NAUTEL NAB 2009

NEW Products!
NEW Technology!
NEW Ideas!

Gary Liebisch
Eastern Regional Sales Manager

Making Digital Radio **Work.**

Overview

- Developments in HD Radio—elevated digital carriers
- Nautel's Power Boost – Progress Report
- Satellite HD Radio program delivery to Multiple network stations
- Local insertion for Satellite HD Radio program delivery
- I + Q over IP for Single Frequency Networks
- Nautel NV Series Transmitters – Now 3.5 to 40 kW
- Nautel's new NX25 AM transmitter
- NV and NX Enhancements: "AUI Anywhere" and "Orban Inside"

HD Radio Power Increase

- NPR Labs, iBiquity, Commercial Broadcasters Alliance
- Advanced IBOC Coverage and Compatibility Study (Field Test)
- Collaboration and unity essential to getting FCC approval
- “Managed” power increase approach
- Study objectives:
  - Critical spacing
  - Mobile sensitivity calibration
  - Impact on SCAs
  - Indoor and Analog benefits
- CPB Funded ($350,000)
- 15-20 Stations involved in tests

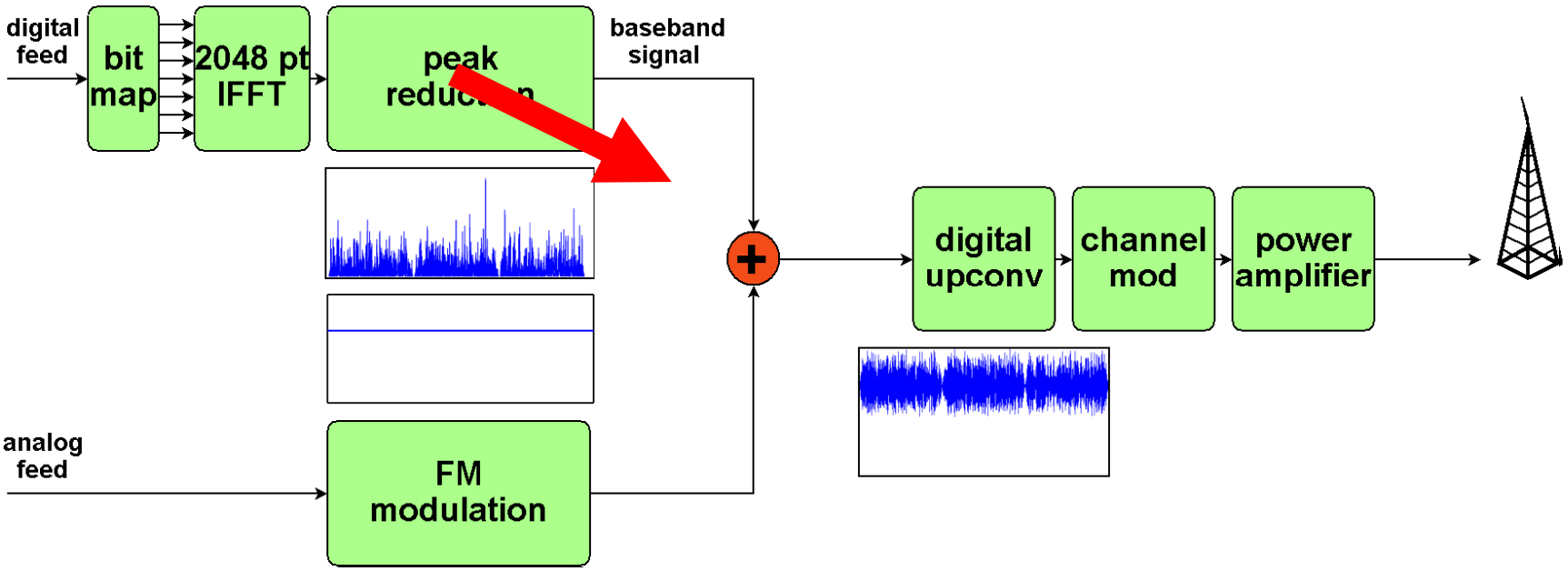
Power Boost Demo

Nautel Power Boost

- Peak-to-Average Power Ratio (PAPR) reduction scheme
- Reduces headroom requirement / less Power Back Off
- SMART detection algorithm--Reduces peaks ONLY when the analog + digital vector sum would otherwise oversaturate the amplifier
- 1 to 1.5 dB increase in available analog power for hybrid (-10) operation
- Future option and product enhancement for Nautel NV Series transmitters and exciters

Proposed PAPR Reduction

Standard PAPR reduction only considers the IBOC signal …



… what if we considered both the analog and digital signals together?

Importance of Reducing PAPR

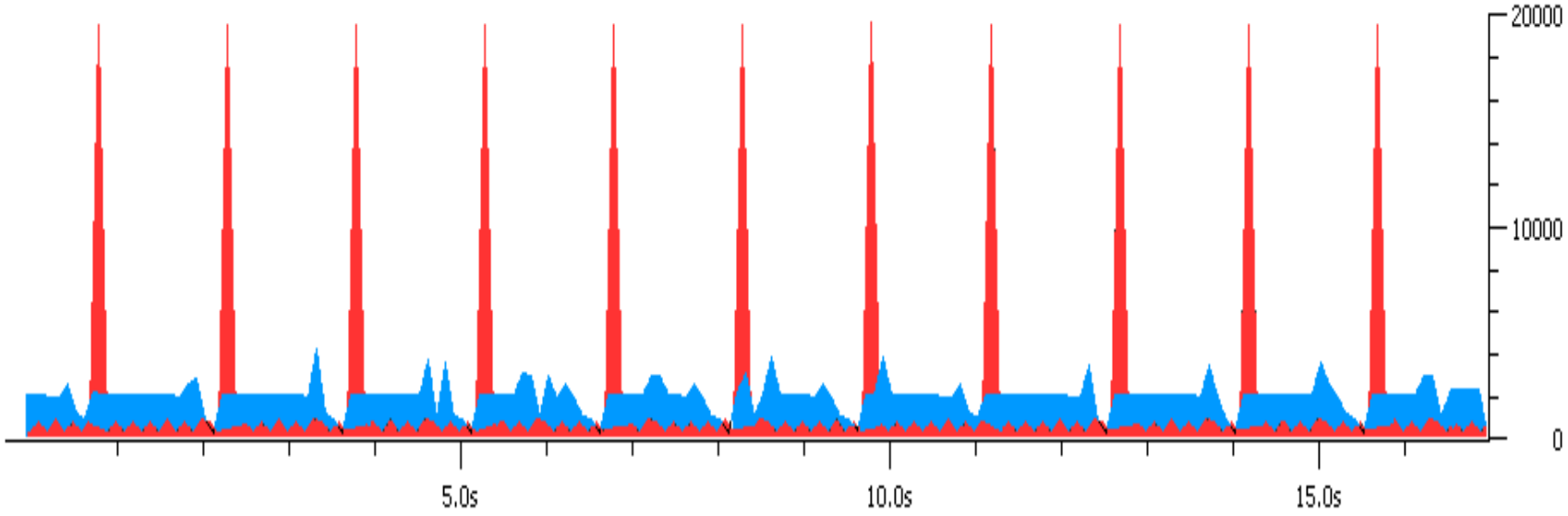
With Power Boost, if a 10kW (Analog) is capable of 4kW (-10 dB Hybrid IBOC), then:

A 1 dB improvement increases average power to 5 kW

A 1.5 dB improvement increases average power to 5.6 kW

Increasing average power (reducing PBO) will also have a positive impact on the transmitter AC to RF power efficiency.

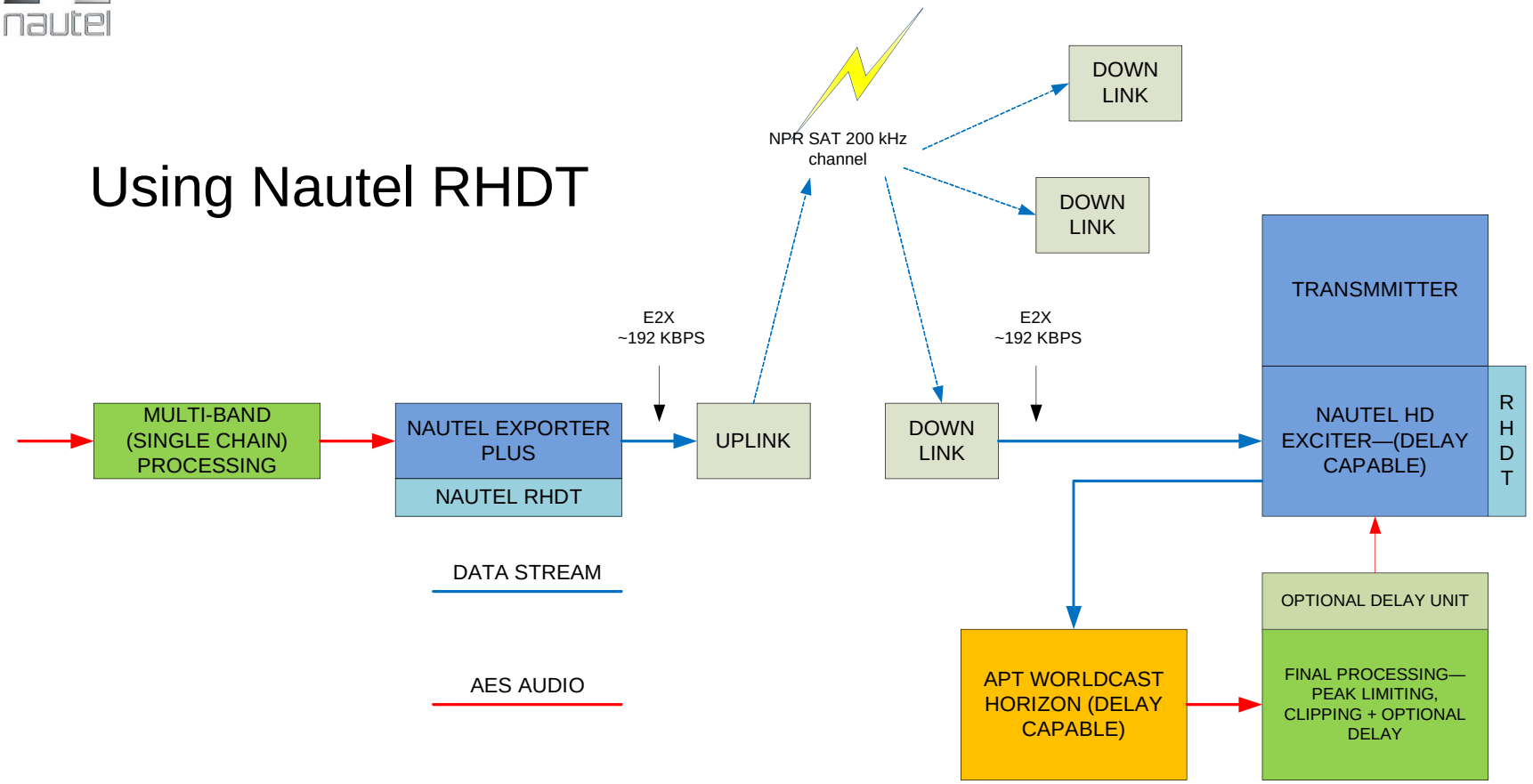
Nautel Reliable HD Transport



- **Reduces instantaneous bandwidth requirements**
- **Assures clock packets are delivered reliably and on time**
- **Make use of return link (if present) to issue retransmission requests**
- **Encapsulated UDP – benefits of TCP/IP without the overhead**
- **Fits in bandwidth limited STL's such as satellite links (200 kHz)**

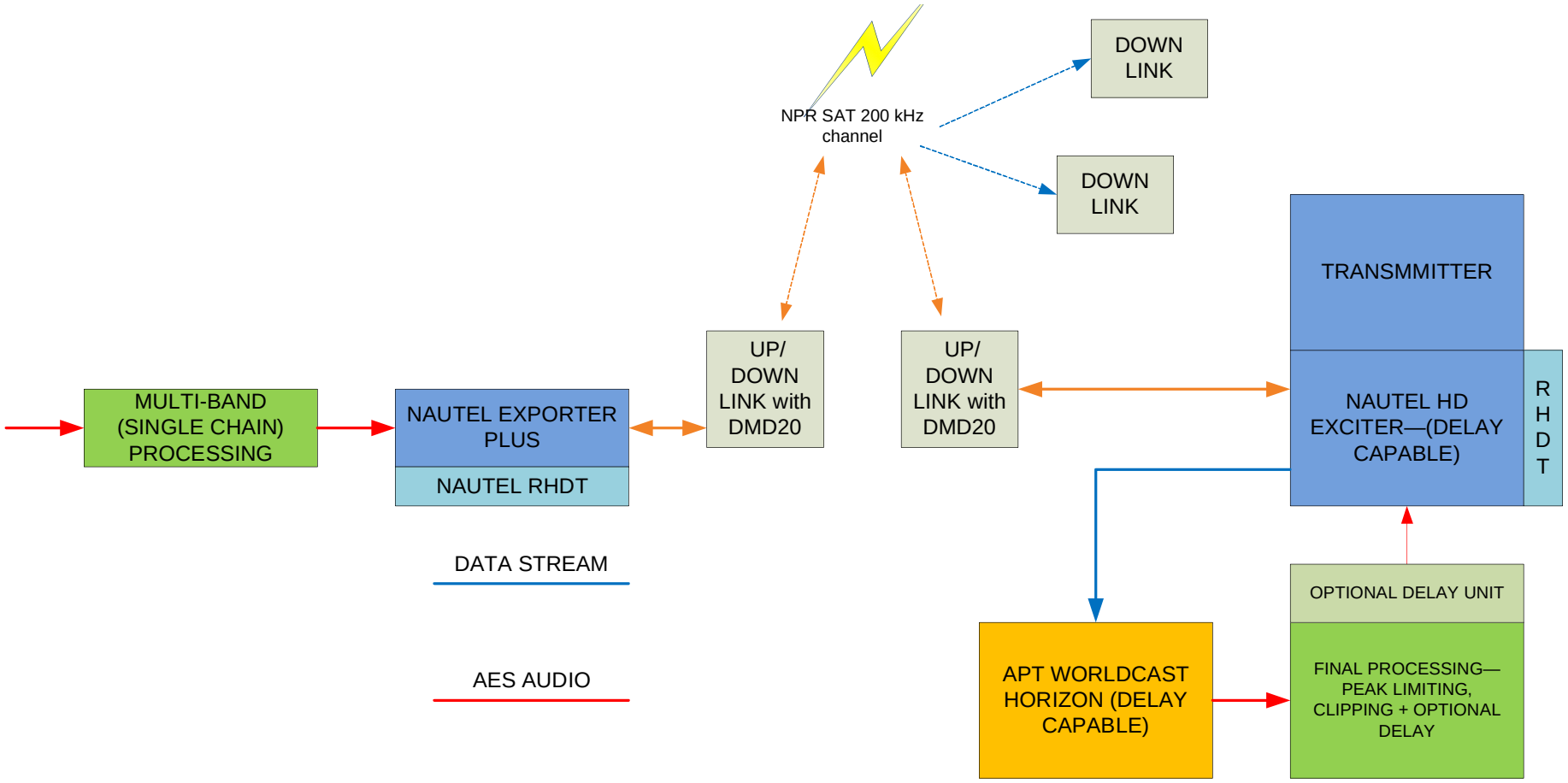
FM Host Extraction over Satellite

Using Nautel RHDT

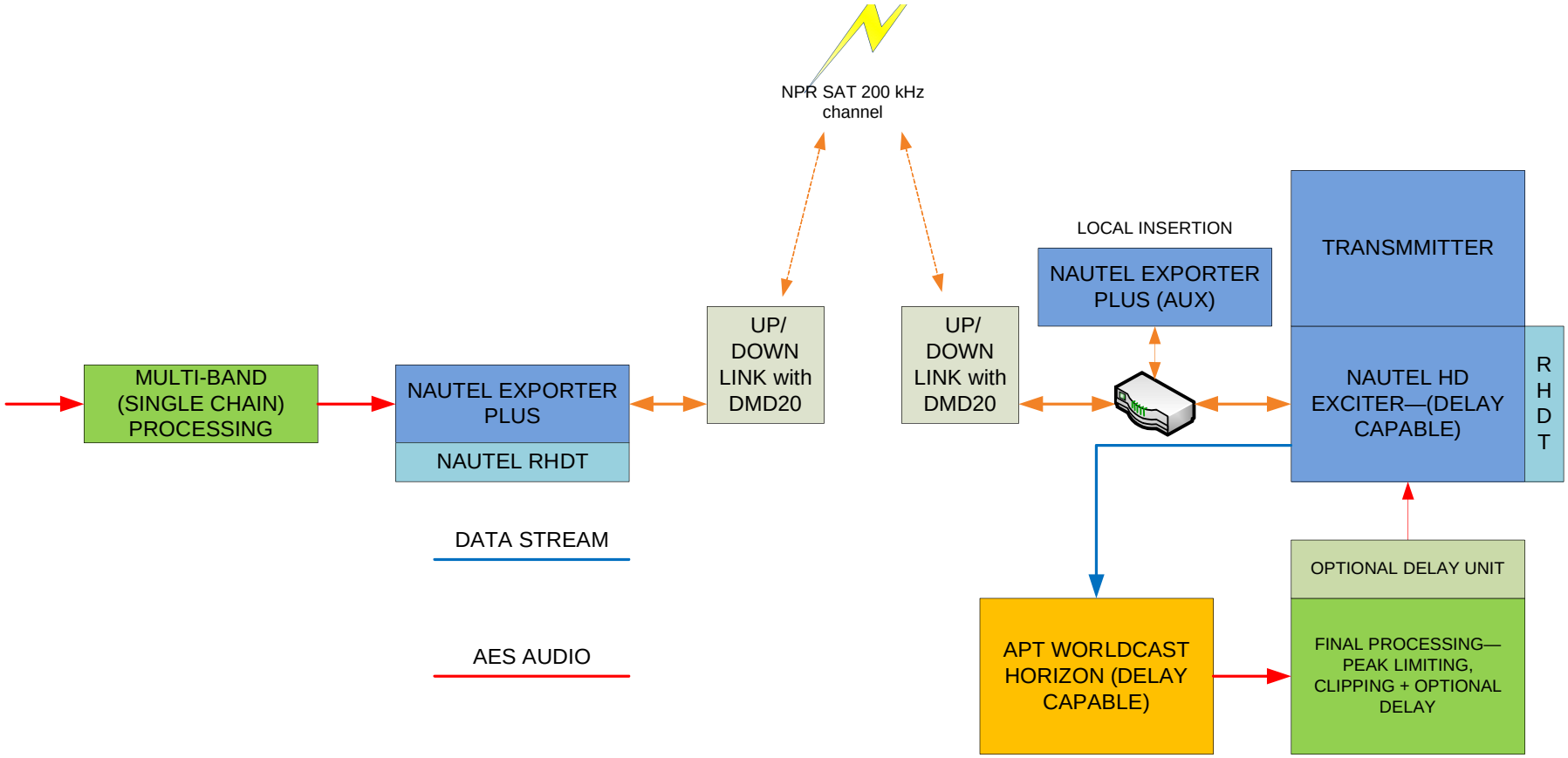


Drawn by G. Liebisch 1/16/09

FM Host Extraction over Satellite (with return link modems)



Satellite Distribution with Local Insertion

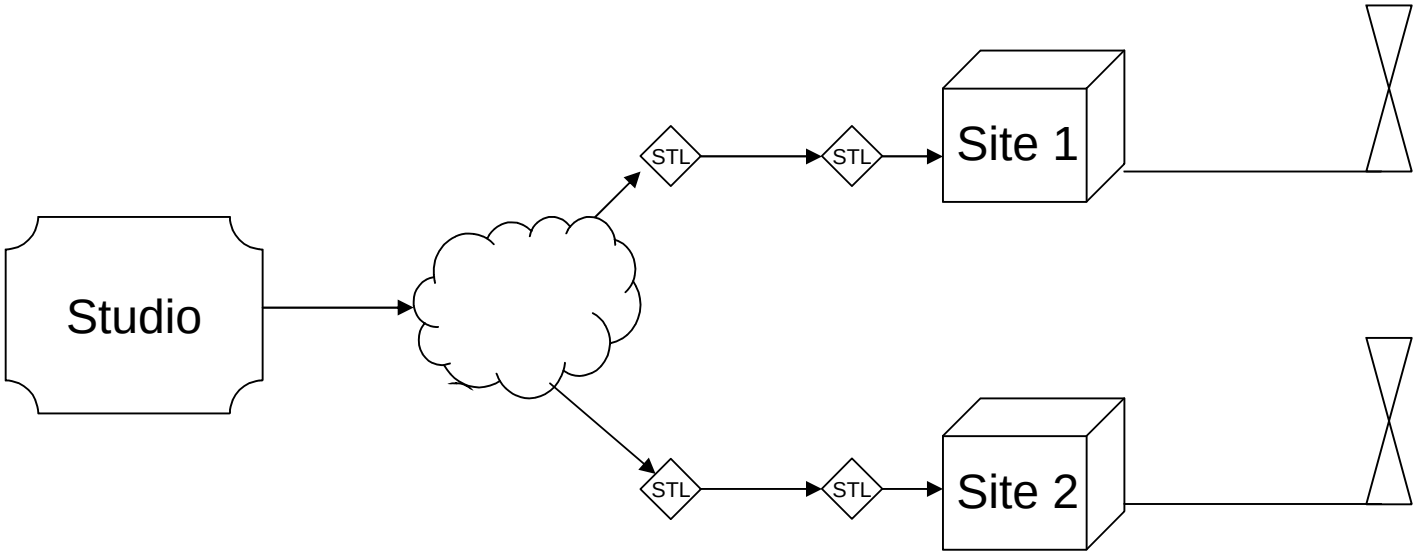


Drawn by G. Liebisch 5/8/09

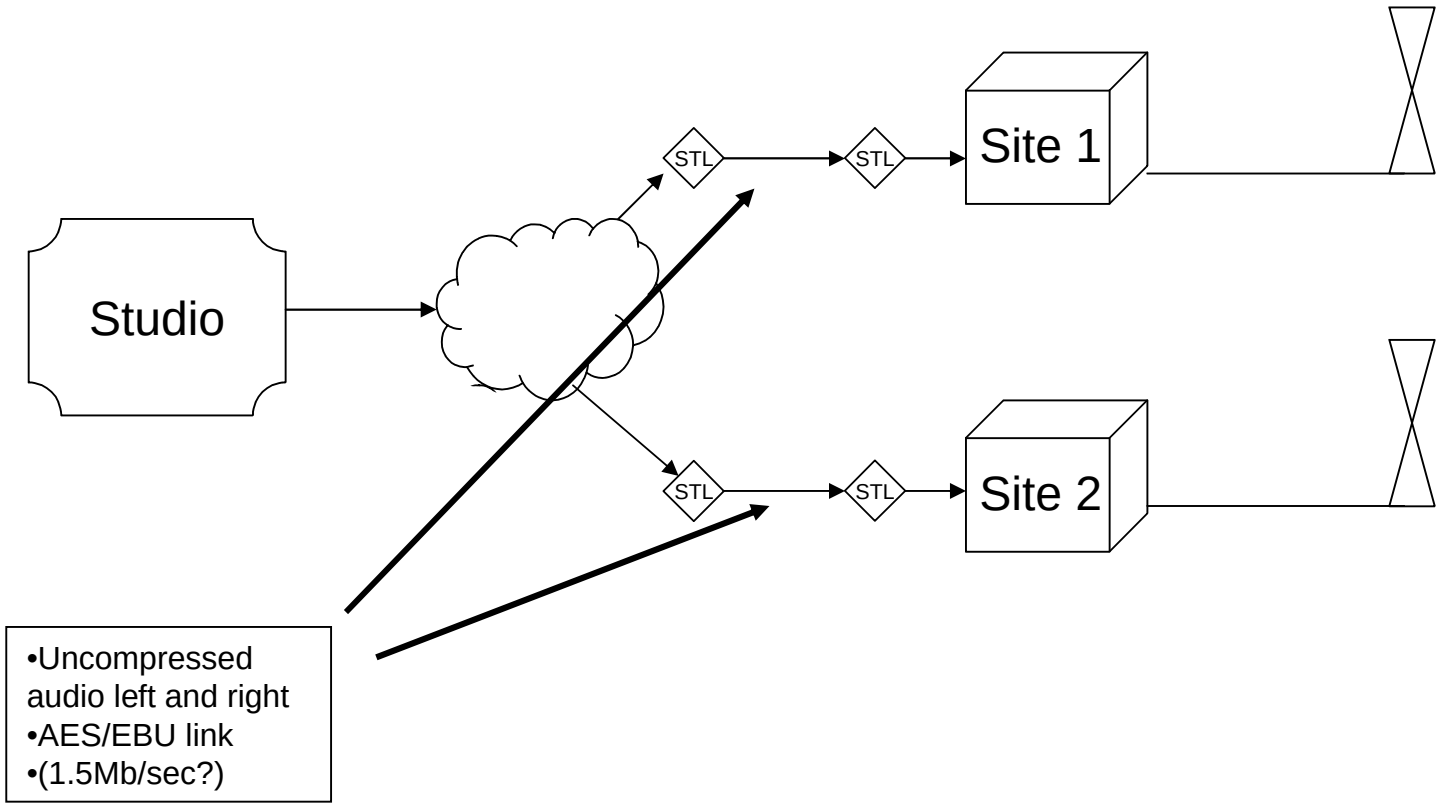
I – Q OVER IP

A Primer for Synchronous FM Boosters

Yesterday's Model



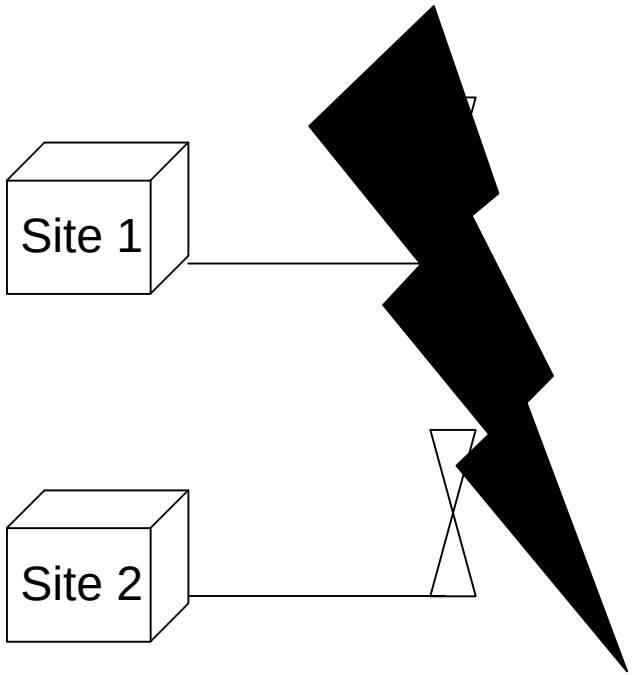
Yesterday's Model



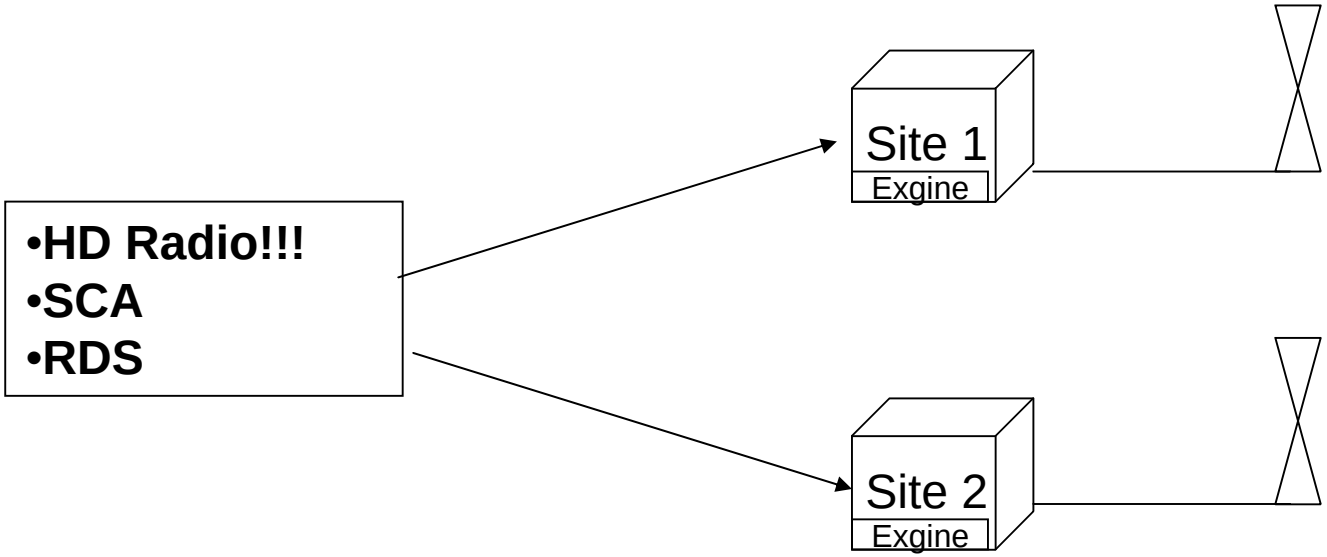
Challenges 1

1.Carrier frequency must be individually synced to GPS at each site
2.Pilot frequency must be individually synced to 10MHz GPS at each site
3.Pilot phase must be individually synced to 1pps GPS at each site
4.Modulation index must be manually adjusted at each site

ANY SLIGHT DEVIATIONS INCREASE INTERFERENCE



Challenges 2



Nautel's Solution

- Create the complete signal to be transmitted once, back at the studio
- Deliver a high resolution, all-inclusive signal to each transmitter site
- Best method is to utilize I/Q, which faithfully represents the signal with timing information embedded in the data stream (total signal description)
- Sync the received signal to GPS
- No longer can the architecture introduce mismatches in control of carrier frequency, pilot frequency, pilot phase and modulation index causing interference

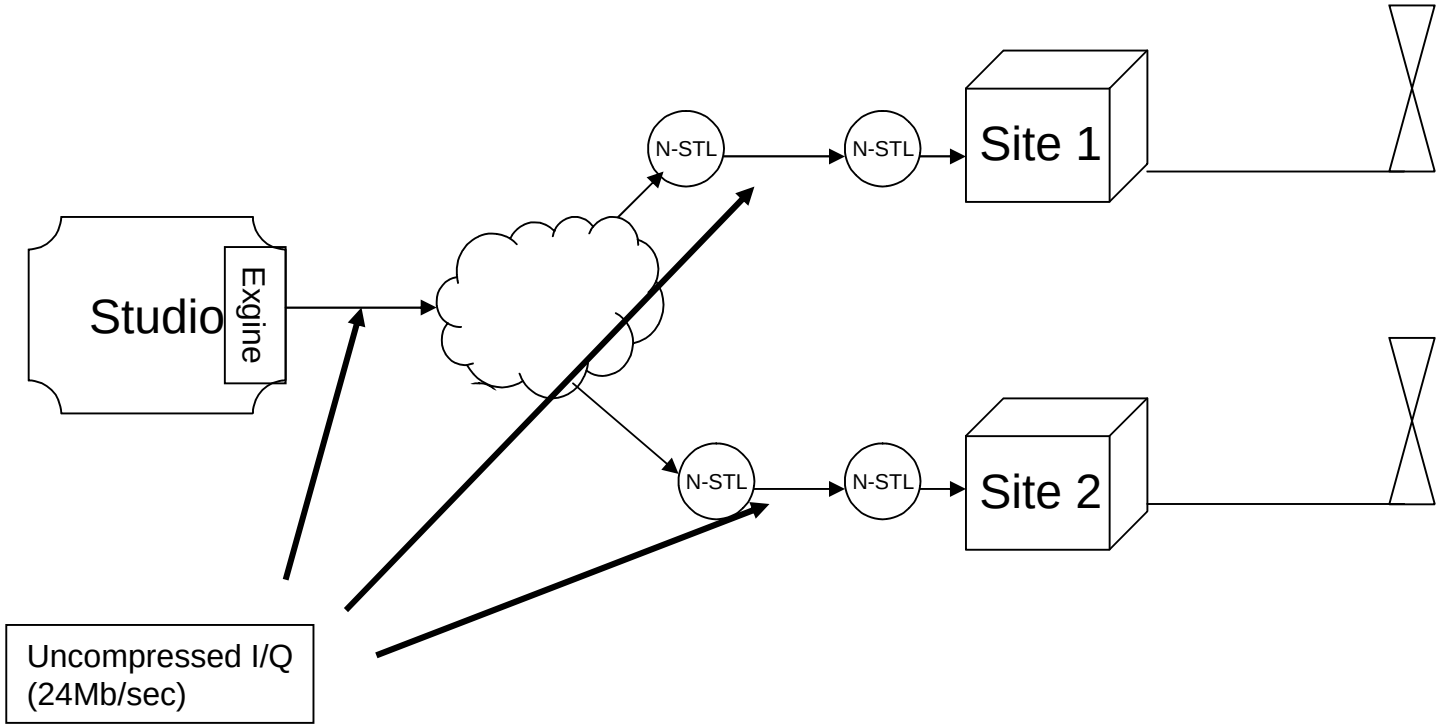
Why I/Q? – Simple View

- We in the RF broadcast world have lots of experience in taking sine waves and modulating the amplitude (AM) or the frequency (FM)
- It turns out that complex signals of any type can be accurately represented by modulating the amplitude of 2 sine waves and them combining those two modulated waves
- This technically simple approach delivers high resolution signals but requires higher bandwidth to deliver the incoming signal to the transmitters

Why I/Q? - Mathematical

- Complex signals can be equally accurately represented by polar or rectangular coordinates
- However, it is difficult to vary precisely the phase of a high-frequency carrier sine wave in a hardware circuit according to an input message signal
- Using rectangular coordinates (I/Q), we simply modulate the amplitudes of the In-phase and Quadrature-phase carriers
- This is significantly simpler, with higher resolution but requires higher bandwidth to deliver the signal to the transmitters

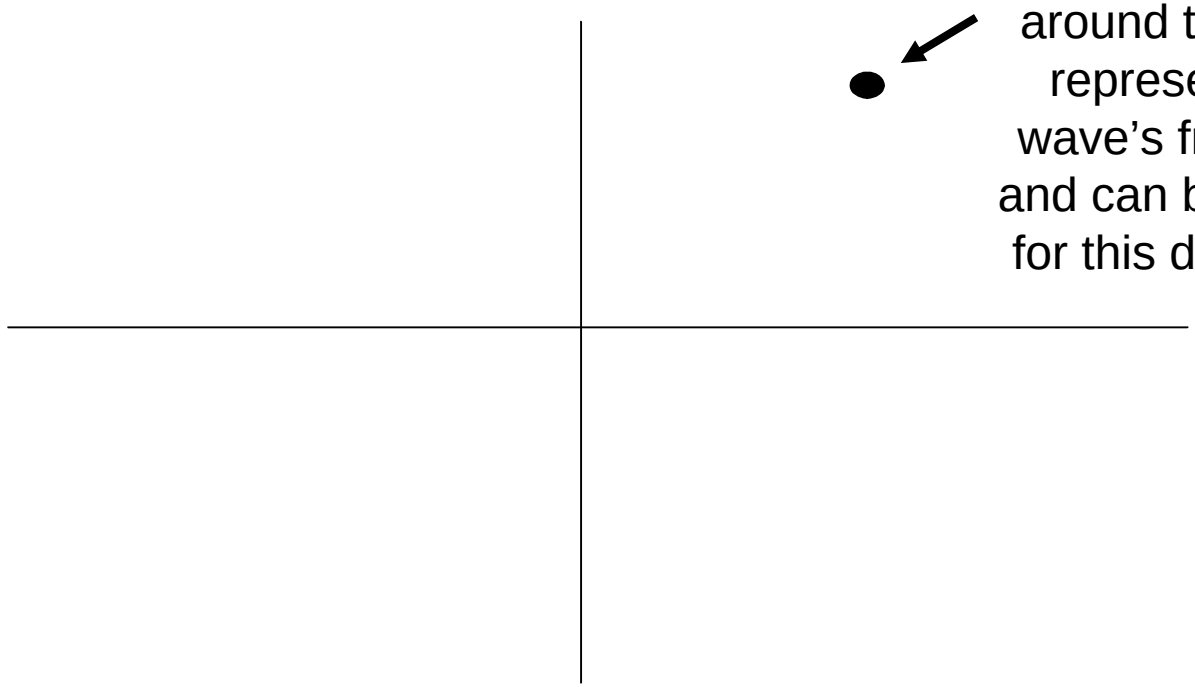
I/Q Over IP


Studio
Exgine
N-STL
N-STL
Site 1
N-STL
N-STL
Site 2
Uncompressed I/Q
(24Mb/sec)

Slightly More Mathematical

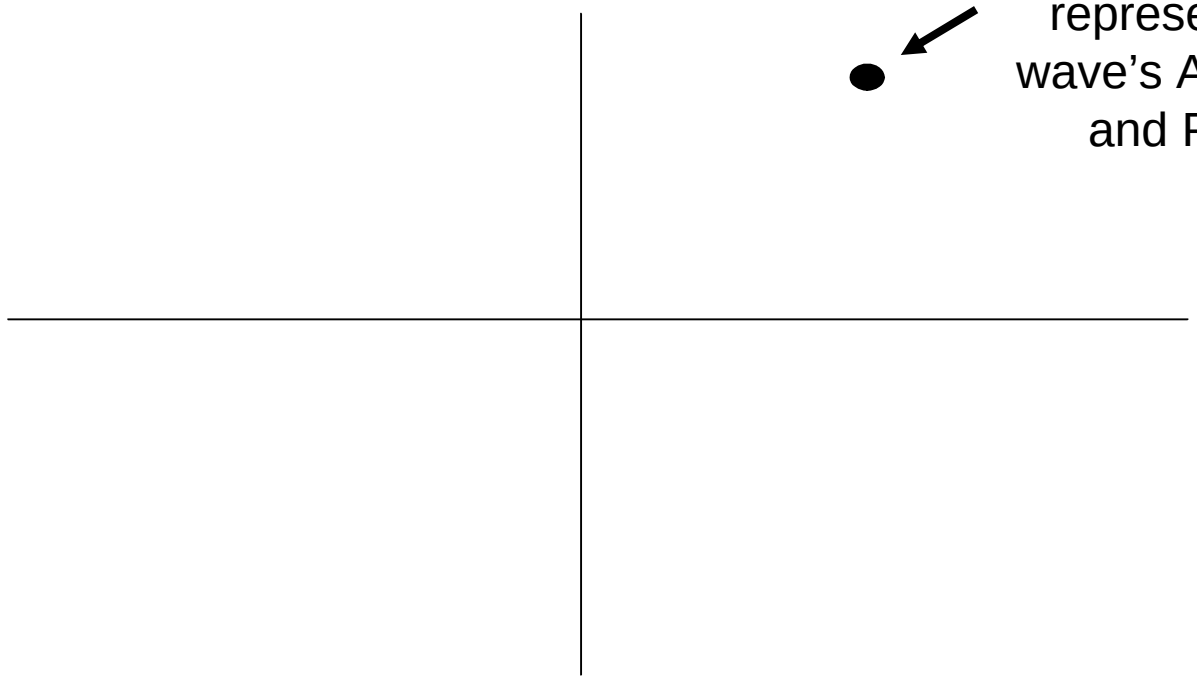
- A modulated wave has 3 components
  - An Amplitude
  - A Phase, and
  - A Frequency
- It can be represented graphically

Instantaneous Representation of the Value of the Wave



How quickly the point moves around the graph represents the wave's frequency and can be ignored for this discussion

Instantaneous Representation of the Value of the Wave

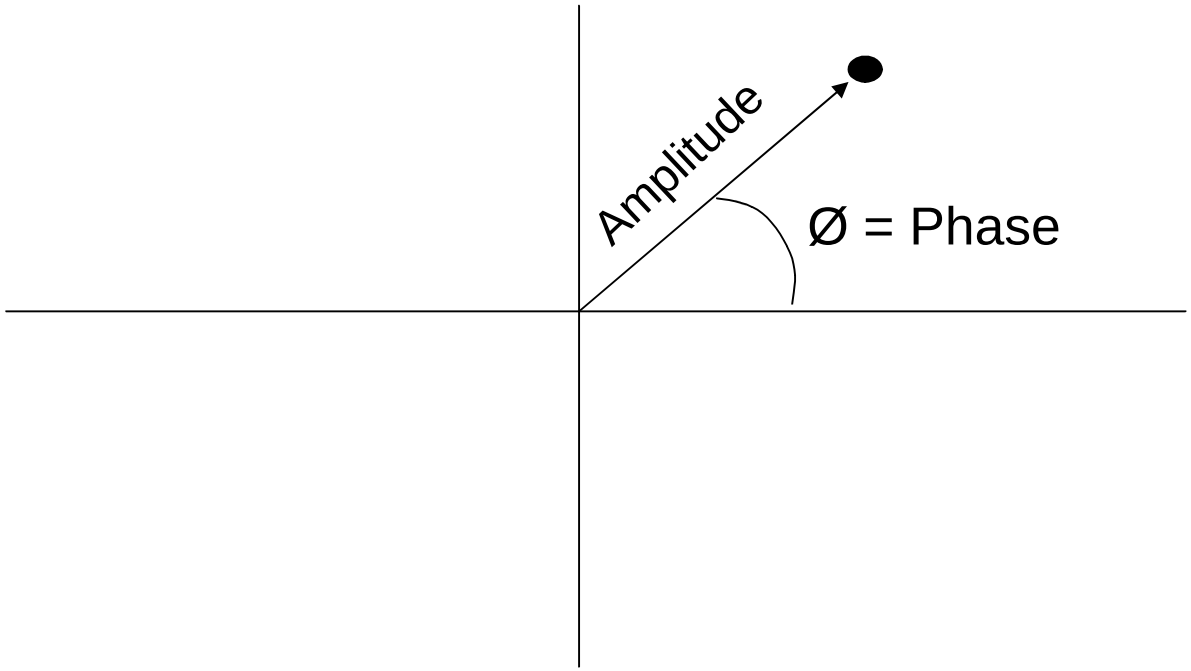


Where the point is on the graph represents the wave's Amplitude and Phase

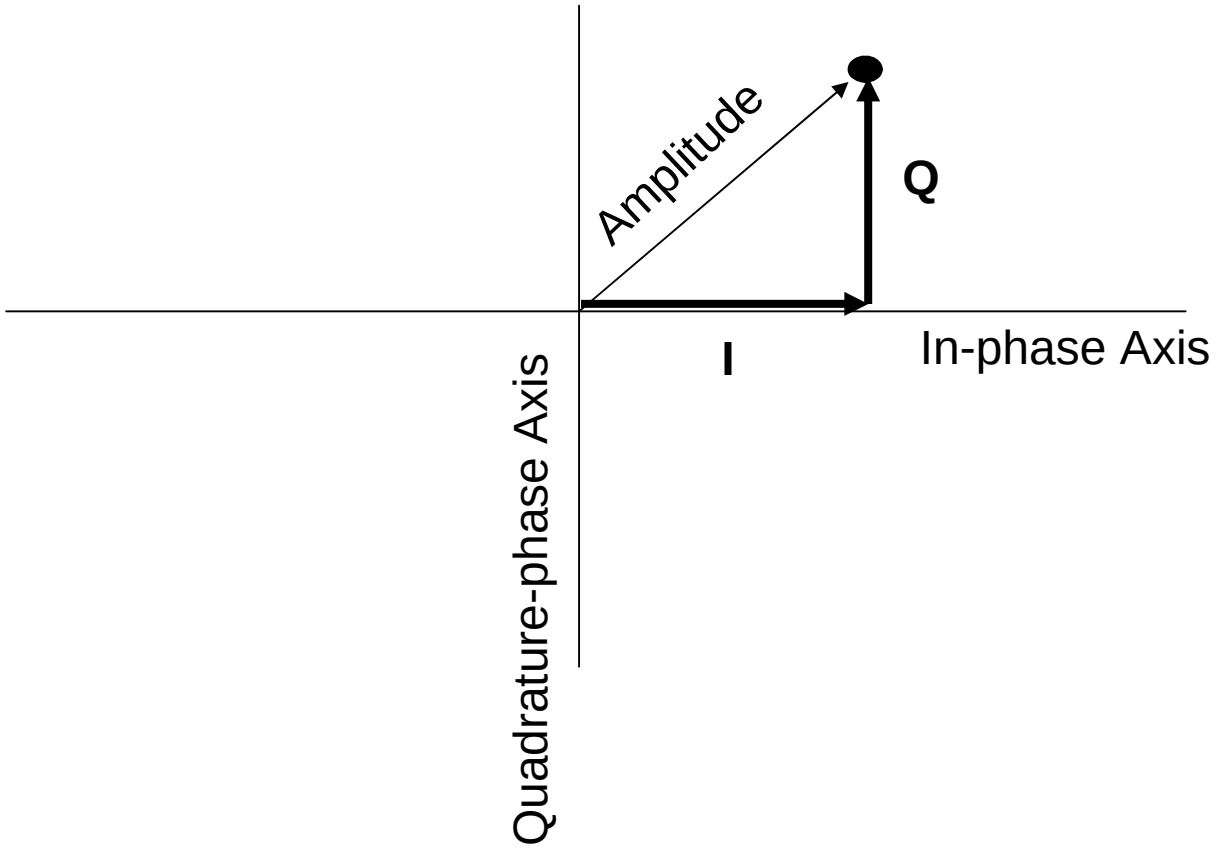
Slightly More Mathematical

- The graphical representation of Amplitude and Phase at a particular instant can take either of two forms

Polar Coordinates



Rectangular Coordinates



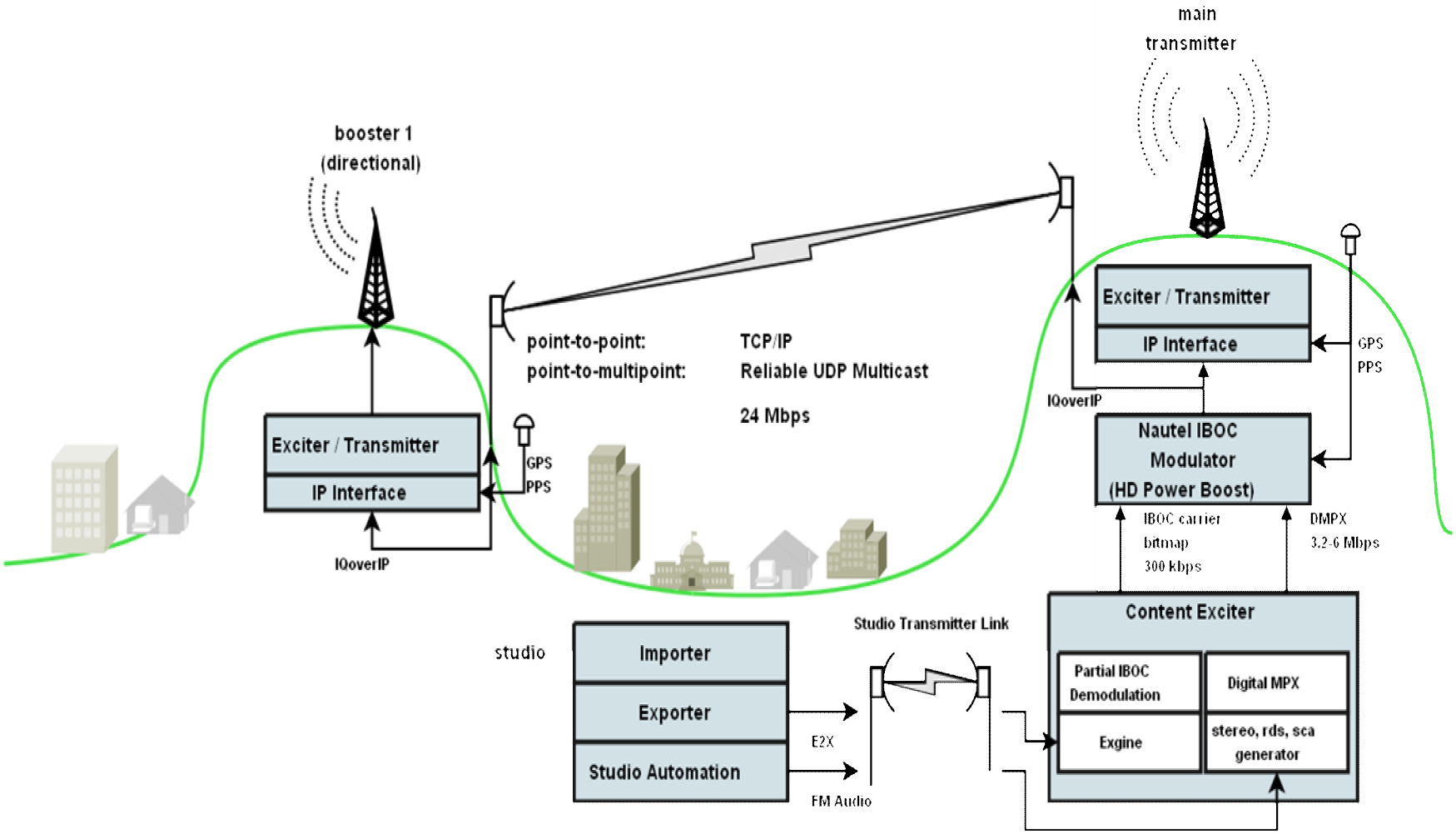
Generating the Wave

- As suggested by the 2 previous diagrams, we can equally faithfully generate the wave by one of two methods:
- Generate a single wave and:
  - Modulate the Amplitude, plus
  - Modulate the Phase
- Or
- Generate two separate waves at 90^0 to each other and:
  - Modulate the Amplitude of each wave
  - Then, combine (add) the 2 waves

Result

- The result of either approach is identical
- However, modulating Phase is very difficult to do
  - So, using that approach is less attractive
- Modulating Amplitude is very easy
  - So, that approach (I/Q) is preferred
- The downside of using I/Q has traditionally been that it requires more bandwidth to transmit the information needed to represent the modulation of 2 waves

I + Q OVER IP


main
transmitter
booster 1
(directional)
point-to-point:
point-to-multipoint:
TCP/IP
Reliable UDP Multicast
24 Mbps
Exciter / Transmitter
IP Interface
GPS
PPS
IQoverIP
Exciter / Transmitter
IP Interface
GPS
PPS
IQoverIP
Nautel IBOC
Modulator
(HD Power Boost)
IBOC carrier
bitmap
300 kbps
DMPX
3.2-6 Mbps
Content Exciter
Partial IBOC
Demodulation
Digital MPX
Exgine
stereo, rds, sca
generator
Studio Transmitter Link
studio
Importer
Exporter
Studio Automation
E2X
FM Audio

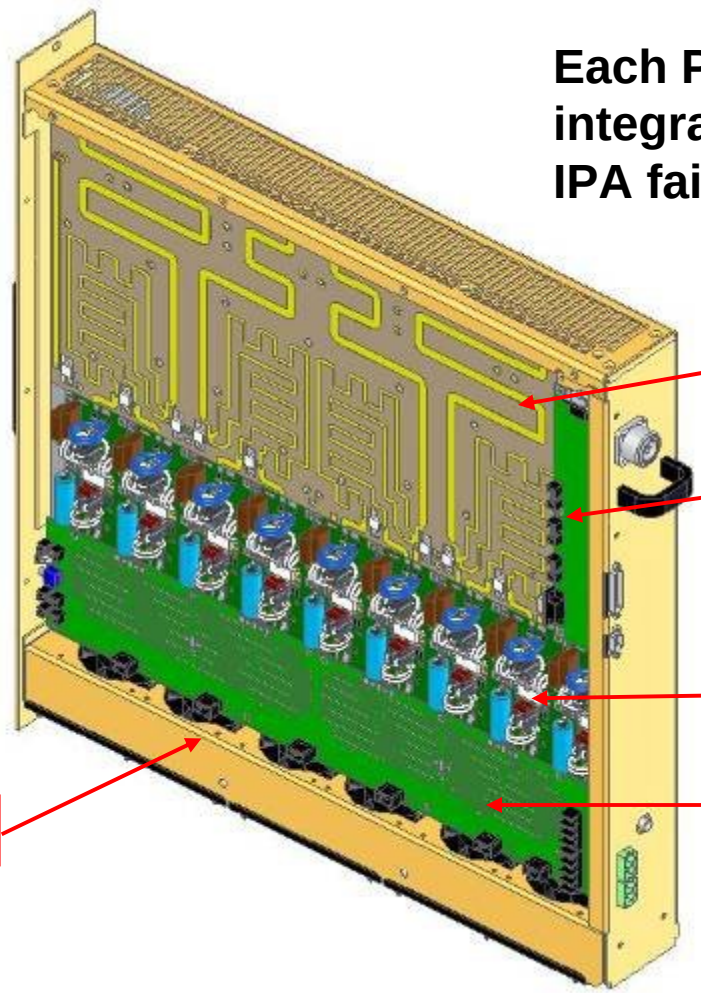
NV Series Transmitter

Product Overview

- Single cabinet solid state design at all power levels
- Broadband, frequency agile, digitally programmable 87.5 to 108 Mhz
- Frequency change by simple local or remote command .makes the NV suitable for N+1 configurations
- Multiple levels of redundancy: PA, IPA, Power Supplies, Cooling, and Control
- Dynamic bias control for RF amplifiers allowing seamless mode changing and maximum power capability in all modes.
- Integral digital exciter (Standby exciter optional). Plug-in upgrade to HD is as easy as adding Exgine card.
- Single or 3-phase at any power level (no upcharges)

NV PA Module

Each PA Module has its own driving IPA integrated in the module, so single point IPA failure is eliminated.



8-Input Combiner

Control-Interface PCB

8 PA's + IPA

RF Drive Splitter PCB

80mm Fans x 6

NV Product Overview

Configuration

	NV15	NV20	NV30	NV40
RF PA Modules (with integrated IPA)	8		16	
PA Power Supplies (2 per PA Module)	16		32	
IPA Power Supply	2		3	
RF Output	@VSWR	<1.2:1		
Analog Mode	16.5	22.0	33.0	44.0
Hybrid (-20)	12.0	16.0	24.0	32.0
Hybrid (-10)	6.6	8.8	13.1	17.5
Efficiency % (A/-20/-10)	61/55/40	64/55/40	61/55/40	64/55/40

NV Product Overview

Configuration

	NV3.5	NV5	NV7.5	NV10
RF PA Modules (with integrated IPA)	2		4	
PA Power Supplies (2 per PA Module)	4		8	
IPA Power Supply	2		2	
RF Output	@VSWR	<1.2:1		
Analog Mode	4.1	5.5	8.3	11.0
Hybrid (-20)	3.0	4.0	6.0	8.0
Hybrid (-10)	1.7	2.2	3.3	4.4
Efficiency % (A/-20/-10)	61/55/40	64/55/40	61/55/40	64/55/40

NV Product Overview

	Dimensions	Weight Uncrated
NV3.5 & NV5	Height: 184.2 cm (72.5 in) Width: 58.4 cm (23 in) Depth: 81.3 cm (32 in)	136 kg (300 lbs)
NV7.5 & NV10	Height: 184.2 cm (72.5 in) Width: 58.4 cm (23 in) Depth: 81.3 cm (32 in)	188 kg (415 lbs)
NV15 & NV20	Height: 184.2 cm (72.5 in) Width: 91.4 cm (36 in) Depth: 81.3 cm (32 in)	386 kg (850 lbs)
NV30 & NV40	Height: 184.2 cm (72.5 in) Width: 165.1 cm (65 in) Depth: 81.3 cm (32 in)	726 kg (1600 lbs)

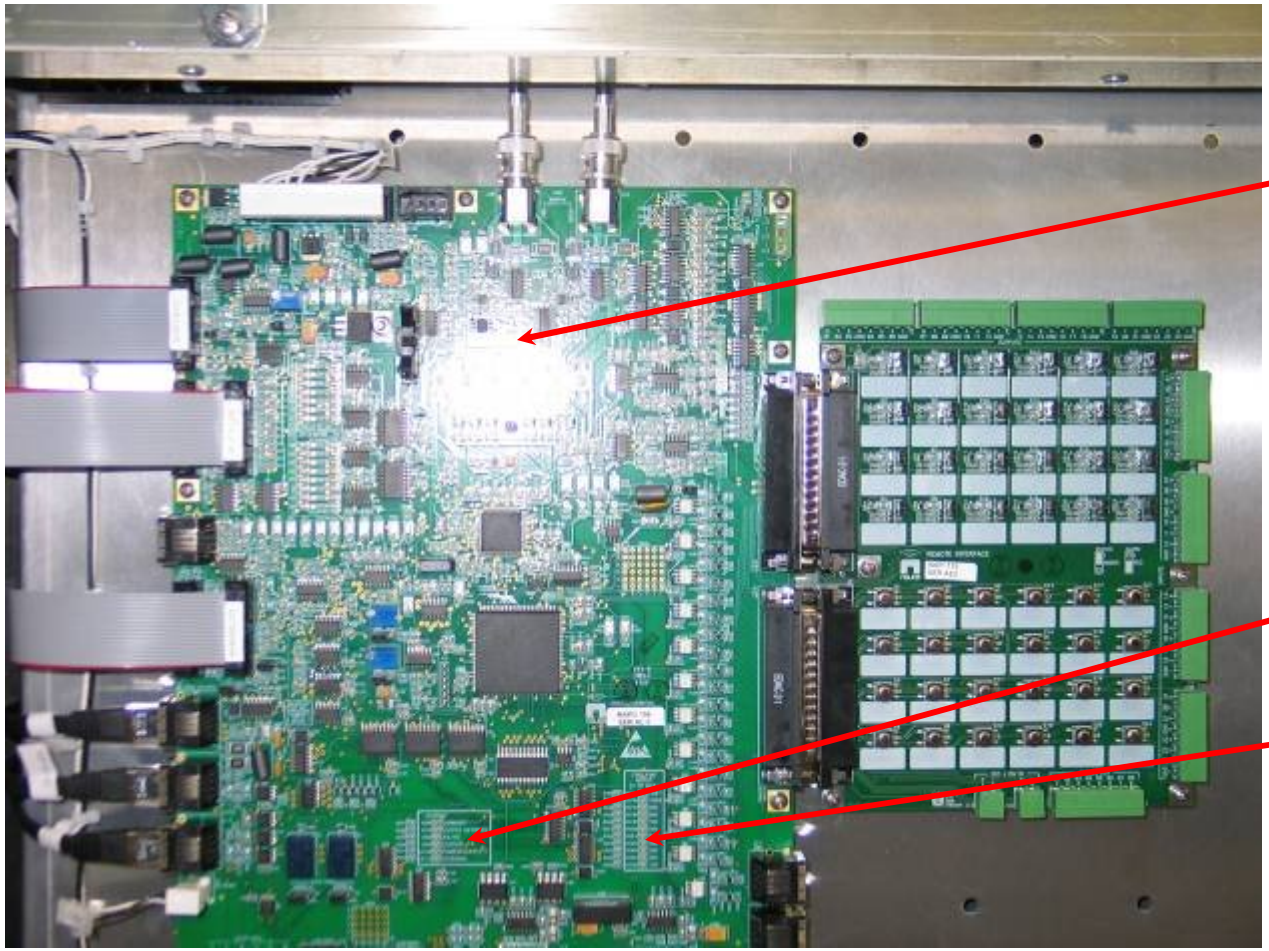
PA/IPA Redundancy

Integral IPA on board EACH PA module

Power Supply Redundancy

- 2 PA Power Supplies per PA Module
- Redundant IPA Power Supplies (same as PA supplies)
- Redundant Fan Supplies (same as PA supplies)
- Redundant Low Voltage Power Supplies (+5, ± 15 V)
- Redundant 12VDC Power Supplies (for SBC)

Control Redundancy

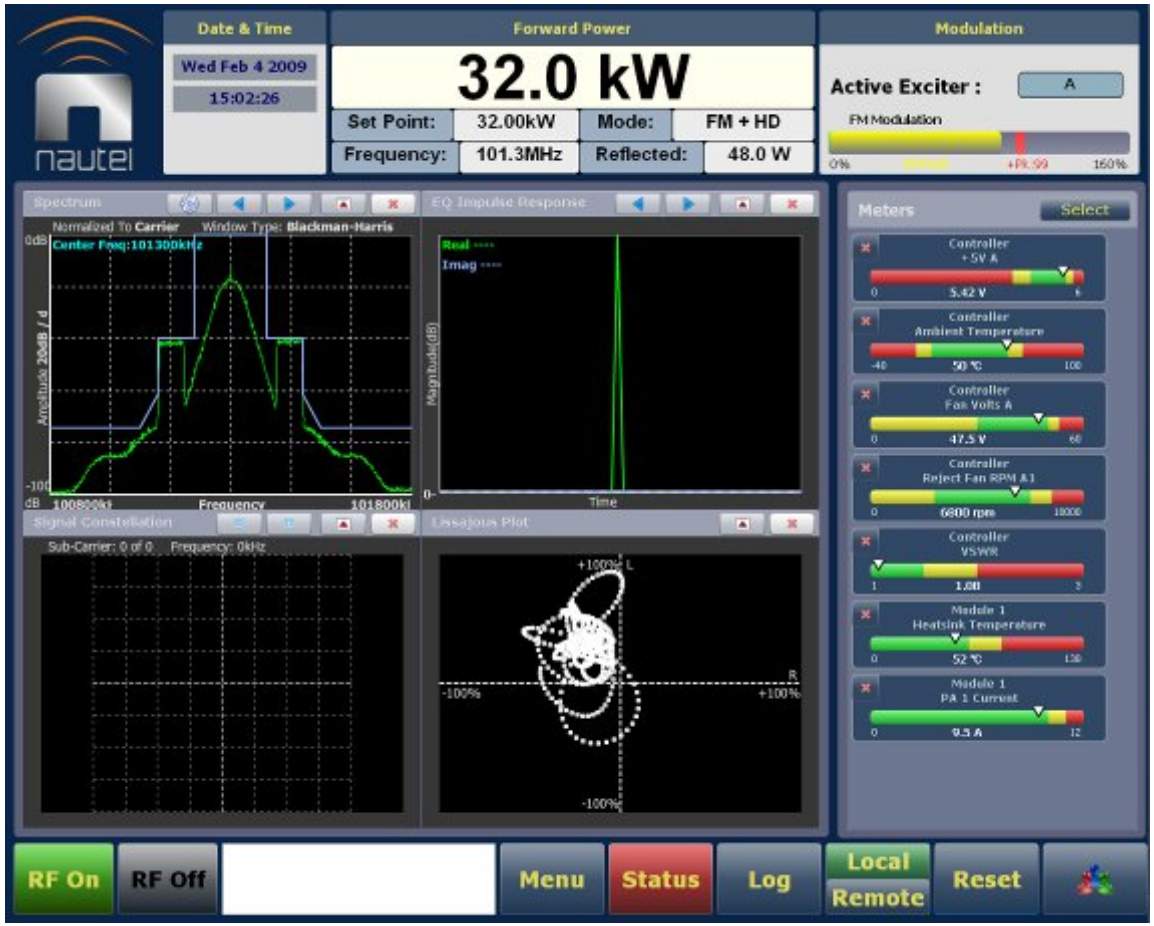


Back-up Control Push button switches for ON, OFF, INC,DEC, LOCAL,REMOTE, RESET

Alarm Status LEDs

Forward Power Meter

Advanced User Interface



Features a 17 inch Color LCD touch-screen with a wide range of configurable displays.

IP connectivity from anywhere to all front panel screens

Features:
- Advanced Instrumentation (*spectrum and audio analyzer*)
- Configurable meters
- Exciter control
- Linux OS
- Enhanced Remote Monitoring/Control (same as local)

Advanced Integral Exciter

Exciter Features:

- Adaptive Pre-correction
- Pre-Equalization
- GPS 10MHz input
- Open platform design – future ready
- No internal adjustments
- PAPR ready
- Single PWB for audio and RF generation
- Exciter control through TX AUI
- Dynamic amp bias control for on the fly analog-IBOC mode switching
- Built in SCA, RDS, RBDS generator

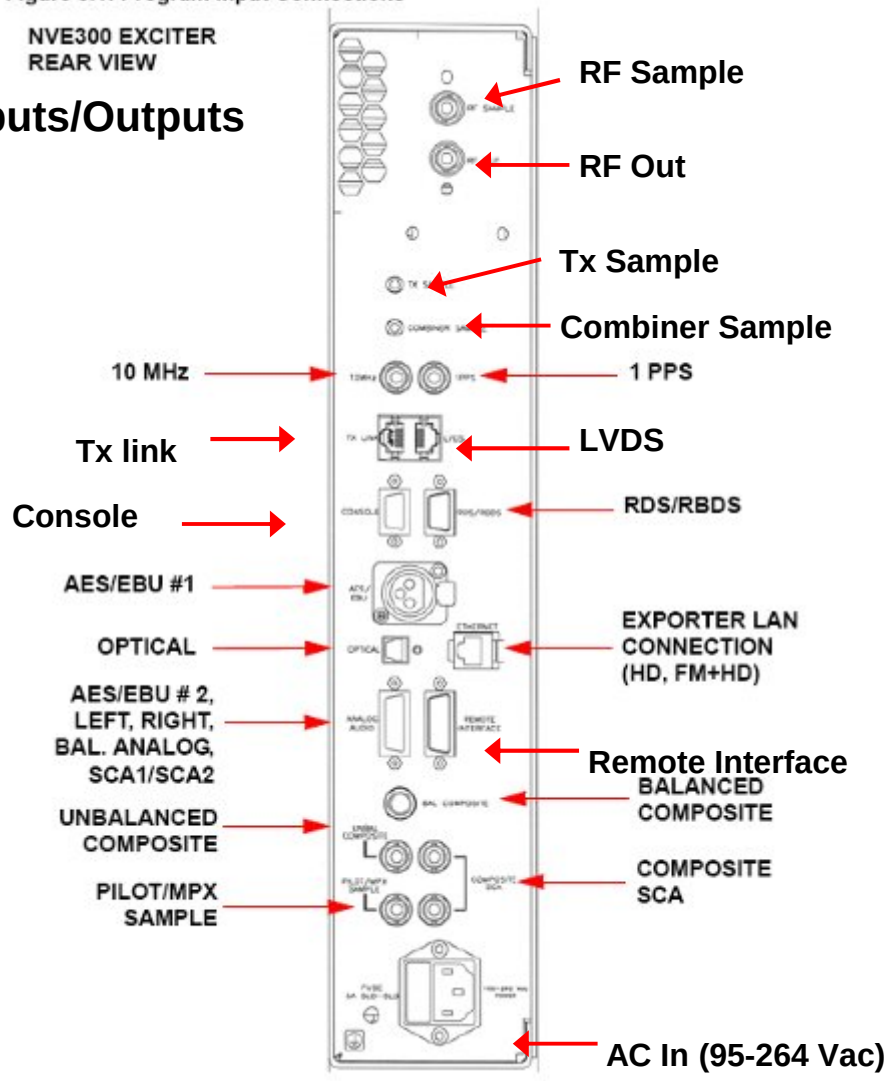
Exciter I/O

Integrated Exciter

Figure 5.1: Program Input Connections

NVE300 EXCITER
REAR VIEW

Inputs/Outputs



Value Considerations

- Half the cost of doing solid state 40 kW as 4 x 10 kW
- 25-30% less than solid state 20 kW as 2 x 10 kW
- Smaller footprint than tube or multiple SS solutions
- FIVE YEAR WARRANTY

Nautel's NEW NX25

- Industry's top efficiency: 88%
- Small footprint: 72.4"H x 37.7"W x 47.2"D
- 17" Touchscreen Interface (remote via IP connection)
- Real Time Spectrum Analyzer
- Real Time Impedance Measurement
- Optional integrated Exgine HD Radio card

AUI Anywhere

AUI Anywhere “Window”

Orban Inside

Thank You