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Driving the MPH™ Mobile TV Standard

How Mobile Pedestrian Handheld (MPH™) Puts Local Broadcasters
in the Driver's Seat for In-Band Mobile DTV Service

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In this increasingly mobile media society, broadcasters want to send their over-the-air TV product to cell phones and portable devices to reach viewers on the go. And they're anxious to capitalize on that expanded market reach to generate new revenue by selling commercials, subscriptions, or even leasing out channels to other programmers.

At NAB 2007, broadcasters were looking for innovative business models to monetize the spare capacity in their DTV channels. While mobile TV was on their short list, they questioned which of the many competing solutions would give them mobile TV capability without jeopardizing the quality and reliability of their core broadcast business.

Of all the mobile TV solutions introduced at the show, only one complements a station's ATSC 8-VSB DTV operation without compromise –MPH™, which stands for Mobile, Pedestrian, Handheld™, a joint development by LG Electronics, Inc., Harris Corporation, and Zenith Electronics Corp., a subsidiary of LG Electronics, Inc.

An In-Band DTV Solution

The MPH In-Band Mobile DTV solution is designed to be implemented within the station's existing studio and -transmission infrastructure. It is fully ATSC compatible using the local station's assigned DTV channel. The MPH signal coexists—and is broadcast simultaneously—with the main ATSC program channels. MPH also supports additions to the ATSC standard, such as the A/110 distributed transmission standard thereby allowing broadcasters to add additional mobile coverage with low power on channel repeaters.

The MPH system has already been successfully tested using prototype equipment to deliver broadcast-quality video and stereo digital audio in four U.S. markets--including Columbus, OH; Las Vegas, NV; Manassas, VA; and Washington, DC—over the past several months.

We demonstrated great reception in vehicles traveling 75 mph on interstate highways as well as in difficult urban situations, like the Las Vegas strip. Laboratory test results verify the feasibility of reception in vehicles moving at more than 200 mph, which will be beneficial in future high-speed train applications.

End to End MPH Solution

In light of these successes, we anticipate delivering a reliable, end-to-end solution by mid 2008. LG will unveil prototypes of commercial MPH receiving equipment at CES, the

Consumer Electronics Show, in Las Vegas, NV, in January 2008. And we anticipate that there will be limited production versions of MPH receiving equipment by NAB 2008 enabling full commercial deployment of MPH technology by mid-2008.

Harris is now developing all of the components necessary for broadcasters to implement an MPH service. Our HAD5000 Series MPH product suite can be used with either a Harris-manufactured transmitter or one from a third-party manufacturer. The HAD5000 product series includes: the Harris MPH program encoder; the MPH-compliant transport multiplexer; and an MPH-ready ATSC exciter.

The LG- Zenith-Harris team is committed to licensing third party equipment and receiver manufacturers that will produce a variety of MPH-compliant receivers, including mobile phones, in-vehicle receiving systems, laptop computers, and PDAs. Also, LG Electronics will produce MPH receiving chips that will enable these OEM manufacturers to produce these products.

Broadcaster-Determined Parameters

MPH technology is designed to be scalable allowing a broadcaster to determine the number of channels that will be broadcast; the payload rate for each channel, which will vary with required video and audio quality needed for the program material; and the robustness required in a given market to overcome signal impairment.

Based on a station's main ATSC channel requirements and the intended mobile business model, broadcasters will determine what portion of their station's ATSC transport stream should be devoted to MPH, as well as what quality video and audio each of their mobile TV channels should offer.

The amount of bandwidth needed for MPH service is determined based on the number of mobile channels to be delivered; the robustness of each channel; and the audio/video payload assigned to each channel.

A broadcaster might wish to allocate less bandwidth to the MPH service during a major sporting event in order to allocate a high data rate to the HDTV service. Or the broadcaster could offer a dedicated mobile traffic channel during rush hour but devote that bandwidth to other channels at other times. The MPH system is completely scalable, and broadcasters can dynamically expand the quality of the mobile TV channels, or add additional channels as the market grows.

We know that broadcasters are sensitive to giving up ATSC payload. However, in our demonstration, which combines two MPH channels totaling 4.4 Mbps, the remaining 15 Mbps is sufficient for one HDTV channel when using the latest MPEG-2 encoders.

MPH Channel Coding

MPH uses H.264 Basic Profile to provide QVGA resolution at up to 30 fps, with coded video rates between 300 and 600 Kbps. The system will also include a scalable audio codec that will support audio systems from mono through 5.1 surround sound. The audio

coding system will be highly efficient, utilizing no more than 24 Kbps to support full 5.1 channel surround service.

The MPH mobile stream is multiplexed into the main ATSC transport stream. Each of the MPH packets contains headers which identify them as MPH information. The resulting stream is fully compatible with current ATSC 19.39 Mbps studio to transmitter links.

Inside the MPH enabled ATSC exciter, the ATSC and MPH packets are demultiplexed and sent through different channels of pre-processing before being recombined, post processed and sent to the 8-VSB modulator.

The ATSC packets are multiplexed with the MPH packets after the MPH packets have been preprocessed. The MPH preprocessing begins with frame encoding where the MPH data is randomized; Reed Solomon coding is applied along with CRC coding; and then the data is split into groups.

The groups are then block processed where outer encoding and interleaving of Serial Concatenated Convolutional Code is applied. The groups are then formatted by placing the payload data, training signals, trellis reset bytes, and signaling bytes in the correct location. The final preprocessing step is to encapsulate the MPH data into NULL packets.

After the processed MPH packets are multiplexed back with the ATSC packets, they are post-processed before modulation. This processing consists of generating 8-VSB byte randomizing sequences and adding Reed Solomon code to the main ATSC data. The data is then interleaved and Trellis coded followed by the generation of correct Reed Solomon parity.

The data then goes on to a conventional 8-VSB modulator and flows through the rest of the RF chain. No modulation changes are made to the system—hence the emission mask, peak to average ratios, and other signal characteristics are the same as a normal ATSC signal.

The additional processing and coding of the MPH data requires overhead so that the ratio of payload versus the amount of transport consumed is approximately a ratio of 1:4. For every bit of payload, there are four bits of transport that have to be given up to signal processing overhead. Work is currently underway to increase the system efficiency and lessen this ratio.

We've been demonstrating the MPH system configured with two channels of video and audio; with one channel coded at "half-rate" and the other channel coded at "quarter rate—with each channel taking up 2.2 Mbps of transport for a total of 4.4 Mbps.
In our testing in Columbus, Las Vegas, Manassas, and Washington, DC, we found great reception of our MPH channels regardless of whether they were encoded at half or quarter-rate.

But in extremely bad reception situations, such as the tunnel under the Las Vegas Convention Center, the quarter rate coding held up better than the half-rate coding because it is more robust.

MPH Signal Coverage

While normal ATSC coverage assumes that the receive antenna is 30 feet off the ground, in a mobile environment, the typical receive antenna is about 45 inches off the ground. In our test runs, we found that the radio horizon is typically between 30 and 40 miles depending on tower height and terrain.

Service coverage can be expanded through the use of distributed transmission—Single Frequency Networks (SFNs)—using the ATSC A/110 synchronization methodology. Synchronization is the key to SFNs that enables multiple transmitters in a large, market wide transmission network to operate effectively on the same RF channel.

Using an SFN configuration, a broadcaster could choose to place on-channel repeaters or additional transmitters around the coverage area to augment the signal to fill in gaps in the coverage area. However, the combination of highly effective training signals, long interleaving, and improved S/N threshold provide for effective service without the use of diversity reception.

Business Models for Mobile TV

Unlike many mobile TV solutions on the market, the Harris MPH In-Band Mobile DTV solution enables local broadcasters to implement and control every aspect of a mobile TV operation. It does not require the involvement of a cell phone carrier or negotiating for carriage on any mobile television network service. It doesn't require additional DTV licensing or spectrum pooling arrangements.

With respect to the programming, the broadcaster can offer a simulcast of the station's primary HDTV or SDTV; or create a brand new channel tailored to the needs of the mobile public, such as a local news-traffic-weather channel.

MPH supports subscription and conditional access business models. To facilitate this, conditional access technology is being included in the MPH standard to enable broadcasters to manage the subscription-based model.

Some broadcasters might implement totally free-to-air MPH systems that rely upon advertising or contributors for support. At least one company has announced technology to include mobile systems like MPH in its audience measurement ratings system. This ratings information will make it easier for advertisers to judge the value of advertising on MPH mobile services. It's also possible to offer a combination of commercial and subscription models.

Since the MPH In-Band Mobile DTV solution is designed as an end-to-end transmission system—from encoding and transmission to reception on a wide range of compact, mobile receivers—broadcasters can decide when and how to launch a mobile service.

And they can generate new revenue streams from ads and subscriptions that contribute to a faster ROI and profitability. MPH In-Band Mobile DTV technology puts local broadcasters on the road to offering their own In-Band Mobile DTV service.

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