

DIGITAL RADIO

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What is Digital Radio?

- Two kinds: Adjacent and separate channel
- Many standards
 - + IBOC (AM and FM)
 - + FMeXtra (FM)
 - + DRM (AM, shortwave, work on FM in progress)
 - + Eureka 147 (Upper VHF)
- Digital makes more efficient use of spectrum

FM IBOC (FM HD Radio)

- Radio companies wanted to go digital
- Didn't want separate channels
 - + Too expensive
 - + Would be too open to new competition
- IBOC uses sidebands adjacent to main carrier
- A/D "Hybrid" mode allows 96kbps
- "Expanded Hybrid" mode allows ~150kbps
- Digital-only allows 300kbps, 25kbps "fallback"
- Multicasting is an option at expense of audio quality
 - + WVTU/WVTW offer "Radio IQ" on IBOC
- iBiquity requires large royalties

AM IBOC (AM HD Radio)

- AM stations wanted to go digital as well
- iBiquity attempted to adapt IBOC to work on AM
- Sidebands 15 kHz wide on both sides of carrier
- Daytime only until recent FCC rules change
- Like FM IBOC, requires large royalties
- Stations suffer self-interference
- Night time operation trashes band
- WABC, WJR among others have ceased IBOC

FMeXtra

- Royalty free, inexpensive digital for FM
 - + Not available for AM use
- Operates similar to FM Stereo
- Requires FM mono carrier to operate
 - + Peacefully co-exists with existing stereo
 - + More capacity if stereo is removed
- Uses newer compression than IBOC
- Can be decoded anywhere FM Stereo is available

European Standards

- DRM

- + Digital standard for frequencies below 30 MHz
- + Requires whole channels, not sidebands
- + Designed to combat fading, variable ECC
- + Not approved for use in Western Hemisphere
- + DRM+ for FM is in progress, may offer video

- Eureka 147 (DAB)

- + Digital standard using upper VHF (TV 7-13)
- + Available across Europe
- + Criticized for poor coverage
- + DAB+ to use better compression, ECC

FM IBOC Issues

- Coverage is very poor
 - + IBOC signal drops out long before stereo
- Sidebands operate at -20 dB relative to analog
- Proposal to increase to -10 dB
- NPR, LPFM operators oppose increase
- Such power increases would be very expensive

- Audio quality is not "CD quality"
- Usually a result of multicasting
- Expanded Hybrid or Digital-only modes
 - + FCC does not currently allow Digital-only

How Does IBOC Work?

- The FM IBOC signal is a digital signal using OFDM (Orthogonal Frequency Division Multiplexing)
 - Essentially, it modulates the digital data onto N different carriers.
- This signal is then inserted into the baseband signal between 130 kHz and 200 kHz.
- Finally, the analog signal, IBOC signal, and additional subcarriers are FM-modulated and mixed to VHF for amplification and transmission.
- AM IBOC works similarly in that the Digital subcarriers are amplitude-modulated into the analog signal between 5 and 15 kHz. This does increase the bandwidth of the AM signal significantly, potentially causing interference with adjacent stations.

The Sony XDR-F1HD and XDR-S3HD

- New line of Sony HD Radios
- Use DSP to filter incoming FM signal
- Allows for unprecedented channel selectivity
- Rejects noise better than almost all analog FM radios.

DEMO