

MA3 All Digital AM

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Speakers



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Agenda

- Welcome
- A bit of history
- A bit about the technology
- Install stories and challenges
- Where is it going?

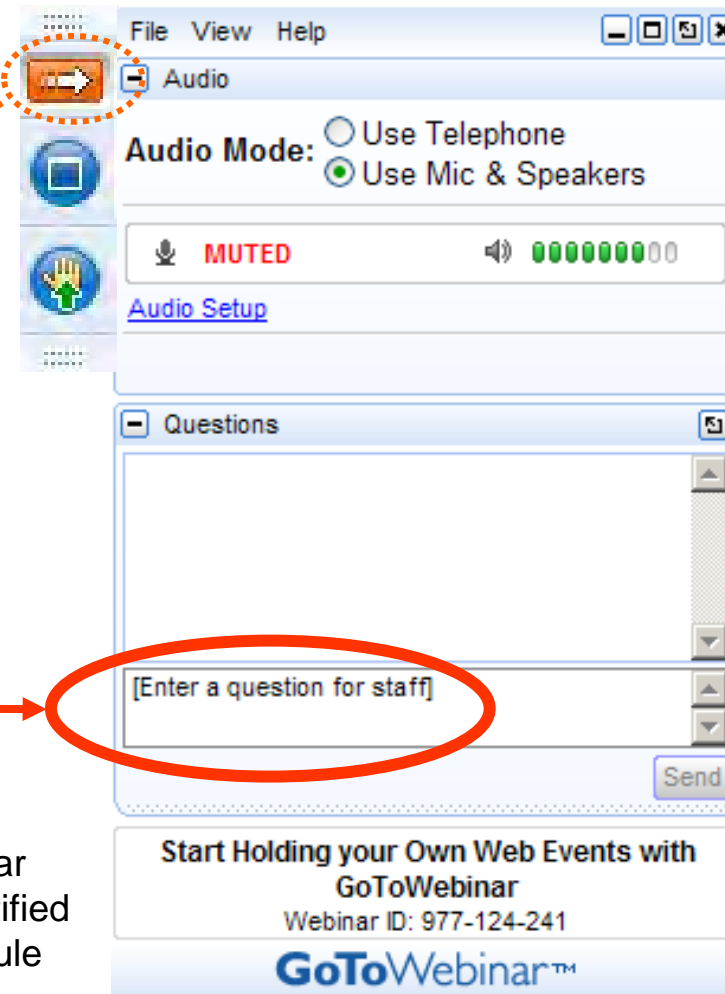
Your questions please?

(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)



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- All-digital AM may be a long-term solution for AM radio
 - Significantly more immune to noise and interference than either analog or hybrid digital AM
 - Improved audio quality (as good or better than analog FM)
 - Potential to support data services and multicasting
 - **Receivable on EXISTING HD Radio receivers**
- All-digital AM is significantly better than hybrid digital AM
 - *Hybrid digital AM is currently-authorized HD Radio signal*
- NAB Labs test project to fully characterize all-digital AM is well underway



All-digital AM

- There are a lot of AM broadcasters in the U.S.
- As of December 31, 2020:



AM STATIONS	4551	
FM COMMERCIAL	6699	
FM EDUCATIONAL	4195	
TOTAL		15,445
UHF COMMERCIAL TV	994	
VHF COMMERCIAL TV	377	
UHF EDUCATIONAL TV	267	
VHF EDUCATIONAL TV	120	
TOTAL		1,758
CLASS A UHF STATIONS	357	
CLASS A VHF STATIONS	31	
TOTAL		388
FM TRANSLATORS & BOOSTERS	8420	
UHF TRANSLATORS	2572	
VHF TRANSLATORS	834	
TOTAL		11,826
UHF LOW POWER TV	1517	
VHF LOW POWER TV	494	
TOTAL		2,011
LOW POWER FM	2136	2,136
TOTAL BROADCAST STATIONS		33,564

All-digital AM

- Principal drawback: all-digital signal not receivable on analog-only radios
 - Introduction of all-digital service requires significant penetration of HD Radio receivers in marketplace
- Another issue: all-digital is not authorized by the FCC
 - Prior to NAB Labs effort, very little testing on all-digital AM
 - First step towards getting FCC authorization is to develop a technical record of all-digital system performance



All-digital AM – test project partners

- Broadcasters:



- Equipment manufacturers:

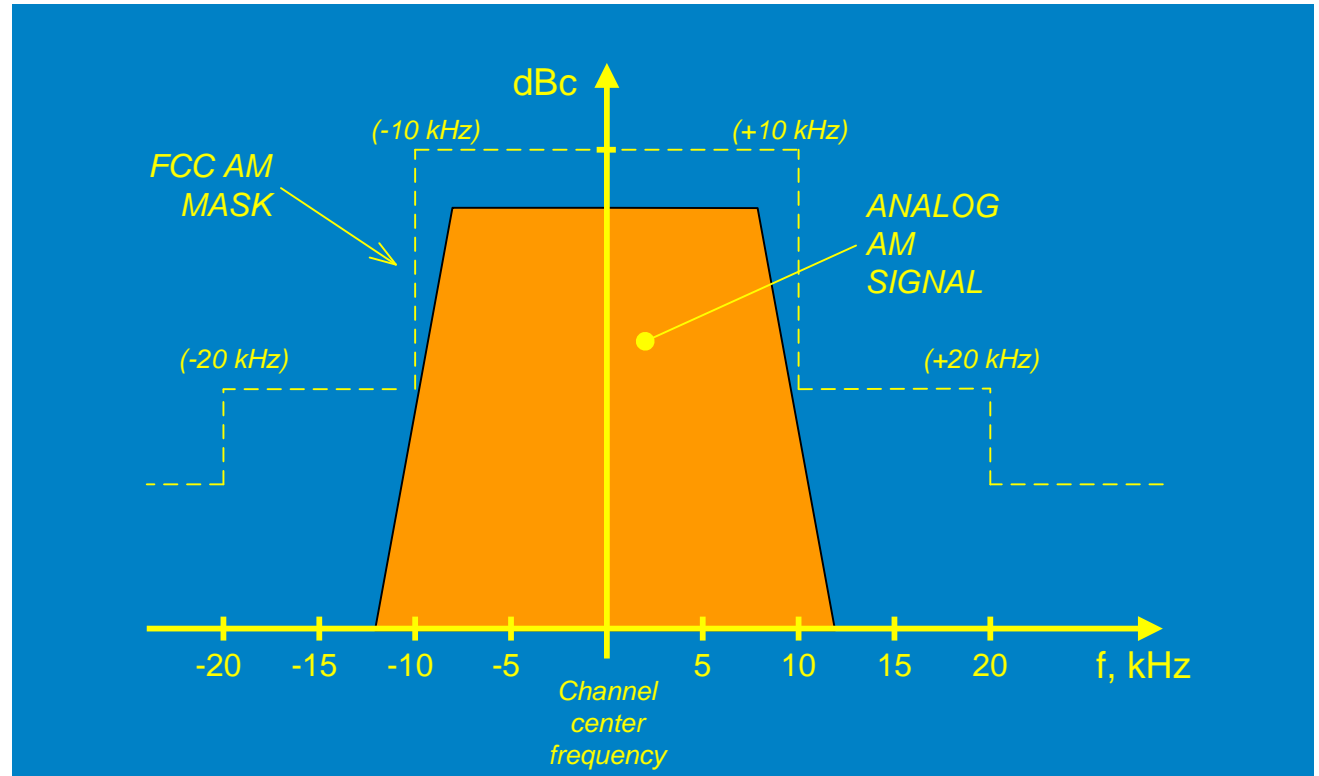


- Others:



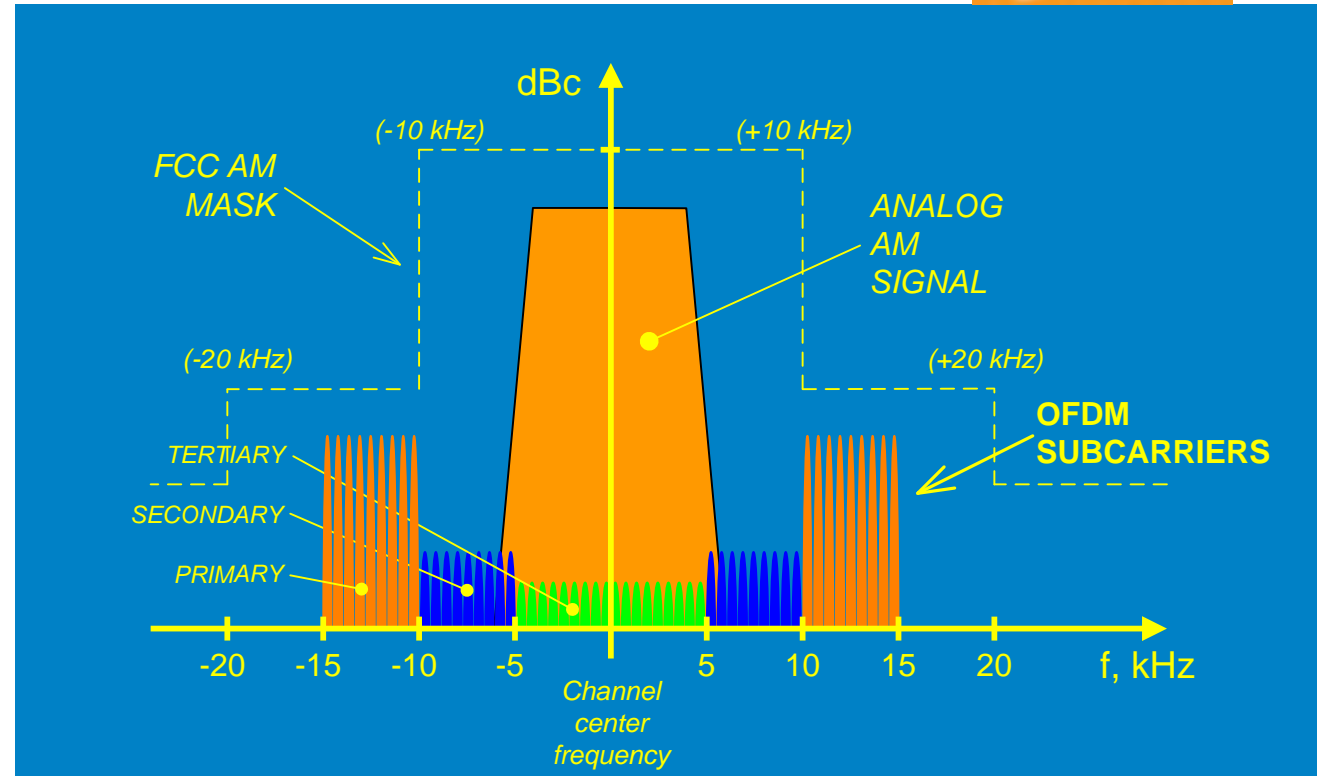
All-digital AM IBOC

- Analog AM signal
 - Plagued by high levels of noise and interference
 - No data capability, not even song title and artist



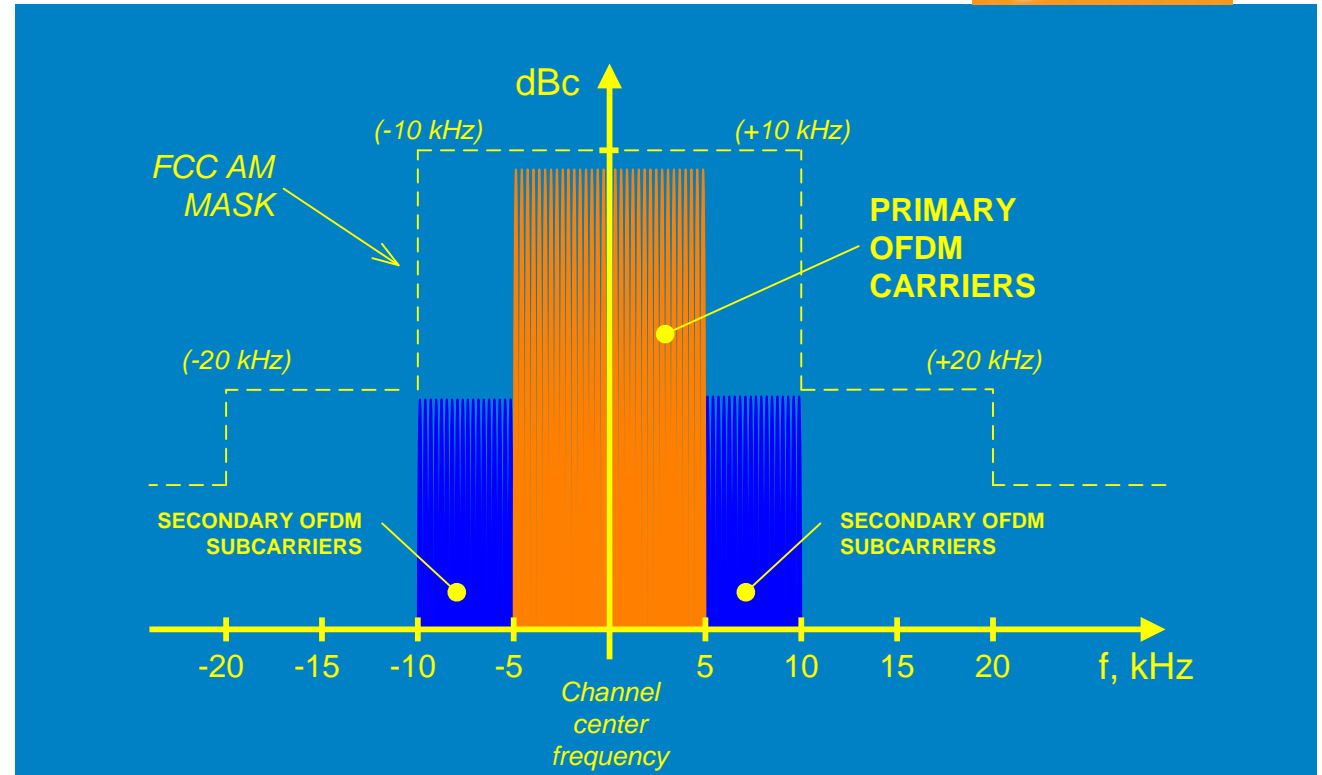
All-digital AM IBOC

- Hybrid AM IBOC signal
 - Authorized by FCC in 2002
 - “HD Radio” is the trademark of iBiquity Digital Corp.
 - Approximately 300 stations licensed for hybrid AM



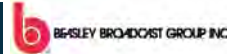
All-digital IBOC

- All-digital AM IBOC signal
 - Currently requires experimental authority from FCC
 - Not receivable on analog AM radios
 - IS receivable on existing HD Radio receivers



All-digital AM field testing

- Original 2014/2015 test sites:

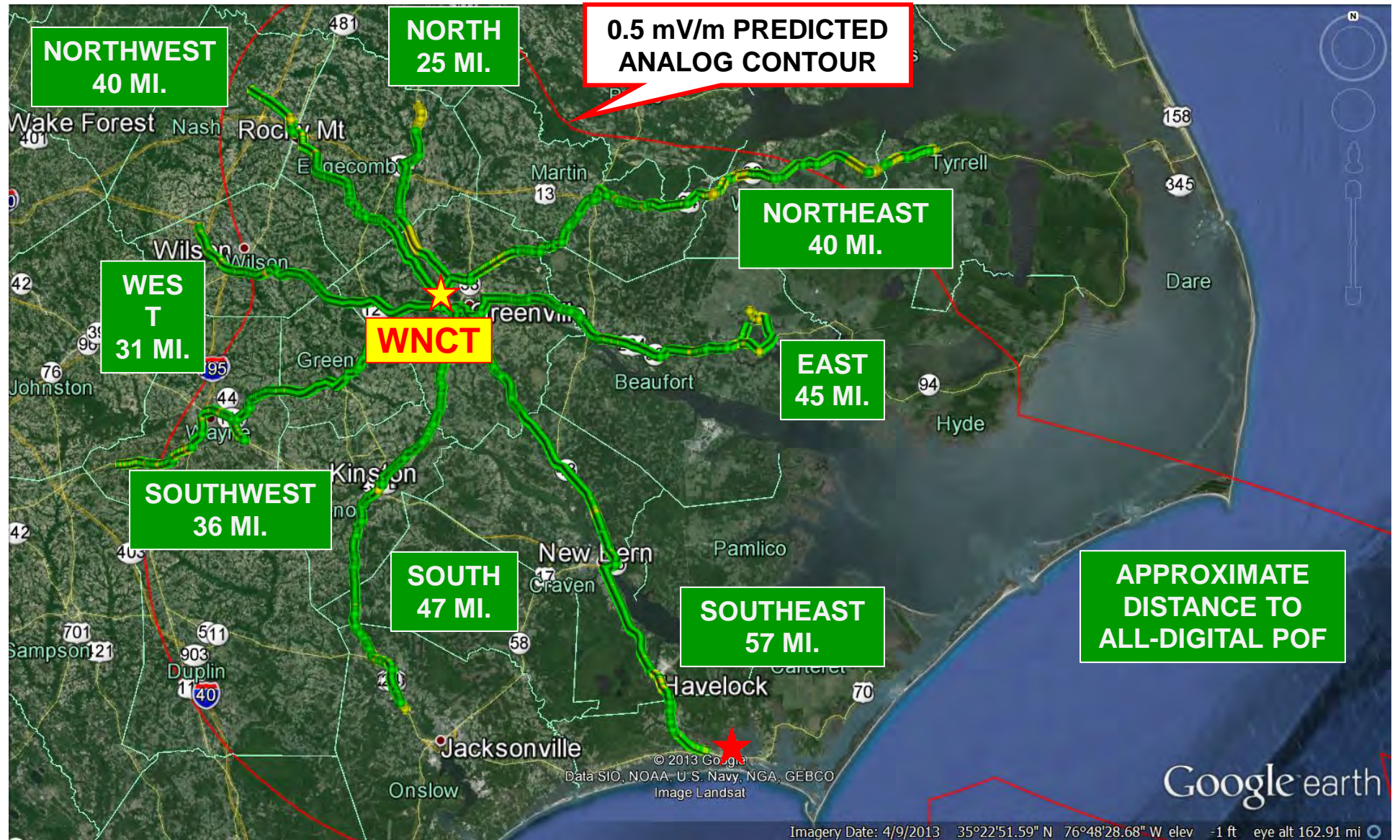


	WBCN	WNCT	WBT	WD2XXM	KTUC	WDGY	KKXA	KRKO
Location	Charlotte, NC	Greenville, NC	Charlotte, NC	Frederick, MD	Tucson, AZ	Hudson, WI	Snohomish, WA	Everett, WA
Freq (kHz)	1660	1070	1110	1670	1400	740	1520	1380
Class	B	B	A	EXPERIMENTAL	C	D	B	B
Day pwr (kW)	10.0	25.0	(not tested)	3.0	1.0	5.0	50.0	50.0
Night pwr (kW)	1.0	10.0	50.0	3.0	1.0	n/a	50.0	50.0
# of towers	1	5	3	1	1	3	4	4
Antenna	ND1	DA2	DAN	ND1	ND1	DAD	DAN	DAN
Date(s) tested	12/12	7/13	8/13, 3/14	10/13, 12/13	2/14	6/14	10/14	10/14

All-digital AM

- Why so many tests?
 - 4,551 AM radio stations as of December 31, 2020 - down 174 since 2014
 - Tremendous variety of AM stations – classes, frequencies, implementations, locales
 - All of these variables have an impact on performance
 - NAB Radio Technology Committee has developed a “test matrix” establishing a minimum set of recommended tests
 - Unusual or not-well-understood results lead to re-tests
 - Class A station WBT was re-tested in March
 - WD2XXM testing was follow-up to earlier tests as well

WNCT daytime (25 kW)



Data collection

- NAB Labs is using consumer receivers for characterizing all-digital signal coverage
 - Primarily OEM receivers in Ford vehicles, available at rental car facilities
 - Limited testing of BMW, Volvo, Mercedes
- Data collection based upon reception of digital audio
 - Connect data collection system to car door speaker wires
 - Software developed by iBiquity



Data collection

- Using antenna optimized by automaker for particular vehicle
- Avoids issues with custom data collection system:
 - Sub-optimal antenna
 - Unrealistic antenna
 - RF signal distribution
- Makes troubleshooting more difficult
- Very reflective of actual consumer experience



All-digital AM – overall status

- NAB Labs test project consists of three components:
 - Field testing – *underway* – demonstrates “real-world” coverage, helps to troubleshoot system and educate broadcasters
 - Lab testing – *underway* – establishes interference behavior between stations
 - Allocation studies – *underway* – needed to understand impact on FCC rules

NAB Labs *initiated* and is *leading* the industry evaluation of all-digital AM radio



WDGY – 740 kHz, Hudson, MI

- Class D, 5 kW, owned by WRPX, Inc.
- Thanks to Greg Borgen





DAN RYSON,
*Cavell, Mertz &
Associates*

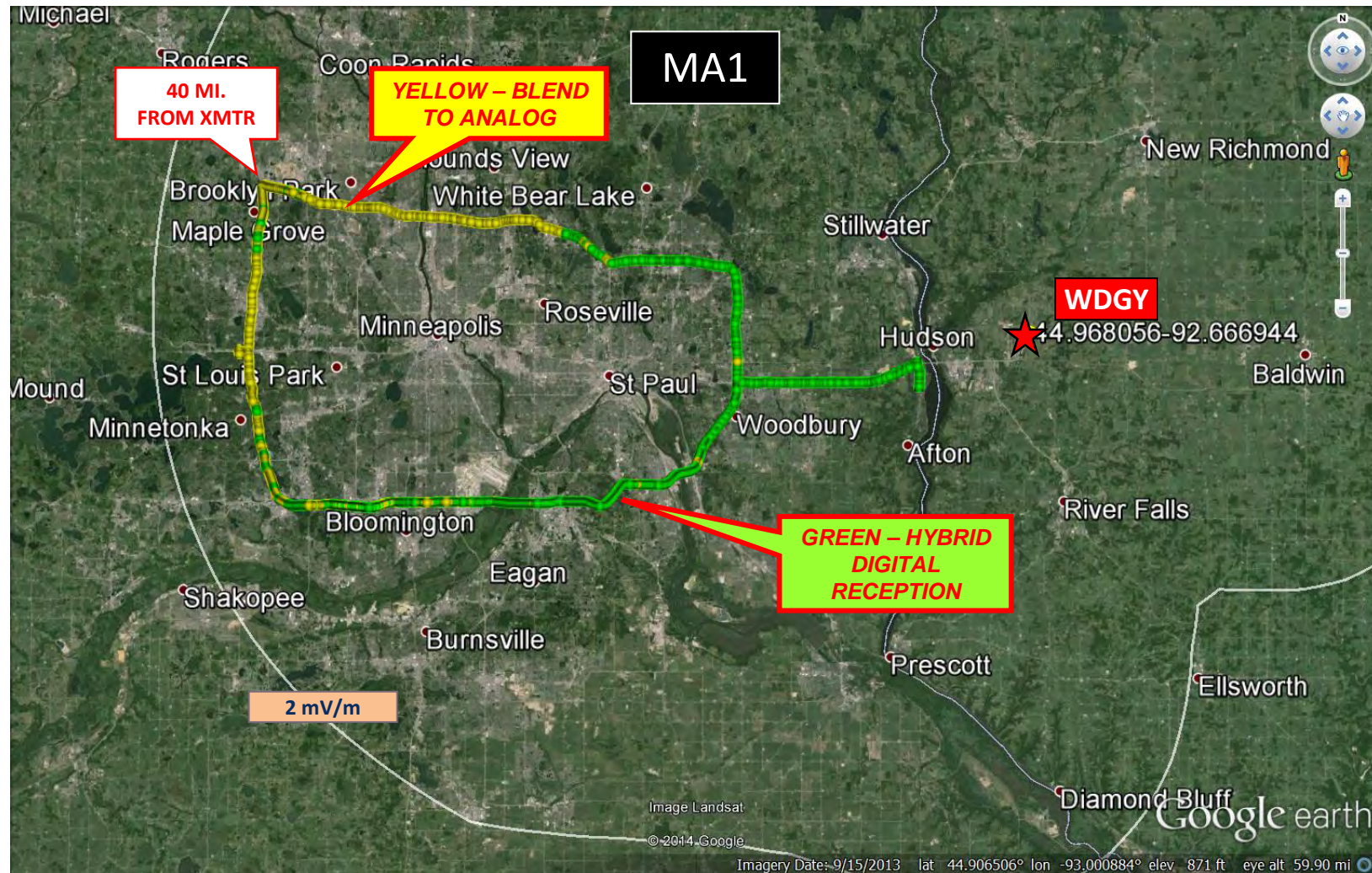
**RUSS
MUNDSCHEK,**
iBiquity

DAVID LAYER,
NAB

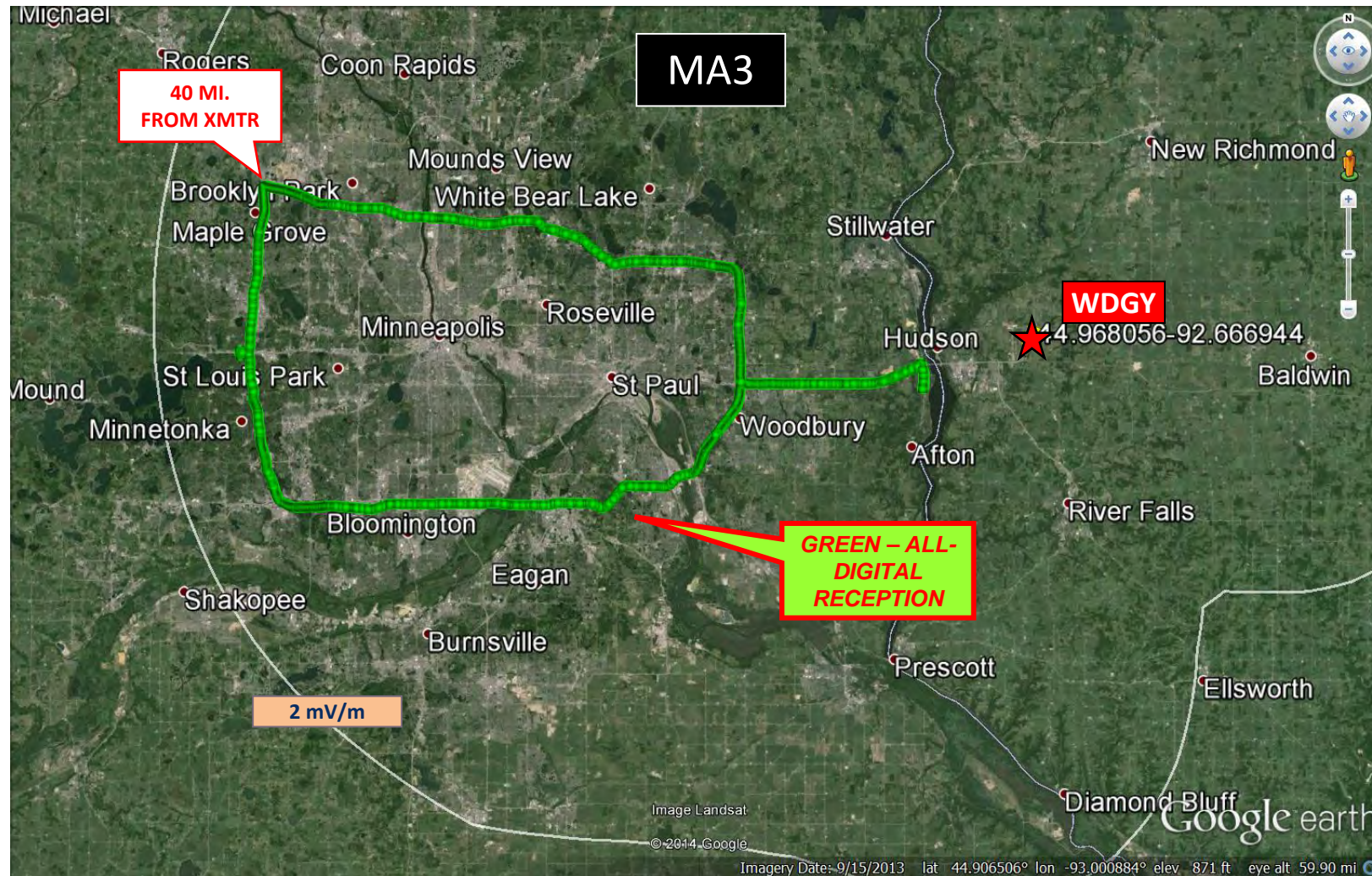
**GREG
BORGEN,**
WDGY

JIM DUBOIS,
*MINN. ASSOC.
OF
B'CASTERS*

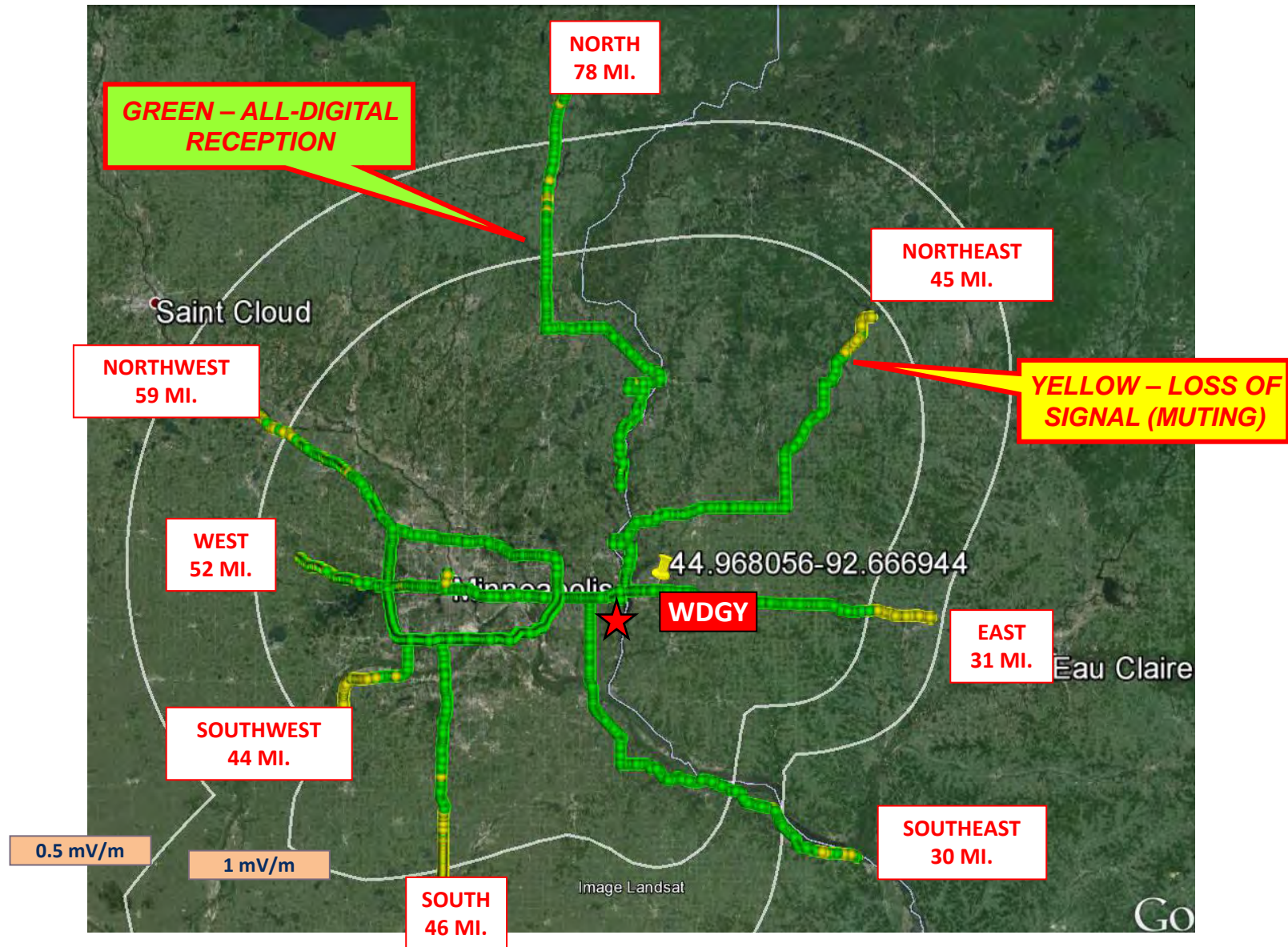
WDGY – MA1 vs. MA3



WDGY – MA1 vs. MA3



WDGY – 5 kW MA3 mode – daytime coverage

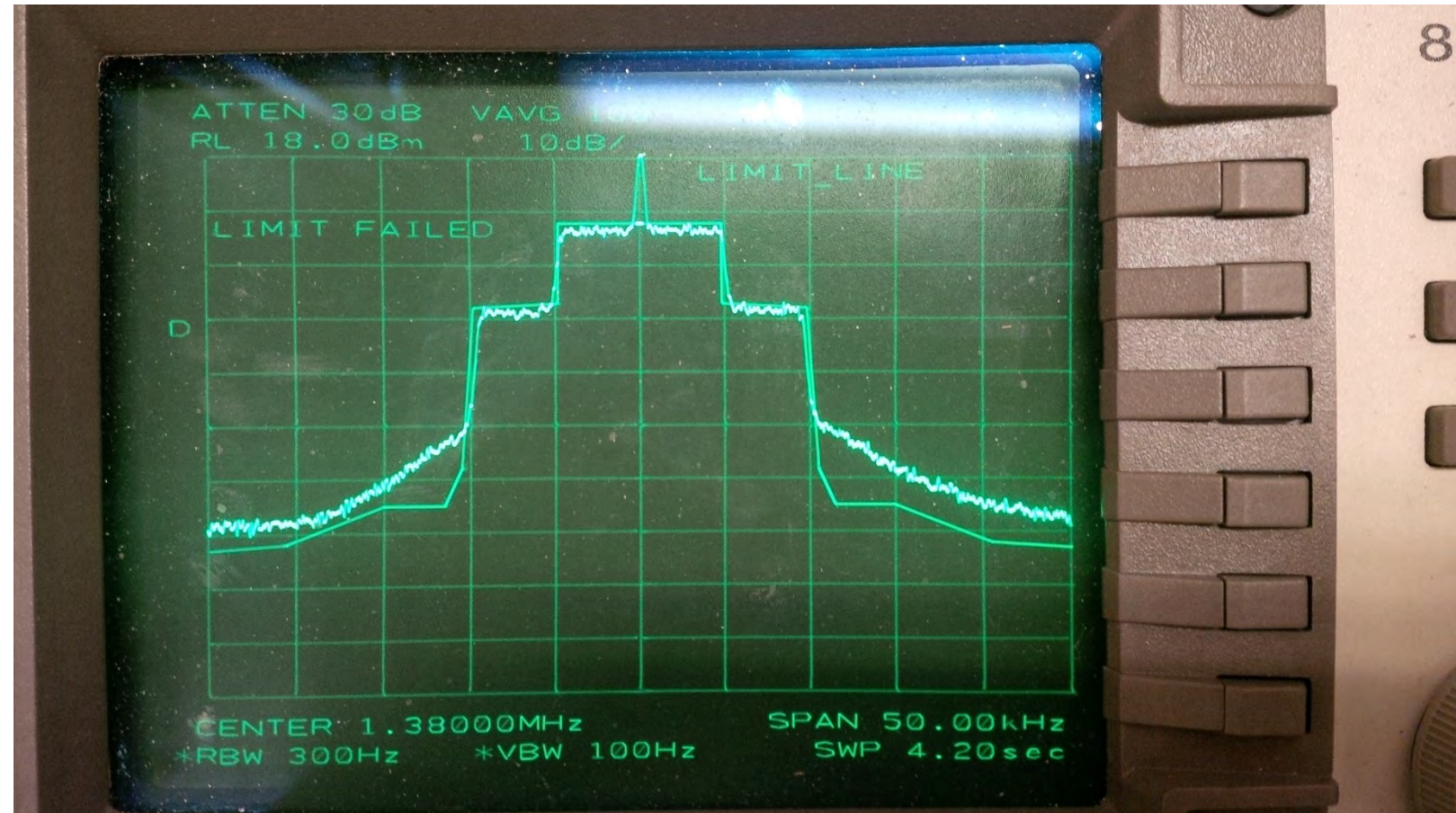


Challenges

At the default signal level, MA3 output power (RMS) is about 80% of MA1 power.

When MA3 is corrected to equal the MA1 RMS power, using a thermocouple ammeter, there can be mask issues.

This will require further work in setting precorrection and predistortion curves.



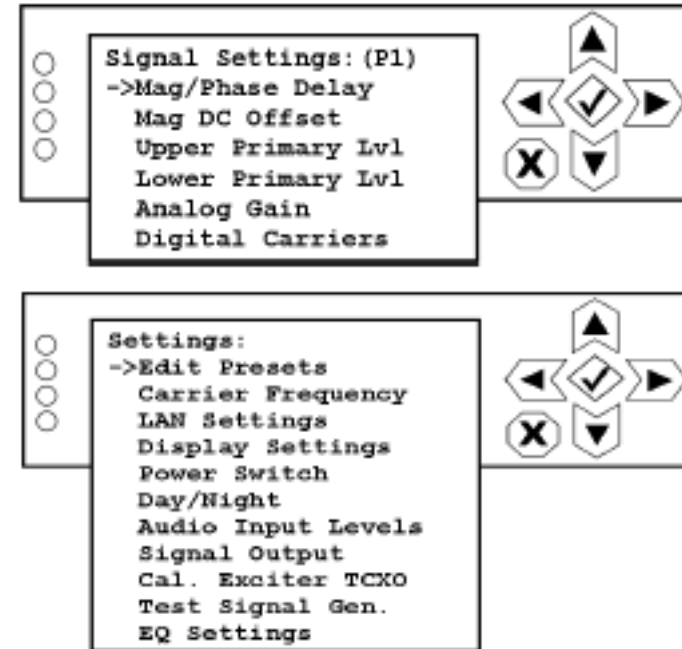
Challenges

Some correction of the mask can be done with the standard signal settings in the Exporter or Engine units.

As the purpose of field tests was to provide head-to-head comparisons, this wasn't done, so as to preserve a level playing field.

Further improvements can be made by loading customer specific EQ Settings, to provide predistortion curves matched to optimize antenna systems.

Similar to AM Stereo setup, there may be some compromise between day/night pattern optimization.

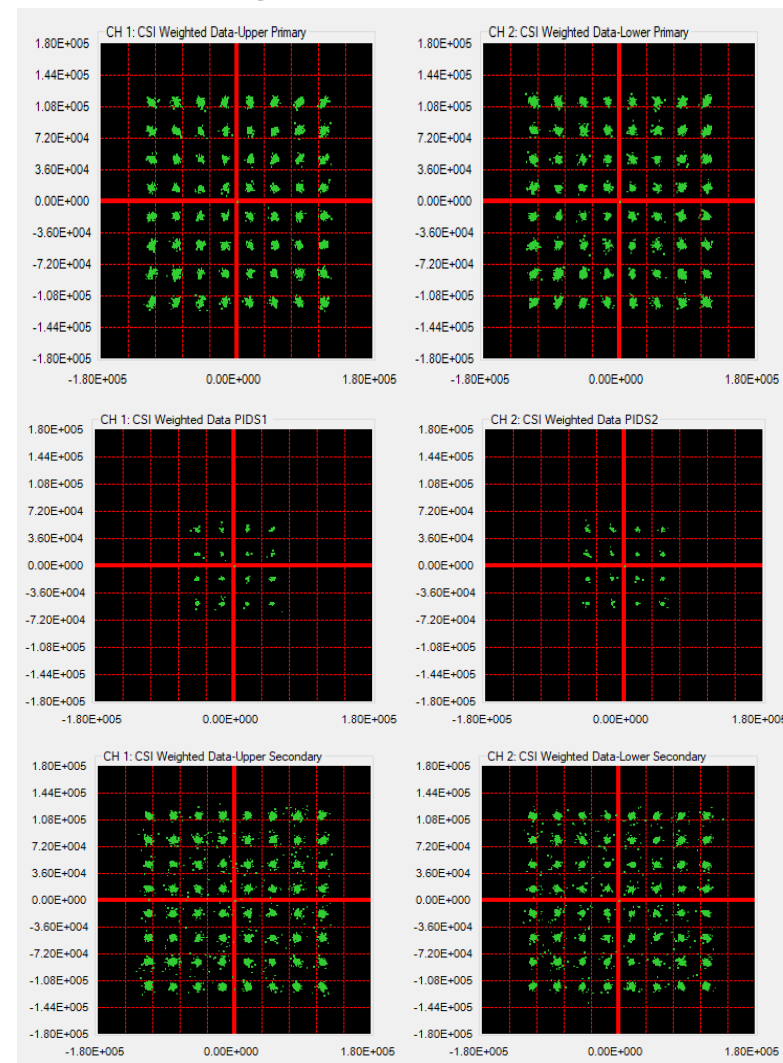
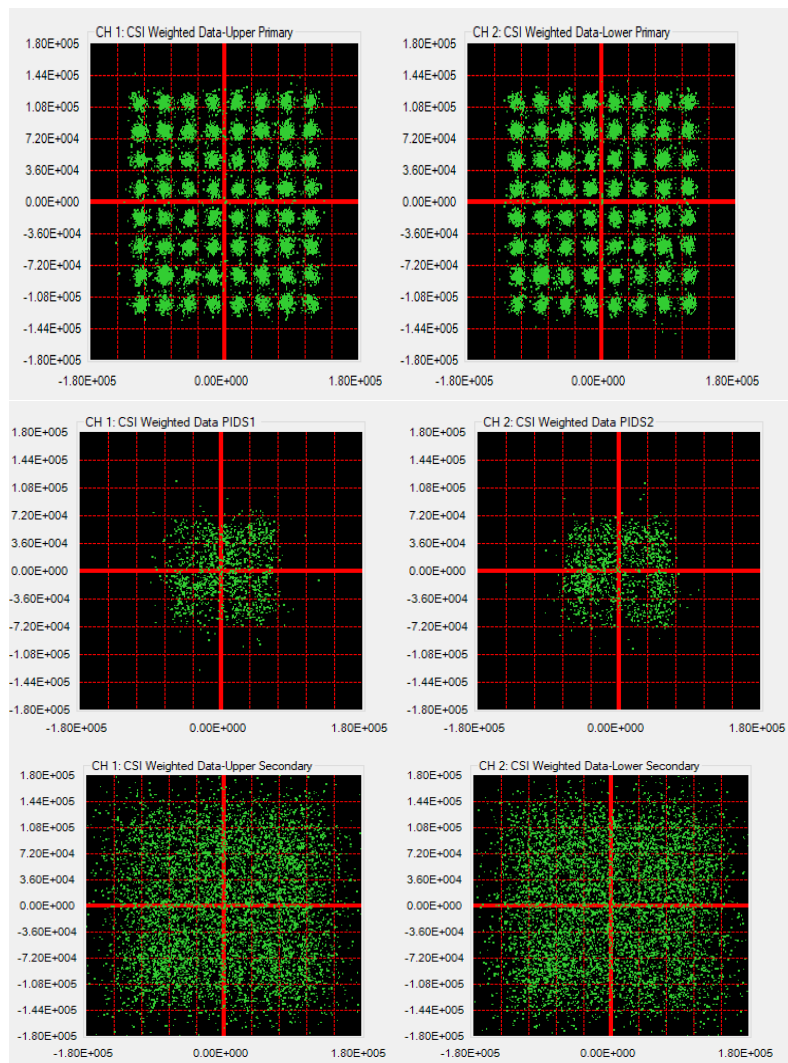


Power measurement changes



Photo courtesy of www.radiomuseum.org

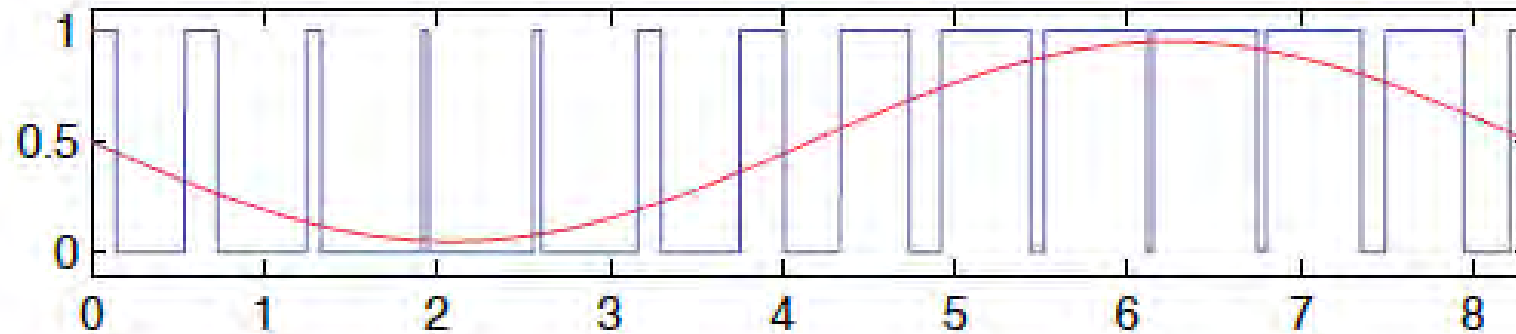
Transmitter with inadequate PDM switching frequency & no CFR vs. Transmitter with proper PDM switching frequency & CFR applied.



1.8 MHz Direct Digital Modulation

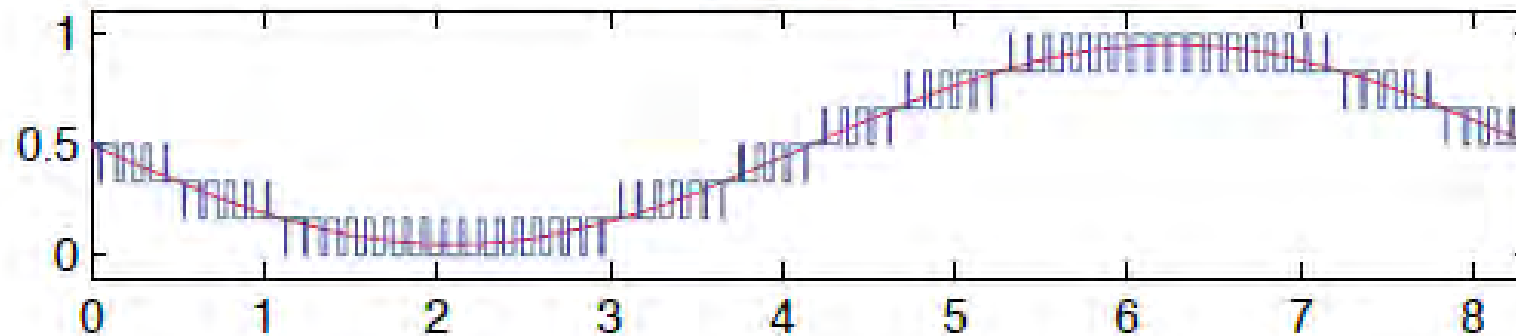
TRADITIONAL MODULATION

1 Phase Modulator

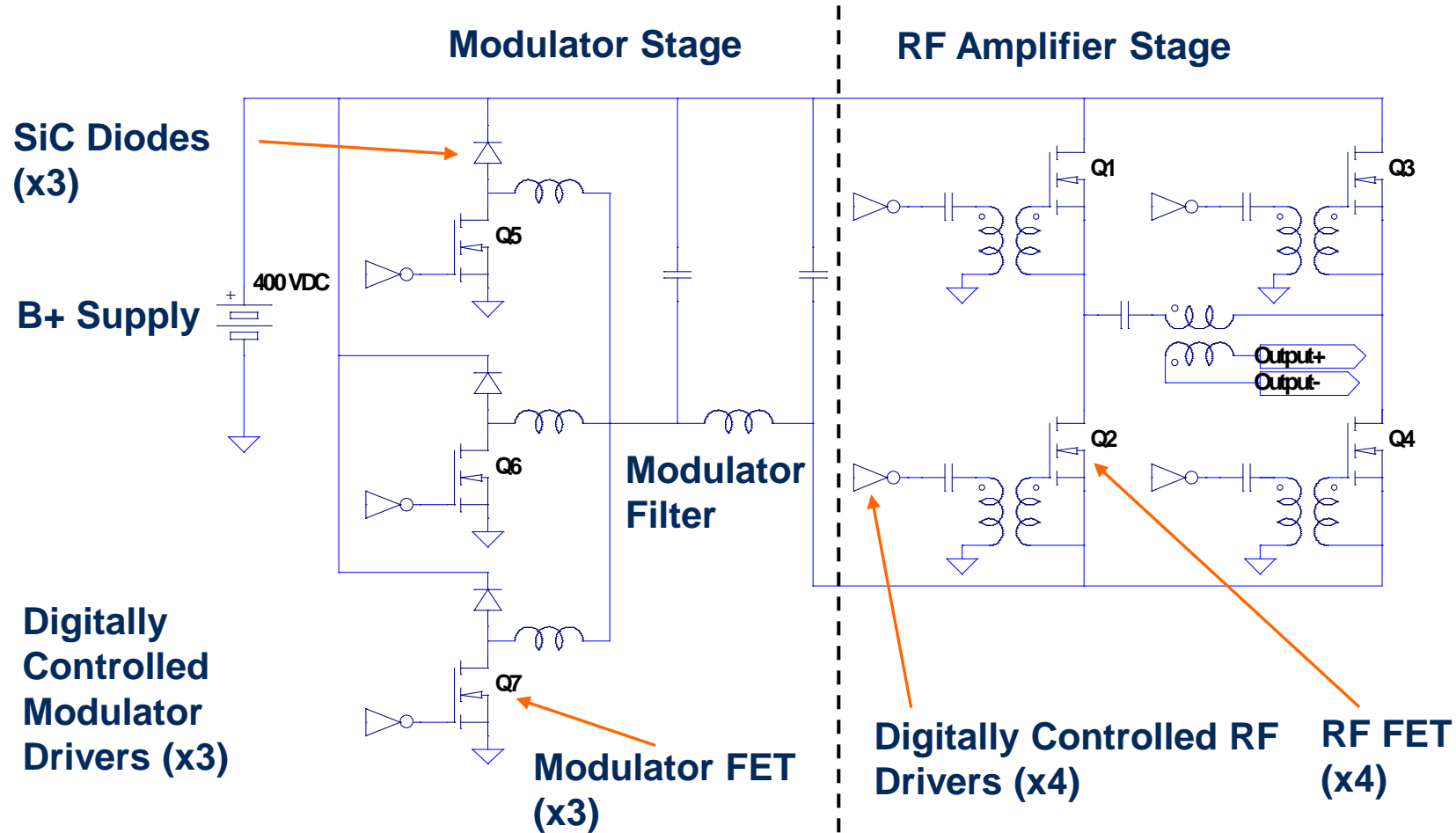


1.8 MEGA-SAMPLES/SECOND SIX PHASE DIRECT DIGITAL MODULATION

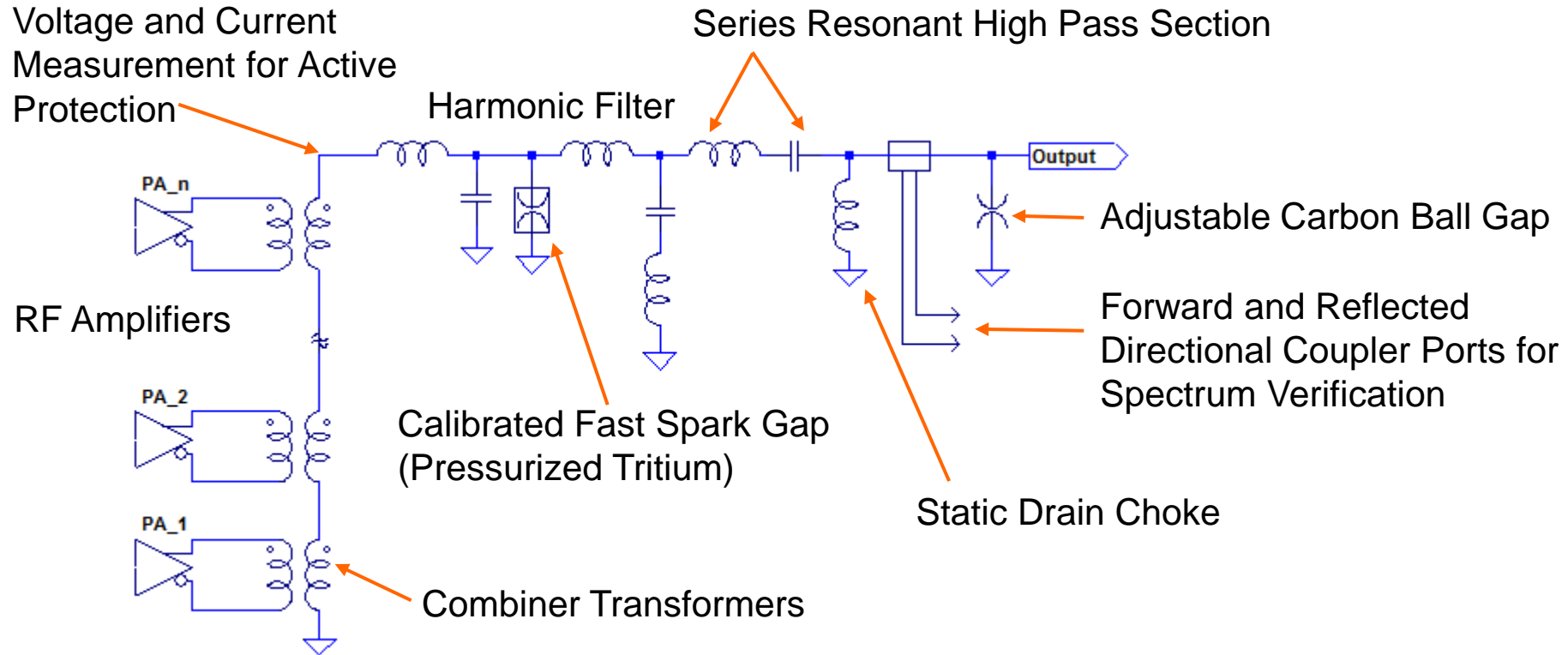
6 Phase Modulator



RF Amplifier / Modulator Module

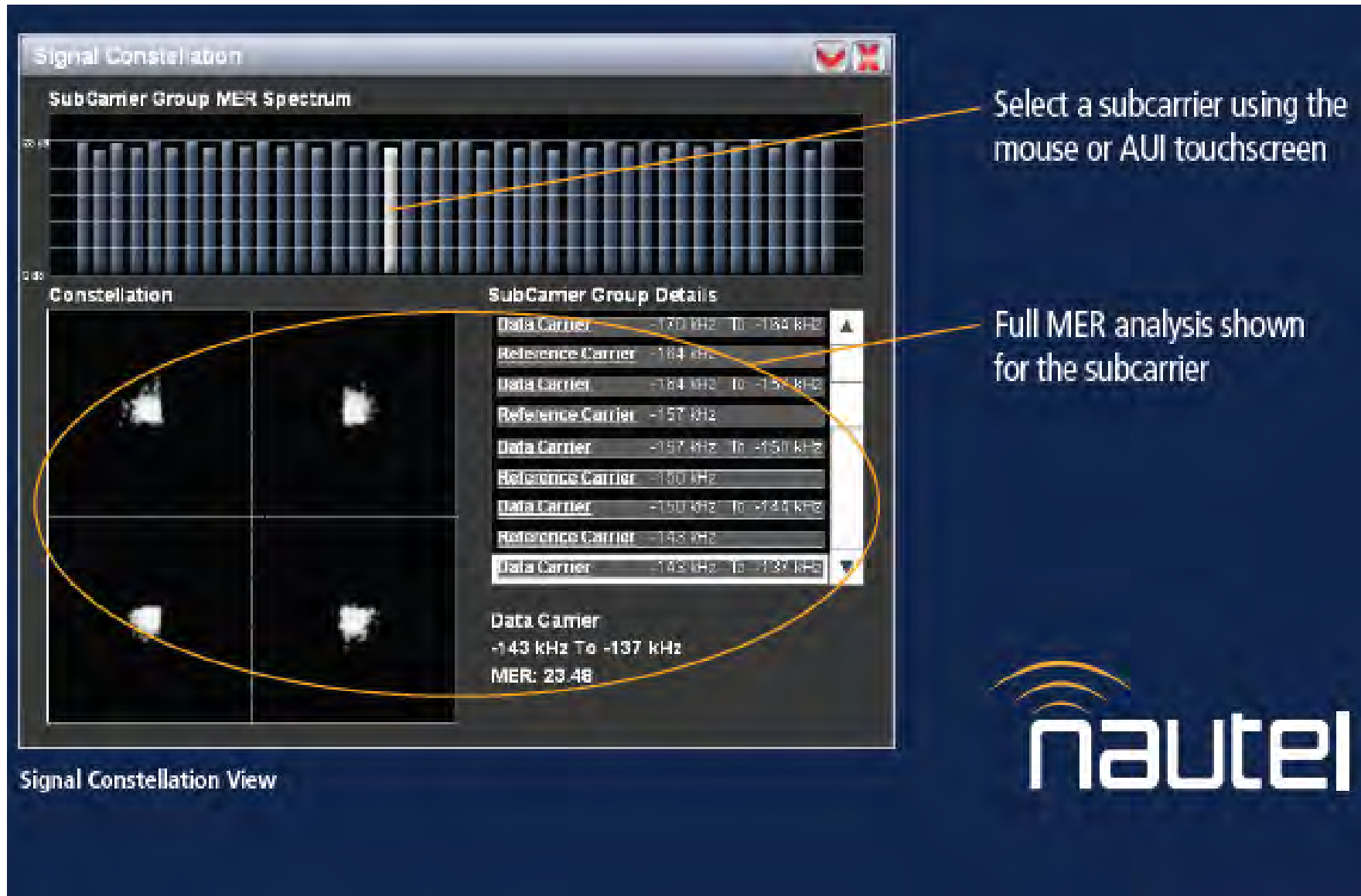


Combiner/Filter & Transient Protection



Frequency Agile: Harmonic Filter Re-Tune in a Few Hours

MER metering



HD RADIO TECHNOLOGY



WWFD-AM DAYTIME PATTERN – ALL DIGITAL

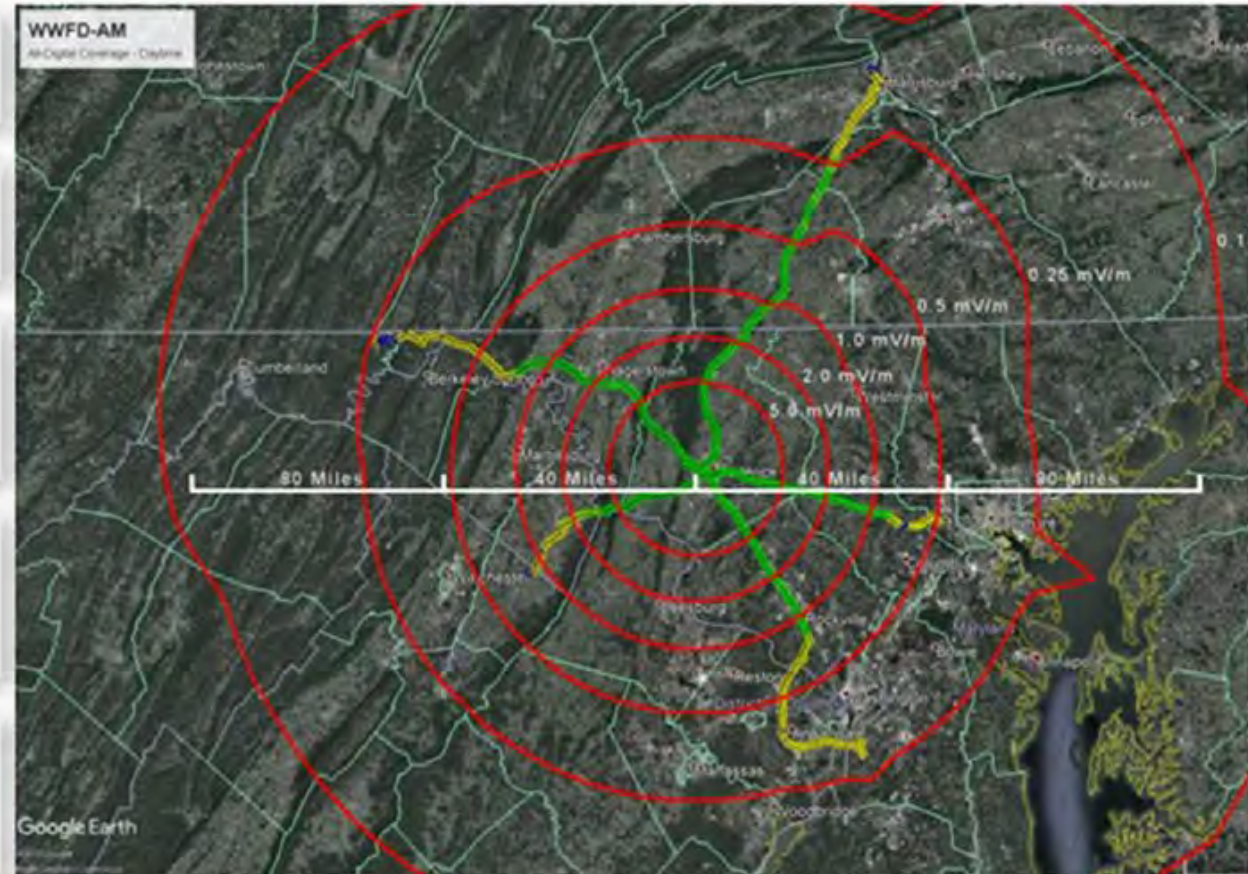
5.0 / 2.0 / 1.0 / 0.5 / 0.25
mV/m contours shown

All-digital signal fills in 0.5 mV/m
protected daytime contour

Class: B – 820 kHz
Daytime Power: 4.3 kW
Day – Non-Directional

Enhanced Mode = Green
Core Only Mode = Yellow
Mute Mode = Blue

5.0 mV/m population = 215,124
2.0 mV/m population = 456,791
0.5 mV/m population = 2,777,722



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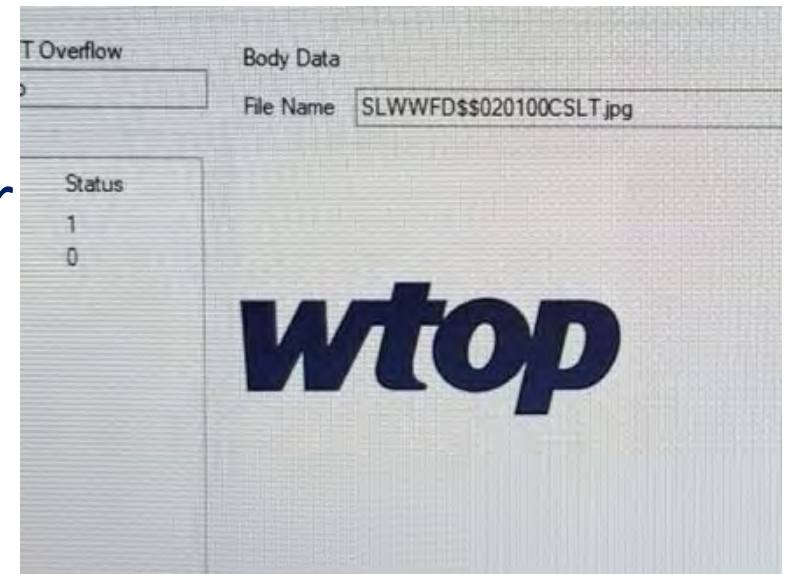
MA3 Improvements: HD2 Testing

Block Count	3
ALFN	847597680
ALFN Status	0
Lock Status	Unlocked

MPS	SPS 1	SPS 2	SPS 3	SPS 4	SPS 5	SPS 6	SPS 7
Tag	Description	Value (Characters 1 to 259)					
TALB	Album Title						
TPE1	Artist Name	WTOP.com					
TIT2	Song Title	News, Traffic and Weather					
TCON	Genre						
COMM	Comment						
COMR	Price						
COMR	Valid Until						
COMR	Content URI						

- The first AM HD2 was tested on WWFD in December 2019
- Program Service Data (PSD) and a Station Logo was transmitted as well

- Signal was received on an Xperi test receiver
- Proof-of-concept demonstrates flexibility of MA3 system
- Possible FM translator implications for AM stations



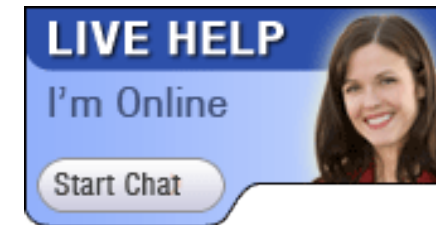
Considerations:

- Core vs Enhanced mode
 - Bandwidth
 - PDM frequency
 - Interference
-
- What's the goal?

Other Questions?

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Thank You