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What's new about HD radio?

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HD radio advertising in the United States is touting the "new" channels that previously "hid" between the regular old analog channels to generate interest in this supposedly new technology. From an engineering perspective, what is new about HD radio?

There are indeed new channels, but they are not exactly "hidden" between the old channels. They are located in the outer upper and lower sidebands of the old channels. They appear "hidden" because they are unintelligible to old receivers since their modulation and data come in digital format, requiring a special decoder only available in new receivers. Unlike the single format set-top decoders and receivers introduced with UHF television, these new receivers for home and automobile seamlessly switch back and forth from the plain old analog to the amazing new digital formats.

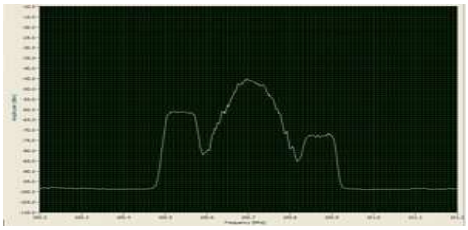
What many people do not realize about today's main channel digital HD radio is that the great new programming they hear is actually a copy of the primary analog channel, while the HD-2 and HD-3 programs embedded in the bit-stream are the new and previously "hidden" channels of programming. For now, this means some sacrifices. Today, many stations are running only one HD channel, since governing authorities still require that the analog channel broadcast remain intact. This single digital stream is of a very high quality. When stations add the HD-2 and HD-3 streams, the quality of all three degrades as they are forced to share a limited amount of bandwidth. When the analog channel requirement ends and stations are free to broadcast exclusively in digital, the HD promise will be fulfilled.

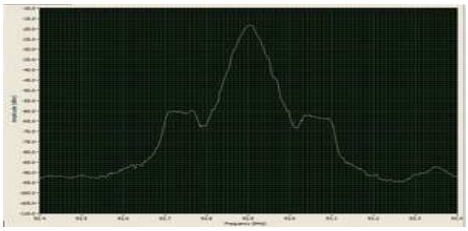
My experiences as a contractor tell me the primary engineering problems are cost, cooling and space. The programming department and the sales department each focus on different problems, but the engineers of the planet care about the first three. In addition, this new digital stream adds additional transmitter power to a transmission system whose line and antenna are unaccustomed to the extra load. As a result, engineers must first determine the health and tuning of the antenna system before attempting installation of an HD system - unless you want to risk blowing up a perfectly good new transmitter when the line fails. If your line or

the antenna is degraded, chances are that your new HD investment will not make many people happy and will be difficult to receive at any distance from the antenna site.
In installing various HD systems, I have seen a roughly 50 percent failure rate in the tuning and Voltage Standing Wave Ratio (VSWR) of the antenna systems. Quality consciousness is key when installing these systems. Line and cable cutting must be done with precision and skill. Connections and fittings must be installed and cleaned correctly. All too often installation techniques are inadequate, and the ultimate product - digital radio - suffers. Unfortunately, problems due to improper assembly techniques are most noticeable just before the new components catch fire.

Common Myths

In the good old analog days people believed that high-quality broadcast transmission required a very good VSWR for audiences to receive the signal properly. This is absolutely true. With digital broadcasting, people believe that the VSWR does not need to be as good as in the analog days. This is absolutely false. The VSWR must be as good as or better than a quality analog FM installation. A VSWR of 1:1.1 is considered an achievable figure of merit. Numbers that approach 1:1.05 are even better, giving depth and symmetry to plus and minus 200 kHz or more. The trouble comes when people assume that digital formats' error correction schemes allow the receiver to 'figure out' any antenna problems. This is not true.





Propagation

Propagation is a 'real world' problem that is exacerbated by terrain and foliage, as well as poor quality line and antenna systems. Numerous field tests have shown that propagation plays a significant role in determining the quality of the recovered HD signal. Figures 1 and 2 show the effects of propagation only a few miles from the transmitter site. They demonstrate how a quality signal and properly tuned antenna affect transmission quality in cases where terrain and foliage almost destroy the recovered signal. Note the lack of symmetry and linearity.

High Power

Today's technology has allowed transmitter manufacturers to develop high-power systems that can eliminate the need for an extra transmitter in an HD installation. The original systems required that a second transmitter be added to the plant, adding additional analog power and placing the digital stream in the system. Such installations were very expensive and created a tremendous additional heat load for the plant. Today, high-power tube transmitters have been modified from class C type power amplification to class AB's more linear amplification. While this switch decreases efficiency, it preserves the required linearity for the HD signal. These transmitters are available in analog power classes to 40 kW in single tube chassis; combined units are also available. The standard air cooled transmitter is being replaced by water-cooled electrodes like the 4CX30,000 water-cooled tube in figure 3.
While HD is still a new technology in the process of being adopted in differing formats and technologies around the world, the fact that it is still radio frequency

(RF) based puts us all on common ground. We still need transmitters and we still need antennas.
Finding the right people to work on these systems is the real issue: They need engineers, not information technology (IT) people. The new transmitters may look a lot like computers but the high voltages and RF through which they operate are nothing like local area network (LAN) cables. As an industry, we need to focus on promoting new young RF engineers and paying them properly or the transmitter engineer will become a thing of the past.

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