HD Multiplex

All Digital IBOC Today

Superior Spectrum Efficiency for the FM Band

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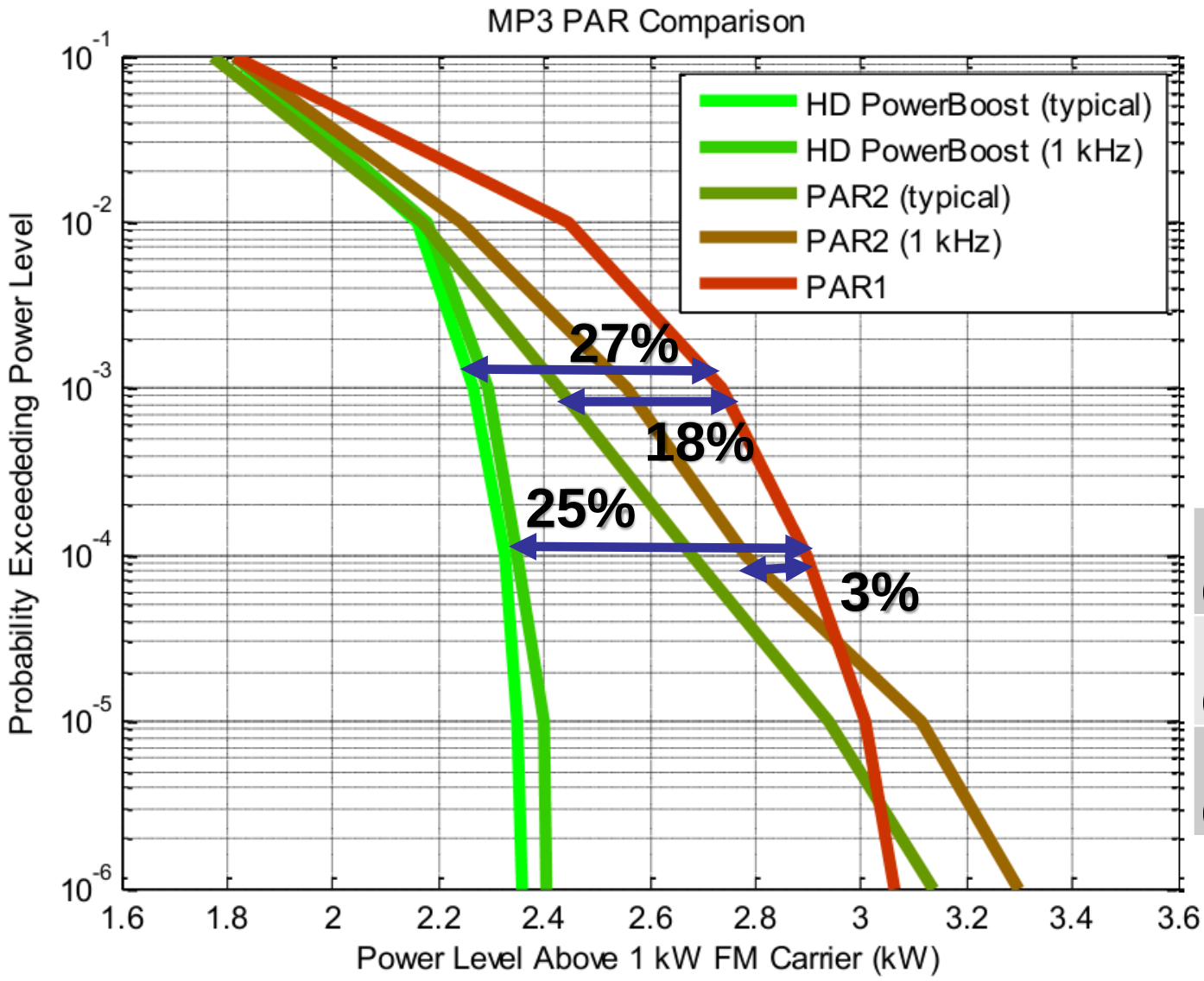
PAR2 vs HD PowerBoost

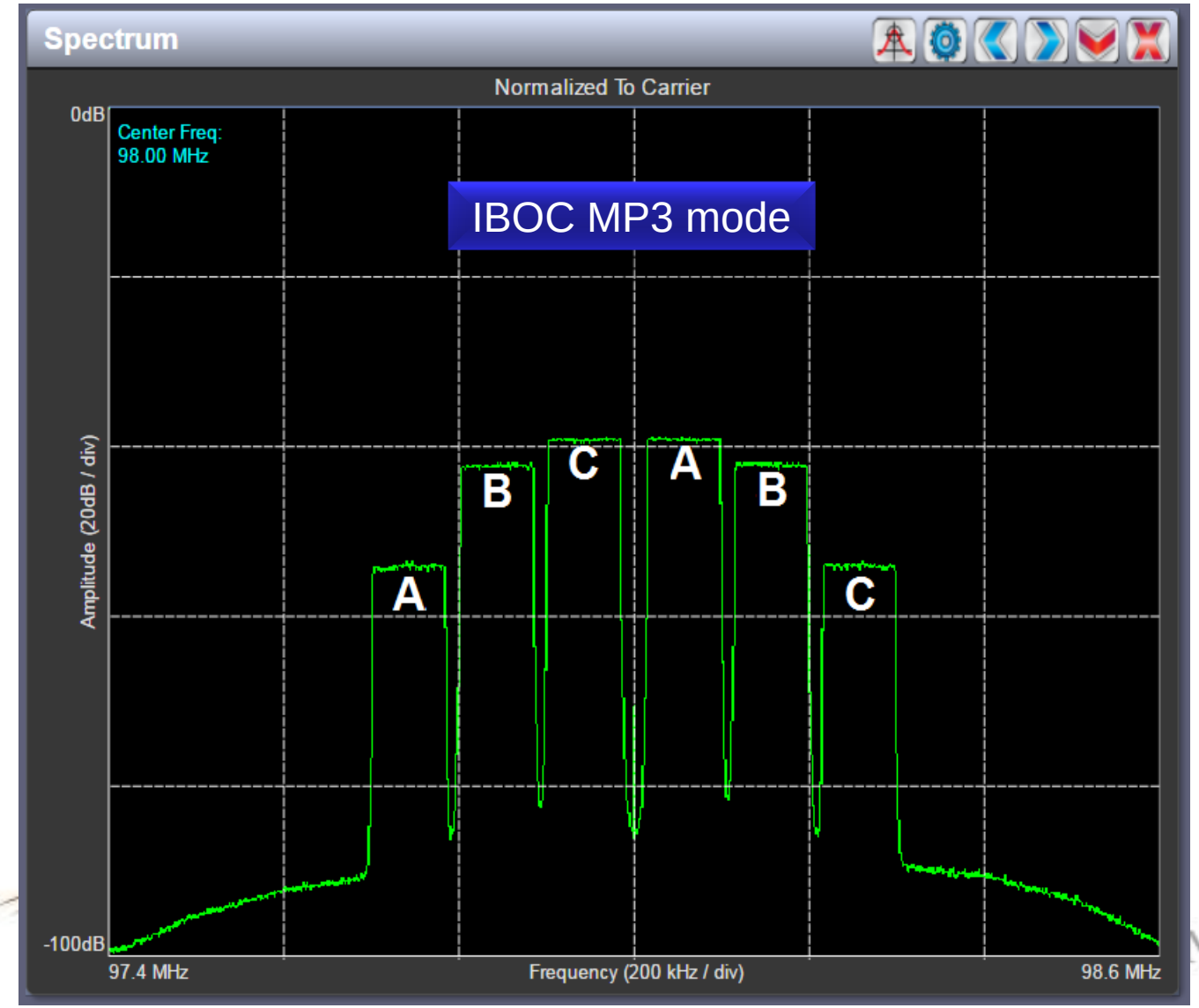


HD PowerBoost has

- Best measured TPO performance
- Best measured efficiency
- Best absolute peak control

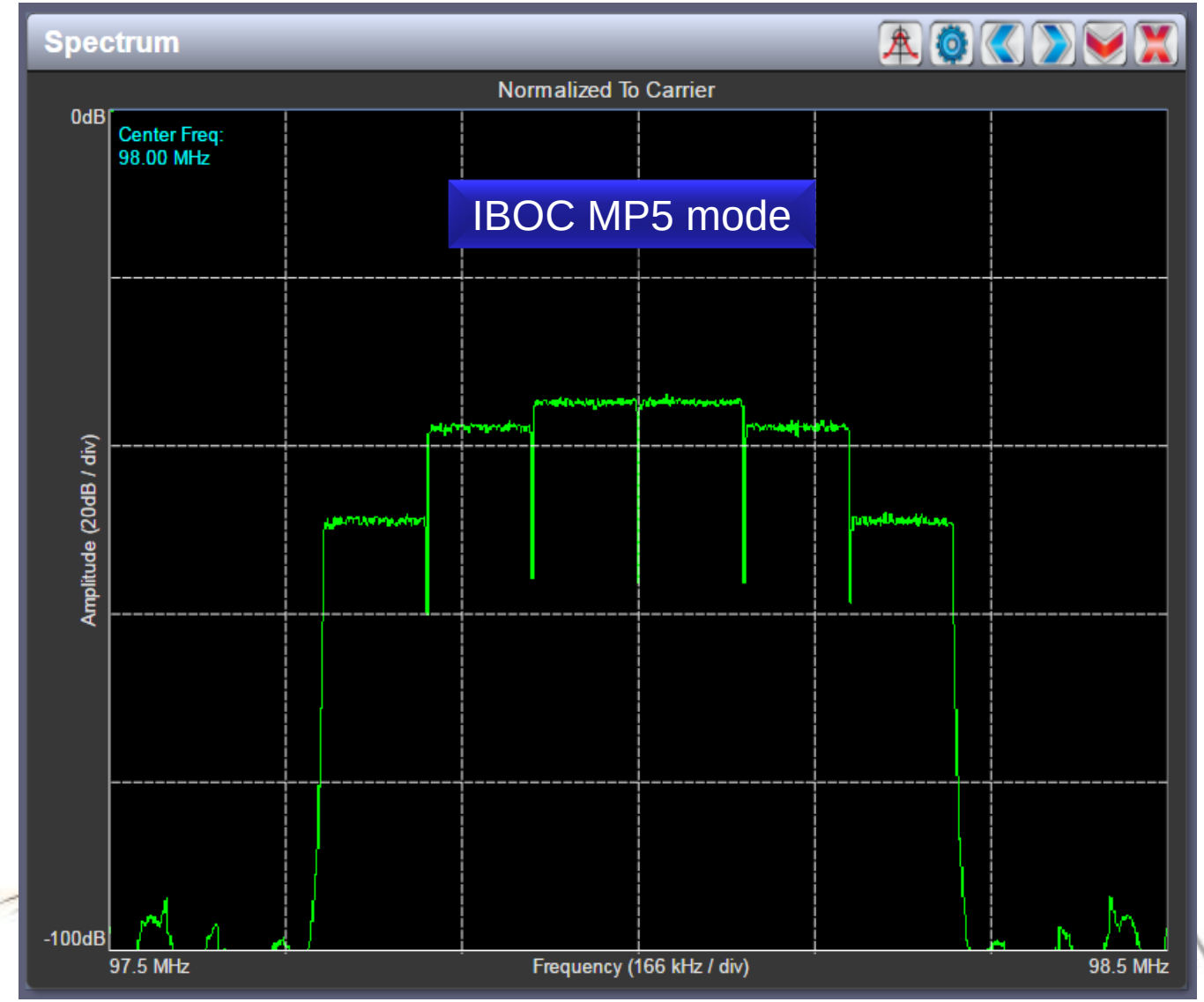
	PAR1	PAR2	HD Power Boost
Power increase (MP3 test tone)	0%	2%	**25%**
Power increase (MP3 typical mod)	0%	18%	**33%**
DC-RF efficiency (MP3 typical mod)	56.0%	61.9% (+5.9%)	67.2% (+**11.2%**)

HD PowerBoost Multiplex



- 3+ IBOC stations
  - A: 97.9 MHz
  - B: 98.0 MHz
  - C: 98.1 MHz
  - 100 kHz “channel” spacing
  - 600 kHz occupied bandwidth
- 3x123.2 kBps => **369.6 kbps**
- up to 15 audio streams
  - 32kbps, 24kpbs and 16 kbps
- Adjustable sideband levels
- **Standard exgine** MP3 and MP5 IBOC modes are compatible with **existing receivers.**

HD PowerBoost Multiplex



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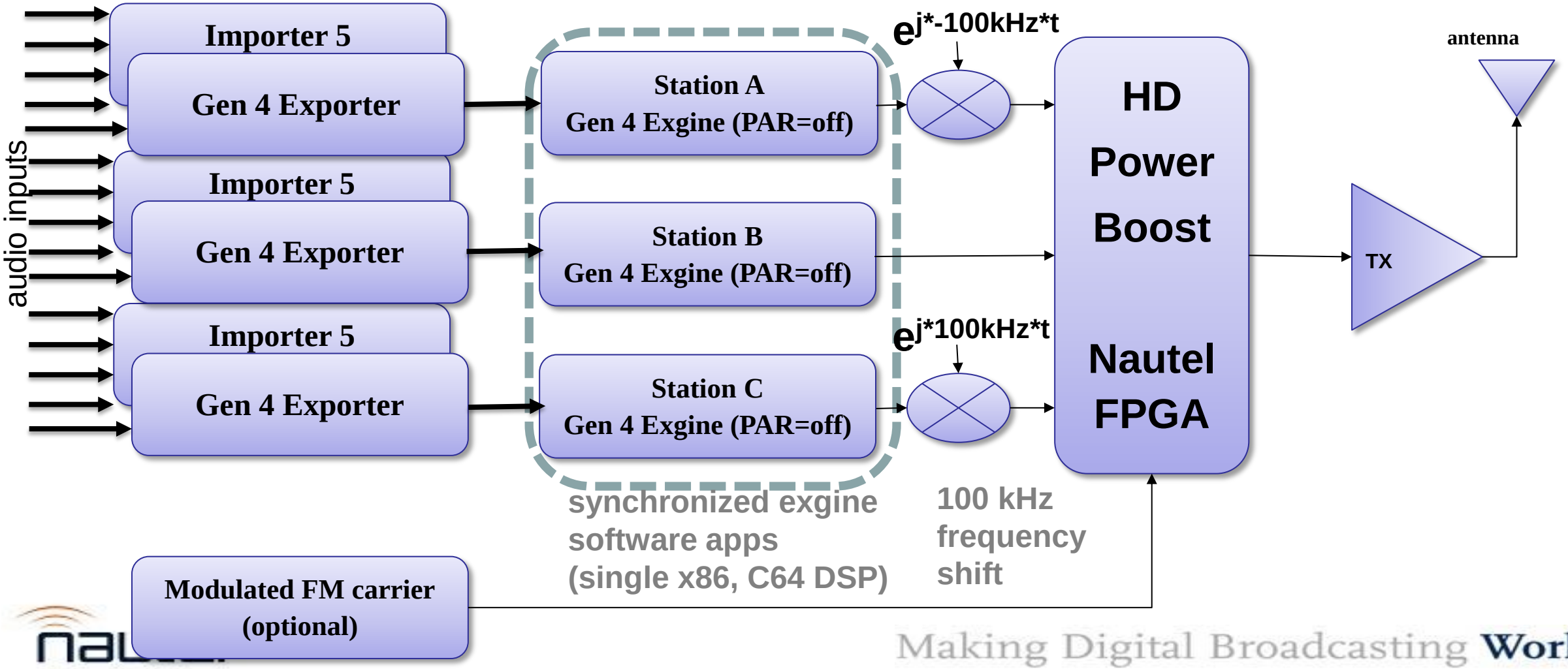


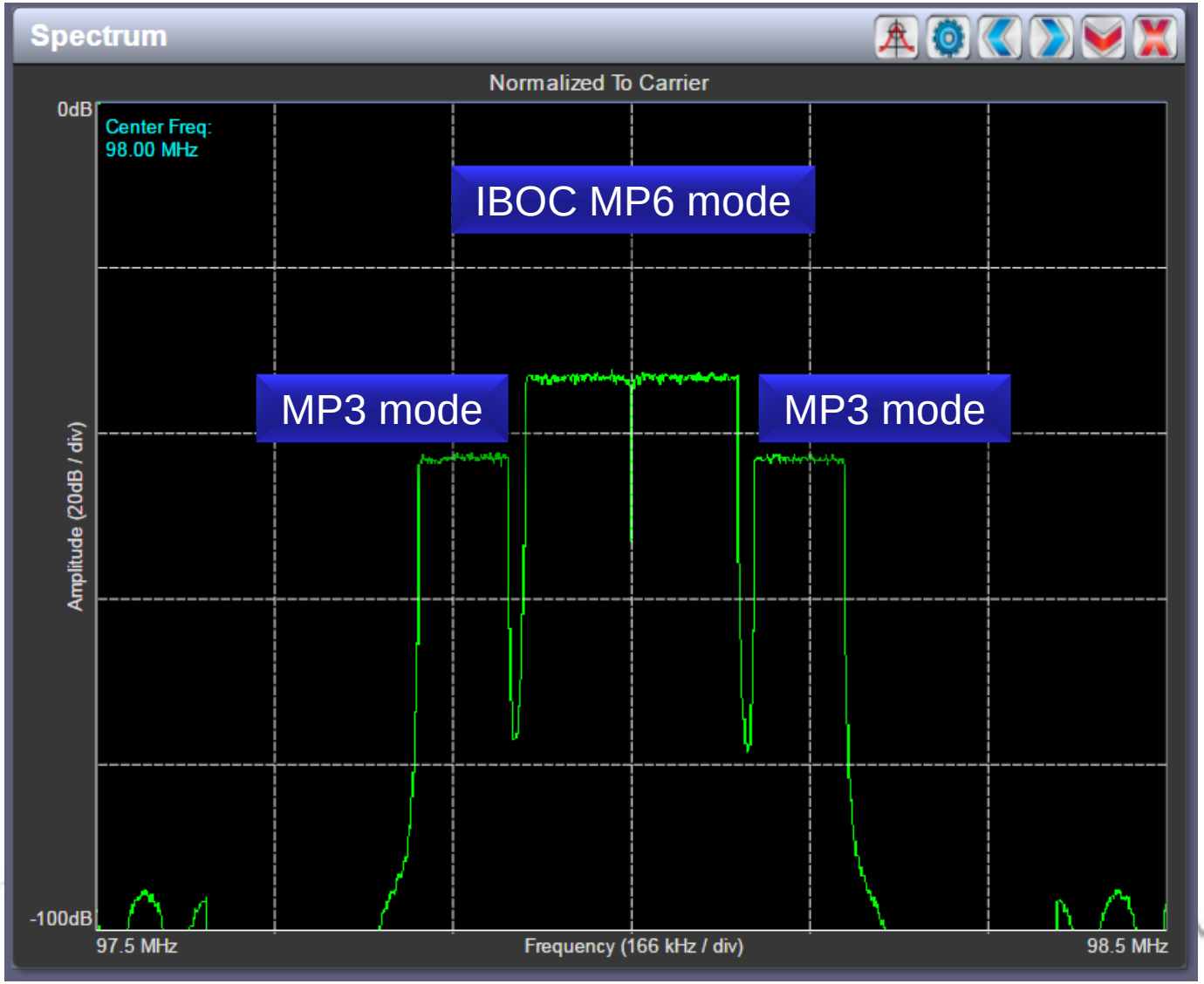
Spectral Efficiency of HD Multiplex

- **200 audio streams** in the FM band could be possible
- Up to 5x audio streams compared to FM per 200kHz channel
- Improved frequency packing
  - All stations in multiplex are OFDM orthogonal
  - Requires no guard spectrum when broadcast as multiplex
    - Receiver sees guaranteed adjacent levels
- IBOC requires only 4-6 dB on channel D/U (20-30 dB for FM)
  - Reduced on-channel interference zones
  - Could a receiver pick up IBOC on 50% of the band?
- Practical bridge to **All Digital** IBOC
  - iBiquity defined all digital IBOC not yet developed – no receivers
  - FM, HD Multiplex and All Digital IBOC can co-exist => Gradual conversion

Redefining Broadcast Economics

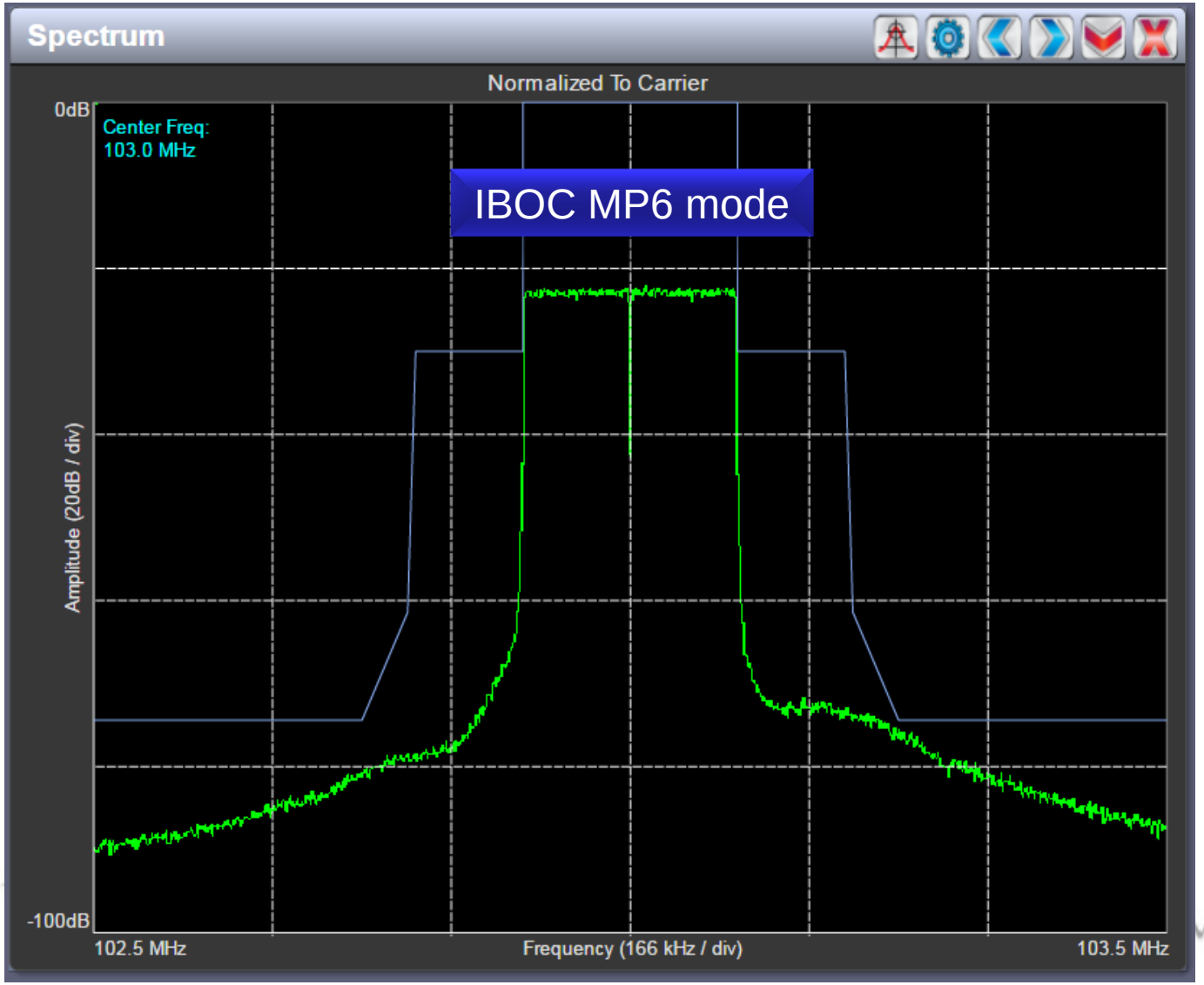
- 10% IBOC power ↔ comparable coverage to FM
  - -10 dBc hybrid injection equals or exceeds FM coverage
  - 30% power for HD Multiplex requires 60-75% of typical FM transmitter
  - Less than 1/2 power bill compared to FM
    - Assumes 50% efficient IBOC TX and 70% efficient FM
  - 400 W per audio stream (15) ↔ 14,285 W FM (10 kW TPO)
  - Single antenna system and lower antenna ratings
- New business model: leasing multicast channels
  - “Easy” IBOC conversion
    - Station must **promote HD listening option** to encourage changing presets
    - provide **value to listener** via artist experience, weather and traffic data services
    - Separate **spot injection** on multicast channel – there is no blending
- Larger netcaster groups can define their own listening experience

HD Multiplex 400 kHz mode



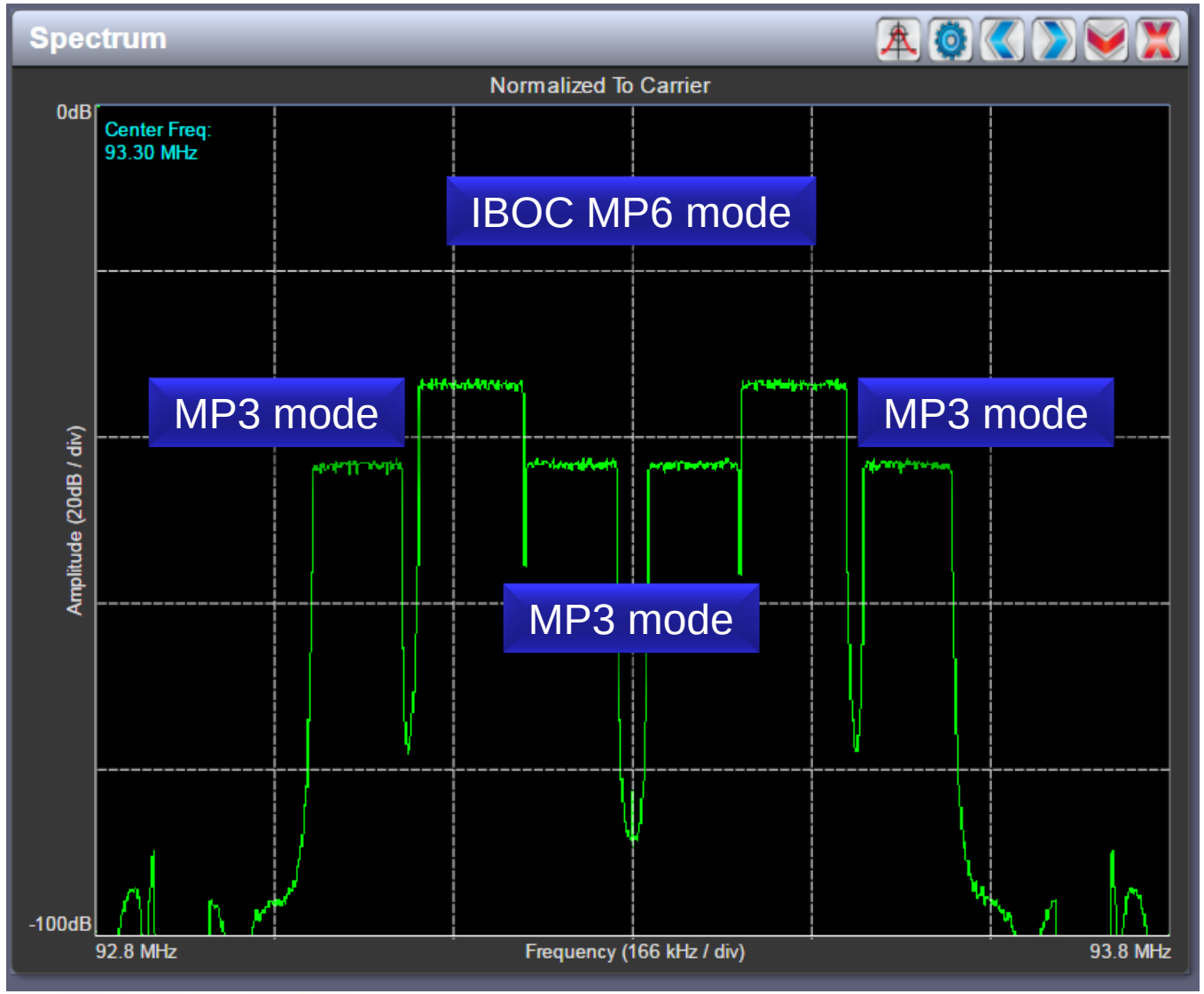
- Outer sidebands are turned off
  - 3 station multiplex
    - 97.9 MHz,98.0 MHz,98.1 MHz
  - Swap inner sidebands
    - 97.9 MHz, 98.1 MHz, 98.3 MHz
    - 200 kHz mode possible
- Inner sidebands at today's +10 dB FM level
- MP6 has highest robustness
  - Could be replaced with future single sideband modes.
  - Some receivers struggle with single sideband locking

HD Multiplex 200 kHz mode



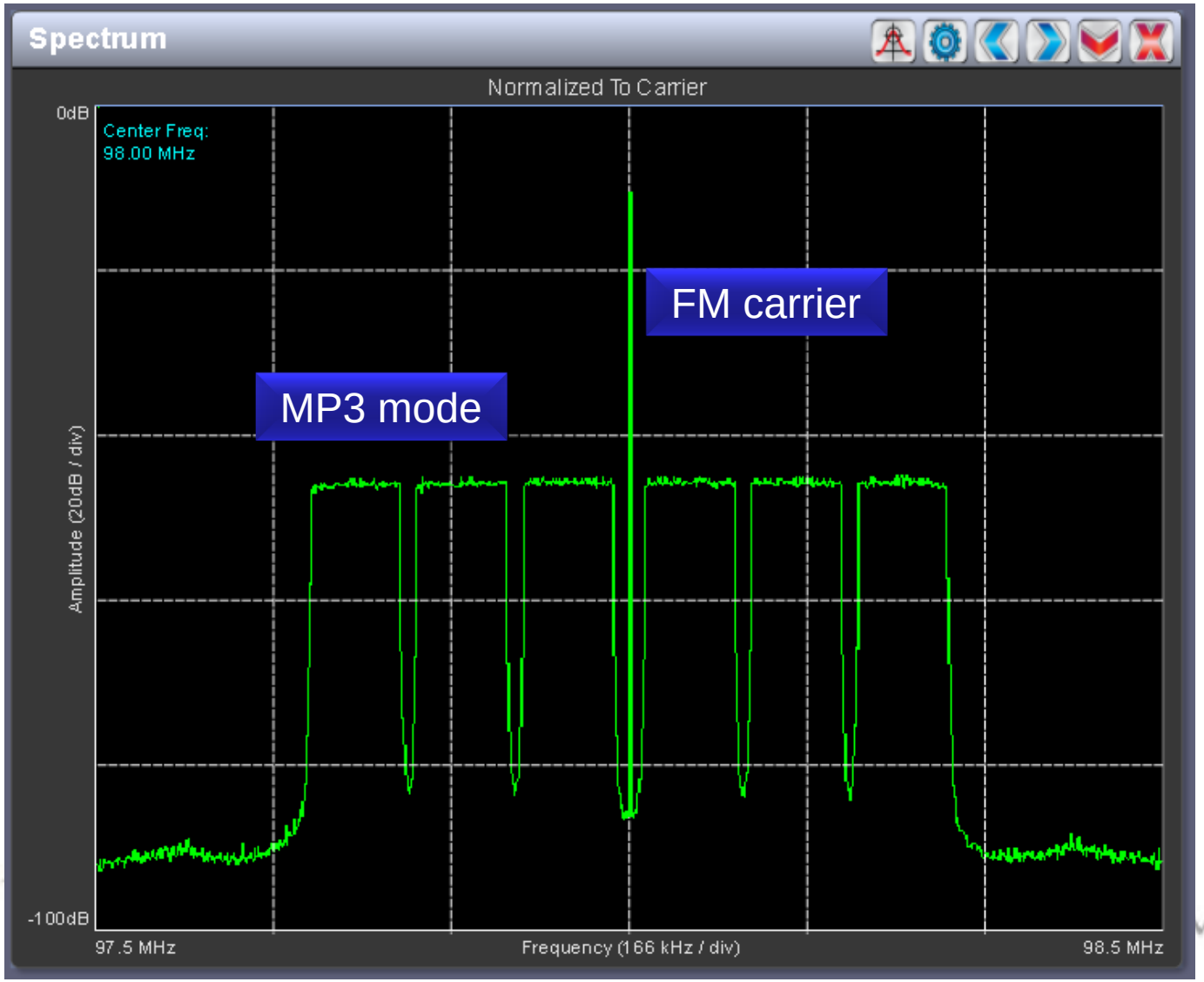
- Outer sidebands are turned off
  - 2 station multiplex
    - 97.9 MHz,98.1 MHz

HD Multiplex 4 stations in 600 kHz



- 3 station multiplex
  - 97.7 MHz SSB MP6
  - 97.9 MHz DSB MP3
  - 98.0 MHz DSB MP3
  - 98.1 MHz SSB MP6

HD Multiplex Receiver Scanning



- Some receivers require an FM carrier for scanning
  - Requires at least 10 dB
- Many receivers offer HD Scan capability not needing FM
- HD PowerBoost can inject FM carrier(s) by design
- But why waste 91% of power?
- Do we want FM recivers scanning this station?

Answer: HD Scan and EPG

HD Multiplex Key Technologies

- HD PowerBoost is needed to reduce the combination of peaks
- Possible with today's IBOC transmitter technology
- 4th generation Broadcast Systems Architecture
  - provides standard exgine building blocks
- Single sideband IBOC service modes
- Receiver improvements
  - Better HD Scan capability
  - 100 kHz tuning capability
  - Single sideband locking
- HD codec audio pre-conditioning and processing
- New spectral planning tools to optimize all digital future
- Electronic Program Guide

HD Multiplex Demonstration

Visit Nautel at booth C2139 to see and hear

- 15 looping audio streams
  - Audio clips processed thanks to Omnia
- Running on VS and GV transmitters
- Service modes MP3,5,6
- More signal combinations
- A variety of receivers
  - Bring your own

Making Digital Broadcasting **Work.**

Thank You