New Life for AM with Digital Transmission

A Look at the Options

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Why the Erosion of AM?

- Quality of signal
  - Noise
    - Atmospheric static
    - Man made noise
    - Receiver bandwidth reduced to combat noise
      - Results in worse frequency response, now ≤4 kHz
      - Cost reductions in receivers further compromise quality
Man-Made Hindrances

• Failure to implement technology
  – Synchronous detectors
  – Noise blanking
  – Variable bandwidth by reception conditions
  – NRSC-1-B response not adopted in receivers (AMAX)
  – Lack of wide-spread adoption of AM Stereo

• Even after receivers entered the marketplace
Further Diminution of AM

- AM stations being donated to non-profits
  - Radio World cites 7 donations including a Detroit AM
- FM simulcasts of large AM news/talk stations
  - WSB Atlanta, WTOP Washington, WFAN NY, WBBM Chicago etc.
- Mexico & Canada migrating AM’s to FM wherever possible
  - Nautel’s home city Halifax (400,000+) now has no AM services
- Many European nations turning off many/all AM
- Auto manufacturers talk of eliminating AM from cars
What Can We Do About It?

- Digitalization
  - It’s not just about sound quality (but partly it is)
    - Rich media experience is what consumers demand today
    - Interactivity (Smart Phone is great for this)
    - “Cool” features
      - Graphics displays
      - More information
The Platforms

- Two Major AM Digital Platforms
  - HD Radio™ Technology
    - Developed in US by iBiquity Digital Corp
    - Has ITU recommendation
    - Deployed in US on 250+ AM stations
      - Mostly the largest, high power stations in big cities
    - Licensing of stations by iBiquity required (in US)
The Platforms

- Two Major AM Digital Platforms
  - Digital Radio Mondiale (DRM)
    - Developed primarily in Europe
    - Has ITU recommendation
    - Deployed globally primarily on SW & MW ~ 30 active sites
    - No broadcast station licensing by DRM
About the Systems

- **HD Radio Technology**
  - Developed in US after Eureka 147 DAB discarded
  - 3 companies ultimately merged to form iBiquity
    - DRE, Lucent and USADR each providing parts of the final system
    - Additional partners: tx, rx, chip manufacturers, broadcasters
  - Company pledged to create an AM and FM IBOC system
  - First regular licensed broadcasting commenced 2002
  - Standards published as NRSC-5C
    - Current implementation is iBiquity’s version
About the Systems

• Digital Radio Mondiale (DRM)
  – Developed primarily in Europe for Short Wave
    • Later migrated to MW and Long Wave
      – The standard today covers all AM broadcast bands and VHF I, II, III
    • DRM is a not-for-profit Consortium
      – Approx 100 members: broadcasters, tx, rx & chip man., research institutions
      – Members contribute to development of new functions
  • First regular broadcasts commenced 2004 on SW
  • Used in numerous countries for SW and MW
More About the Systems

• Both are OFDM systems
• Both require audio bit reduction
• Both are “bits” so stream can be audio or data
• Both have all digital or combination hybrid modes
  – iBiquity calls it Hybrid, DRM calls it Simulcast
• Both have to mitigate host and adjacent interference
More About the Systems

• Both systems have fairly stringent antenna requirements
  – iBiquity requires good symmetry
    • iBiquity recommends VSWR to be no worse than 1.2:1 to 10 kHz Fc and no worse than 1.4:1 out to 15 kHz Fc
  – DRM requires much lower VSWR
    • VSWR at ± 10 kHz Fc should be ≤1.1:1 & < 1.05:1 at ± 5 kHz
More About the Systems

- Sidebands should be as symmetrical as is practical

- Proper tuning
  - Keeps quadrature information in quadrature
  - Minimizes crosstalk
    - Digital into main
    - Main into digital

- Match the driving point of the transmitter

Courtesy iBiquity Digital Corp
More About the Systems

- Both systems have similar tx requirements
  - Tx must be linear or pre-corrected to linear
    - Mask compliance is required or interference results
    - Most modern AM tx capable of either system
  - DRM mask more difficult/demanding on transmitter
More About the Systems

**Simulcast Principles**

- DRM Simulcast using a 18kHz Bandwidth
  - DRM in lower frequencies
  - AM in upper frequencies

- DRM Simulcast using a 20kHz Bandwidth
  - DRM in lower frequencies
  - AM in upper frequencies

- DRM in upper frequencies
  - AM in lower frequencies

- DRM Simulcast using a 18kHz Bandwidth

- Note that “double channels” required
- DRM antenna requirements over the DRM portion are appropriate, may be more relaxed over the AM portion
- Many AM receivers will still have noise issues
- Not currently in regular deployment
More About the Systems

Lower Digital Sidebands

Analog 5kHz Audio Signal (Mono)

Upper Digital Sidebands

Lower Digital Sidebands

Analog 10kHz Audio Signal (Mono)

Upper Digital Sidebands

iBiquity Conventional AM MA1

Modified MA1
More About the Systems

• The difference between the two AM modes
  – MA1 offers full stereo, wider freq response
    • Subjected to in/out with core and enhanced mode
    • Requires 5 kHz response limit on AM audio
  – Modified MA1 reduces host interference, para stereo
    • Permits 9 kHz audio response on AM
    • Eliminates the annoying in/out with core/enhanced
CODECS

• Both Systems require audio bit reduction
  – HD Radio offers 2 modes each (in hybrid & pure digital)
  – DRM offers 4 main modes each with 2 sub modes
    • Trades off robustness versus coverage
  – DRM uses AAC but other CODECS can be used if desired
  – HD Radio uses HDC (developed by Coding Technologies)
    • Some compare it to AAC+ with SBR
    • Dual modes supporting the 2 HD modes (lower bit rate)
    • iBiquity HDC CODEC is proprietary, no details published
### Bitrates Available

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<thead>
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<th>MODE (Total Kb/s)</th>
<th>Kb/s P1</th>
<th>Kb/s P3</th>
<th>Kb/s PIDS</th>
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<td>MA1 Hybrid Reduced Digital b/w Config (20.6)</td>
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**Note** – Mode E only for DRM+

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### Nominal Signal Bandwidth (kHz)

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Why Hybrid or Simulcast?

• Creates an orderly market transfer to digital
  – Existing receivers continue to operate
  – New receivers add features not available in analog
• The ultimate is to create the all digital mode
  – Improved coverage/lower transmission costs
  – Reduced interference
  – Higher bit rates
Why Hybrid or Simulcast?

• Hybrid has issues
  – Introducing digital signals into the band creates interference
  – Digital power levels are restricted to mitigate interference
  – Coverage therefore is not maximized

• Both systems employ “tricks” to minimize interference
  – DRM reduces power level to -14 to -16 dBc
  – DRM digital can be in the channel above or below analog
  – IBOC can curtail upper or lower sideband power levels
    • Use modified MA-1 to further reduce host interference
    • Sidebands are out of phase and cancel within the host to reduce interference
What Listeners Want Today

- The speed of now – the audience has become spoiled/demanding
  - Interactivity
  - Not just audio (but rich media)
  - Content relevant to them and tailored to them
  - Small portable devices (transistor radios are out, and desk top and laptop sales are off, smart phones are skyrocketing)
  - Shorter bits, not long form programming – ideal for quick downloading/streaming
Why Broadcasting Then?

- Cell data networks are not keeping up with demand (crippled in places)
- Data is not free, and almost nowhere is it unlimited
- Data coverage is not universal especially in more rural areas
  - Network speeds are also not 3G or 4G LTE in more rural areas
  - Spotty coverage is annoying to listeners
- Broadcasting is free over the air and can cover a wide area with MW and LW and at very low transmission costs (10-20% of analog)
- Coupled with Smart Phone as back channel, is interactive
- Multicasting is possible with both DRM and HD Radio technologies
What Can AM Broadcasters Offer?

- Radio with pictures and more
- Traffic, news weather, graphics, album art, client or station logos, etc.
- Better quality audio – approaching FM quality with stereo
- Small scale motion video or still slides/graphics
- iTunes Tagging (which is also a potential revenue stream)
- Instant interactive couponing and contests
- Location-based services
- Much wider coverage area than FM, FM-HD, DAB, DAB+, etc.
Summary

- AM is failing in many parts of the world and needs a boost (digital!)
- Both systems – HD Radio and DRM are OFDM based
- Transmitter requirements are similar, exciters differ
- Both require antenna verifications and possible broadbanding
- Both can offer significant wide area digital coverage
- Both offer an array of rich media features desired by consumers
- Both offer an interim hybrid or simulcast mode on path to full digital
- Both offer significantly reduced transmission cost over analog
- Both have demonstrated the core technologies work
Acknowledgements

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Thank you!

For more information:

www.ibiquity.com

www.drm.org

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