ACI Solution to FM/HD Time Alignment

A built-in feature of Wheatstone processors can bring FM/HD diversity into perfect sync.

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When the FCC authorized IBOC HD technology for FM in October 2002, most of us in the industry had little knowledge of how complex the HD system was; it has only become more complicated over the years as new features and capabilities have been added.

IBOC experienced growing pains in its early days, as do most technologies. I recall many colleagues mentioning that their HD gear had "locked up again." Usually only a reboot of the HD hardware was needed. As there were few HD listeners then, most stations weren't terribly concerned that their HD signal was off the air again. What they were concerned about was the HD hardware *also* taking the FM analog signal off the air – the signal that was paying the bills! (It had probably funded the HD installation, too.)

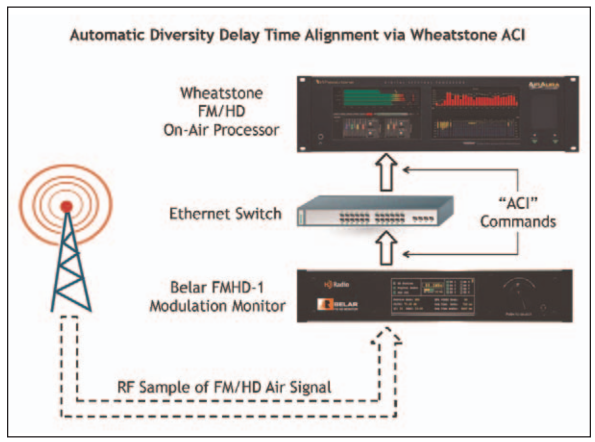
If you're unfamiliar with early HD hardware, you're wondering why a station's FM analog signal would go off the air when the HD encoder died. It's because one of the functions the encoder provided was diversity delay to time-align the analog and HD signals. Since the analog audio had to pass *through the HD gear*, when the HD hardware went down, so did the analog signal.

It was probably out of sheer frustration that station engineers began calling the manufacturers of other gear in their air chains, asking if a diversity delay could somehow be added. One obvious candidate was the station's on-air processor. Thus was born a new processing feature! Once FM on-air processors gained the ability to handle diversity delay, stations began to rearrange their air chains to separate the FM and HD audio as close as possible to the program source. This allowed the HD system's hardware to misbehave without affecting the FM analog signal.

Some stations that split their air chains happily discovered that even though their FM and HD systems didn't share a common synchronizing clock such as GPS, when using the diversity delay built into the on-air processor, FM/HD time alignment remained virtually perfect. Unfortunately, other stations weren't so lucky; those ended up needing to make frequent adjustments to keep their FM and HD audio in reasonable sync.

Even today, some of those stations are still making manual diversity delay corrections to keep their FM and HD in sync. But they don't need to! Recent advances in FM modulation monitor technology have made it possible to eliminate diversity delay drift and maintain virtually perfect audio synchronization (plus or minus one digital sample, or about 20 microseconds). Legendary manufacturer Belar Electronics offers a software upgrade for their FMHD-1 modulation monitor that adds the ability to continuously measure time offset errors using an RF sample. It then calculates the correction required to bring the timing error to zero.

Wheatstone and Belar joined forces during the summer of 2014 on an exciting HD time alignment project. The goal was to merge Belar's new error measurement technology with the ACI (Automation Control Interface) protocol common to all Wheatstone on-air processors. Belar's addition of ACI allowed the FMHD-1 to send real-time diversity delay corrections to the processor over an Ethernet network.



Wheatstone's ACI is a secure, proprietary TCP/IP-based network protocol designed for communication, monitoring, and control. For nearly fifteen years, ACI has found utility for interfacing not only Wheatstone products, but also other broadcast equipment: audio processors, consoles and surfaces, automation systems, and audio routers. The list of ACI-equipped Wheatstone products is long; if it's a Wheatstone product and it connects to a network, chances are it also has ACI built in.

It wasn't very long after the press release announcing the Wheatstone/Belar project that calls began coming in, asking what our ACI protocol actually was and what it could do. Although various automation and playout vendors had been using it for years, now there appeared to be real interest in learning what its other capabilities were. The fun had just begun! To try to answer these questions, I'll make some very general comparisons between the "tweaking" capabilities of analog and digital on-air processors – my focus here at Wheatstone.

Historically, an analog audio processor's controls were physical, mounted on the front panel. Both its location on the panel, as well as its silkscreened label, identified each control for the convenience of the user. Physical controls also had fixed physical limits, beyond which they couldn't be turned. Unless you were handy with a soldering iron, understood audio processing circuitry, and knew how to change component values, a control's physical limits kept its effect on the processing within the range the designer intended. Adjusting a control on an analog processor was easy – if you were in the same room. You walked up to the unit, grabbed the knob, and just turned it.

The controls for today's digital processors are very different. Most controls are virtual, having no physical knob. Each is assigned a unique digital identity and adjustment range by the designer. These reside in the processor's software engine, and in many cases can be easily changed without even plugging in a soldering iron (no more burned fingers!).

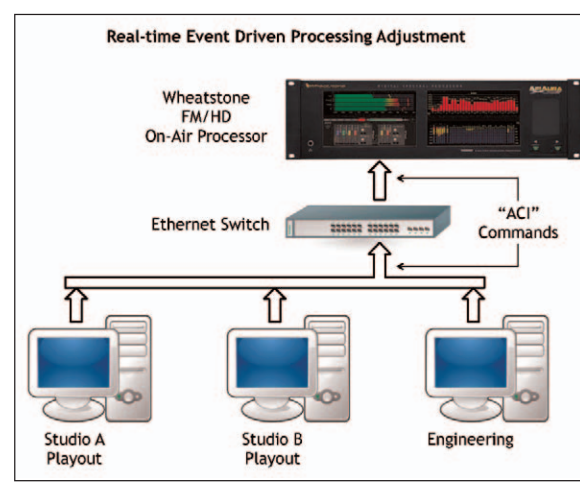
What is also different about a digital processor is that user controls and their settings can be reached from a distance, whether it's inches of cable between the software engine and the processor's front panel, or thousands of miles between the processor and a PC running its Graphical User Interface (GUI) software. Using a software-based GUI or Wheatstone's ACI protocol, anything that has a "knob" or a "button" or a "value," can not only be changed from a distance, but also inspected. This underlines another difference between analog and digital processors, and it's not minor: to see where a particular knob is set on an analog processor you have to physically walk up and take a look at it!

Wheatstone's ACI protocol provides easy and secure access to the "guts" of our on-air processors – one processor, or racks full of them. Interested in checking a setting on a processor? Use the ACI to ask that knob on that processor where it is currently set, without disturbing the setting. Much of the functionality available in the ACI protocol for monitoring and control is available without aid of the software GUI.

What else can be done with ACI and Wheatstone's on-air processors? For starters, you can ask the processor what its current preset is. Or, you could ask it for its operating temperature. Maybe you only need to know which optional features are enabled. Maybe you need to know which audio input is active and whether audio is present on the backup input. You can even ask the processor which processing sections are turned on.

While it's certainly cool to be able to ask your on-air processor questions and get instant answers, what if you're just not in an asking mood right now? Suppose you're in a telling mood? What then? This is where things get *really* cool!

I mentioned earlier that every one of our on-air processors' settings has an assigned identity stored within its software engine. That's really not very different from how other digital processors on the market work. But on our processors, every one of those settings can also be controlled via our ACI protocol!



One of our customers uses a virtual GPI signal (SLIO, or Software Logic I/O) from his Wheatnet-IP audio routing system to change inputs on his AirAura X3 processor. If he wanted or needed to, he could do even cooler things like reducing the AGC's band 3 threshold by 1.62 dB while an SLIO signal goes logical high and then setting it back to its original value when the SLIO goes logical low. ACI makes all such things "easy peasy."

We recognize that a few other manufacturers are offering alternative solutions to the diversity delay drift problem. More than one of those is a standalone hardware box which must be installed in the air chain to measure and make delay corrections. Wheatstone believes it has a better solution than adding another potential point of failure in the air chain: a network-centric solution that, throughout our ten years in on-air processing, has been a built-in feature of every single Wheatstone on-air processor from the beginning. *– Radio Guide –*