

R&S®THR9 WITH HD SYNC

White paper | Version 01.00 | Maurice Uhlmann

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GENERAL

The HD Radio™ standard, formerly known as IBOC (In-Band-On-Channel), allows the simultaneous transmission of the same radio program over an analog and digital transmission path in a hybrid mode. The hybrid signal contains the normal FM carrier and digital subcarriers. Standard FM receivers can still receive the analog program, while compatible HD Radio™ receivers may receive either the analog or the high quality digital program. Modern HD Radio™ receivers also have the ability to blend between analog and digital signal, depending on the reception situation. Especially in vehicles, the digital signal strength varies over the distance travelled. This can cause the receiver to switch repeatedly between the digital and analog signal. To enable a smooth blending, which is not noticeable for the listener, it is essential that signals are exactly time-aligned. The related specification NRSC-5-C requires for this reason an accuracy better than ± 3 samples (68 μ s).

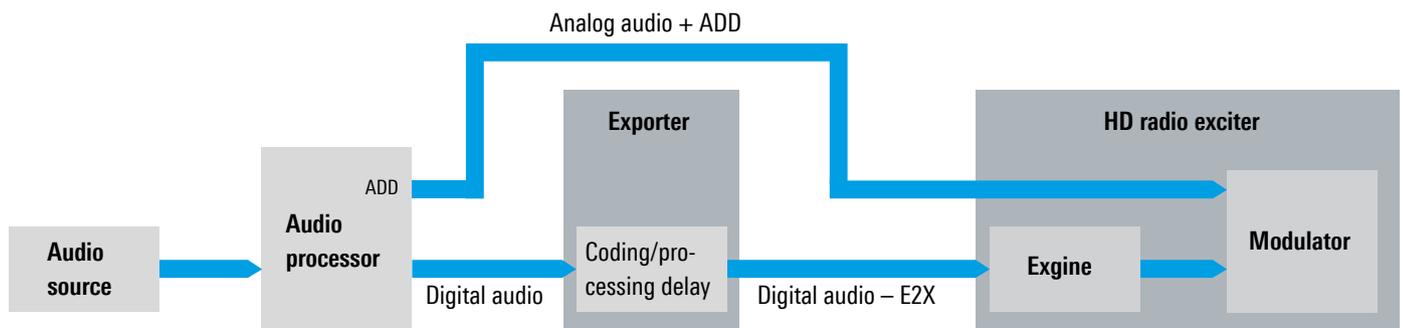
This paper discusses different approaches of synchronizing digital and analog signal to ensure a great listener experience by enabling a seamless change between digital and analog signal. The new HD SYNC feature of the R&S®HDR900 exporter enables a permanent measurement and an automatic time-alignment of the analog and digital signal. Additional monitoring receivers are no longer required.

ANALOG DIVERSITY DELAY

In HD Radio™ hybrid mode the analog and a digital signal (HD1) carry the same audio content (Fig.1). Usually the audio signal for the analog and digital HD1 originates from the same source. It is routed to an audio processor and then further to the exporter, where the digital part is encoded and processed. This encoding and processing causes a delay of a few (7 to 10) seconds, before the signal is routed as an E2X stream via the Engine to the HD Radio™ exciter.

The exciter also receives the analog audio, which is transferred nearly instantaneously. To get the analog audio synchronized with the digital signal at the moment of transmission (at the antenna), it has to be delayed by exactly the value of coding-/processing delay. This delay (analog diversity delay – ADD) is usually included in the audio processing unit. For accurate alignment, a HD Radio™ monitoring receiver is required which is suitable for diversity delay measurements.

Fig.1: Analog diversity delay adjusted in audio processor



HD SYNC – AUTOMATIC ANALOG DIVERSITY DELAY ALIGNMENT

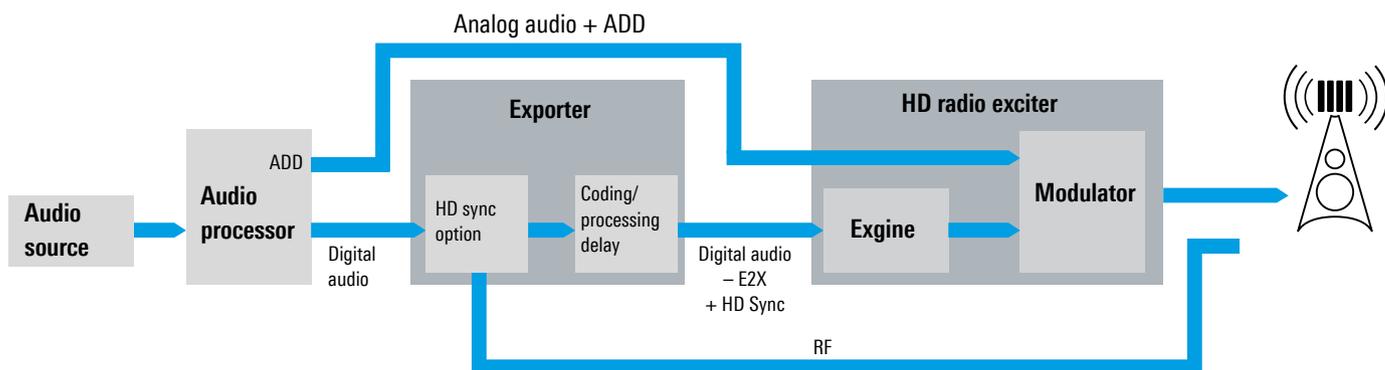
The timing relation between analog and digital part of the hybrid HD Radio™ is not stable. Signals are transported between the studio and transmitter site via studio-transmitter-links (STL), very often on different paths. Older audio connections via RF microwave links are more and more replaced by modern IP links, audio is transported with modern audio over IP (AoIP) mechanisms via IP networks to the transmitter site. This brings new challenges like jitter or path delay changes due to IP routing. To summarize this, a once set delay does not remain constant. It is therefore essential to permanently monitor and – if necessary – to automatically compensate the delay. In the past this was mainly achieved with monitoring receivers, which could measure the diversity delay and send correction information to the unit, in which the analog diversity delay was adjusted (audio processor or exporter). Nevertheless, not all receivers were compatible with all types of audio processors or exporters. Lately, modern HD monitors are able to align directly the delay. They are installed in either the analog or digital audio path and the detected delay difference is added directly to the related path.

With the new HD SYNC feature in the R&S®HDR900 exporter it is possible – without any additional equipment – to keep both the analog and digital proportion synchronized. A built-in receiver is connected to the RF output of the HD Radio™ transmitter, or alternatively to an antenna. It measures the current delay OFF AIR between analog and digital signal proportion and eliminates a too high delay difference. The highly sophisticated correlation algorithm allows an extreme accuracy according to the specification NRSC-5-C. Broadcasters can choose, if they want to use the HD SYNC feature in the analog or in the digital signal path by simply changing a configuration parameter.

HD SYNC IN THE DIGITAL PATH

Fig.2 shows the system diagram for performing the automatic analog diversity delay alignment in the digital path. In this case, the analog path is pre-adjusted with a fixed delay, e.g. 9 s in the audio processor. The correlation algorithm has to correct only the difference between the pre-adjusted delay in the analog path and the coding/processing delay in the exporter. This method is considered the most common way, as the analog path remains “untouched” by any correlation algorithm. Besides this, it is possible to feed the analog audio on a completely separate path to the transmitter site. This setup meets best the requirement for redundancy (analog program always ON AIR). Any failure in the exporter will not affect the analog transmission.

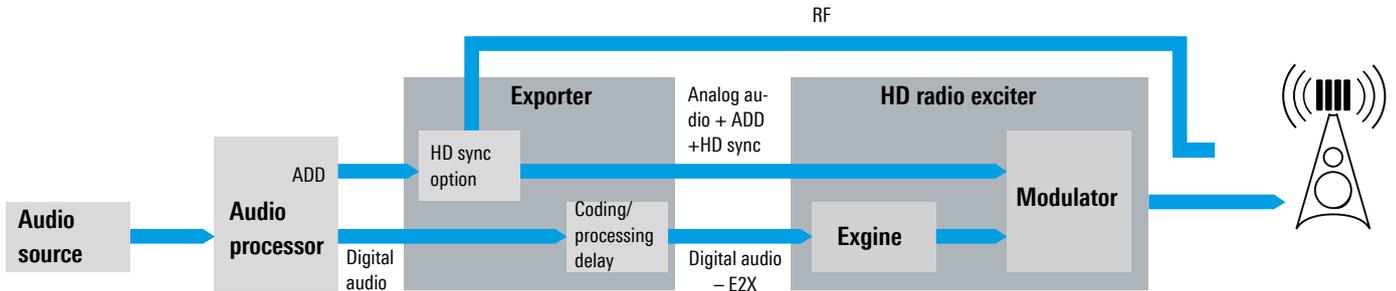
Fig.2: HD Sync alignment in the digital path



HD SYNC IN THE ANALOG PATH

Due to limitations in the existing infrastructure, it can be required to do the time alignment in the analog path. The HD SYNC option supports this option as well (see Fig.3).

Fig.3: HD Sync alignment in the analog path



In this setup, the delayed analog audio from the audio processor feeds into the exporter, along with the non-delayed digital audio stream. The HD SYNC option determines the current system delay and holds the analog signal back for perfect synchronization. The routing of both the analog and digital signal through the exporter has an undesirable side effect – it creates a single point of failure. In the rare event of a failing exporter, the transmitter loses the digital and analog signal and will consequently be OFF AIR. This is why it is recommended to implement an automatic bypass for the analog signal path around the exporter.

SUMMARY

The new HD SYNC option for the R&S®HDR900 exporter allows broadcasters to keep their hybrid HD Radio™ signal synchronized in a very efficient way. Simply connect the built-in receiver with an antenna or with the RF probe at your transmitter output and tune it to your radio frequency. The measurement and delay correction is performed automatically in the shortest possible time without compromising the listening experience. Regardless, if there is only a small drift in the path delay of one of the signal proportions, or even a sudden change in delay, e.g. after a reboot or exporter reconfigurations. The built-in web interface allows a quick setup, a detailed status overview and a comfortable logging function. Various alarms can be defined with different priority levels (warning/fault/info). Each alarm can be independently delayed with an adjustable guard and recovery time. The unit can be completely operated via SNMP and is fully compatible with other HD Radio™ excitors.

By configuring the R&S®HDR900 as exporter and importer, a complete all-in-one-box solution is provided to multiplex up to four HD programs including data services, artist experience etc. into a digital stream to the HD Radio™ transmitter and in which the new HD SYNC option completes the package.

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