The

Broadcasters' Desktop Resource

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Broadcast Operations

Modulation Monitors Aid Diversity Delay

By Mark Grant

[May 2016] This is the third in a series of articles that help show what we can learn from modulation monitors and how to use that information to ensure stations' signals are as good as possible.

The last part of our series deal with the role of modulation monitoring in what is perhaps today's hottest HD Radio topic: Diversity Delay.

The roughly eight-second delay between the analog and digital signal has long been a thorn in the side of engineers. As the digital signal strength fades in weak reception areas – usually on the outer market edges, inside tunnels, buildings, and congested metro areas – that signal then blends with the analog FM program.

New innovations driven by modulation monitor manufacturers have started to address these challenges.

Some tackle the problem directly inside the modulation monitor; Belar takes the approach of communicating changes to other key components in the air chain, where continuous corrections take place.

MOD MONITOR DIVERSITY DELAY

Whichever approach an engineer favors, we have reached a point where broadcasters have several options.

It is now possible to effectively attack the main challenge of delay elimination – while taking advantage of other innovations that further automate and streamline measurements and applications.

The road to bringing effective diversity delay solutions to market was slow, with gradual improvements over several years that finally took shape at the 2015 NAB Show. Manual corrections reigned supreme until this point, but the days of using headphones to compare analog in the left ear versus digital in the right; or retaining a special radio to listen to and align the signals, have now passed.

And the timing could not be better, as automakers continue to roll out HD radio as standard equipment in more models every year. In this mobile environment, maintaining an accurate diversity delay has to become a necessity.

OPTIONS APLENTY

Whether corrections are made within the modulation monitor or elsewhere in the air chain, the modulation monitor must be in communication with one of three components to achieve proper time alignment between the digital and analog program.

The first option is to use a separate delay line from a company like 25-Seven. This was an early innovation, before manufacturers started integrating delay lines into standard HD Radio air chain components, including the audio processors.

These delay lines are interesting in of themselves as they excel in delay adjustment through compression and time-shifting. That allows the broadcaster to speed up the program without changing the pitch. Since there is no noticeable difference to listeners, broadcasters can actually squeeze a few more ad spots into each program hour.

Separate delay lines remain the most sophisticated algorithm due to its sample-accurate time adjustments in fractions of a second and it remains a viable option for broadcasters with older HD Radio architectures. Exporters and precision delay devices incorporate a ramping function to support this but, in processors, the time adjustments are often jarring for the listener.

USING AUDIO PROCESSORS TO DELAY

Companies like Omnia, Orban, and Wheatstone have begun to build delay lines into their on-air processors.

That built-in capability enables a direct connection to a modulation monitor. In the case of Belar, our Automatic Delay Correction (ADC) soft-ware connects to the processor through a network interface. Analog and digital time alignment is continuously measured, with corrections fed through that interface via a closed-loop procedure.

Broadcasters running HD Radio can also leverage an exporter for time alignment. Companies like GatesAir and Nautel offer a built-in control protocol to communicate between the modulation monitor and exporter, thus continuously monitoring and correcting delays.

AN IMPROVED WAY

Additionally, broadcasters applying corrections through a processor can now achieve a smoother transition between analog and digital signals.

New enhancements in diversity delay software support a gradual ramping feature that delivers a smoother transition similar to the algorithm used in exporters and separate precision delays.

Tracking the delay error requires the calculation of a correlation function using samples from the digital and analog audio streams. The computation time of this function is dependent on the width of the time window being analyzed. At Belar, we use a variable-length time window, allowing us to tailor the length of the correlation to the actual delay error.

The algorithm tracks the delay, automatically adjusting the correction window size if the delay creeps out of range, then contracts the window as the delay is pulled into alignment.

The advantage of this approach is a faster acquisition of delay corrections, which results in a tighter overall alignment of the analog and digital audio streams. This makes the adjustments nearly imperceptible to the listener, eliminating any obvious time jump.

ALTERNATIVE CONCEPTS

While these three options are viable today, we see other opportunities to extend communication from the mod monitor to other air chain components – notably the transmitter.

Our expectation is that this will be among the next developments in expanding the Diversity Delay architecture.

The integration of a scan function to correct up to six preset stations in a market is another interesting development in the past several months. This supports automatic cycling through the presets, and establishes unique IP connections to each station's delay device. The appropriate time-alignment corrections are executed once the connection is made.

This provides a benefit today for stations that are monitoring multiple stations on different frequencies, and one that Belar FMHD-1 users are successfully accomplishing in the field.

Hubbard Broadcasting is one such station, using the FMHD-1 with built-in ADC software to scan two stations, KMQV(FM) & KRWM(FM), using two separate inputs to service two different RF feeds, frequencies, and delay devices.

SINGLE FREQUENCY NETWORKS

The greater emergence of single-frequency networks has added a new wrinkle to the fold.

These networks are becoming more common as a means to enhance coverage in challenging locations, such as mountainous terrains and congested metropolitan areas. To achieve greater coverage, the radio broadcaster operating an SFN adds strategically positioned boosters and repeaters – typically lower power – to strengthen coverage, locking the transmitters together over a single frequency.

This is similar to how a cellular phone network works.

OVERCOMING THE CHALLENGE

The challenge: How does the broadcaster keep costs low, and processes manageable, when delivering HD Radio over such a complex network?

The traditional model of a standalone transmitter with an exporter and processor for each location quickly adds up in an SFN configuration. Instead, engineers are architecting these networks to support multiple transmitter sites from a single exporter, with signals fed over multipoint IP networks.

As more networks like this are deployed, the need to develop a diversity delay within the transmitter grows in importance. Since there is no need to duplicate each transmitter site with dedicated exporters and/or expensive standalone processors – enabling corrections inside the transmitter represents one viable solution.

The multi-scan function previously mentioned could be applied in this scenario allowing one monitor to provide alignment corrections for a group of transmitters.

THE SOFTWARE ADVANTAGES

Perhaps the greatest benefit of a software-defined system is the ability to continuously tweak and improve the platform without significant technical overhaul. Over time, this reduces the cost burden to broadcasters.

In addition to these continuous improvements, it also means the ability to do more within a single box, reducing the number of components – and associated costs and complexity – in the air chain.

One thing is certain: As the need for better diversity delay solutions grows, the technology to support this need will continue to evolve and mature through more software-defined innovations.

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