IEEE BTS
Radio Implementation Presentation
Buenos Aires, Argentina BTS Chapter

November 17, 2015

BTS IEEE Broadcast Technology Society

Who am I?

Paul Shulins

Dir. of Technical Operations

for Greater Media Boston, MA U.S.A.

My Background:

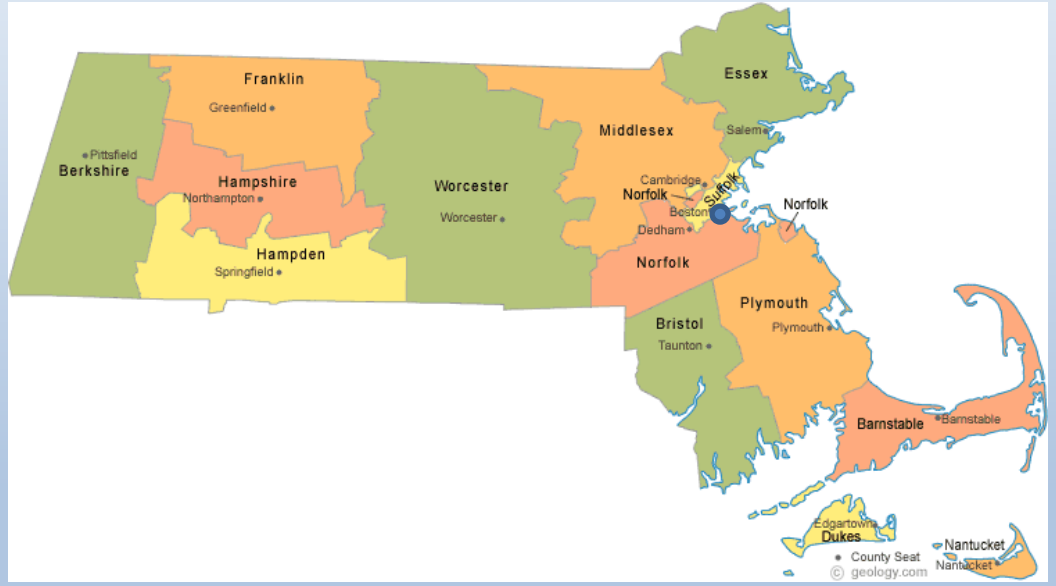
- Graduated from the University System of New Hampshire, Plymouth NH, USA, 1979
- Laconia, NH Engineer 1979-1981
- Springfield, MA Chief Engineer 1981-1985
- Rochester, NY Chief Engineer 1985-1987
- Boston MA, Director of Technical Operations 1987-Present (28 Years)

Responsibilities

- Oversee Engineering Department
- 4 Engineers
- 1 Digital Playout Specialist
- 1 IT Desktop Support Person
- Consulting firm employed for higher level Network Issues

My home is in the Northeast USA

New England and the State of Massachusetts



City of Boston Massachusetts

Radio Market Statistics

MKT CODE	RANK	TYPE	FREQ	MARKET	DST	METRO 12+ POPULATION	HISPANIC 12+ POPULATION*	BLACK 12+ POPULATION**
001	1	PPM	13	New York	BH	16,157,500	3,845,200	2,740,600
003	2	PPM	13	Los Angeles	BH	11,271,300	4,807,500	810,100
005	3	PPM	13	Chicago	BH	7,939,500	1,594,300	1,357,900
009	4	PPM	13	San Francisco	BH	6,463,500	1,430,100	447,200
024	5	PPM	13	Dallas-Ft. Worth	BH	5,633,600	1,470,200	886,000
033	6	PPM	13	Houston-Galveston	BH	5,362,100	1,816,300	928,300
015	7	PPM	13	Washington, DC	BH	4,793,400	705,100	1,272,600
007	8	PPM	13	Philadelphia	BH	4,558,200	366,000	932,600
047	9	PPM	13	Atlanta	BH	4,549,700	456,400	1,507,300
013	10	PPM	13	Boston	BH	4,192,800	406,100	309,800
429	11	PPM	13	Miami-Ft. Lauderdale-Hollywood	BH	3,906,200	1,924,000	800,200
011	12	PPM	13	Detroit	B	3,803,600	143,300	841,500

5 HD and HD 2 Stations

Typical Studio Layout

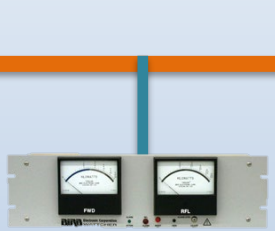
Studio - Transmitter

Typical Transmitter Site Overview

Greater Media Boston, Prudential Transmitter Site

DUAL FEED ANTENNA

CIRCULATOR



BIRD BPME 3126

BIRD BPME 3129

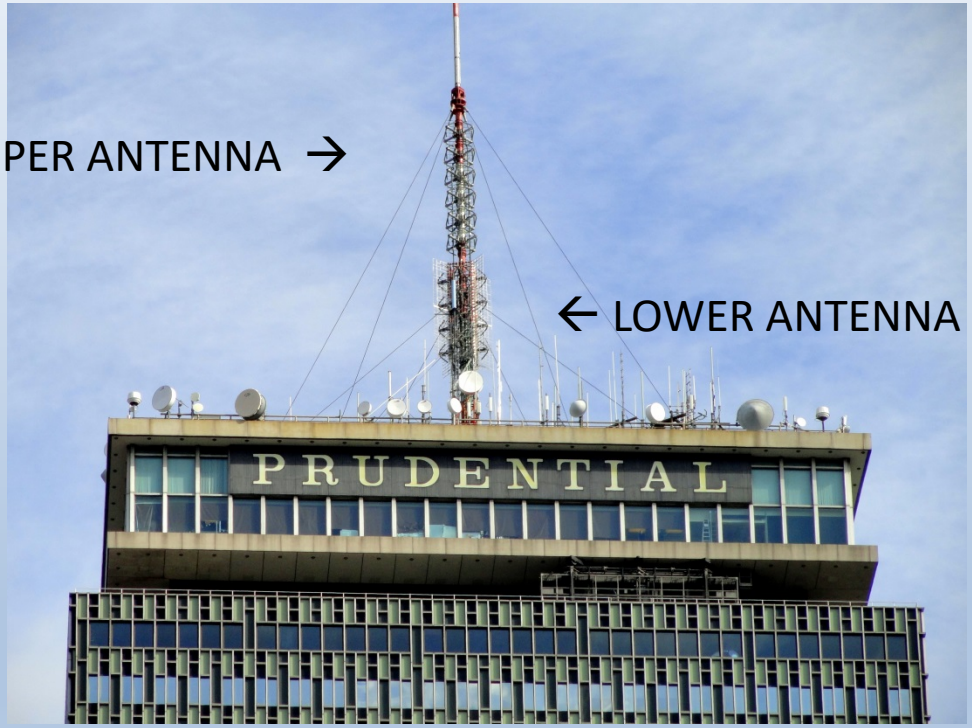
DIELECTRIC 6000
SERIES COAX SWITCH

BE FM 20T

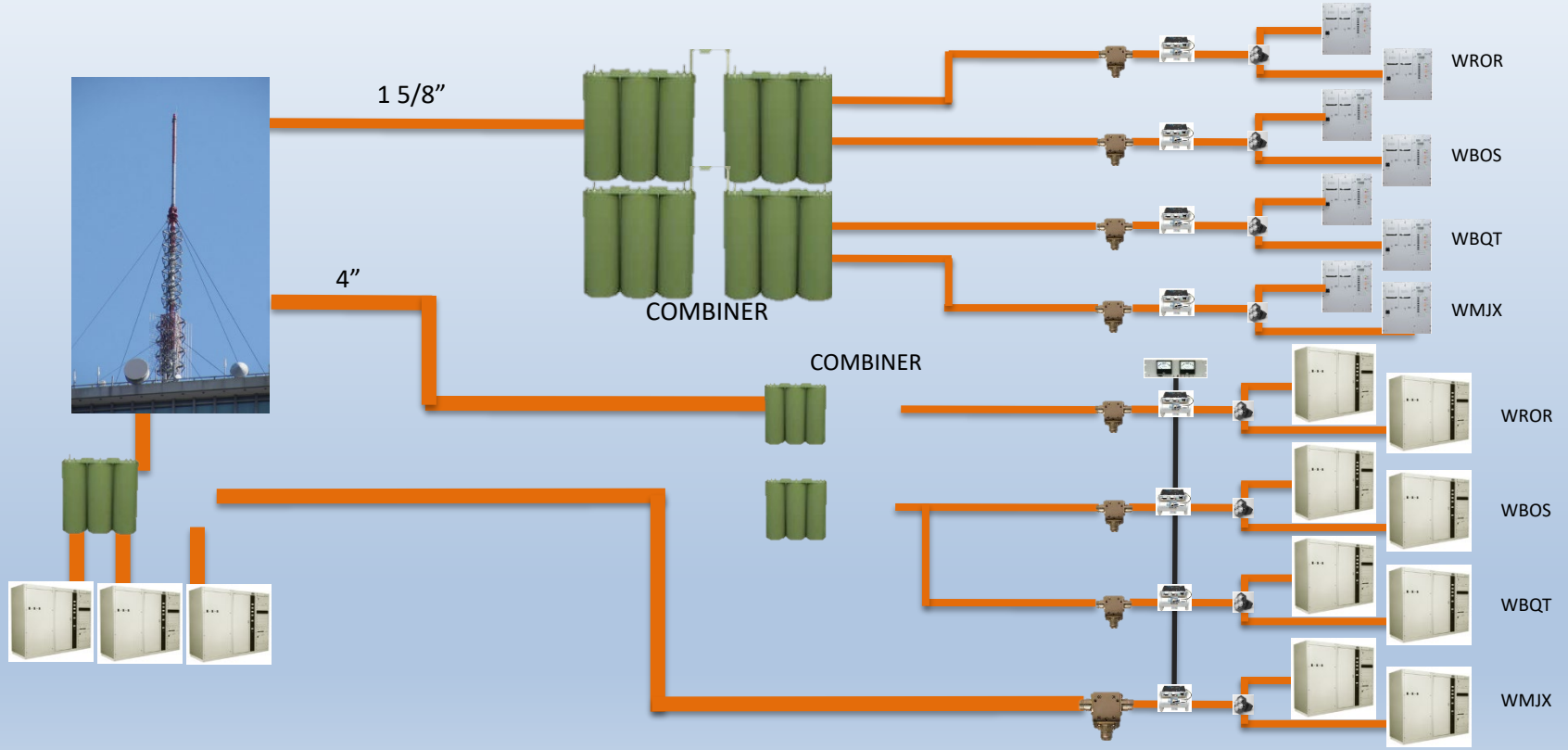
BE Fmi 703

DUMMY LOAD

Studio - Transmitter



PRUDENTIAL LOWER ANTENNA



PRUDENTIAL UPPER ANTENNA

Redundant UPS sytems

Make before break Bypass Switch

UPS Bypass Switch

Tower Site Security and identification

Modulation Monitoring

Modulation Monitoring

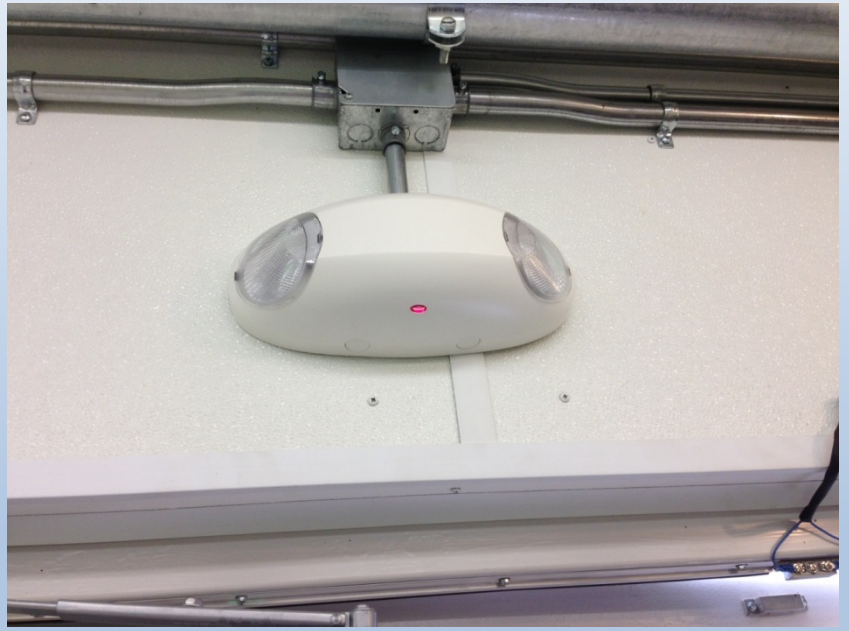
- Critical to adjust and verify Modulation Levels
- Critical to adjust and verify pilot injection levels
- Important tool for making audio performance measurements
- RDS Monitor to maintain and verify RDS Injection levels, and RDS Content
- Most accurate when coupled directly to a transmission line sample
- Off the air samples feeding modulation monitors are subject to many variables that can potentially cause inaccurate measurements especially if not carefully planned.

SAFETY

- Clearly identify all circuits

SAFETY

- Clearly identify all circuits
- Battery operated
  Emergency lighting



SAFETY

- Clearly identify all circuits
- Battery operated
  Emergency lighting
- Secure loose tanks to Wall

Power Metering

Use True averaging power meters for digital signal

Outside RF indicators

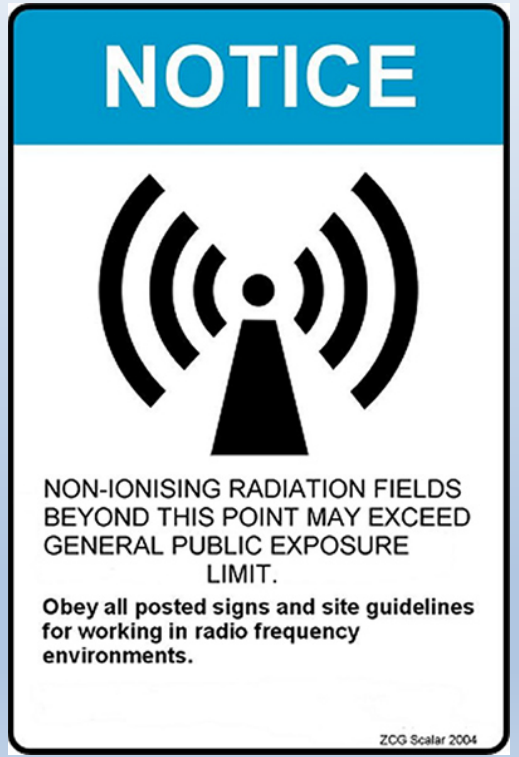
RF Exposure Meter

RF Exposure

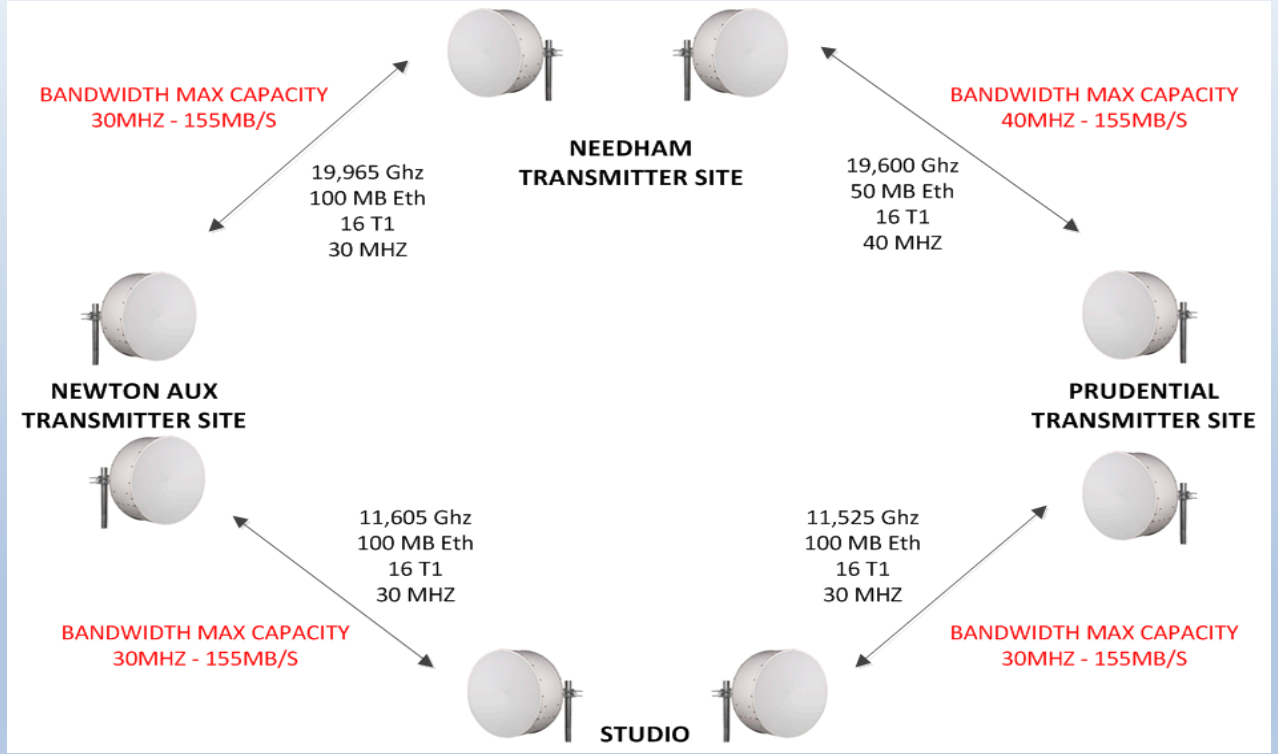
FCC Maximum Exposure Limits (Occupational/Controlled) Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density 2 (mW/cm)	Averaging Time (minutes)
0.3-3.0	614	1.63	100	6
3.0-30	1842/f	4.89/f	900/f	6
30-300	61.4	.163	1.0	6
300-1500	---	---	f/300	6
1500-100,000	---	---	5	6

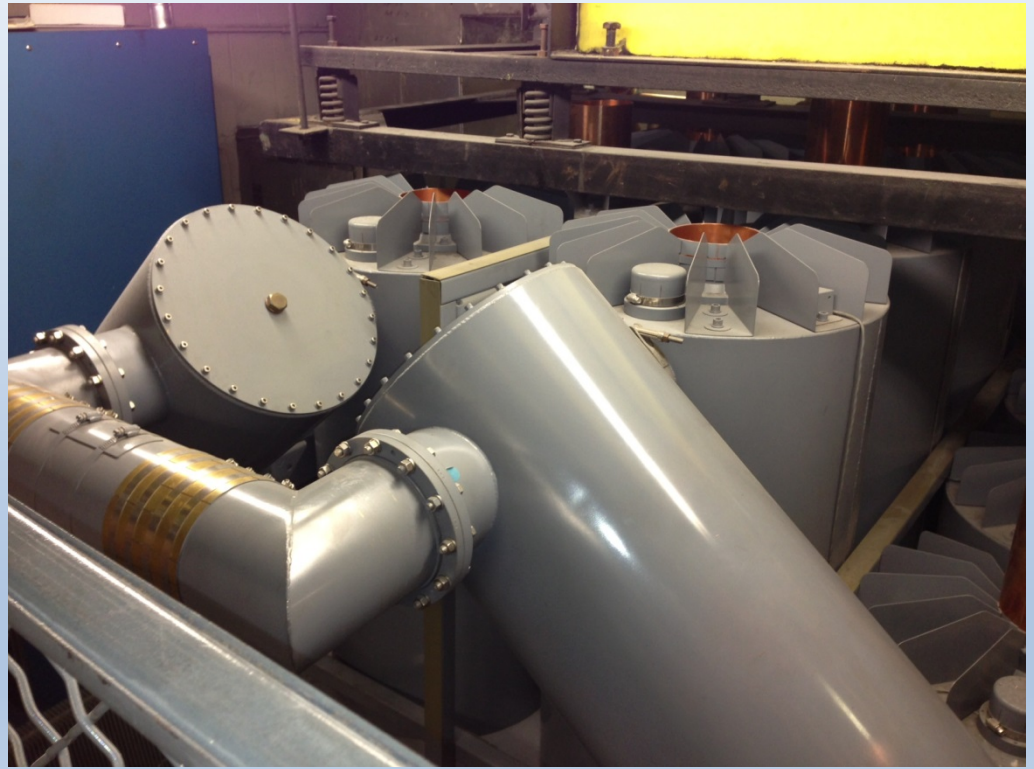
Typical RF Signs



STL


BANDWIDTH MAX CAPACITY
30MHZ - 155MB/S
19,965 Ghz
100 MB Eth
16 T1
30 MHZ
NEEDHAM
TRANSMITTER SITE
BANDWIDTH MAX CAPACITY
40MHZ - 155MB/S
19,600 Ghz
50 MB Eth
16 T1
40 MHZ
NEWTON AUX
TRANSMITTER SITE
PRUDENTIAL
TRANSMITTER SITE
11,605 Ghz
100 MB Eth
16 T1
30 MHZ
11,525 Ghz
100 MB Eth
16 T1
30 MHZ
BANDWIDTH MAX CAPACITY
30MHZ - 155MB/S
BANDWIDTH MAX CAPACITY
30MHZ - 155MB/S
STUDIO

FM Combiner System



FM Combiner System

FM Combiner System

VSWR Protection

- Protecting the Transmission Line and Antenna is obviously critical
- Antenna / Transmission line repairs are expensive, time consuming, weather dependent, and can keep your site out of commission for long periods of time!
- Do not rely on Integrated Transmitter VSWR Fold back Systems to protect your antenna and transmission live systems
- Interlock All Transmitters feeding the antenna
- If part of a combiner system, make certain each station is interlocked to a master protection system and do an “interlock check” routinely to verify compliance

VSWR Protection

HD Radio Installation considerations

Studio Considerations

1. STL Bandwidth
2. Provide OFF AIR Enunciation to Control rooms
3. Purchase HD radios for Air monitoring of each stations HD Signal.
4. Silence Sense monitoring of each Station feed for Audio/Carrier Loss

HD Radio considerations

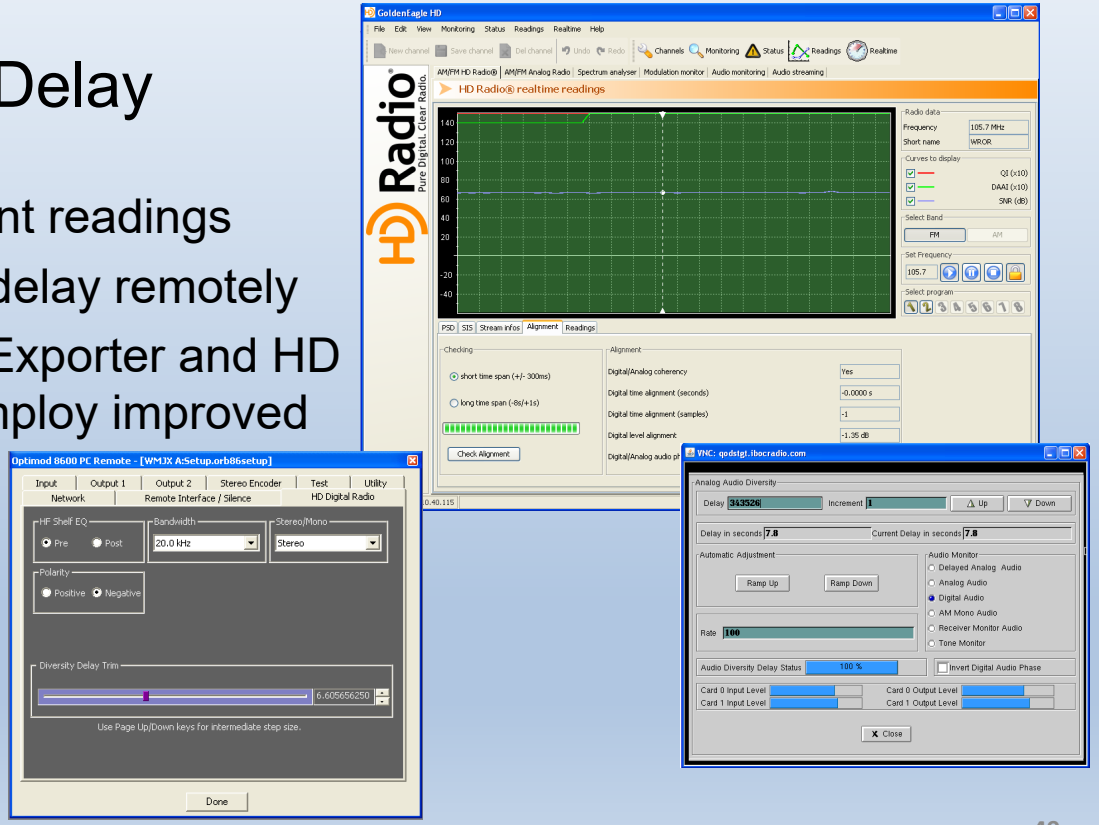
Transmitter Control Considerations

1. RF isolation Protection
2. Proper interlock for Coax Switches
3. Proper interlock for Reject Loads
4. Proper interlock for VSWR
5. Deploy control system with remote control capability via Smartdevice, Secured Web page, Telephone interface

HD Diversity Delay

Audio Diversity Delay

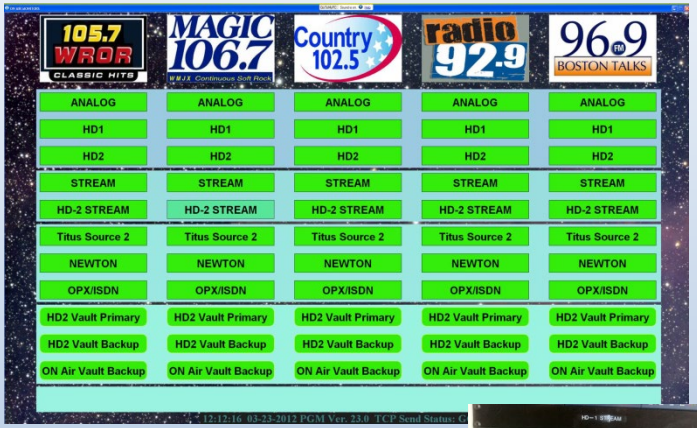
1. Ability to take delay alignment readings
2. Ability to calibrate Diversity delay remotely
3. New Software revisions for Exporter and HD Audio processing usually employ improved changes in delay times.

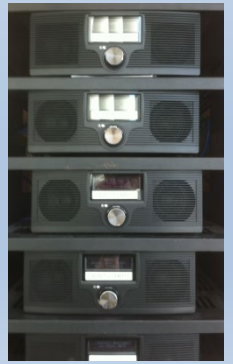


Studio Considerations

For PPM rated markets

1. Provide enough monitoring for all PPM sources
   STL feeds, HD1, HD2, Streams
2. Include monitoring for all Internet Streams
3. Monitor PPM and Silence Sensing.
4. Provide adequate PPM alarm enunciation in control rooms
5. Provide Timely PPM alarm alerts to staff
   E-Mail, Paging, Text Message, Growl Alert





Why use an FM Combiner?

- Use a single Antenna System to serve multiple radio stations
- Pooling resources allows for a much higher budget to invest in a better performing antenna system
- Real estate on a tower or tall building is limited and expensive
- Intermodulation products can be reduced or eliminated
- Suppression from lightning damage is generally increased
- Ability to construct a backup antenna or a lower/upper antenna array is much more practical and affordable
- Ability to design the antenna for RFR Suppression is increased

VSWR Protection

- Protecting the Transmission Line and Antenna is obviously critical
- Antenna / Transmission line repairs are expensive, time consuming, weather dependent, and can keep your site out of commission for long periods of time!
- Do not rely on Integrated Transmitter VSWR Fold back Systems to protect your antenna and transmission live systems
- Interlock All Transmitters feeding the antenna
- If part of a combiner system, make certain each station is interlocked to a master protection system and do an “interlock check” routinely to verify compliance