

the standard

Synchronizing Multiple DTV Transmitters What it Does, and How!

The ATSC has approved a standard designed to facilitate the construction of unique transmission systems through the use of multiple transmitters in a single frequency network (SFN). A/110, “Synchronization Standard for Distributed Transmission,” received final approval in July, following a long period of development as a Candidate Standard.

A/110, prepared by the ATSC Specialist Group on RF Transmission (T3/S9), defines a standard for synchronization of multiple transmitters emitting 8-VSB signals in accordance with the ATSC DTV Standard (A/53C). It also provides for adjustment of transmitter timing and other characteristics through additional information carried within the specified packet structure.

In an SFN, transmitters emit identical signals, several of which may be received more or less simultaneously by individual receivers. The receivers must treat the multiple received signals as echoes of one another, extracting the data being transmitted despite the possible interference from alternate transmitters within the SFN.

It is important to note that, while distributed transmission (DTx) holds the potential to greatly improve the coverage and service areas of DTV transmission, it also holds the potential to cause interference within the network that some receivers — particularly early designs — may not be able to handle. Consequently, distributed transmission networks must be carefully designed to minimize the burden placed on the adaptive equalizers in such legacy receivers while maximizing the improvement in signals delivered to the public. The impact on any specific receiver will depend upon the receiver’s location, the use of directional receiving antennas, and other factors related to the design of the receiver.

Transmission Options

Several types of system architectures can be used for digital television transmission. The classic scheme is a tall tower with a high power transmitter to cover a large area. Another fundamental approach is the use of a multiplicity of smaller towers with lower power transmitters to cover smaller areas. This is the single frequency network. Although not technically the same as a cellular communications system for a variety of reasons, the areas covered by transmitters in such a system are nonetheless often called “cells.” SFNs can be designed using a few cells covering relatively large areas — the so-called “large cell” scheme — or they can be designed with many cells covering relatively small areas — the “small cell” scheme. Network designs may be optimized through one or more of the following:

- Placing areas of interference within the network in locales having low population
- Use of terrain shielding where available
- Use of directional transmitting antennas
- Adjustment of network emission timing

Distributed Transmission Concept

Distributed transmission, or transmitter diversity, is unlike any method used in broadcasting in the past. Previously, translators and boosters (on-channel translators) have been used to extend the service areas or fill in gaps in coverage of conventional, high power broadcast stations. Such techniques have been applied to both FM radio and television broadcasting. The power levels of the translators and boosters generally have been low, and the service they provide has been treated as secondary in class.

Distributed transmission (DTx) is intended to use a multiplicity of transmitters to cover a service area without necessarily requiring

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Transmitters

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the inclusion of a conventional, high power station, although one or more may be part of the network of transmitters. DTx allows the signal levels throughout a service area to be higher than they would be from a single transmitter, and it also permits better control of interference to neighboring stations.

Implicit in distributed transmission is the use of a separate distribution channel to feed each transmitter. This channel can be a conventional studio-to-transmitter link (STL) for distributed transmitters, or it can be a different broadcast channel from that on which the transmitters operate, in the case of distributed translators. This allows power levels sufficient for large cell designs that would be impossible with on-channel repeaters. The signals fed to the transmitters are the same digital signals normally carried on a digital STL with the addition of a small amount of extra synchronizing information.

The DTx system consists of three primary elements:

- A Distributed Transmission Adapter (DTxA) situated at the source end of the distribution (studio-to-transmitter link, STL) subsystem
- A slave synchronization subsystem included in each of the transmitters
- An external time and frequency reference, such as GPS

The DTxA creates a pair of synchronization signals that are multiplexed into the Transport Stream (TS) prior to distribution over the STL system. The signals produced by the Distributed Transmission Adapter are a Cadence Signal, which establishes the phase of the Data Frames relative to the TS packets, and a Distributed Transmission Packet (DTxP), which carries information for slaving the pre-coders and trellis coders in the transmitters, and carries command information specifying the necessary time offset for each transmitter.



Merrill Weiss led the development of the Synchronization Standard for Distributed Transmission

At the transmitters, a Slave Synchronizer is employed to capture the Cadence Signal and the Distributed Transmission Packet, to slave the Data Frame phasing to the Cadence Signal, and to slave the pre-coder and trellis encoder to the data in the Distributed Transmission Packet.

A common time and frequency reference (such as GPS) is required at several locations in the system. The time component of the external reference is used by the Distributed Transmission Adapter to produce the time-offset information to be sent to the Slave Synchronizers to adjust the emission times of their associated transmitters. The DTxA uses the frequency component to precisely maintain its output Transport Stream data rate to tight tolerances. The time component also is used by the Slave Synchronizers at the transmitters to adjust the emission times of the associated signals to the time offsets sent from the Distributed Transmission Adapter while the frequency component helps the transmitters maintain their frequencies to tight tolerances.

For Further Information

ATSC Standard A/110 can be downloaded from the ATSC Web site at no charge. This document includes several informative sections that explain the distributed transmission concept in general and synchronization methods in particular. In addition, a companion Recommended Practice on the design of synchronized multiple transmitter networks has been developed and is expected to be published soon. ■

ATSC Publishes Recommended Practice for DTV Receivers

A concerted, cross-industry effort has led to the publication by ATSC of a Recommended Practice on DTV receiver performance. A/74, “Recommended Practice: Receiver Performance Guidelines,” was developed by specialist group T3/S10 under the leadership of John Henderson of Hitachi.

The guidelines contained in the RP are the result of a collaborative effort of broadcasters, consumer electronics manufacturers, semiconductor manufacturers, and other ATSC Members. The successful completion of this work fulfills a commitment made to the FCC, which suggested that the industry develop voluntary DTV receiver performance guidelines.

The new Recommended Practice provides performance guidelines for receiver sensitivity, multiple signal overload, phase noise, selectivity, and multipath. The document suggests the use of the antenna control interface developed by the Consumer Electronics Association (CEA-909), which facilitates automatic control of antenna parameters. It also provides guidelines for implementation of received signal quality indicators for use by consumers. A/74 offers guidance for receiver manufacturers while allowing for product innovation.

A Recommended Practice is a document that typically provides guidelines for operation and performance. Development and adoption of a Recommended Practice follows the same consensus-driven development process and voting requirements for adoption as that of a Standard. ■

Enhanced VSB Approved for Expanded Flexibility

Broadcasters have a new tool in their tool chest, called Enhanced VSB (E-VSB). E-VSB is an optional mode of transmission that provides broadcasters with the ability to trade-off data rate for a lower carrier-to-noise threshold for selected services. Services transmitted in the E-VSB mode have additional forward error correction coding layers that allow reception under weaker signal conditions. Examples of potential applications for

E-VSB include delivery of “fall back” audio, programming services targeted at small DTV receivers with indoor antennas, non-real time transmissions of file-based information to handheld and pedestrian receivers, and robust data broadcasting to devices such as desktop and laptop computers. E-VSB is documented in a new amendment to the ATSC DTV Standard (A/53C). The ATSC has also published a number of related

Candidate Standards that support the E-VSB System. CS/T3-608 and CS/T3-609 provide transport specifications, and CS/T3-606 provides enhancements to the ATSC PSIP Standard (A/65). Enhancements to AC-3 audio (E-AC-3) are contained in documents CS/T3-613 and CS/T3-614. ATSC Standards and Candidate Standards are available at www.atsc.org/standards.html. ■

“I was delighted by the cooperative and enthusiastic spirit in which the hard work of creating this RP was undertaken by the members of T3/S10. The signal conditions described in the RP represent the collective judgment of experts from all relevant industries, and the document is an important technical contribution to knowledge useful for DTV receiver design. I urge that the RP be examined carefully by all manufacturers of ATSC receivers.”

— **John Henderson**
Hitachi

Interactive Television – Learn all about it!

Attention content creators, broadcasters, cable operators and consumer electronics manufacturers! Make plans now to attend the seminar on ATSC’s specifications for interactive television - “Advanced Common Application Platform” (ACAP) - on December 7th at the Radisson Barcelo Hotel in Washington, DC.

The seminar will cover procedural and declarative environments, common infrastructure, interaction channel, transport, security, and application development.

“Television enters a whole new realm with the roll-out of ACAP, and everyone in the industry involved in planning or implementing new technologies has something to gain from attending this seminar,” commented Mark Richer, ATSC president. “The seminar provides a wealth of practical information on this new, highly advanced technology that will ultimately revolutionize the way consumers utilize television.”

Register now for this valuable event at:
<http://www.atsc.org/seminars.html>. ■

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Changes in the ATSC Line-Up
Director of Operations Tara Healy has left the ATSC after 6 years of excellent service. Healy will be missed and remembered for her nimble wit, creative vocabulary, unfailing good nature and Zen-like calm.

ATSC welcomes Lisa Hester as the new Director of Communications. Hester will take on responsibility for future editions of The Standard, and brings her own style and color to the ATSC offices. She can be reached at lhester@atsc.org.

Digiknow?

Profile: Andy Bater, Tribune Broadcasting

"Ten years ago I would have never dreamed that I'd now be involved in crafting the future of digital television!" claims Tribune's Andy Bater. "I have found participating in ATSC to be an incredible learning experience. I hope that I have been able to give back a little too." And he has. Andy has been an enthusiastic participant in a variety of ATSC specialist and ad hoc groups, including serving as Vice Chair and Secretary of ATSC's T3/S10 Specialist Group on Receivers and functioning as a popular presenter at ATSC's technical seminars.

Andy has been with Tribune for over twenty years, but began in radio as chief engineer of WPIX-FM (later WQCD) in New York. There Andy was responsible for many industry firsts, including development of an experimental microwave system used by WQCD as well as other stations and networks to transmit digital audio back from remote locations. This system, mated to the station's multi-channel audio production truck for mixing live concerts, premiered providing audio backhaul for the 1991 worldwide radio broadcast of Paul Simon's Central Park concert. WQCD also obtained groundbreaking FCC waivers in order to relocate its transmitter back to the Empire State Building (ESB).

After Tribune sold WQCD in 1997 Andy moved over to television where as Director of RF Systems Engineering he manages the planning and installation of digital and analog transmitter systems for twenty-seven television stations. Andy also coordinated the transmission restoration efforts for the TV broadcasters displaced from the World Trade Center during the months following September 11. "Some of the files left over from when I was chairman of the ESB Master FM Broadcasters came in mighty handy!" says Andy. Of these post September 11 efforts, ATSC Board member Joseph Flaherty of CBS commends, "Andy Bater is an engineer's engineer – knowledgeable, practical, unflappable. He was on the restoration of the New York transmitters on 9/12 and has been a key member of the MTVA Engineering team ever since. In helping to manage the host of technical problems that still bedevil the project, his calm and deliberate approach has been an example to us all."

Andy chairs the Ad Hoc 2 GHz Reallocation Committee that provides strategic planning assistance to organizations such as MSTV, NAB and SBE for that band's impending change to digital operation. The committee's most recent efforts include development of a proposed transition plan and a nationwide equipment replacement cost census.

Bater attended SUNY at Buffalo and New York University, and is currently finishing Master Gardener certification from Rutgers. When not trolling the Internet and electronics retailers assessing the DTV transition, he tinkers with diesel vehicles and welding, "plays" the piano, gardens of course, and volunteers as a tour guide at the Frelinghuysen Arboretum. His wife (a portfolio manager) and daughter (a sophomore at William & Mary) both just wish he would finish a number of long running home improvement projects! ■



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The ATSC is an international, non-profit organization developing voluntary standards for digital television. The ATSC has member organizations representing the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

Revision of Conditional Access Standard Approved

The ATSC has approved a revision of document A/70, "Conditional Access System for Terrestrial Broadcast." The new specification, A/70A, is the first major update of the ATSC conditional access (CA) specification since originally approved in May 2000. A/70A is based, whenever possible, on existing open standards.

This standard makes no presumption of a business model. In fact, the likelihood is great that multiple business models will exist. The standard instead defines building blocks necessary to ensure interoperability; that is, any ATSC CA module can operate with any ATSC-compatible hosts

designed to support ATSC CA. As the ATSC CA module is replaceable, ATSC hosts are protected against obsolescence as security is upgraded.

The ATSC CA standard is designed for broadcasters of ATSC signals and services and ATSC receiver manufacturers for the purpose of allowing the broadcaster to field pay services using a conditional access system. A/70A applies to all CA vendors that supply CA service on behalf of an ATSC service provider. This standard is available at www.atsc.org/standards.html. ■

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News from ATSC Volume Five, Issue Three, September 2004

Mexico Adopts ATSC DTV Standard: ATSC – The Choice for North America

On July 2, 2004 the Government of Mexico announced that they had adopted the ATSC Digital Television (DTV) Standard for digital terrestrial television broadcasting. Leonardo Ramos, Televisa's Director of High Technology Projects commented, "With several experimental ATSC DTV stations successfully on the air in Mexico, we are pleased that the first official step into the DTV era in Mexico has been taken. We will work together with our fellow broadcasters as we transition all of North America into the digital age."

Echoing those sentiments, Michael McEwen, Secretary General of the North America Broadcasters Association said, "The industry is now set for an historic leap forward. With a North American market of well over 400 million consumers, consumer DTV equipment will have the advantage of the economies of scale of a huge mass market."

Adoption of the ATSC Standard is contained within a detailed policy document for DTV broadcasting issued by Mexico's Secretary of Communications and Transportation. The policy is based on recommendations developed by a government and industry consultative committee following an October 2003 directive from President Vicente Fox. The plan projects that by December 31, 2006, commercial DTV services will be in Mexico's three largest cities: Mexico City, Guadalajara and Monterrey, as well as in certain cities along the Mexico-US border. Mexico selected the ATSC DTV Standard based on a comprehensive review of competing standards.

"Mexico's adoption of the ATSC Standard significantly boosts the prospects for a common DTV standard

throughout the Americas," said Robert Graves, Chairman of the ATSC Forum. "A common standard throughout the hemisphere will mean more equipment from more suppliers at lower prices, accelerating the transition to DTV throughout the region."

The Inter-American Telecommunication Commission (CITEL) of the Organization of American States (OAS) adopted a resolution last October in which CITEL urged the OAS member states to implement digital television broadcasting as rapidly as local conditions permit, using a common standard throughout the hemisphere. Mexico's action to adopt the ATSC Standard and to begin implementing DTV services is expected to lead the way for other countries in Latin America to do the same. Argentina adopted the ATSC Standard in 1998, broadcasters in Chile have recommended it to their government, and a number of other countries in the region are considering the ATSC Standard for their transitions to digital broadcasting. ■