Radio Air-Chain INNOVATION

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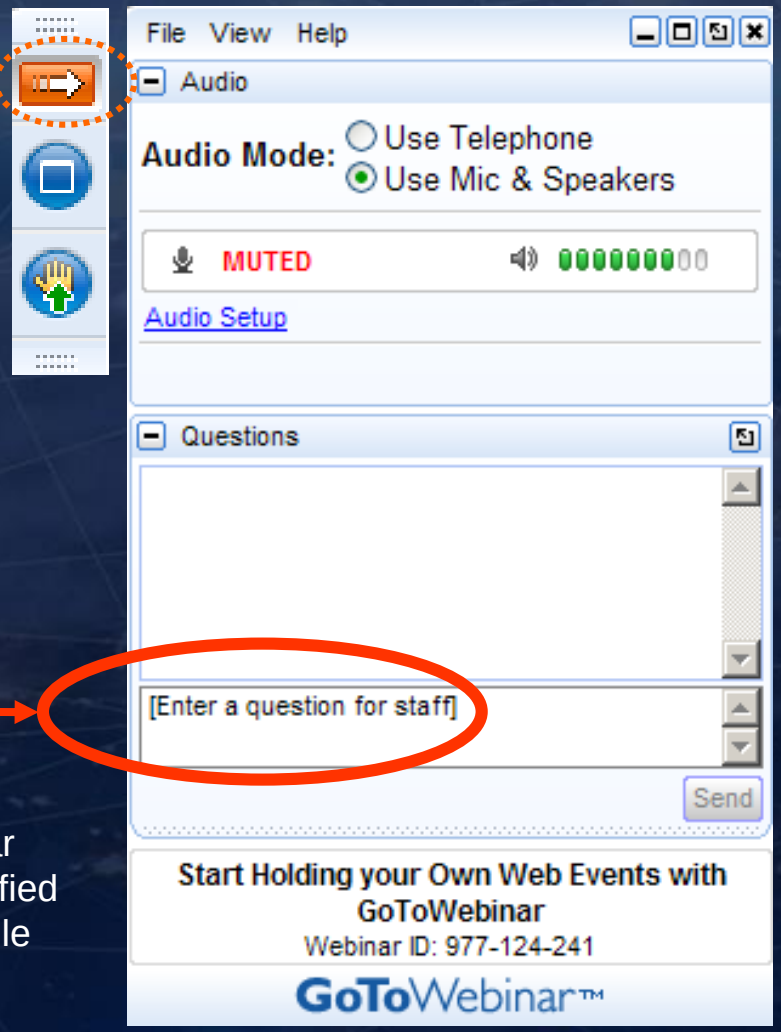
Problem solved, Webinar 2 of 3

August 27, 2020

Your questions please?

(if you don't see the control panel, click on the orange arrow icon to expand it)

Please enter your questions in the text box of the webinar control panel (remember to press send)



Remember: The completion of a Nautel webinar qualifies for ½ SBE re-certification credit, identified under Category I of the Re-certification Schedule for SBE Certifications.

Host Jeff Welton
Sales Manager, Central USA

Panelist Geoff Steadman
Omnia Product Manager

Panelist Philipp Schmid
Nautel Chief Technology Officer

Panelist John Whyte
Nautel Head of Marketing

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Today's topics

- Nautel and Telos Alliance Collaboration
- Review of Air Chain Challenges
- Detailed Blend Alignment problems
- Software Technologies
  - Telos Alliance Enterprise Omnia 9s
  - Software HD Radio Server
  - Made for Radio: E2X and MPX
- Demonstration

So why this current collaboration and why now?

- Nautel and Telos Alliance: Passion & innovation

Digital Signal Processing

AoIP

- Change:
  - Industry & technology
- Challenges:
  - Listeners, locations, competition, complexity
- Fresh approaches
  - Apply new technologies, reduce complexity, drive out costs

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Digital Radio matters more now

- 65 Million HD Radio cars
- Opportunities:
  - Podcasts/Streams On-Air
  - Ethnic broadcasting
  - Leased channels
  - Sports coverage
- Over 2300 HD Radio stations
  - but 13,000 Analog only
- Challenging for many:
  - Too complex? Too expensive? ROI?

Cheaper, Easier, More Flexible Air-Chain Solutions

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HD Radio Diversity Delay Challenges

"Audible blending artifacts are the top complaint from auto manufacturers and consumers regarding the HD Radio experience"

Source: Alan Jurison, "The Need for Automatic Alignment of HD Radio Diversity Delay", RadioWorld

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HD Radio adds complexity and cost

Initially Importer and Exporter at studio to minimize HD STL bandwidth
Often a 2nd STL and even a 2nd transmitter required

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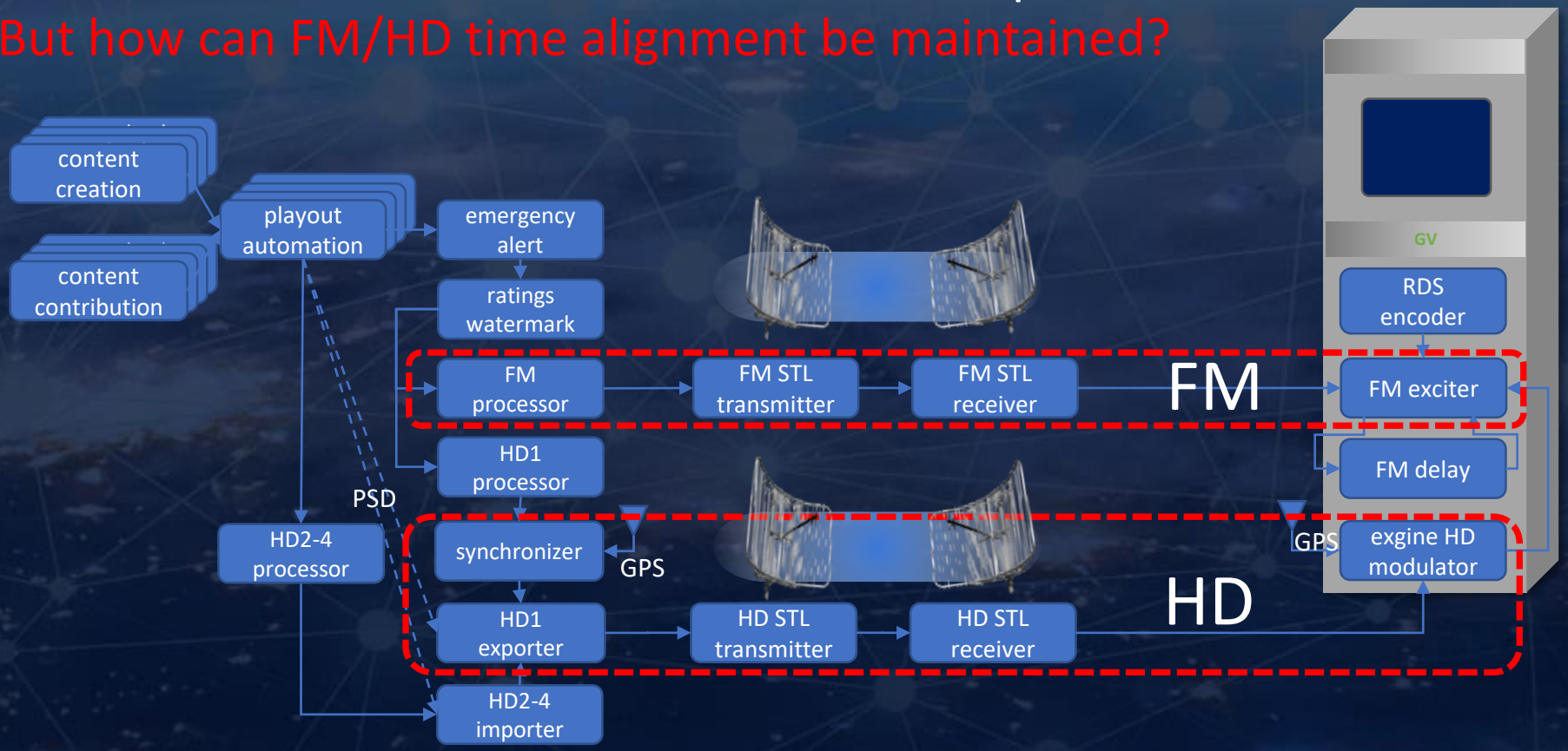
HD Radio adds complexity and cost

Initially Importer and Exporter at studio to minimize HD STL bandwidth

Often a 2nd STL and even a 2nd transmitter required

But how can FM/HD time alignment be maintained?



FM and HD audio must be within **3 audio samples**

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Why does IBOC delay HD1 audio?

- Interleaving spreads burst type errors in time

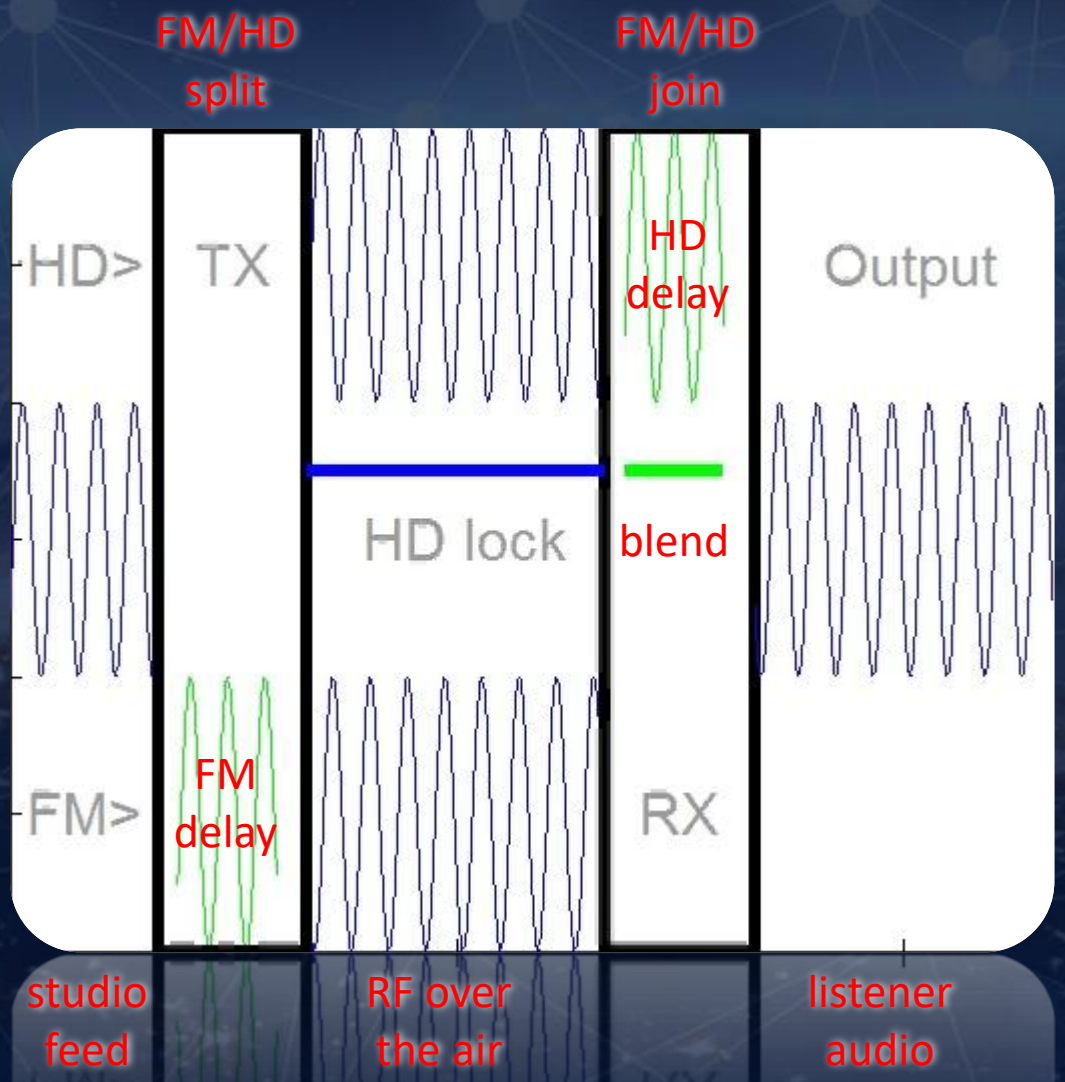
in order:	bytes_are_####t_in_time
out-of-order:	b_s_itrlne####yapimeei_
re-ordered:	b#te#_are#split_in_#ime

Example taken from “The IBOC Handbook”

- Interleaver adds 4.5s of HD1 audio delay
  - 1.48s interleaver in exciter,
  - 1.48s for transmission,
  - 1.48s de-interleaver in receiver

- Many other delays in the IBOC air chain … 8-10s typical, more on HD2-4

HD1 falls back to FM on severe RF Impairment



FM delay is on the transmit side

- delay is set in processor, exporter, or exciter

IBOC delay is split between transmission and receiver

Receiver blends to FM on HD loss

FM audio is good by the time HD1 audio plays – seamless blend

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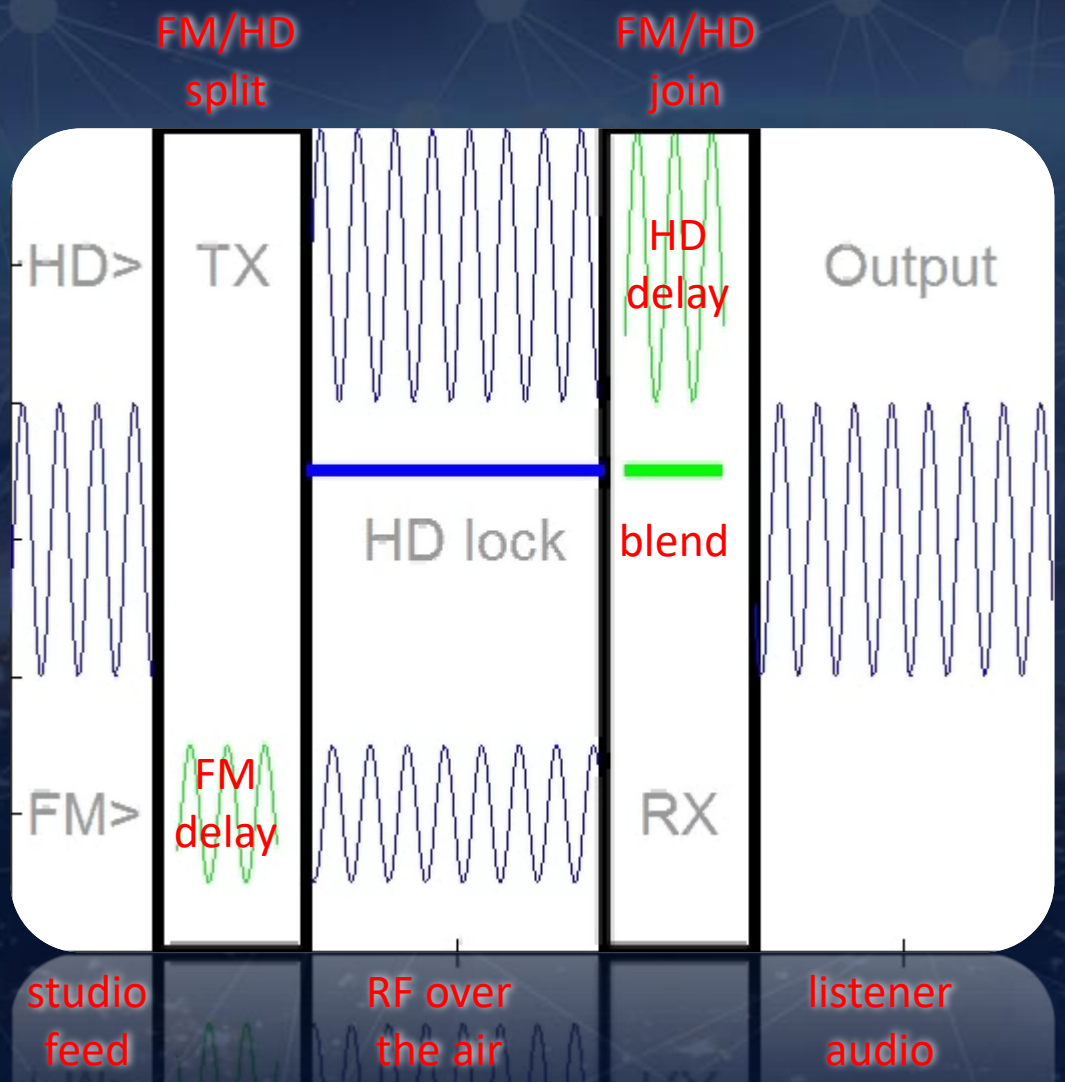
Differences in HD1 and FM Audio Levels



FM and HD1 audio levels should be matched to with 0.5 dB

1. Set up FM for 100% modulation
2. Match HD1 levels in processor

They typically stays static;
set and forget.

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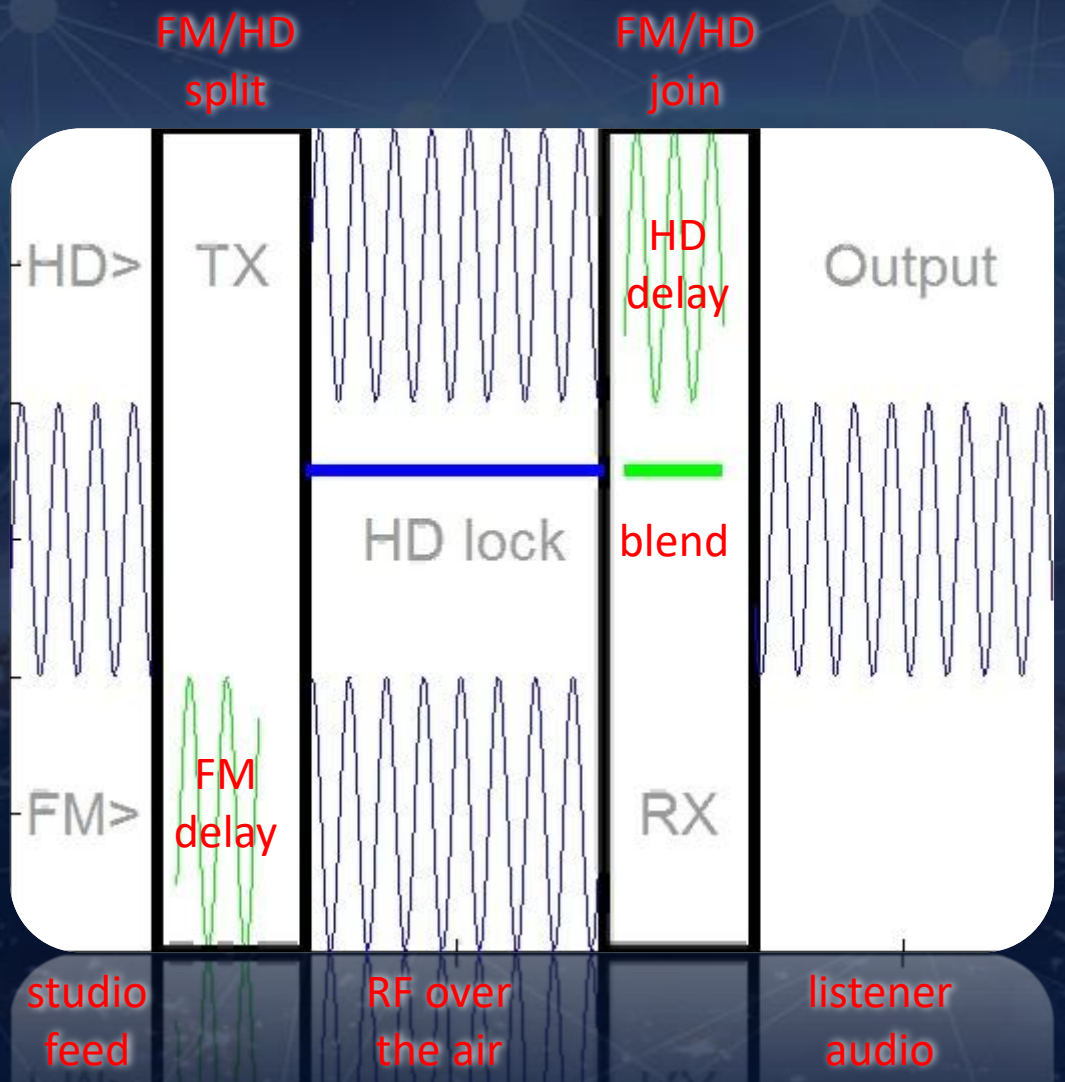
Time Alignment Error



Main blend impairment is diversity delay misalignment

Large errors (50ms+) cause audio skip or repeats

Small misalignments can cause audible audio artefacts

How closely do we need to be aligned?

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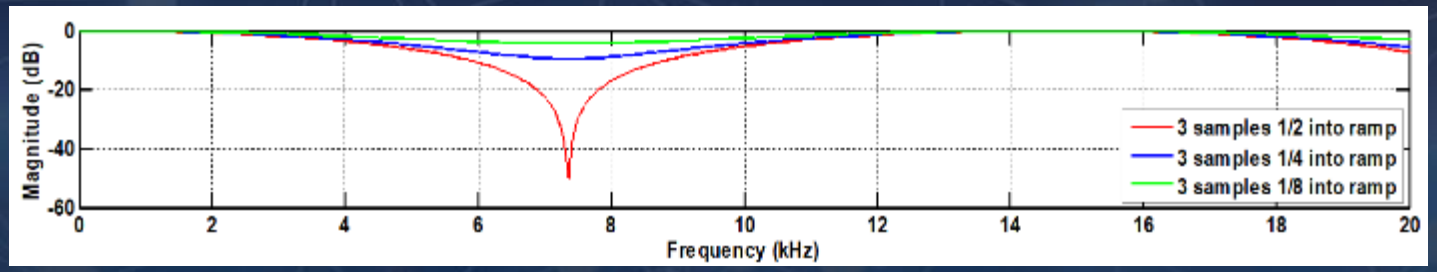
Audio Filtering Effects during Blending

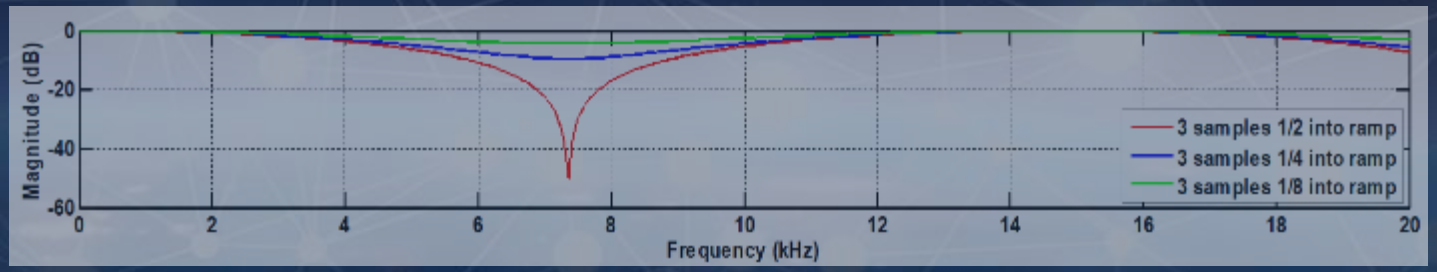
Best blend within 68µs
or 3 audio samples
(NRSC-5 specification)

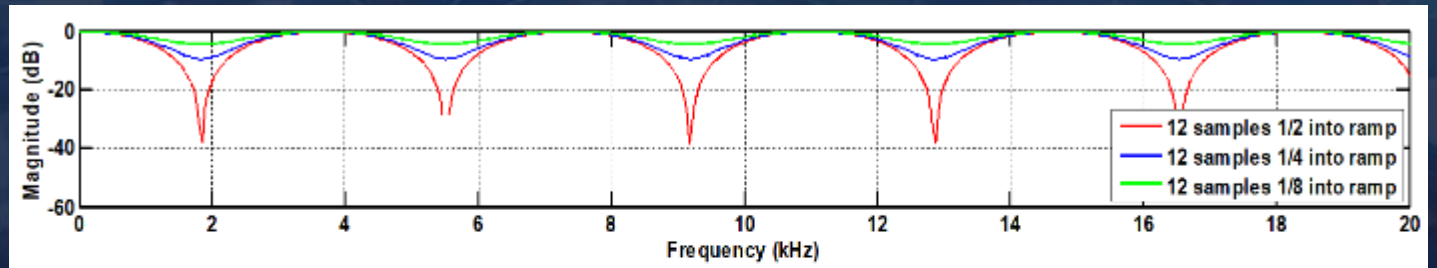


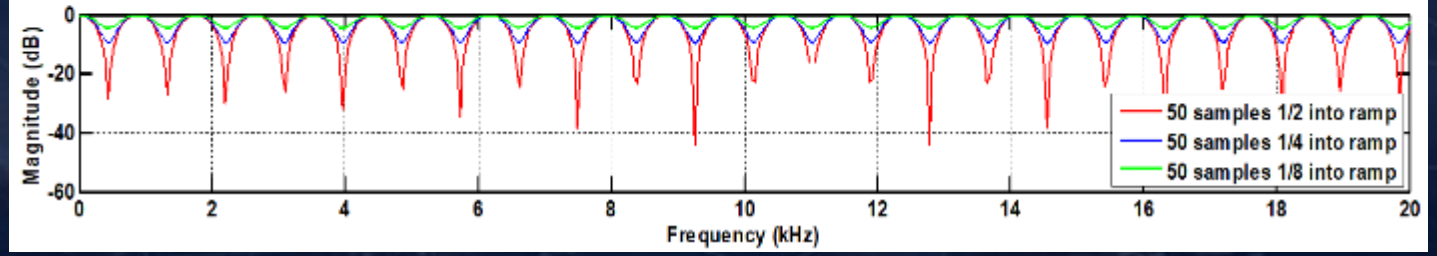
Audio Filtering Effects during Blending

Best blend within 68µs
or 3 audio samples
(NRSC-5 specification)

12 to 50 samples
(272µs to 1.1ms)
notches significant
audio content
(comb filter effect)







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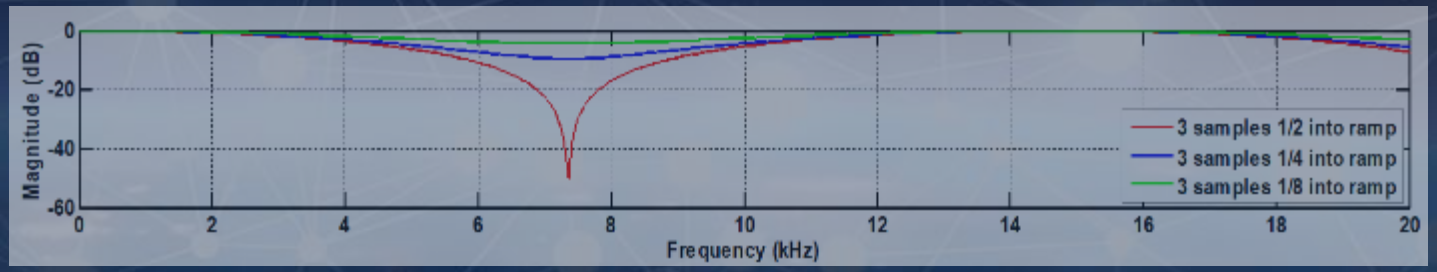

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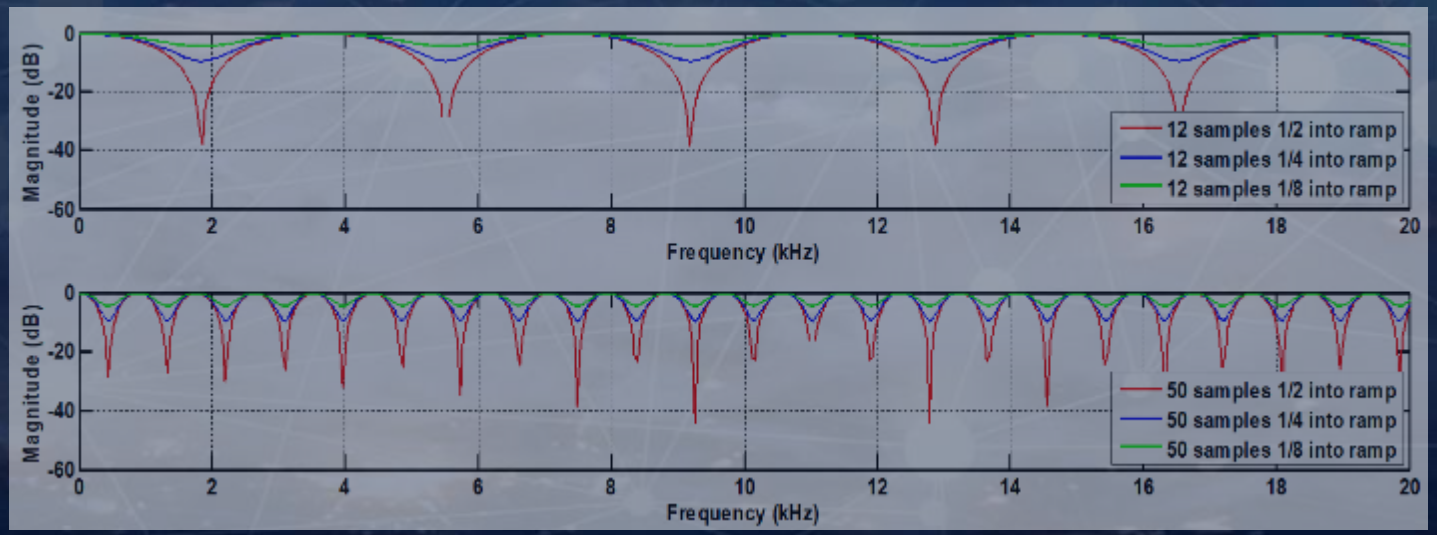
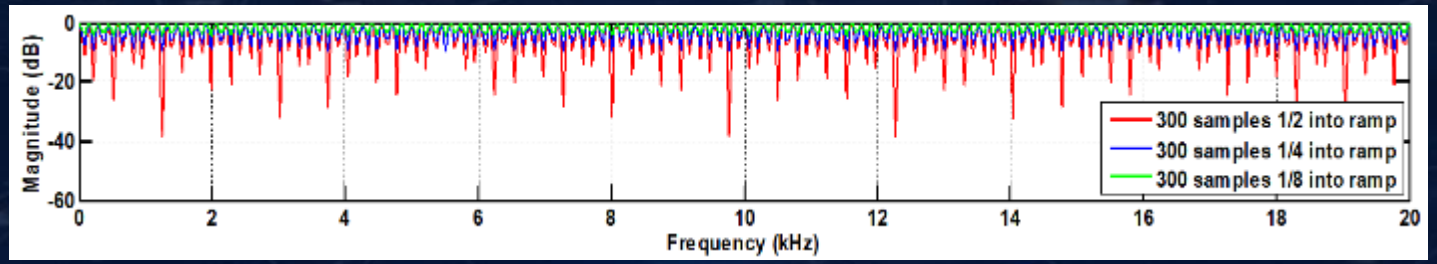


Better blend with
selective notches
300 samples / 6.8 ms



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Typical Diversity Delay Drift Measurements*

Without 10 MHz GPS Synchronization

200 samples / 4.5 ms swing

With 10 MHz Exciter Synchronization

15 samples / 340 µs swing

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*NRSC-G203 NRSC IBOC Time and Level Alignment Guideline

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Approaches for Optimizing FM/HD Blend Experience

All HD equipment AND audio processor is suggested to be at the transmitter site*

*NRSC-G203 NRSC IBOC Time and Level Alignment Guideline

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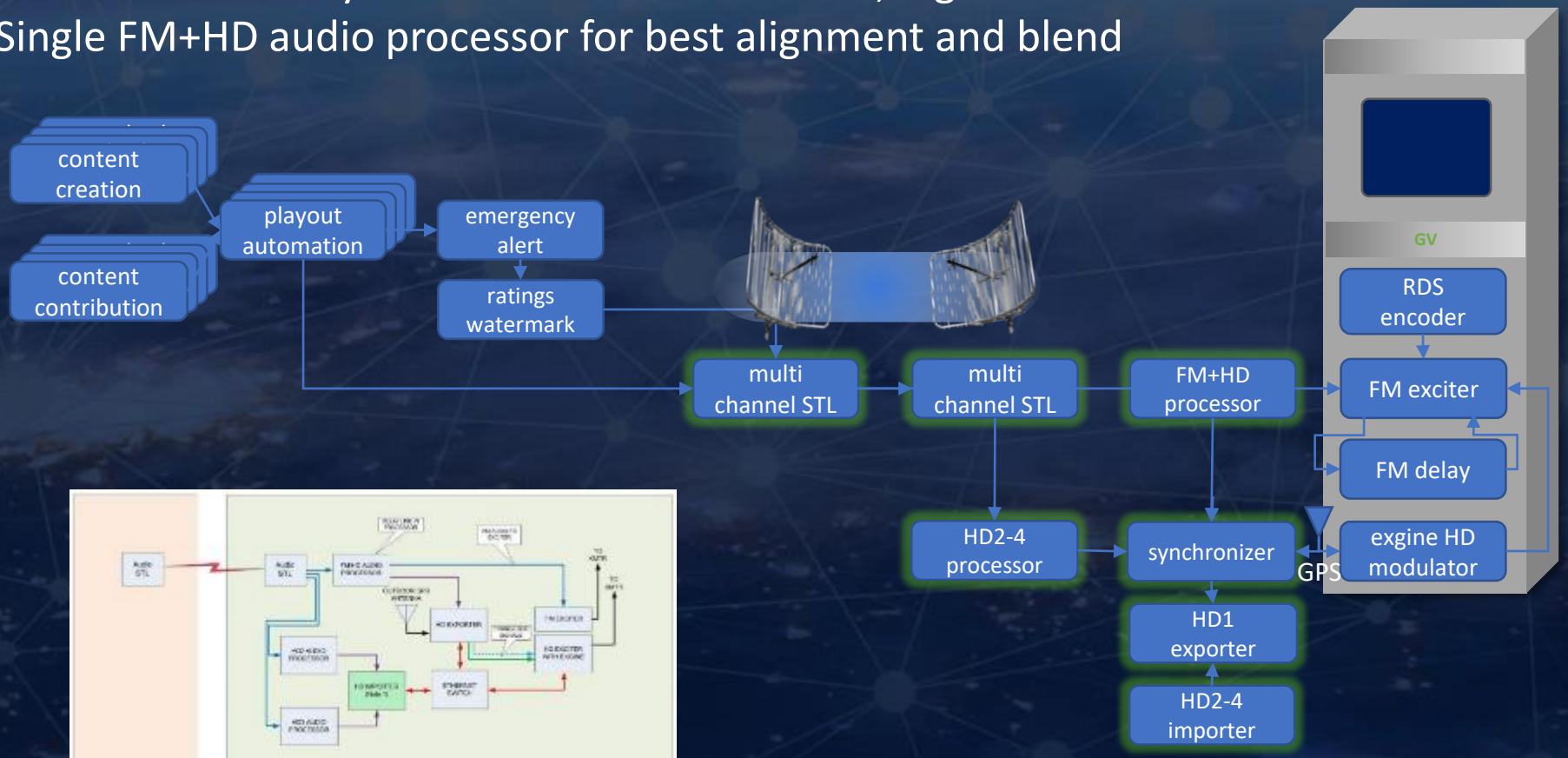
Approaches for Optimizing FM/HD Blend Experience

All HD equipment AND audio processor is suggested to be at the transmitter site*
STL must now carry all HD1-HD4 audio streams, high bandwidth
Single FM+HD audio processor for best alignment and blend

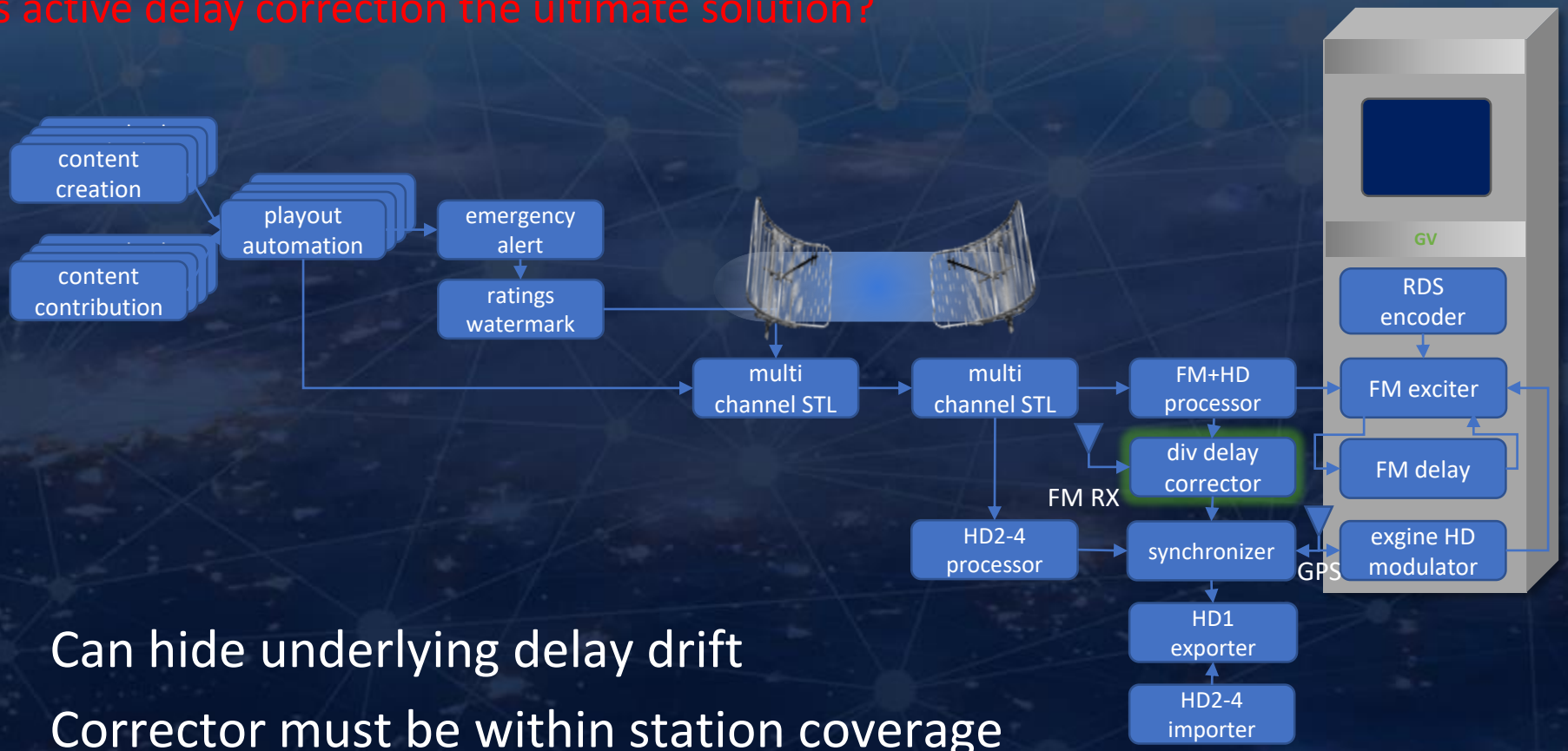


*NRSC-G203 NRSC IBOC Time and Level Alignment Guideline

Reactive Off-Air Delay Correction

Active Diversity Delay Correction using Receiver

Is active delay correction the ultimate solution?

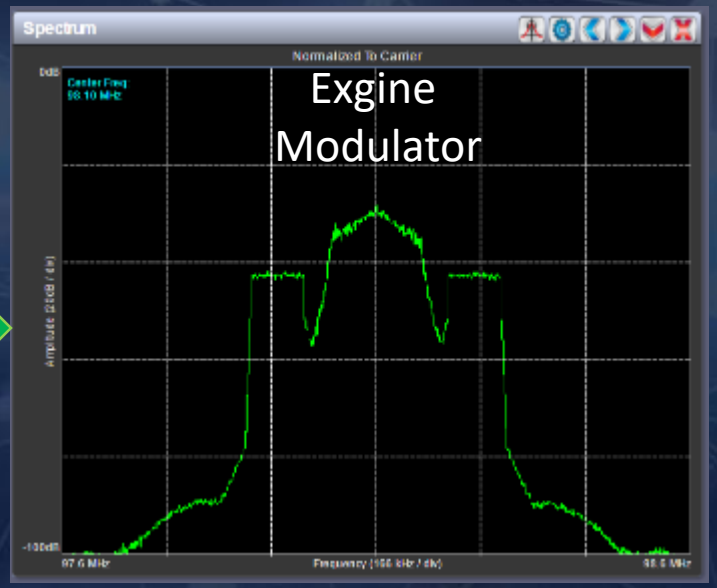


Can hide underlying delay drift

Corrector must be within station coverage

Made for Radio: Exporter 2 Exgine (E2X) link

UDP or TCP



- Connects exporter to exgine modulator over Ethernet
  - Carries HD Radio content ONLY, no FM content
  - Designed for IP STL transmission, low bandwidth
- Accepted “de-facto” industry standard
  - Not defined in NRSC specification … but everyone uses it
  - Interoperability with all major vendors
  - Backwards compatibility
  - Nautel Reliable HD Transport improves E2X transmission reliability

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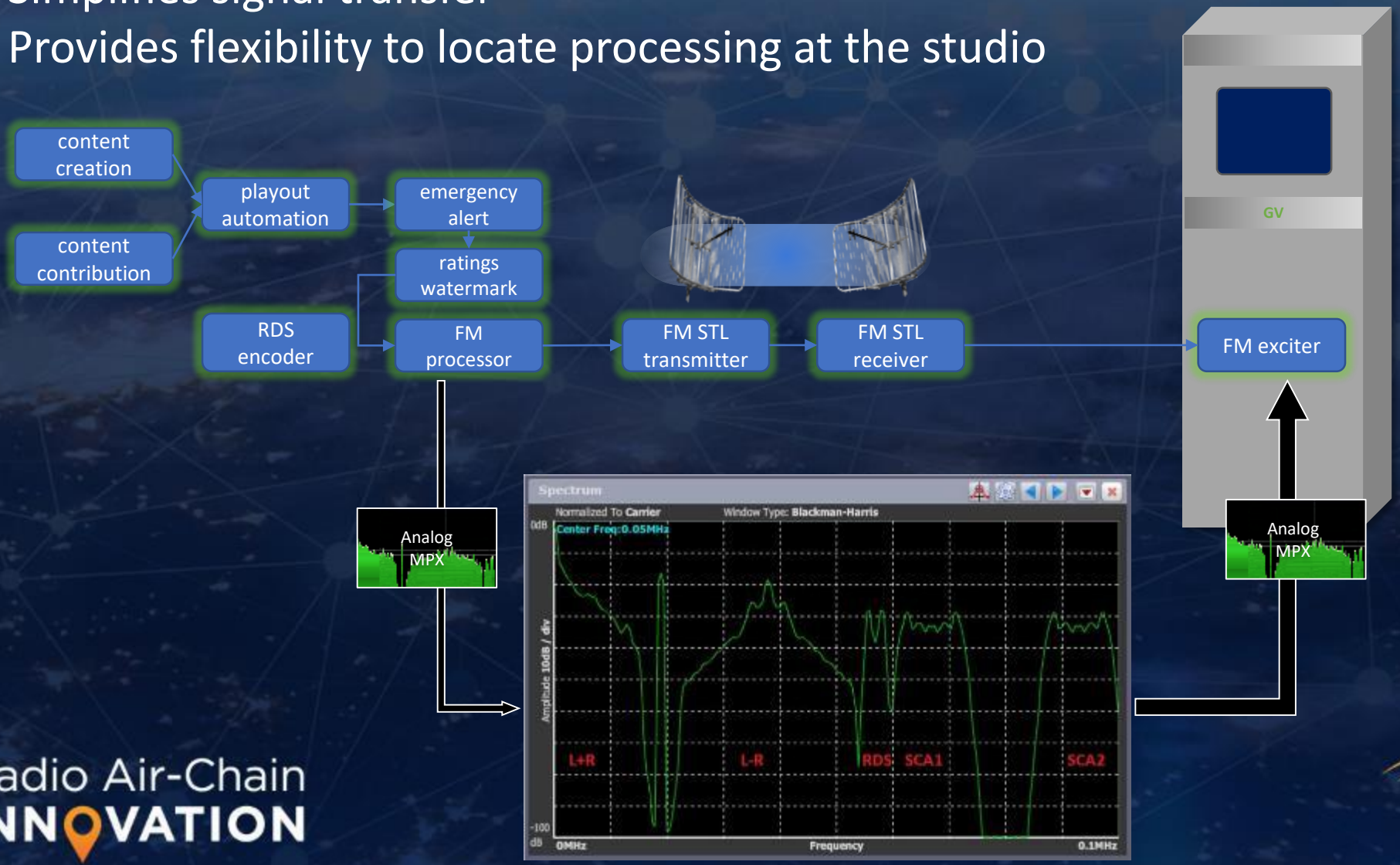
Made for Radio: MPX over IP

Composite signal carries all FM signal components
Simplifies signal transfer
Provides flexibility to locate processing at the studio



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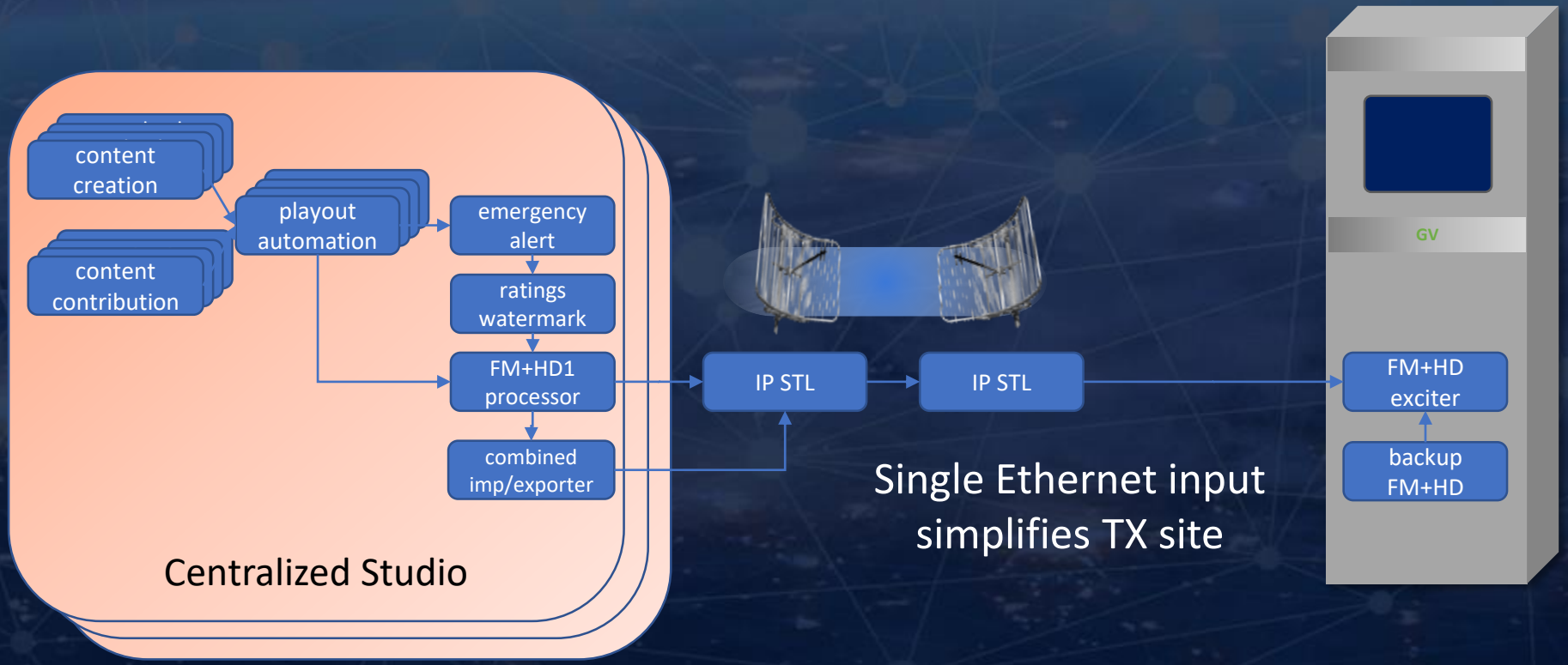
Can we Centralize the Entire Radio Air-Chain?

Can we move the FM and HD Air-Chains together?

Can we utilize “Made for Radio” standards & technologies?



A New Approach:
A Software HD Radio Server

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Omnia Enterprise 9s Software Audio Processing

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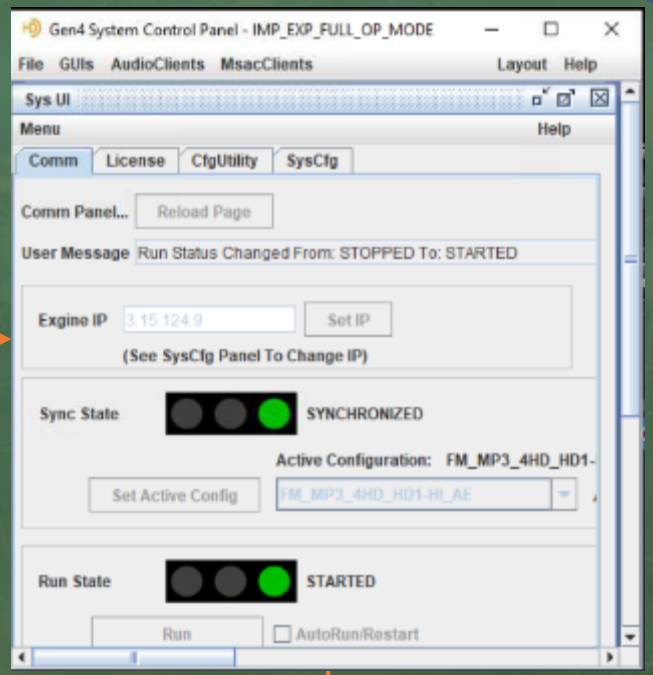
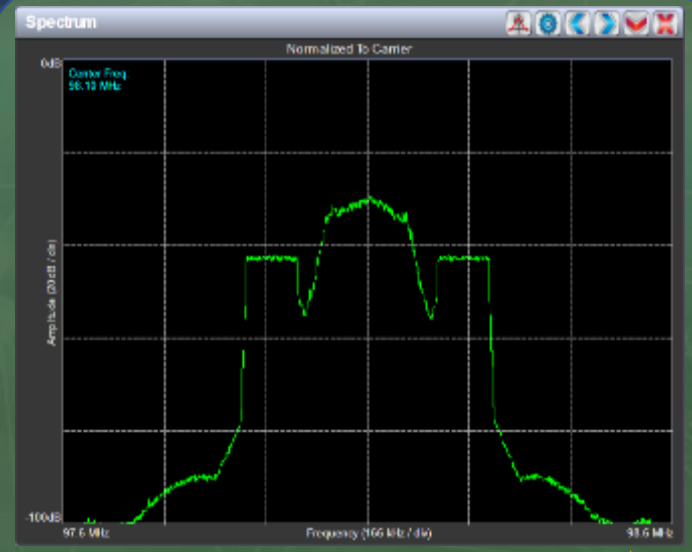
Synchronous System from SPLIT to JOIN

main audio feed

time keeper

44.1 kHz
HD1 L/R
176.4 kHz
MPX





E2X

MPX

buffer

MPX E2X MPX E2X

TCP/IP

exgine

FM modulator

JOIN

Software HD Radio Server

Nautel Exciter

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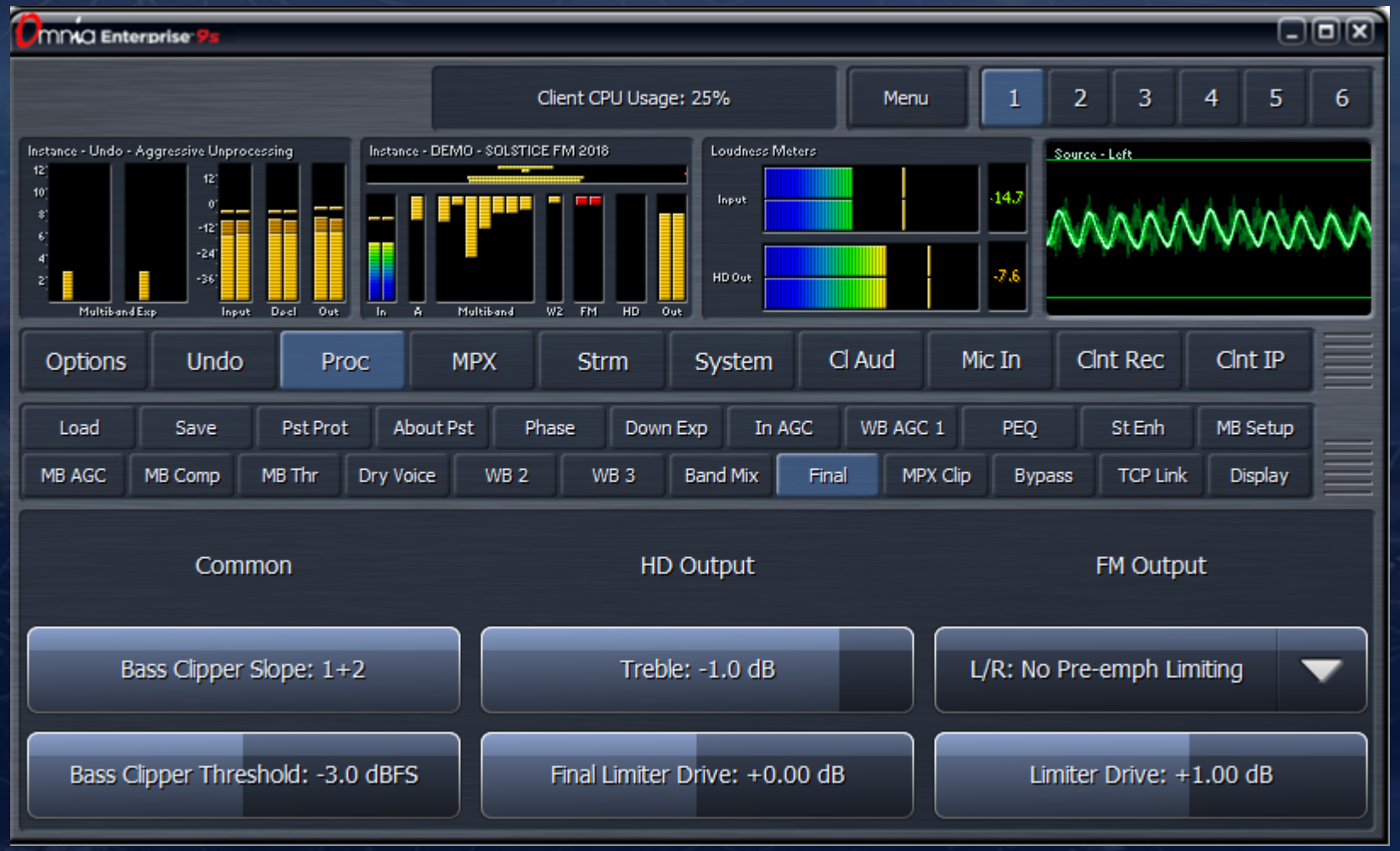
Omnia Enterprise 9s



- Built from the Omnia 9
- Highest quality audio
- Common feature “DNA”
  - Undo
  - Advanced Signal analytics
  - Flexible Monitoring
  - Embedded pilot & RDS

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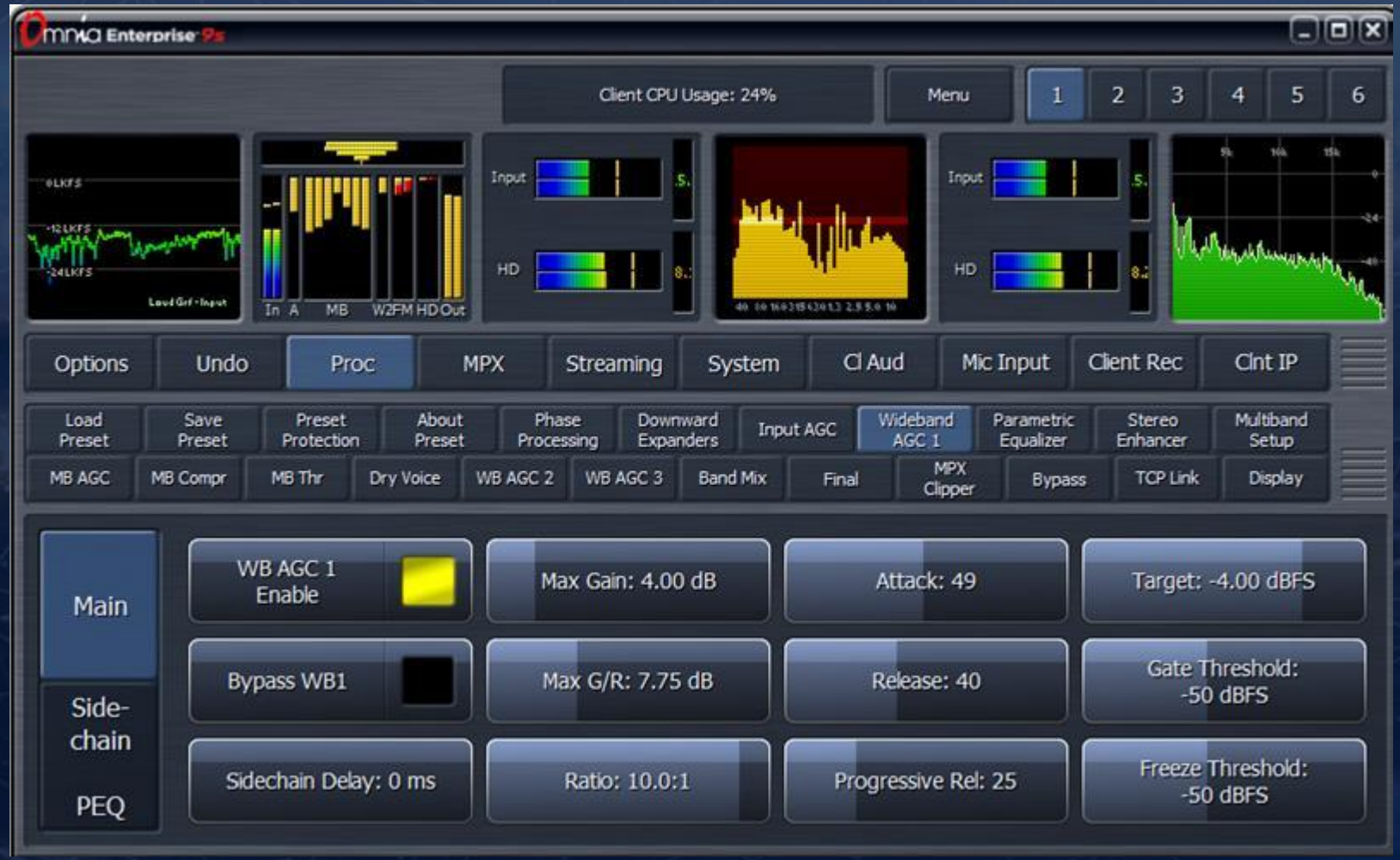
Omnia Enterprise 9s: Sonic Visibility



- NF Remote application
  - Powerful Real-Time metering
  - up to 8 simultaneous displays
  - View and listen to any point in your processing chain

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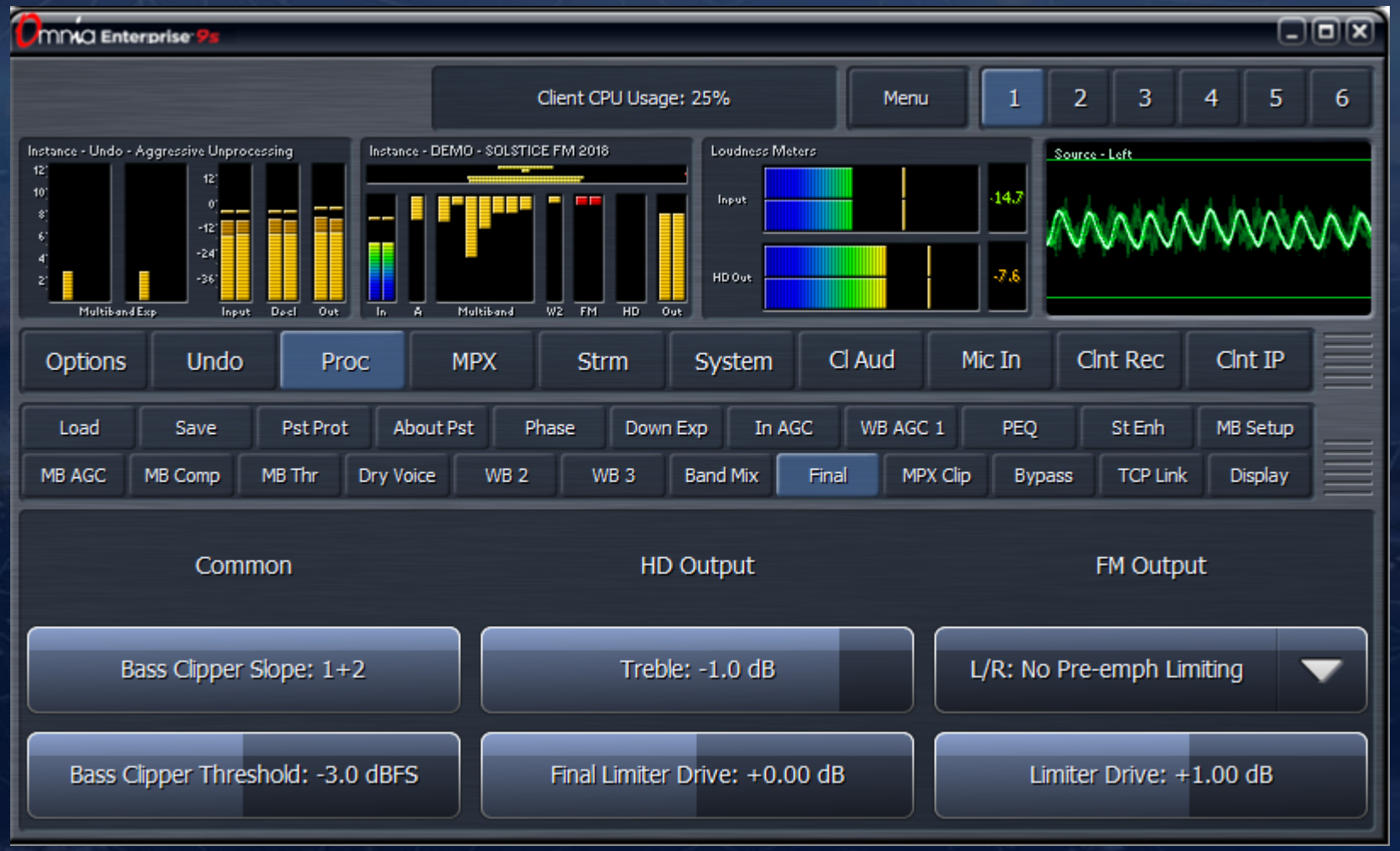
Omnia Enterprise 9s: HD1 & FM Cohesion



- Shared processing structure up to final output stages
- Greatest possible HD-FM sonic coupling

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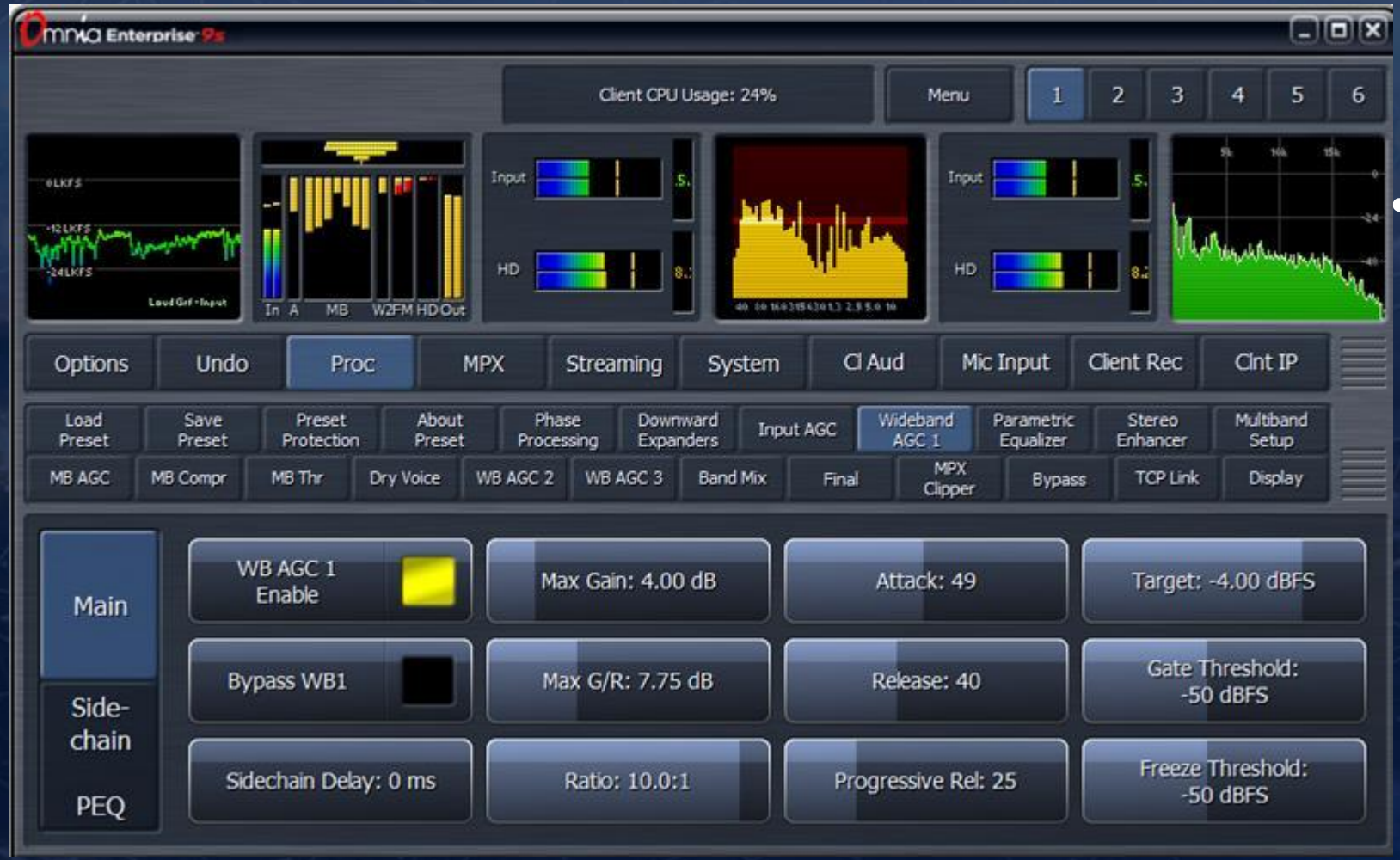
Omnia Enterprise 9s: Uncommon Power



- Preset cloning and deployment
  - Develop and share presets between FM, HD1, HD2, HD3, Streams & Codecs.
  - Export Settings to other instances

Omnia Enterprise 9s I/O

- Livewire+ AES67
- Stream Inputs

Omnia Enterprise 9s
FM / HD Processor

- L/R
  - Livewire +AES67
- Composite
  - Linear MPX over IP
  - µMPX
- Streams
  - AAC
  - HE-AAC
  - MP2
  - MP3
  - FLAC

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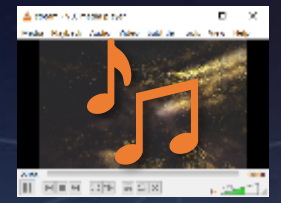
Benefits of Omnia Enterprise Processing

- Ability to run multiple instances on a single server
- Ability to host the server on premises or in the cloud
- Ability to integrate processing within other workflows
- Scalability
- Leverage of expanding IP Infrastructures
- Enabled by standards based IP audio

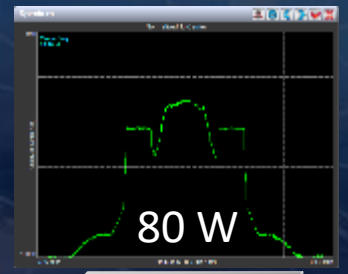
Demonstration

Long distance IP delivery over public Internet
Stable delay without GPS synchronization

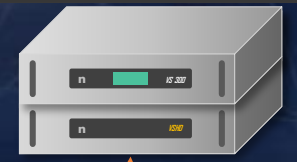


Sofia RX

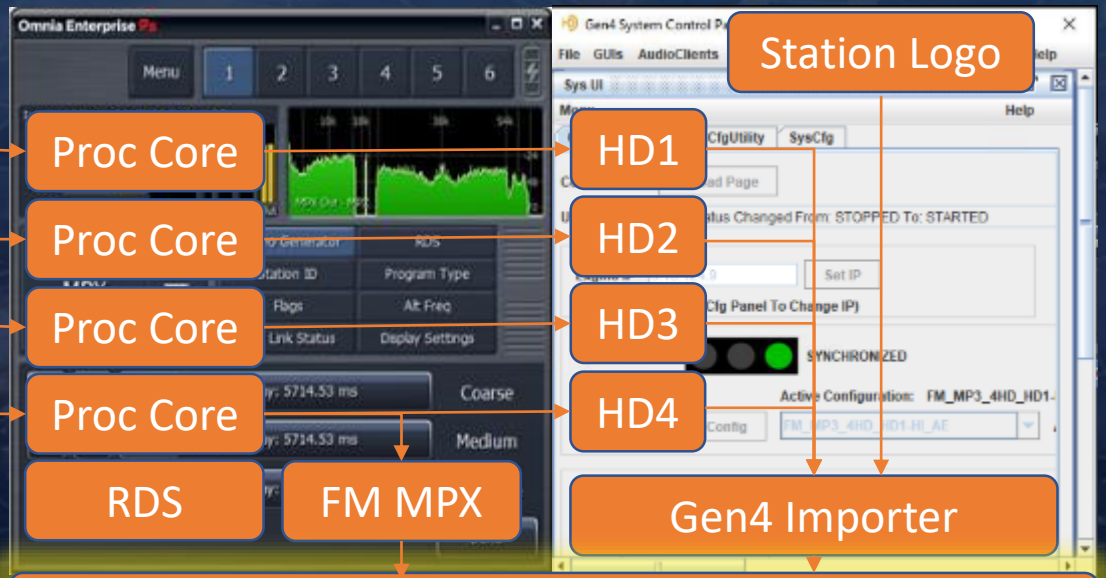
Justin 808



Nautel VS300



icecast
Livewire
Livewire
Livewire



Software HD Radio Server

1470 miles
(39 ms ping)

Public Internet
TCP/IP: E2X + Linear MPX

firewall

Nautel HQ

Saint Cloud, Minnesota
Alex Hartman's Garage

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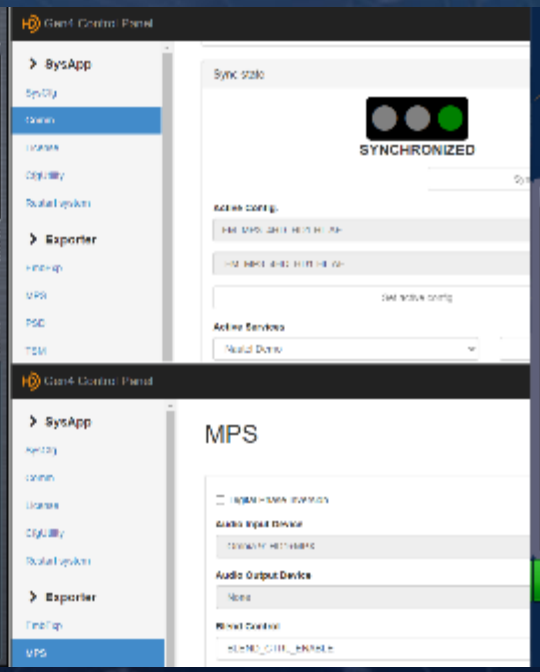
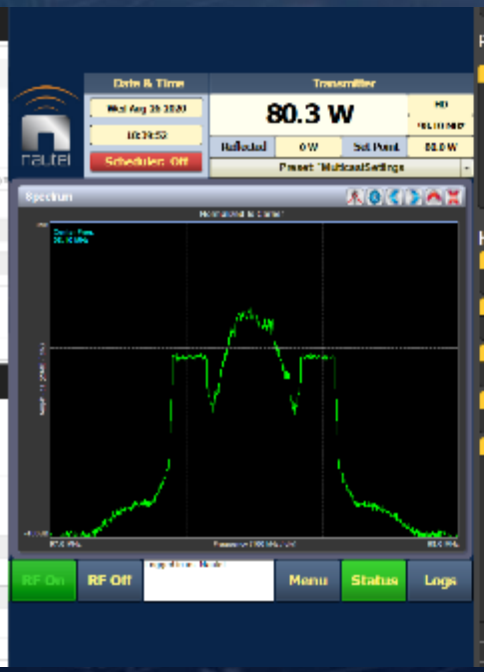
Demonstration: What you'll see

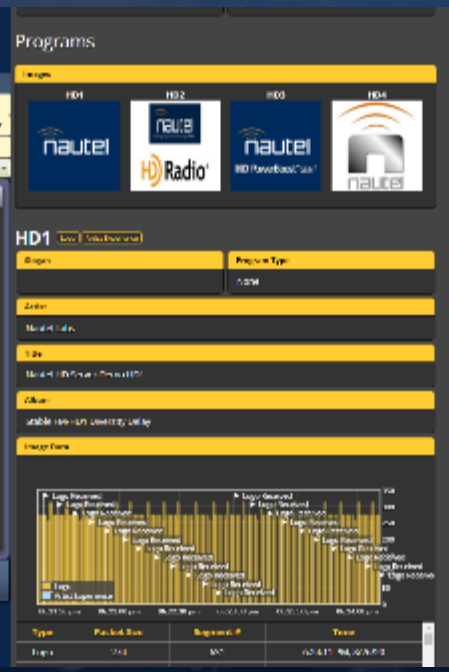
Omnia Enterprise 9s
Remote UI



GEN4 Importer
Web UI



Nautel
Web UI



Inovonics Sofia
Streaming Receiver

Inovonics
Justin 808

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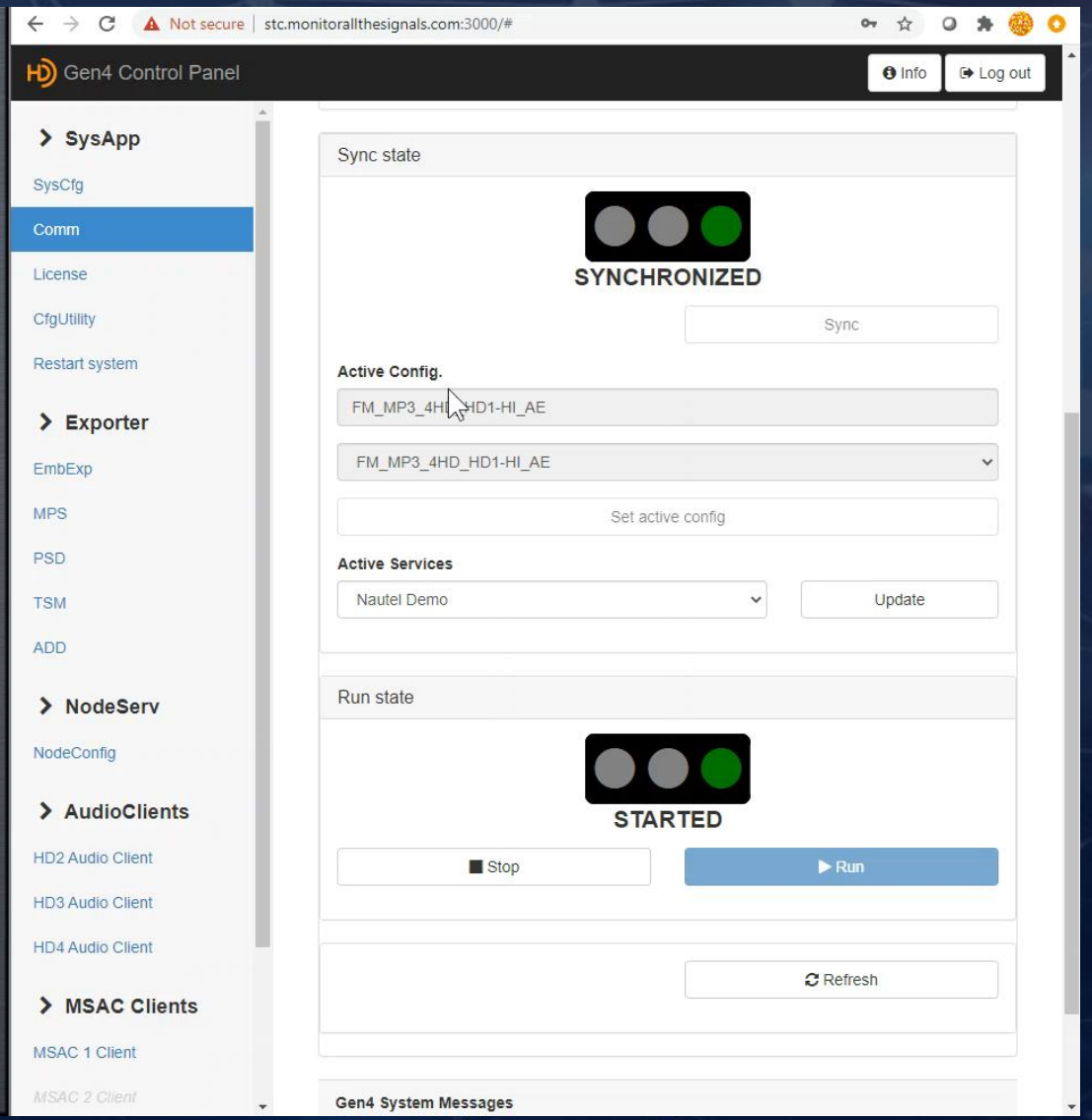
Demonstration: What you'll see



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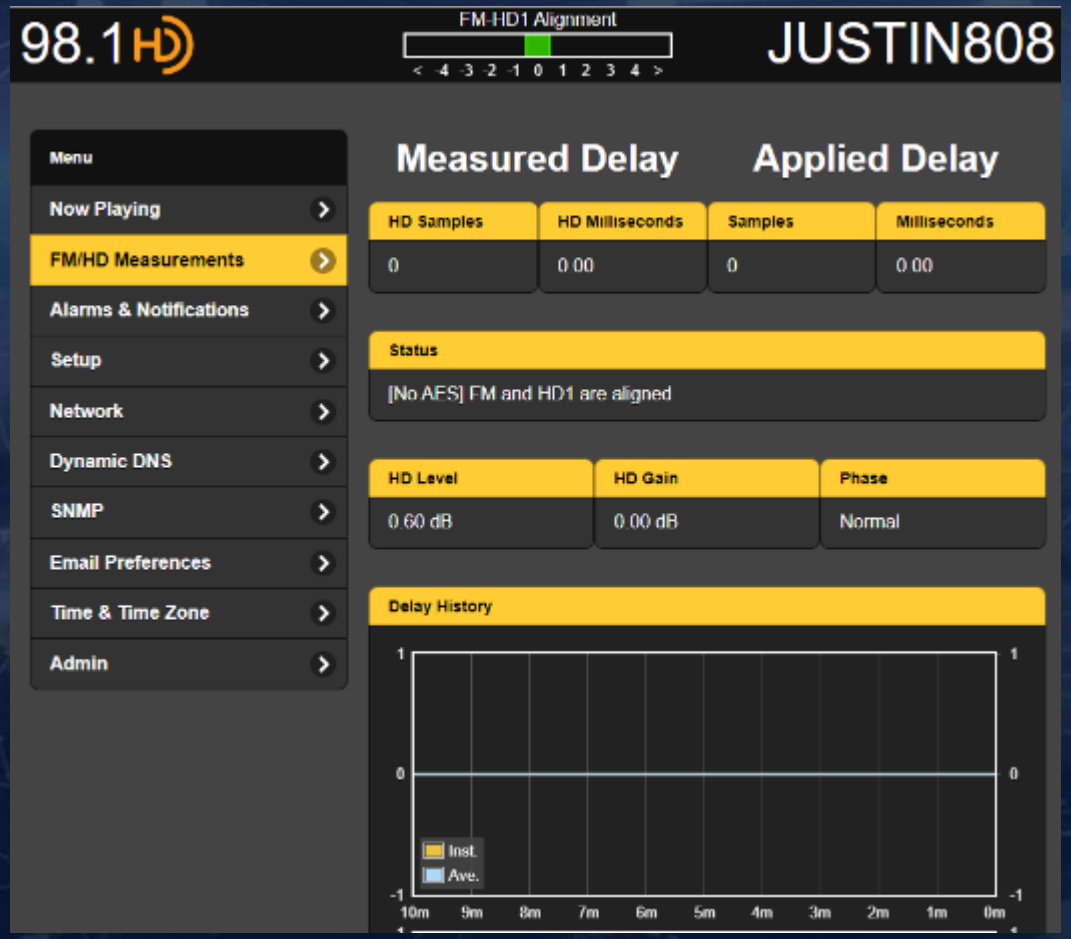
FM/HD Diversity Delay Problem Solved



FM and HD1 time lock is achieved by synchronously

1. splitting the audio in the audio processor
2. transmitting E2X and MPX in a single IP stream
3. joining modulated FM and IBOC in the exciter

The HD Radio air chain is now location agnostic

- transmitter site or studio
- centralized/regional studio

HD Radio air chain is entirely software based

- no audio cards or specific hardware
- no reactive diversity delay monitor required
- GPS is not required to maintain diversity delay

Legacy + Cross Compatibility using

1. E2X in HD only legacy mode (back to 2005 vintage)
2. µMPX and MPX Node
3. reactive diversity delay correction receivers

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Can we Centralize the Entire HD Radio Air-Chain? YES

In today's demonstration:

- Ability to centralize the HD Radio air chain
- Flexible software only HD Radio air chain
- Time locked FM and HD1 to eliminate alignment drift

Tune in to the next webinar to examine options for a new way forward …

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AUG 13
Made for Radio Standards
1
AUG 27
Problem Solved
Live Demo #1
2
SEPT 10
A New Way Forward
Live Demo #2
3
?