news-related shows, daytime "soaps," late-night chat shows, and special events. Total broadcast hours of HD television from the seven major networks during 2005 was as follows:

ABC 1355 hours (estimate for 2005-2006 season)
CBS 1845 hours
Fox 1405 hours
NBC 1286 hours
PBS 218 hours (includes 21 hours repeats)
UPN 312 hours
WB 572 hours

ABC and Fox use the 720P format for HD content, while the other networks all use 1080I. The debates from previous years about the relative merits of the two formats are now largely over, and it is accepted that both systems produce excellent picture quality. Many major prime time shows are also produced with 5.1 channel surround sound, providing superior sound quality that matches the enhanced video. Most local broadcast stations have facilities for passing through network HD programming, with local 480I SD content being upconverted to the same HD format, although some stations have upgraded their station infrastructure for local HDTV production. As well as carrying an HD program, many DTV stations now provide multicast program services within a single 6-MHz broadcast channel. A common configuration is one HD program and one standard-definition (SD) program. During 2005, NBC-Universal continued the rollout of their NBC Weather Plus program service in cooperation with NBC owned and affiliated broadcast stations. This provides national, regional, and local weather information for an SD multicast channel. Large numbers of stations in other groups, including Raycom Media, Tribune, and Sinclair, have agreed to carry in their multiplex an SD program from "The Tube" music network. Other local stations produce or procure material for their multicast channels, and many PBS stations adopt a four-channel SD multiplex during daytime for a variety of informational and educational programs from the PBS network, switching to one HD and one SD program in the evening. Stations owned

by the Paxson group have been broadcasting up to six SD programs in a single multiplex.

USDTV

Starting in 2005, USDTV (United States Digital Television) introduced a terrestrial digital subscription TV service, partnering with broadcasters to provide a low-cost alternative to multichannel cable services. Currently available in Albuquerque, Dallas/Fort Worth, Las Vegas, and Salt Lake City, USDTV provides approximately 30 digital channels in several multiplexes broadcast from partnered DTV stations in each area. To make more efficient use of available bandwidth, USDTV is currently migrating its video coding technology from MPEG-2 to the MPEG-4 AVC/H.264 advanced video codec. At the NAB2006 convention, a USDTV receiver at the DTV Hot Spot demonstrated live over-the-air AVC video carried by a local ATSC digital television station.

Spectrum Repacking

At the start of the DTV transition, most stations were assigned a second RF channel for their DTV service. In order to optimize the repacking of the spectrum as analog channels are closed down, some of these assignments will need to change and, to complete the transition, all stations must move into the "core" channels 2-51. This move from the upper 700-MHz spectrum band will free up 60-MHz for auction to mobile wireless carriers and 24-MHz for emergency response agencies. The FCC allowed stations to choose (subject to approval) their final channel for the DTV service. The first two rounds of allotments have been completed, and in May 2006, the FCC released a list of tentative DTV channel designations for 1,789 licensees. A final Table of Allotments is expected at the end of 2006.

The FCC has not yet finalized general rules for DTV operation by the approximately 4,500 TV translators and 2,700 low power and Class A television stations. It has, however, indicated that it will consider requests from low-power stations to operate DTV service on replacement channels on a case-by-case basis. In many cases, TV translators will make the transition to DTV by simply changing from analog to DTV operation on their existing channels at some point in time. In other cases, new translators will be added to provide DTV service on new channels. The FCC will initiate a rulemaking proceeding to address issues relating to the general authorization of DTV service by low-power stations in the near future.

Improvements in Transmission

All digital terrestrial broadcasting in the U.S. currently use the ATSC 8-VSB-transmission system. Several schemes for updates and improvements have been initiated during the past year.

Distributed Transmission

In July 2005, the ATSC published its revised *Synchronization Standard for Distributed Transmission*, A/110A, and in November 2005, the FCC adopted a Clarification Order and Notice of Proposed Rulemaking that explains the Commission's existing guidelines for stations' interim use of distributed transmission systems (DTS) and initiates a rulemaking to establish rules for the future use of DTS by digital television stations.

DTS allows a DTV station to employ multiple synchronized transmitters spread around a station's service area, enabling broadcasters to fill gaps in service coverage in order to, for example, provide coverage to areas previously blocked by terrain. In the *Second DTV Periodic Review Report and Order*, issued in August 2004, the FCC approved the use of DTS and set guidelines for DTV stations' interim use of the technology. The FCC also said that it would undertake a rulemaking proceeding in the future to adopt rules for DTS operations.

At NAB 2006, the transmitter manufacturer Axcera presented an operating demonstration of distributed transmission, distributed translator, and RF watermark technologies, and operated its Distributed Transmission Adaptor, which allows an ATSC DTV broadcaster to establish a single frequency network of transmitters to improve signal coverage. Some distributed transmission transmitters have already been deployed, with WPSX-DT in State College, PA, being the first to employ the technology.

E-VSB

Enhanced VSB (E-VSB) is a part of the ATSC transmission standard that provides enhanced signal-to-noise ratio performance for a broadcaster-adjustable portion of the transmitted stream, by devoting part of the stream to additional forward error correction coding. It provides a robust DTV signal that can be received under more difficult reception conditions such as indoor recep-

tion or, possibly, handheld devices. This could be used for robust fallback versions of the main program or for alternative programming. The "enhanced stream" can share the DTV channel with a regular "main stream" transmission, with the trade-off being that the bit rate used for the enhanced stream is reduced by a factor of either 2 or 4 for the usable payload being carried. The system is designed such that legacy 8-VSB receivers can continue to receive programs in the main channel in the presence of new enhanced stream elements that they cannot process.

In April 2006, the ATSC published an amendment to ATSC standard A/53, to revise Annex C for E-VSB transport. This defines the E-VSB system and makes provision for carriage of AC-3 and Enhanced AC-3 audio, MPEG-2 video, and private data in the enhanced stream. As ATSC has not yet completed standardizing new video coding technology, this new annex does not describe transport of any video compression other than MPEG-2.

Tests with indoor reception carried out, using signals from WNUV-DT in Baltimore, MD, and reported at the NAB2006 Broadcast Engineering Conference, confirmed that E-VSB generally has a 6-dB improvement in signal strength margin over the main signal, with no adverse effects on the main signal.

A-VSB

Based on a perceived need for a robust mode for pedestrian/handheld devices and mobile applications, manufacturers Rohde & Schwarz and Samsung have been developing Advanced-VSB, an emerging ATSC DTV technology that brings extensibility to the 8-VSB physical layer. Three of the tools supported by A-VSB were demonstrated at the NAB2006 DTV Hot Spot: Supplemental Reference Sequence and Turbo Stream coding, which is expected to improve DTV reception under harsh conditions, and Harmonized Single Frequency Network (SFN). One of the harsh conditions demonstrated was operation with simulated reception at speeds of 125 mph.

Work on standardizing this A-VSB technology is now in progress in ATSC.

Advanced Codecs

The video industry has continued to evaluate the use of advanced compression technologies, in particular, AVC/H.264 (MPEG-4 Part 10) and SMPTE VC-1. These may be used to replace MPEG-2 video codecs in order to decrease the amount of bandwidth required to transmit digital video while maintaining high quality. These advances are expected to allow existing video delivery services to provide more programming. Both DirecTV and Dish Network have introduced new satellite direct-to-home services using AVC/H.264 compression, with new channels providing local HD broadcast stations to local customers. The cable television industry has been actively investigating the introduction of AVC/H.264 compression for cable systems, including provision for bitstream splicing for local advertisement insertion. AT&T has indicated that its Lightspeed broadband TV distribution systems now being rolled out will use both AVC/H.264 and VC-1.

For terrestrial broadcasting, the Enhanced AC-3 audio codec has been added as an ATSC audio compression option for E-VSB, and revised standard A/52B was approved in July 2005. E-AC-3 offers new coding tools that improve performance, compared with AC-3, and allow operation over a wider range of bit rates and number of channels.

Work is in progress within ATSC for adding advanced video codecs as options for compression and candidate standards have been published for various aspects of the introduction of AVC/H.264 and VC-1. Broadcasters are also investigating the use of more efficient advanced codecs for program contribution and distribution links, again to save bandwidth while maintaining quality. One issue that requires careful consideration if signals are subsequently broadcast using MPEG-2 compression is the artifacts that may be introduced due to concatenation of codecs with different compression algorithms.

Meanwhile, researchers at NHK of Japan claimed new improvement to the MPEG-2 encoding process that would allow for a substantial improvement in coding efficiency, primarily for interlaced images, within the existing standard and compatible with legacy decoders. A paper in the October 2005 edition of the *EBU Technical Review* detailed the techniques based on adaptive selection of the picture structure and optimized selection of the motion vectors and macroblock coding modes.

ACAP Interactive Television

In August 2005, the ATSC approved the *Advanced Common Application Platform (ACAP) Standard*, A/101.

ACAP provides content creators, broadcasters, and consumer electronics manufacturers with a specification that allows development of interoperable interactive television services and products. It resulted from a harmonization of the ATSC DTV Application Software Environment (DASE) specifications with CableLabs' OCAP specifications.

Since mid-2004, Korean terrestrial broadcasters have been transmitting experimental ACAP-based interactive applications, along with HDTV programming. In September 2005, Mexico's Televisa made the first transmission and demonstration in Mexico of the ACAP standard during HDTV soccer matches, providing programming with interactive puzzle games, realtime information services, TV commerce, and audience polling. Data file transfers for educational purposes were also demonstrated. ACAP field trials are planned in the U.S. later in 2006 or in 2007.

Receivers

The sale of DTV consumer electronics and displays continues to accelerate, and the performance of DTV receivers continues to improve. ATSC receivers with fifth-generation chip sets became available, providing superior capability for receiving DTV signals under difficult conditions, particularly with large and varying multipath interference. CEA predicted that in 2006 total sales of digital televisions (including monitors) will exceed those of analog sets.

NAB/MSTV Set-top Box Project

In mid-2005, the Association for Maximum Service Television Stations (MSTV) and NAB announced a joint program for the development of a high-quality, low-cost, terrestrial digital converter box for use in the U.S. consumer marketplace to convert broadcasters' ATSC 8-VSB digital transmissions with MPEG coding to the analog SD format for display on NTSC receivers. Prototype boxes were developed by Thomson and Zenith/LG with funding from NAB and MSTV and demonstrated at the NAB2006 convention. NAB and MSTV expect that these will form the basis for future products from manufacturers to help ensure that the more than 70 million analog televisions relying exclusively on terrestrial broadcast signals will continue to receive free over-the-air television service when the analog service is discontinued in 2009.

Set-top Box Vouchers

The bill that sets the date for the end of analog broadcasting also defines a program to be implemented by the NTIA whereby households may obtain coupons that can be applied toward the purchase of digital-to-analog converter boxes. The coupon value is $40, with a limit of two coupons per household. They will be available between January 1, 2008 and March 31, 2009 and, if not used, will expire after 3 months. $1.5 billion has been allocated for this coupon program.

NTIA has also been given $5 million to use for consumer education on DTV and program administration costs.

Antenna Selection

The Consumer Electronics Association's (CEA) updated the software used to drive the AntennaWeb.org website that helps HDTV owners select the proper antenna for terrestrial over-the-air reception. This website is based on work by the CEA R5 Antenna Systems Committee that developed the technical parameters to use. The algorithm now takes more account of local topography and obstructions to better predict reception conditions at a given location, and hence provides a more accurate recommendation.

DTV Quality Issues

DTV broadcasting has the capability for greatly improved picture and audio quality compared to traditional analog transmissions, particularly with enhanced resolution and elimination of noise and ghosting. However, several degradations that are largely unique to DTV are on occasions observed on DTV transmissions. These relate primarily to image formatting, lip sync, audio levels, and compression artifacts.

Image Formatting

Image format problems occur due to the change from 4:3 to 16:9 aspect ratio for production, transmission, and display. Inconsistencies at different points in the program chain may result in pictures with bars at the top and bottom or on each side, with the possible result of the infamous "postage stamp" image in the middle of a black background. It is also common to see widescreen displays showing 4:3 produced programming stretched to fit. A coordinated effort took place during 2005 and 2006 with SMPTE and the Consumer Electronics Association

producing new standards and a recommended practice for the generation, distribution, and use of metadata to describe the format of the picture. These Active Format Description (AFD) and Bar Data specifications were harmonized with existing ATSC and DVB (AFD only) DTV standards for transmission. The parameters carried are intended to guide receivers as to how images should be optimally displayed. An associated SMPTE standard has also been developed for carrying pan-scan metadata through the professional distribution chain to allow downstream extraction of different aspect ratio images from a widescreen master version of the program.

Lip Sync

Audio-video synchronization, commonly known as lip sync errors are not unique to DTV, but their incidence and severity have generally increased with digital broadcasting. Such errors may be introduced at different stages in the broadcast chain from production through transmission and in the receiver. During 2005 and 2006, SMPTE, the European Broadcasting Union, the International Electrotechnical Commission TC100 group, JEITA, and the World Broadcasting Union's ISOG group, all had investigations into the magnitude and causes of such errors and methods for reducing or eliminating the problem. The EBU published two reports: Tech 3311—*EBU Guidelines for Multichannel Audio in DVB and* Recommendation R37-2006—*The Relative Timing of the Sound and the Vision Components of a Television Signal.* Work is ongoing in all the mentioned organizations to produce standards and recommended practices to address this common problem.

Audio Levels

Undesirable variations in audio levels during and between programs are also not new to DTV, but, again, the incidence and severity of variations has increased with digital broadcasting. Audio compression systems such as AC-3 provide sophisticated methods using transmitted metadata for setting and adjusting level and dynamic range of audio signals output by the receiver, and little or no audio compression and limiting is typically done at the broadcast station (as is essential for analog transmission). It is thus necessary that the audio metadata parameters should be correctly set in the audio encoder, but they are not always adjusted as required. Stations and networks have become increasingly aware of the need to generate and distribute metadata to enable audio encoder parameters to be correctly set for each program segment. The increasing use of the Dolby E multichannel compressions system for program distribution enables this metadata to be carried and interfaced to a Dolby Digital AC-3 audio encoder for emission. In 2006, Dolby also introduced a Program Optimizer product that allows file-based programs to be analyzed and corrected for audio loudness, without affecting the original dynamic range.

Compression Artifacts

Compression artifacts degrade DTV pictures, particularly when the bit rate or allocated bandwidth is insufficient for the demands of the program material. This may change on an instantaneous basis and is greatest for high-definition pictures with high detail and fast motion. Degradations, particularly pixel blocking, but also loss of resolution and certain types of noise, have become noticeable as some broadcasters try to squeeze more programs into a single DTV channel, especially if some of the DTV channel is allocated to other services such as data broadcasting. Such artifacts may be reduced or eliminated by allocating a higher bit rate to the program service, by using a higher efficiency encoder or, in some cases, by applying statistical multiplexing to the programs making up the multiplex.

Regulatory Issues

DTV Tuner Requirements

On November 3, 2005, the FCC amended its rules to change the date on which all TV sets with off-air tuners must include the capability to receive digital television signals to March 1, 2007. It also made this tuner requirement apply to all television receivers, regardless of their size. The Commission said this was done to help speed the DTV transition. The Commission noted the particular value of small, portable, typically battery-powered products for enabling the reception of news and public safety information in times of emergency.

PSIP

The FCC introduced a Report, Order which requires all DTV stations must fully comply with the ATSC *Program and System Information Protocol Standard* (A/65B) by February 1, 2005. This requires that broad-

casters transmit all mandatory PSIP information with their digital programming. PSIP tables and descriptors provide information about DTV channels and programs that enable DTV receivers to rapidly tune to new channels and to assemble functioning electronic program guides. PSIP Event Information Tables (EITs) should have proper data for each program (event) on the schedule, including title and time information. If the event has closed captions, the correct parameters for those captions must be in the Caption Service Descriptor, and if any parental advisory information is provided, the correct codes must be in the Content Advisory Descriptor. Several stations have been fined by the FCC for noncompliance with the requirements.

Closed Captioning

FCC rules for closed captioning on DTV channels were introduced, requiring that after January 1, 2006, 100% of most new video programs (there are some programs that are exempt) must be captioned with closed captions in accordance with the DTV closed captioning recommended practice CEA 708.

A revised version of CEA 708C was published in June 2006. This has been harmonized with revised versions of SMPTE standard 334M and ATSC A/53, to better define the requirements and implementation of closed captioning from production to receiver.

Broadcast Flag

In a Report and Order issued in November 2004, the FCC defined a system for control of redistribution of broadcast content on the internet, otherwise known as the broadcast flag. This was due to come into effect on July 1, 2005, but, following a lawsuit brought by the organization Public Knowledge, the U.S. Appeals Court for the D.C. Circuit on May 6 overturned the FCC's order establishing the broadcast flag.

EAS Emergency Alerting System

In November 2005, the FCC released the text of a First Report and Order and Further Notice of Proposed Rulemaking regarding the review of the Emergency Alert System (EAS). This expands the EAS rules (Part 11) to include providers of digital broadcast and cable TV, digital audio broadcasting (DAB), satellite radio, and direct broadcast satellite services. The FCC requires that all DTV (including digital low-power television and digital Class A television) and DAB (IBOC) radio stations will have the same EAS obligations as analog stations. This includes installing and maintaining an encoder/decoder and conducting periodic tests. The FCC is also requiring digital cable services to comply with the same EAS rules as analog cable.

The FCC also sought comments on topics such as: how wireless services could be effectively integrated into a next-generation alert and warning system, system architecture/message distribution, whether there should be a Common Alerting Protocol, and whether performance standards will be necessary to ensure that public alert and warnings arrive in an accurate and timely fashion.

During 2005, the Association of Public Television Stations joined Federal Emergency Management Agency (FEMA) and other federal departments and agencies, and several private communication companies and broadcasters, for a series of tests using digital technology to improve America's alert and warning system. The tests were part of a one-year pilot project to demonstrate how the Department of Homeland Security can improve public alert and warning during times of national crisis through the use of local public television's digital television broadcasts. The tests became the beginning of the Integrated Public Alert and Warning System program designed to provide critical life saving information to the nation in a timely and effective manner.

Emergency Preparedness

On November 30, 2005, the Media Security and Reliability Council II (MSRC II) released a planning tool that broadcasters should use to create a written disaster recovery plan for their stations.

MSRC is a Federal Advisory Committee, formed by the FCC in the aftermath of September 11. Recognizing the fundamental and essential role that local media play in providing and coordinating communications in emergency situations, the Commission created MSRC to study, develop, and report on communications and coordination designed to ensure the optimal reliability, robustness and security of the broadcast and multichannel video programming distribution industries in emergency situations.

2 GHz BAS Relocation

On February 7, 2005, Nextel Communications, Inc. accepted the FCC's *800 MHz Report and Order*, which required Nextel to eliminate commercial mobile radio service and the public safety radio interference at 800 MHz and clear 2-GHz licensees, including Broadcast Auxiliary Services (BAS), which are used for remote news contribution links, from the 1990 MHz-2025 MHz band. This triggered the beginning of an FCC-mandated 30-month 2-GHz band relocation process, which requires all 2-GHz BAS licensees to vacate ENG channels 1 and 2 and begin operating in the new 2025-2110 MHz BAS band, with seven 12-MHz-wide digital channels, by September 2007. It is Nextel's responsibility to pay for this relocation.

In April 6, 2005, Nextel filed a *BAS Relocation Schedule and Implementation Plan* with the FCC that included the so-called "Narrow in Place" process by which BAS equipment will be replaced with digital equipment that operates on the center frequencies of the existing 17/18 MHz channels, but with a narrowed emission bandwidth. Once all of the licensees in a particular market have installed the new equipment, the licensees will simultaneously convert to the new compressed 12-MHz channel plan by shifting the center frequencies to the new channel plan. In July 2005, the FCC released a Public Notice announcing special licensing procedures to facilitate the efficient transition of BAS and other licensees out of the 2-GHz band.

2 GHz Data Return Links

The seven new 12-MHz BAS channels have a remaining 1 MHz of spectrum arranged as two 500-kHz wide guard bands, at 2025.0-2025.5 MHz, and 2109.5-2110 MHz. Within each of these guard bands will be twenty 25-kHz-wide data return link (DRL) channels. The Society of Broadcast Engineers proposed that the DRL channels would be from an electronic newsgathering (ENG) central receive site to an ENG platform attempting to communicate with an ENG receive-only site.

Anticipated uses for the DRL channels would be as a homing beacon and as a highly robust "handshaking" signal, to help the ENG truck operator establish a successful link. This would allow automatic transmitter power control and other facilities for the remote ENG site. In January 2005, the ATSC formed a Specialist Group on Digital ENG (TSG/S3) with the goal of defining the parameters and permissive uses for the DRL channels. In May 2006, it published a Candidate Standard for *Automatic Transmitter Power Control (ATPC) and Data Return Link* (DRL). Time was of the essence in this process because, if broadcasters do not start using the valuable 1 MHz of 2 GHz spectrum that the DRL channels represent, the FCC may reallocate that highly-in-demand spectrum to other users.

Station Issues

Infrastructure and Equipment

Most DTV stations have largely completed their migration to DTV for transmission, although some will need to make further changes for the final frequency allocation. Many broadcast stations and network centers, however, have continued their refurbishment programs with major system and equipment upgrades for studio systems. The trend has been to provide infrastructures that are capable of carrying HD signals in the uncompressed domain, although many local stations still carry out local programming operations in standard definition, with HD reserved for network feeds and DTV master control. However, the cost of HD production equipment has generally decreased significantly during this period, and many stations are now planning systems for producing local programming in HD, while others have already carried out the necessary upgrades.

Although most stations still have a backbone of SDI and HD-SDI coax-based signal distribution with a central routing switcher, there has been a steady migration away from videotape and linear programming to file and server-based infrastructure and workflows. This has at least partly been enabled by an increasing use of systems and equipment relying on the SMPTE MXF suite of standards to ensure interoperability and managed workflows.

PSIP and Captioning

To comply with FCC mandates for PSIP and closed captioning, equipment upgrades to correctly generate and insert these signals have occurred at all levels of stations. Stations have introduced systems for transferring information about upcoming programs into the PSIP generator using the ATSC A/76 standard *Programming Metadata Communication Protocol* or other communica-

tion methods. The vast majority of DTV program captioning is still authored in accordance with the analog 608 captioning standard, with translation to the 708 caption format taking place either when captions are placed into VANC of HDTV signals (as per SMPTE 334M), or immediately before feeding captions to the ATSC encoder.

Staffing and Resources

Often due to budget constraints, engineering departments are being asked to reduce manpower levels, while at the same time workloads due to multicast channels and new technologies are increasing. Such demands are partially resolved by an increased reliance on automation systems and on centralized monitoring systems with custom software for operational support and trouble-shooting.

The steady migration to computer and IT-based systems has greatly changed the skill sets needed by many broadcast engineers, and regular training and education in new technologies is a necessity for most levels of technical staff.

Mobile Video Broadcasting

During 2005 and 2006, several technologies were announced or started their rollout in the U.S. that can be used to broadcast video to portable and mobile devices such as wireless phones and Personal Digital Assistants (PDAs). Technologies include Digital Video Broadcasting-Handheld (DVB-H), Terrestrial-Digital Multimedia Broadcasting (T-DMB), and MediaFLO. These all comprise overlay distribution networks separate from the cellphone network, which are constructed in a service area and can operate in various frequency bands.

DVB-H is based on the European digital TV standard and has been adopted in the U.S. by the content creation and distribution organization Modeo. T-DMB is based on the European digital radio standard (Eureka-147), with modifications developed in Korea. The third mobile video system, MediaFLO, has been developed by Qualcomm Inc.

One of the criticisms of MediaFLO has been that it is a proprietary system. The FLO Forum organization has been working to enable standardized solutions for deployment in the field, and this process took a step forward with the announcement in November 2005, that the Forum had ratified the Forward Link-Only air interface specification specifying the protocols used over the air between the FLO network and a FLO device.

Verizon Wireless announced that it has agreed with Qualcomm to use MediaFLO for a high-quality mobile television service. The new service will be launched toward the end of 2006 in approximately half of the markets already covered by Verizon Wireless' broadband network, complementing Verizon's existing high-speed V-Cast service, and with plans to expand throughout other markets.

As noted earlier, the ATSC had work in progress during 2005 and 2006 for an extension to the ATSC standard for a robust transmission mode (to be known as A-VSB), which potentially will allow ATSC transmissions to be received on such devices.

Potential for Interference

MediaFLO is intended as a nationwide network operating on channel 55, which Qualcomm purchased in an FCC auction held in 2002 and 2003. This type of advanced wireless services (AWS) system is regulated under Part 27 of the FCC's Rules, which requires that they operate on a noninterference basis if they begin service before completion of the DTV transition. However, Qualcomm has petitioned the FCC to allow them to use different interference calculation procedures than those set out in section 27.60 to demonstrate compliance with the TV/DTV protection criteria.

In March 2006, NAB and MSTV filed comments opposing the Qualcomm petition because of the interference that would result to existing broadcast services from using these different interference calculation procedures.

This has been an interesting year for broadcast engineers as they dealt with a stream of regulatory and standards-related issues, acknowledging the reality of the end of analog television and the migration to HD as the mainstream television format. With ever-increasing competition from other distribution media, over-the-air broadcasters face considerable challenges in the coming years. However, technical systems and standards now in place and under development will provide opportunities to offer new and improved services to viewers for many years to come.