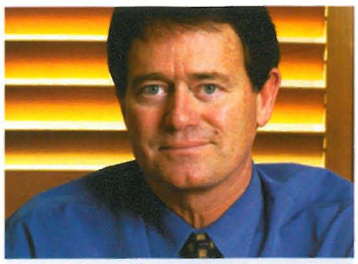
Advanced Television Systems Committee Standards Update



Jerry Whitaker

Whitaker supports the work of the various ATSC technology and planning committees and assists in the development of ATSC standards and related documents. He currently serves as secretary of the Technology and Standards Group and Secretary of the Planning Committee, and is closely involved in work relating to educational programs.

Whitaker is a Fellow the Society of Broadcast Engineers and a Fellow of SMPTE. He is the author and editor of more than 30 books on technical topics, including: "The Standard Handbook of Video and Television Engineering," 4th ed.; "NAB Engineering Handbook," 9th ed., "DTV Handbook," 3rd ed., and "The Electronics Handbook," 2nd ed. Prior to joining the ATSC, Whitaker headed the publishing company Technical Press, based in Morgan Hill, CA. He has served as a board member and vice president of the Society of Broadcast Engineers.

atsc
Advanced Television Systems Committee

By Jerry C. Whitaker, Advanced Television Systems Committee

Advanced Television Systems Committee

This article summarizes some of the significant work of the ATSC that has occurred in the current reporting period relating to terrestrial transmission enhancements, technical standards, handheld and mobile services, non-realtime (NRT) services, and interactive television (ITV) applications. The driving force in this work has been the adoption of a Strategic Plan for ATSC.

Strategic Plan to Guide Future Work on DTV

In December 2006, the ATSC adopted a comprehensive plan for future work of the organization, reflecting the evolution of technology over the next two to five years. The ATSC Board of Directors developed this Strategic Plan, taking into account both the likely progression of technology and the importance of backwards compatibility with existing DTV consumer receivers. The new efforts will focus on comprehensive solutions that enable compelling services and products. Major recommendations include the following:

Documentation of service levels that group standards together to form a logical bundling of features and functions, specifically:

- ATSC 2.0 – new services for conventional fixed DTV receivers
- ATSC-H – delivery of programming to handheld and portable devices
- ATSC-M – delivery of programming to mobile devices

The Strategic Plan furthermore calls for development of a standard for non-realtime (NRT) delivery of new services that leverage the low cost of storage and provide consumers with content they want, when and where they want it.

Although not directly related to new technologies, the current state of DTV audio implementation is identified by the Strategic Plan as an important issue needing further study in coordination with other industry organization. While the AC-3 Digital Audio Standard (A/52) has been on the books for many years, implementations in the field have varied, in particular with regard to lip-sync and sound levels. The ATSC Specialist Group on Video and Audio Coding (TSG/S6) is now studying issues.

ATSC Mobile/Handheld

While still in the early stage of the development process, the planned "ATSC-M/H" services will be carried in the DTV broadcast channels along with regular programming and services. The presence of the new services will not preclude or prevent operation of current ATSC services in the same RF channel or have any adverse impact on legacy receiving equipment. It is expected that ATSC mobile and handheld technology will be utilized for a variety of services to mobile and handheld devices, which may include but are not limited to:

- Free (advertiser-supported) television content and other services delivered in realtime.
- Mobile and handheld subscription-based TV, video-on-demand (VOD),

pay-per-view (PPV), and electronic sell-through (EST) services.
- Non-realtime content download, to playback later.
- Datacasting.
- Interactive television.
- Realtime navigation data for in-vehicle use.

These new services may transmit various types and quantities of content that may be versions of regular TV programming optimized for handheld and/or mobile reception (simulcasting) or specific audiovisual content and/or data produced for mobile reception.

Estimates of the timeline for finalizing an ATSC-H/M standard are difficult to make at the present time; however, it is recognized that broadcasters in the United States would like to have the opportunity to announce and launch new mobile and handheld broadcast services before the close of analog services in February 2009. To meet this date, of course, the standardization work needs to move forward quickly.

The ATSC Specialist Group on ATSC Mobile and Handheld Services (TSG/S4) is currently reviewing documents submitted pursuant to a Request for Proposals on ATSC-M/H, which was issued in May.

Non-Realtime Services

The ATSC Specialist Group on Data Broadcasting (TSG/S13) has begun work to define a comprehensive NRT service. A number of possible "service scenarios" have been proposed. While not an all-inclusive list, these scenarios provide insight into potential applications for NRT standards, for example:

- News, weather, traffic, and sports clip service. This service provides for the delivery of national and local content. Clips are downloaded to storage within receiving devices for playback at a later time. Receivers may provide a menu of available data types, including search capabilities.
- Telescoping ads. This service focuses on ads with additional content pushed to the receiver to allow the viewer to drill down for more detail. Additional Web pages and video segments are pre-downloaded as files—possibly based on user-defined profiles. Additional content may be pulled, if the application and return channel (if present) allow.
- Long-form entertainment programming. This service provides the consumer with the capability to download entertainment content to receivers; for example, TV episodes and movies ranging from 20 minutes to 2 hours in length. Possible business models include advertising-supported, subscription-based, and pay-per-view-based. Free local DTV broadcast channels could be blended together with the private long-form entertainment to provide more value.

As currently envisioned, inbound transmission will be broadcast to the fixed, handheld, or mobile NRT devices and the outbound transmission—when necessary—will be through a broadband internet connection. Not all scenarios will require an internet return channel.

Improvements in Transmission

All digital terrestrial broadcasting in the U.S. currently uses the ATSC 8-VSB-transmission system. The ATSC has standardized two transmission enhancement schemes:

- **Distributed Transmission System (DTS)**, as documented in ATSC Standard A/110, "Synchronization Standard for Distributed Transmission." 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.
- **Enhanced VSB (E-VSB)**, as documented in ATSC Standard A/53 Part 2:2007, "RF/Transmission System Characteristics." E-VSB is an optional enhancement that provides improved 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. The "enhanced stream" shares 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 two or four 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.

Advanced VSB

New work related to transmission improvement was initiated during 2006 on a system proposed jointly by Samsung and Rohde & Schwarz and known as Advanced-VSB (A-VSB). The system brings extensibility to the 8-VSB physical layer, using three tools:

- **Supplemental Reference Sequence (SRS)** added to the emitted transport stream.
- **Turbo Stream coding**, which is intended to permit DTV reception under harsh conditions (such as mobile operation).

- **Harmonized Single-Frequency Network (SFN)** that utilizes built-in elements of A-VSB to facilitate transmitter synchronization, which is necessary for an SFN.

Standardization work on the A-VSB system is being done in the ATSC Specialist Group Transmission (TSG/S9). Laboratory tests have been conducted and field tests were set to begin as this issue went to press.

New Organization for Digital Television Standard

In January 2007, the ATSC published a new version of document A/53, "The ATSC Digital Television Standard." A/53 is the core document for DTV, describing the key system characteristics, including the following:

- Video encoder input scanning formats, and the pre-processing and compression parameters of the video encoder.
- Audio encoder input signal format, and the pre-processing and compression parameters of the audio encoder.
- Service multiplex and transport layer characteristics.
- VSB RF/transmission subsystem.

A/53 is modular in concept, with the specifications for each of the modules contained in separate annexes. However, it became evident some time ago that the introduction of system enhancements presented a document management challenge, in that, to modify one aspect of the DTV system required "revising" the entire standard. Following considerable discussion, it was decided that a different structure, where each technical module was contained in a standalone "Part" and then combined into an overall document set, would be preferable. This permits a modification in one Part to be made without impacting the entire standard.

Accordingly, an editorial restructuring of A/53E (the current version of the standard) was undertaken, resulting in division of the document into six parts:

- **Part 1** – System (formerly the body, plus the former Annex F)
- **Part 2** – RF/Transmission System Characteristics (formerly Annex D)
- **Part 3** – Service Multiplex and Transport Subsystem Characteristics (formerly Annex C)
- **Part 4** – MPEG-2 Video System Characteristics (formerly Annex A)
- **Part 5** – AC-3 Audio System Characteristics (formerly Annex B)
- **Part 6** – High-Efficiency Audio System Characteristics (formerly Annex G)

Additional Parts may be added in the future to define new enhancements to the DTV system.

Transport Stream Verification Standard

The ATSC has developed a Recommended Practice on DTV transport stream verification. A/78, "Transport Stream Verification," outlines a common methodology for describing transport stream conformance criteria for digital television. The document explicitly describes the elements and parameters of ATSC Standards A/53 and A/65 that should be verified in a transport stream, for it to be considered a proper emission. The document does not cover RF, captioning, or elementary streams.

While ATSC standards strictly define the contents and characteristics of the DTV emission transport stream, there may be a number of interactions and interrelationships among various components. Successful tuning and display of programs can be ensured if the transport stream adheres to the applicable specifications.

The A/78 Recommended Practice identifies transport stream issues by type, dividing errors into the following general categories:

- PSI errors
- PSIP errors
- Timing model and buffering errors
- Consistency errors
- General errors

Each error type is provided with a defined "error severity," as detailed below:

- **Transport Stream Off-Air:** The station is effectively off-air as the transport stream errors are severe enough that transport level logical constructs are damaged beyond utility. Receivers will not be able to tune and decode anything within the broadcast. The complete or repeated absence of sync bytes would be an example of this level of error.
- **Program Off-Air:** A main service (virtual channel) is flawed to the point that that service is effectively off-air for conformant/reasonable receiver designs. This could involve all of the program elements being improperly constructed or incorrect/missing signaling about elements. The absence of an entry in the Virtual Channel Table (VCT) for a service would be an example of this type of error.
- **Component Missing:** One of the program components that is signaled by PSIP or the Program Map Table (PMT) as present is either not present or cannot be found and decoded. One example would be a mismatch between the video

Program ID (PID) signaled in the Service Location Descriptor (SLD) and the actual PID used for the video elementary stream.

- **Quality of Service:** Parameters are out of specification by such a margin that a significant fraction of the receivers can be expected to produce flawed outputs. In many cases, the broadcast is viewable, but may exhibit some form of degradation to the viewer. An example might be the Master Guide Table (MGT) cycle time being somewhat larger than the specification, which would cause slower than normal channel-change tuning.
- **Technically Non-Conformant:** Violates the letter of the standard, but in practice will have little effect on the viewing experience. Errors of this type should be corrected, but do not have the urgency of higher severity errors. An example might be a single instance of a 152 ms MGT cycle time (with the remainder of the MGTs coming at less than 150 ms intervals).

A layered approach that indicates the severity of the error is important within the confines of real-world television station operation. For example, the threshold for an error set at strict adherence to the applicable rules—regardless of the ultimate impact at the consumer's receiver—could lead to such a high false alarm rate that the monitoring equipment would, after a time, tend to be ignored.

Following implementation experience with A/78, a revised version was developed and approved (A/78A).

ACAP Interactive Television

ATSC has launched an ambitious project to demonstrate the capabilities of the Advanced Common Application Platform (ACAP) for interactive television. ACAP is an ITV standard developed by the ATSC that is optimized for terrestrial broadcast and compatible with the cable industry Open Cable Application Platform (OCAP) specifications.

ACAP defines the technical details needed by content providers, broadcasters, cable and satellite operators, and consumer electronics manufacturers to develop interoperable services and products that provide consumers with advanced interactive services. ACAP is important because it provides a single method of delivering interactive applications to terrestrial receivers and cable set-top boxes (STBs).

Field Trial Project

In an effort to move ITV applications forward, the ATSC Planning Committee launched a major demonstration project of the ACAP ITV system, designed to illustrate how ACAP can be used to enhance the viewing experience. The project has been divided into two major elements:

- Phase 1 – a standalone demonstration of ACAP applications "broadcast" to and run on ACAP and OCAP receivers.
- Phase 2 – a field trial in select market(s) of ACAP applications broadcast over the air and distributed on cable systems to run on ACAP and OCAP receivers.

A developmental lab has been set up at NBC's 30 Rockefeller Center headquarters to facilitate development of ITV applications and to test the interoperability of ACAP- and OCAP-enabled set-top boxes. Seamless interoperability is critical for content producers, who need to know that their ITV applications will play as intended on television sets receiving signals over the air and from cable. Interoperability with satellite systems is being studied.

The overall goals of the field trial project are to:

Demonstrate the interoperability of ACAP and OCAP.

- Raise awareness for broadcasters of content and business opportunities.
- Raise awareness for content producers of interactive opportunities.
- Raise awareness for MSOs of possibility of carrying ACAP interactive content on cable systems using OCAP-enabled set-top boxes.

Phase 1 of the project has essentially been completed, with demonstrations at the following venues:

- 2007 Hollywood Post Alliance Technology Retreat in Palm Springs.
- DTV Hot Spot at NAB2007 in Las Vegas.
- The Cable Show '07 in Las Vegas.
- SCTE Cable-Tec Expo 2007 in Orlando.

Phase 2 of the project is expected to begin in the Fall.

Updating A/101

One side benefit of the ACAP project is that it has identified elements of the ACAP standard that may need to be refined to provide optimum end-to-end performance. The project team has found some subtle differences in the performance of certain ACAP and OCAP devices it tested. This is likely due in some part to implementation choices made by vendors and due to changes in the OCAP standard since the original harmonization effort with ATSC. The ATSC Specialist Group on ACAP (TSG/S2) is considering these issues and others, with the plan to produce an amendment to A/101 in the coming months.

New Standards Published

New ATSC Standards published during the reporting period of the past 12 months include the following:

- A/53, "ATSC Digital Television Standard, Parts 1 – 6, 2007," dated 3 January 2007 (as described previously).
- A/71, "ATSC Parameterized Services Standard," dated 26 March 2007. This supplementary standard defines a general-purpose method to enable announcement of the technical attributes of program elements that must be supported in a receiving device to render the programming on a particular virtual channel. It is not a replacement for fully-defined and optimized combinations of program elements defined for a particular service type, such as those established by A/53 and A/97.
- A/76A, "Programming Metadata Communication Protocol Standard, Revision A," dated 18 September 2006. Revision A adds support for the ACAP data broadcast services and changes to a modular design approach. It also includes one minor change in order to add optional support for multiple languages in the RRT.
- A/98, "System Renewability Message Transport," dated 3 January 2007. This document defines the method for transport of System Renewability Messages. A System Renewability Message (SRM) is a message issued by the administrator of a Content Protection System (CPS) that, when sent to devices that use that CPS, can revoke permission of certain devices or groups of devices to obtain content protected by that CPS. Different CPSs will each have their own SRMs to maintain the integrity of their systems; e.g., in the event that device keys are stolen and cloned.
- A/102, "ACAP Service Signaling and Announcement," dated 12 September 2006. This Standard augments the MPEG-2 transport signaling defined in A/101 (ACAP) by defining the required signaling for current services and the mechanism for announcement of future services.

Active Groups and Committees

Table 1 lists the current active specialist groups and committees within ATSC.

Group Number	Group Name	Chair
TSG	Technology and Standards Group	William Miller, ABC/SMPTE
TSG/S1	PSIP Metadata Communication	Art Allison, NAB
TSG/S2	Advanced Common Application Platform	Thomas Jung, Alticast
TSG/S3	Digital ENG	Dane Ericksen, Hammett & Edison
TSG/S4	ATSC M/H	Mark Aitken, Sinclair
TSG/S6	Video and Audio Coding	Pat Waddell, Harmonic
S6-3	TSG/S6 AHG on Loudness Issues	Jim Starzynski, NBC Universal
S6-4	TSG/S6 AHG on Lip Sync	John Henderson, Hitachi
TSG/S8	Data Multiplex/Transport	Mark Eyer, Sony
TSG/S9	RF Transmission	Charles Einolf, MSTV/CBS
S9-5	TSG/S9 AHG on Testing	Victor Tawil, MSTV
TSG/S10	Receivers	John Henderson, Hitachi
TSG/S13	Data Broadcasting	Mike Dolan, TBT
S13-1	TSG/S13 AHG on NRT Services	Rich Chernock, Triveni Digital
PC	Planning Committee	Graham Jones, NAB
PC-4	ATSC 2.0	Jeff Johnson, Gannett

Table 1. Active ATSC Specialist Groups and Committees.