Receiver Blocking and What to Do About It

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CSI TELECOMMUNICATIONS, Inc
April 7, 2015

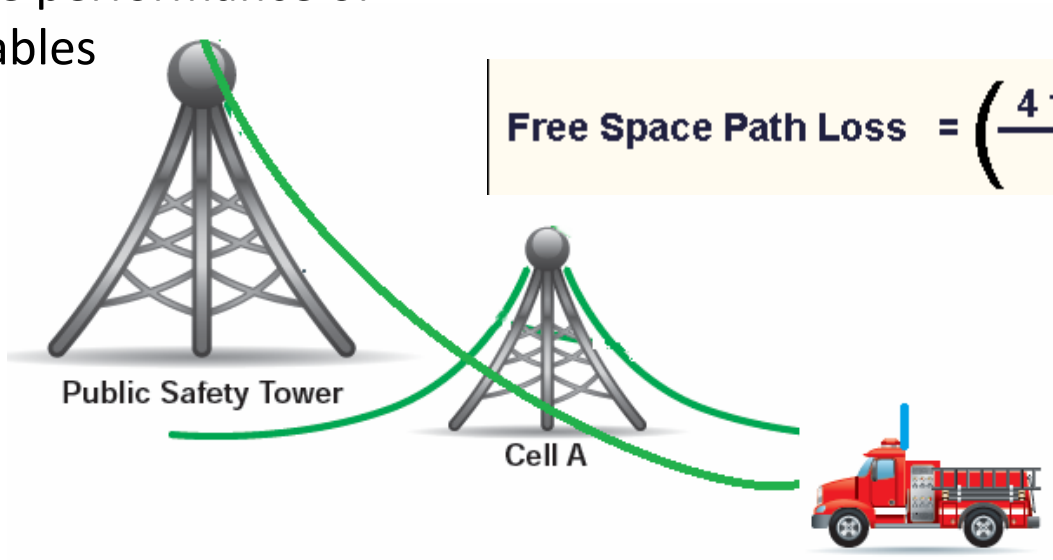
What are the Symptoms?

- Conventional Repeaters
  - Intermittent Receive
  - Transmit okay

- Trunked Repeaters
  - “Bonk”, No Transmit or Receive

Blocking, the Near Far Problem

- Power drops 6 dB for every 2X distance
  - Becoming common to get 80 dB difference 4G Near to Far
    - 80 dB is the performance of most portables



TIA Receiver Blocking Performance

3.1.19 Blocking Rejection

Applicable method of measurement and definition are described in [102.CAAA] clause 2.1.19.

Standard

The blocking rejection ratio shall be at least that specified in Table 13.

Table 13 - Blocking rejection

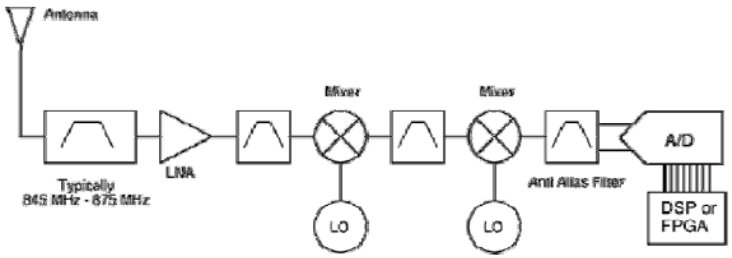
Receiver Class	Mobile	Portable	Base Station
A	90 dB	80 dB	90 dB
B	80 dB	70 dB	80 dB

9

- CW Test signals vs. 4G signals

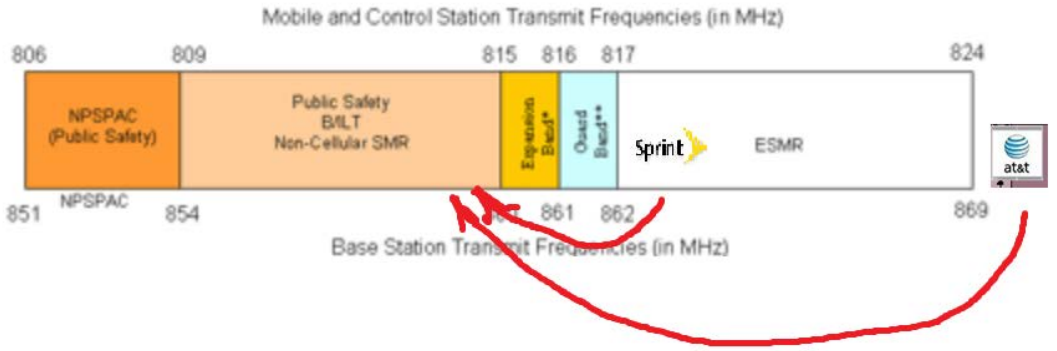
What Causes Receiver Blocking?

- Receiver Design (Filtering)
  - What Countries Served by model?
- Overload of Preamplifier
  - TOI of Semiconductor
    - Compression (reduced sensitivity)
    - IM products
- Overload of Mixer
  - LO Drive
- ADC Overload
  - Clipping of Desired Data on Interference peaks

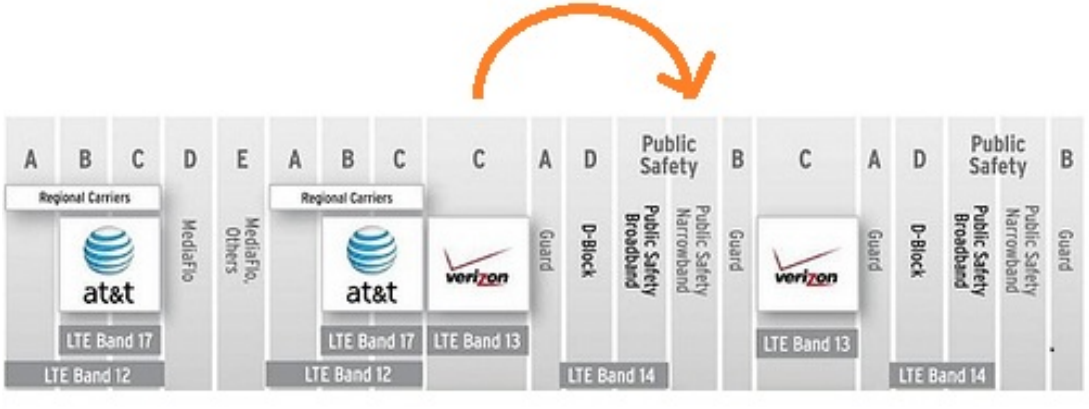


Common Blocking Frequencies

- 800 MHz

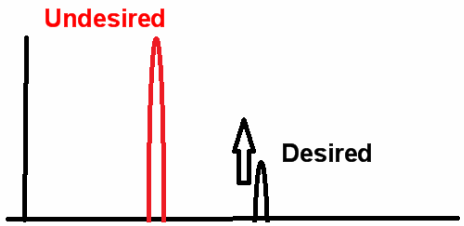


- 700 MHz

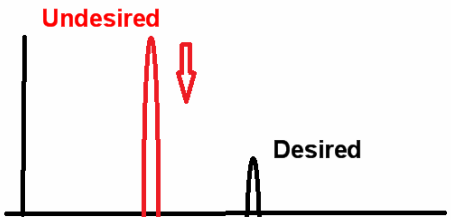


What Can you do?

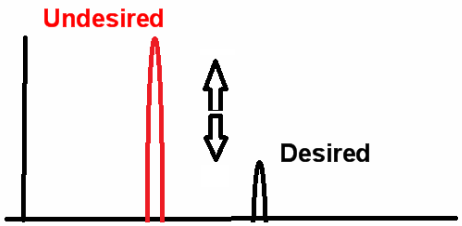
- More Desired Signal



- Lower Blocker Level

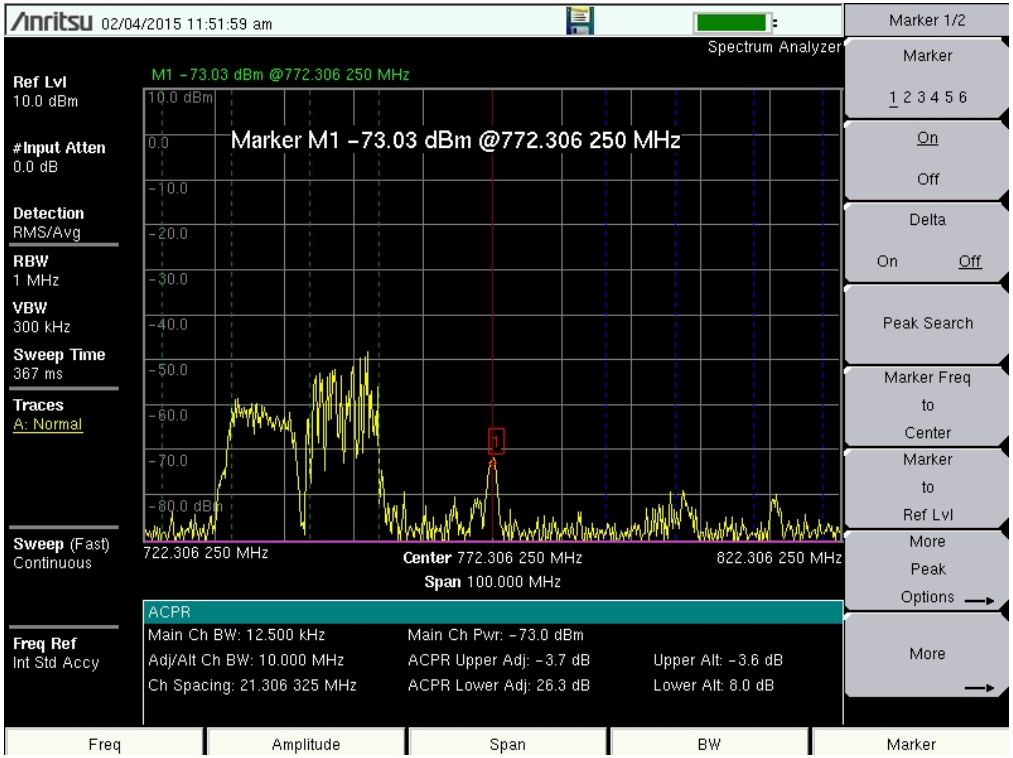


- Better Receivers

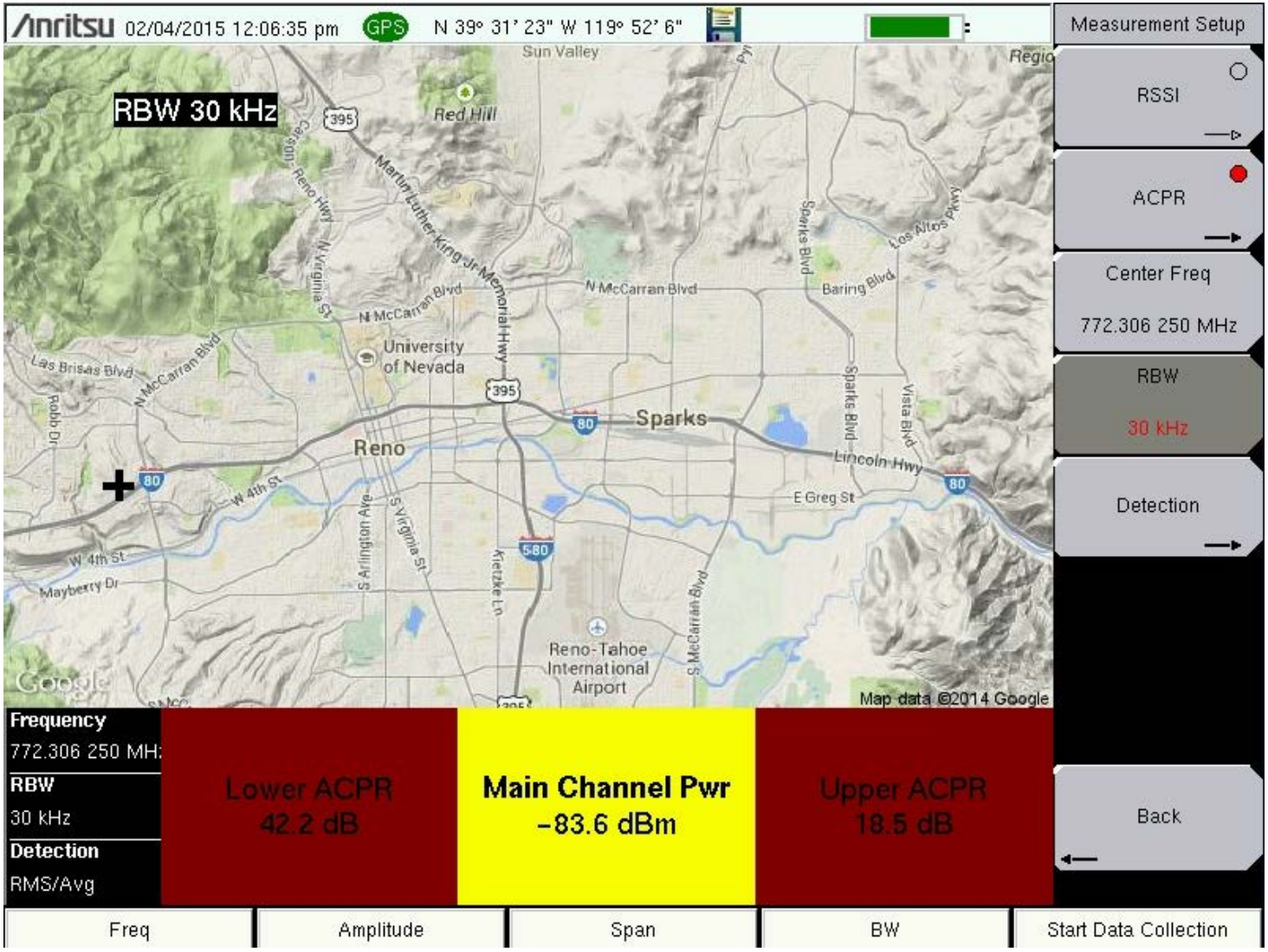


Making Measurements

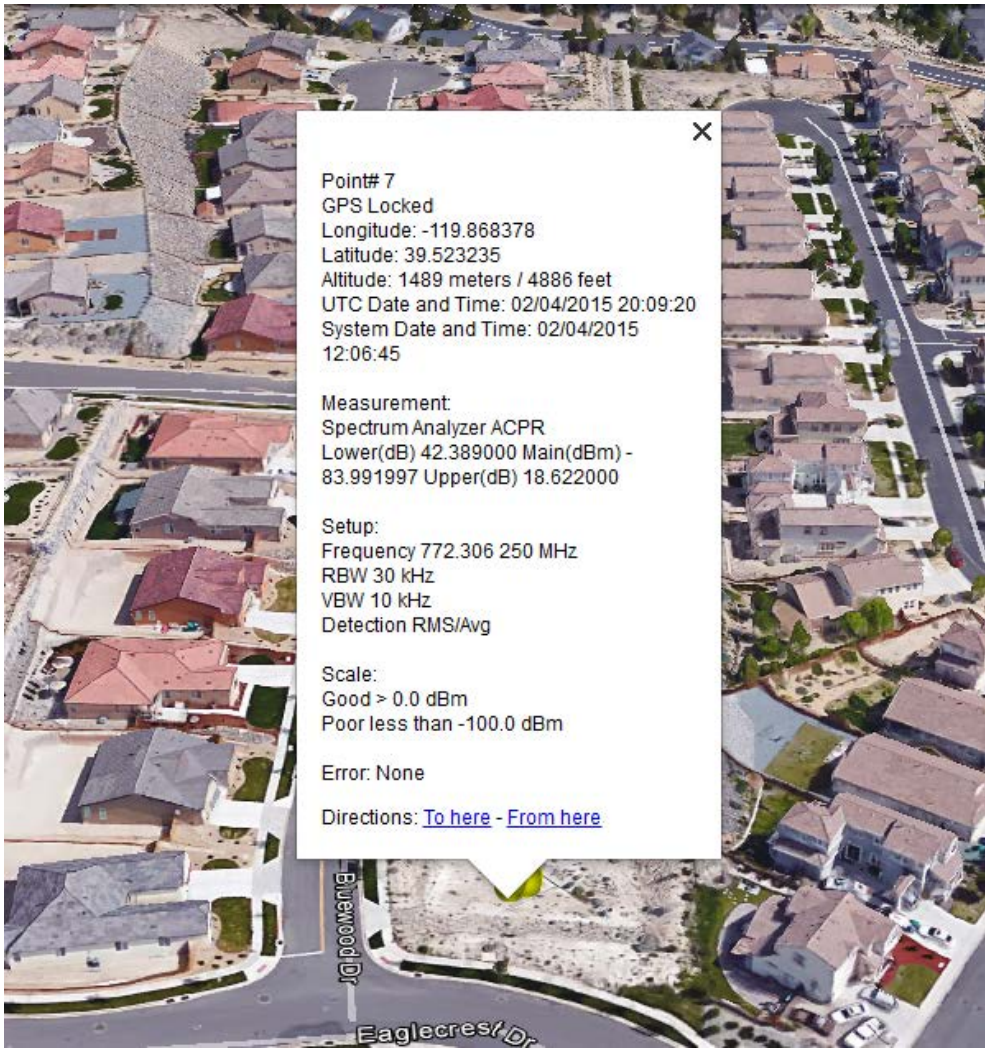
- What are the relative levels over the coverage area?
- ACPR coverage mapping



ACPR Maping



ACPR Mapping



ACPR Mapping

#Pt	GPS Statu	Longitude	Latitude(Y	Altitude	UTC Date	UTC Time	System Da	System Ti	Measurement					
Point# 1	GPS Locke	-119.868	39.52325	1489 mete	2/4/2015	20:09:12	2/4/2015	12:06:38	Spectrum	ACPR	Lower(dB)	42.23	Main(dBn	-83.608
Point# 2	GPS Locke	-119.868	39.52325	1489 mete	2/4/2015	20:09:12	2/4/2015	12:06:38	Spectrum	ACPR	Lower(dB)	41.4	Main(dBn	-83.808
Point# 3	GPS Locke	-119.868	39.52325	1489 mete	2/4/2015	20:09:13	2/4/2015	12:06:38	Spectrum	ACPR	Lower(dB)	41.4	Main(dBn	-83.808
Point# 4	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:19	2/4/2015	12:06:44	Spectrum	ACPR	Lower(dB)	39.496	Main(dBn	-83.992
Point# 5	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:19	2/4/2015	12:06:45	Spectrum	ACPR	Lower(dB)	39.496	Main(dBn	-83.992
Point# 6	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:19	2/4/2015	12:06:45	Spectrum	ACPR	Lower(dB)	39.496	Main(dBn	-83.992
Point# 7	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:20	2/4/2015	12:06:45	Spectrum	ACPR	Lower(dB)	42.389	Main(dBn	-83.992
Point# 8	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:20	2/4/2015	12:06:45	Spectrum	ACPR	Lower(dB)	41.614	Main(dBn	-83.216
Point# 9	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:20	2/4/2015	12:06:45	Spectrum	ACPR	Lower(dB)	41.614	Main(dBn	-83.216
Point# 10	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:20	2/4/2015	12:06:46	Spectrum	ACPR	Lower(dB)	41.614	Main(dBn	-83.216
Point# 11	GPS Locke	-119.868	39.52324	1489 mete	2/4/2015	20:09:20	2/4/2015	12:06:46	Spectrum	ACPR	Lower(dB)	40.546	Main(dBn	-83.216
Point# 12	GPS Locke	-119.868	39.52323	1489 mete	2/4/2015	20:09:21	2/4/2015	12:06:46	Spectrum	ACPR	Lower(dB)	40.584	Main(dBn	-83.2
Point# 13	GPS Locke	-119.868	39.52323	1489 mete	2/4/2015	20:09:21	2/4/2015	12:06:46	Spectrum	ACPR	Lower(dB)	40.584	Main(dBn	-83.2
Point# 14	GPS Locke	-119.868	39.52323	1489 mete	2/4/2015	20:09:21	2/4/2015	12:06:46	Spectrum	ACPR	Lower(dB)	40.584	Main(dBn	-83.2
Point# 15	GPS Locke	-119.868	39.52323	1489 mete	2/4/2015	20:09:21	2/4/2015	12:06:47	Spectrum	ACPR	Lower(dB)	40.229	Main(dBn	-83.2
Point# 16	GPS Locke	-119.868	39.52323	1489 mete	2/4/2015	20:09:21	2/4/2015	12:06:47	Spectrum	ACPR	Lower(dB)	39.249	Main(dBn	-82.988
Point# 17	GPS Locke	-119.868	39.52322	1489 mete	2/4/2015	20:09:22	2/4/2015	12:06:47	Spectrum	ACPR	Lower(dB)	39.249	Main(dBn	-82.988
Point# 18	GPS Locke	-119.868	39.52322	1489 mete	2/4/2015	20:09:22	2/4/2015	12:06:47	Spectrum	ACPR	Lower(dB)	39.249	Main(dBn	-82.988
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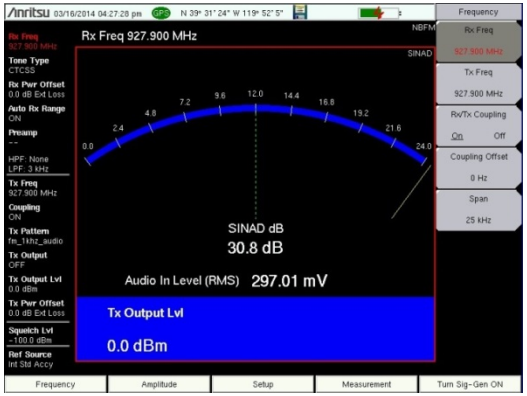
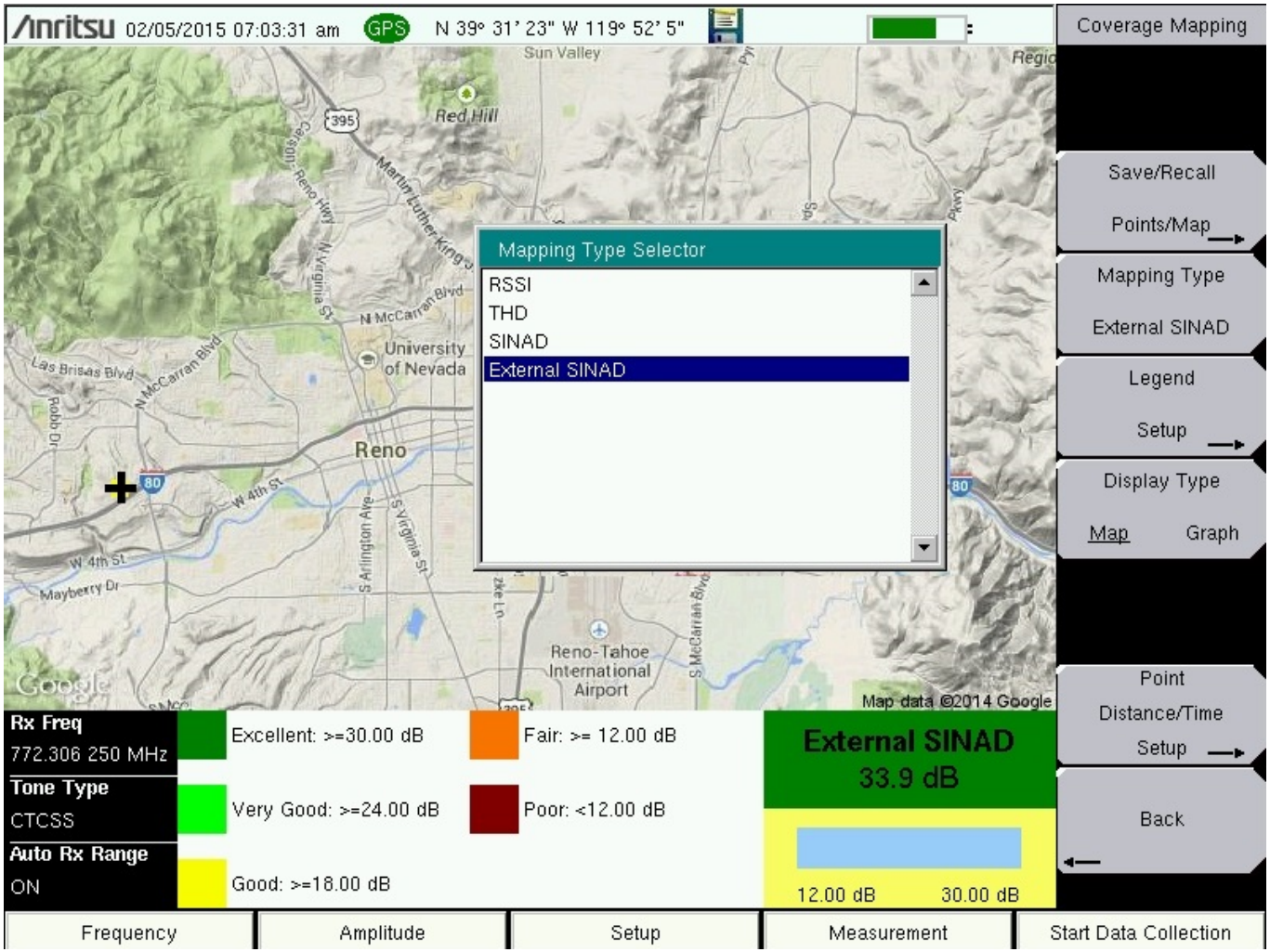
SINAD Mapping

- What are the relative levels over the coverage area?
  - Your Channel NBFM 12.5 kHz 1 kHz test tone
- SINAD coverage mapping



SINAD Mapping



What Can you do?

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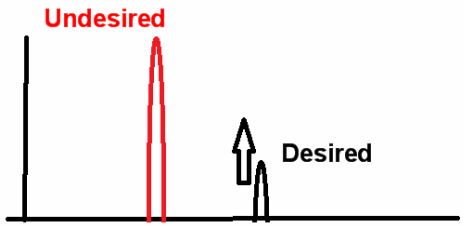
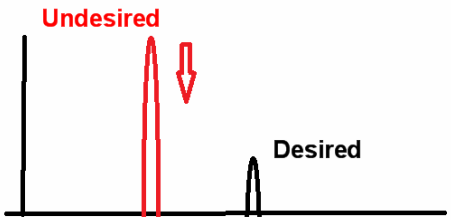
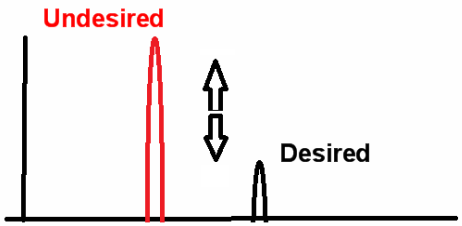


- Lower Blocker Level

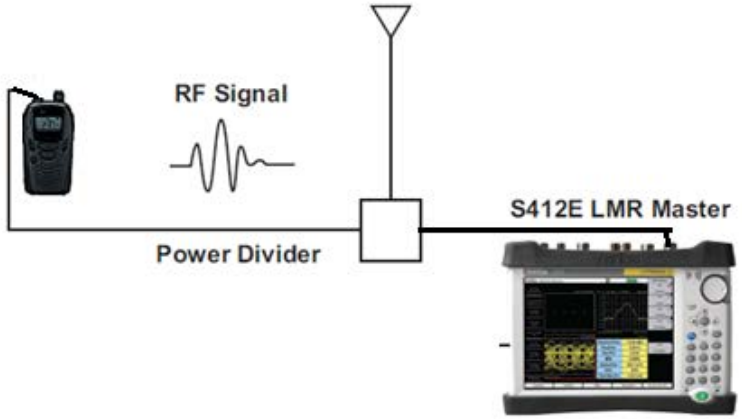


- Better Receivers



How much more desired?

- Sum external antenna with Blocker with Desired signal from signal generator



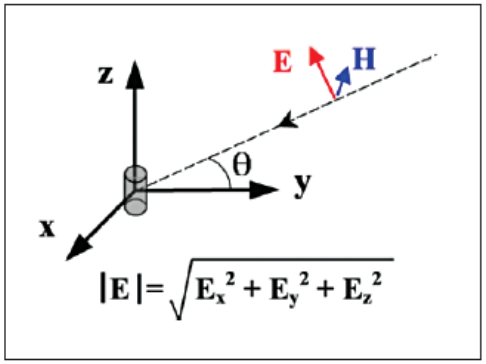
- Increase Desired level until BER is < 5%

S412E LMR Master mounted on a vehicle dashboard.

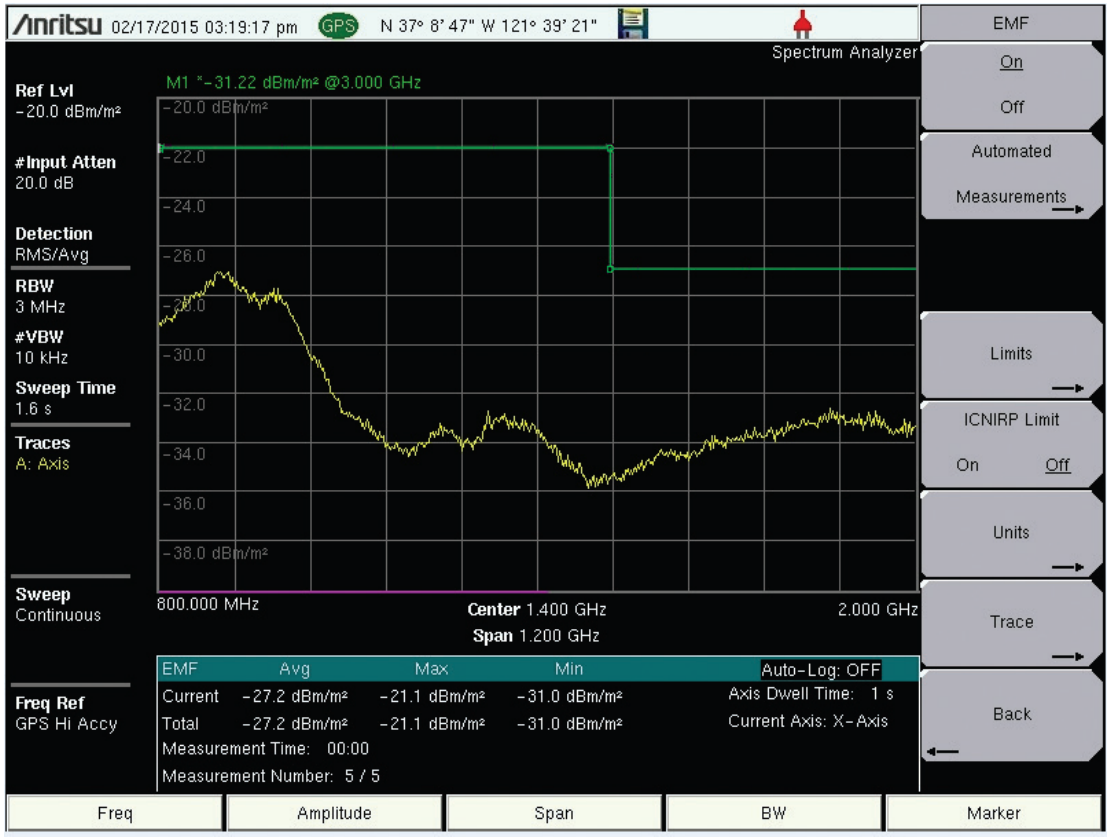
How Much Less Undesired?

- Measure Field Strength
  - FCC NPRM FCC 14-181
    - 40 dBµV/m
- File Complaint with Undesired
- Present case with defendable accuracy
  - Calibrated antenna
  - No Nearby Metal (vehicle)
- Channel loaded with traffic?
  - Assess and extrapolate

EMF Measurements



Total measurement given by formula shown

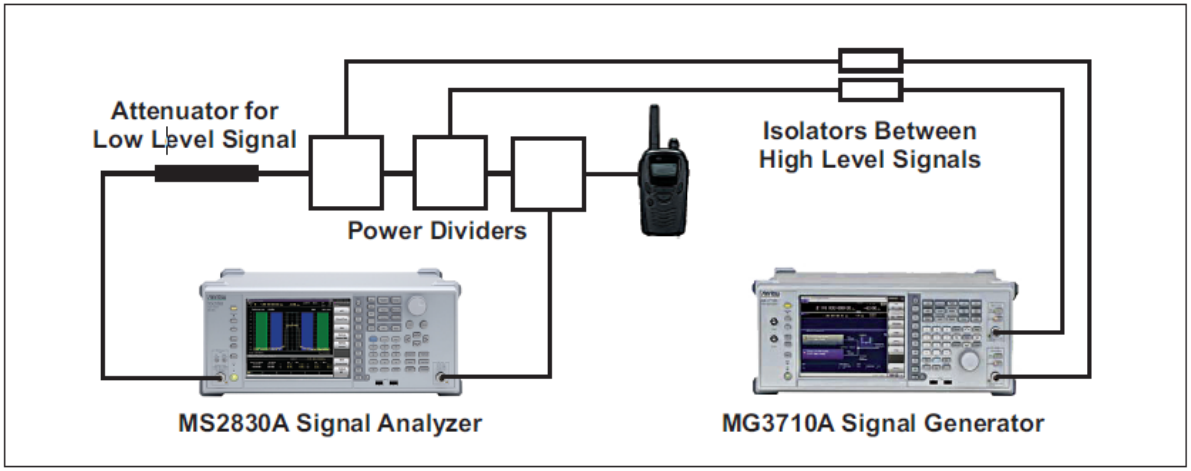


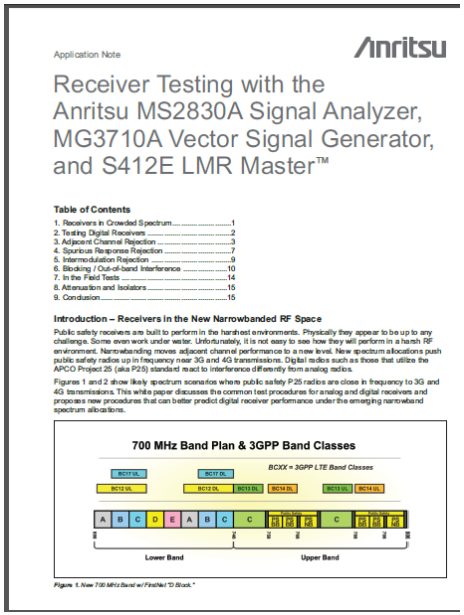
EMF Measurements

Better Receivers?

- TIA 102 and 603 procedures
- Move receive frequencies away from undesired

Receiver Testing





Application Note

Anritsu

Receiver Testing with the Anritsu MS2830A Signal Analyzer, MG3710A Vector Signal Generator, and S412E LMR Master™

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Introduction – Receivers in the New Narrowbanded RF Space

Public safety receivers are built to perform in the harshest environments. Physically they appear to be up to any challenge. Some even work under water. Unfortunately, it is not easy to see how they will perform in a harsh RF environment. Narrowbanding moves adjacent channel performance to a new level. New spectrum allocations push public safety radios up in frequency near 3G and 4G transmissions. Digital radios such as those that utilize the APCO Project 25 (aka P25) standard react to interference differently from analog radios.

Figures 1 and 2 show likely spectrum scenarios where public safety P 25 radios are close in frequency to 3G and 4G transmissions. This white paper discusses the common test procedures for analog and digital receivers and proposes new procedures that can better predict digital receiver performance under the emerging narrowband spectrum allocations.

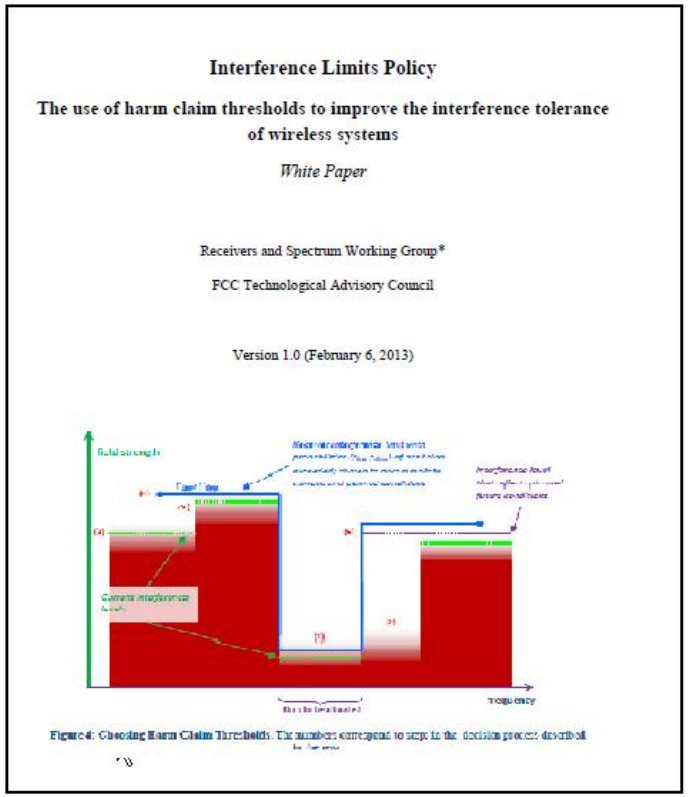
Figure 1. New 700 MHz Band w/ FirstNet "D Block."

Receiver Settings

- Front End Attenuator in AGC.

Trends

- More 4G, More Crowding, More Problems
- Different Rules
  - Harm Claim Thresholds
    - "A receiver operator could only make a claim for harmful interference if the aggregate signal strengths from neighbors exceeded the harm claim threshold.



Interference Limits Policy

The use of harm claim thresholds to improve the interference tolerance of wireless systems

White Paper

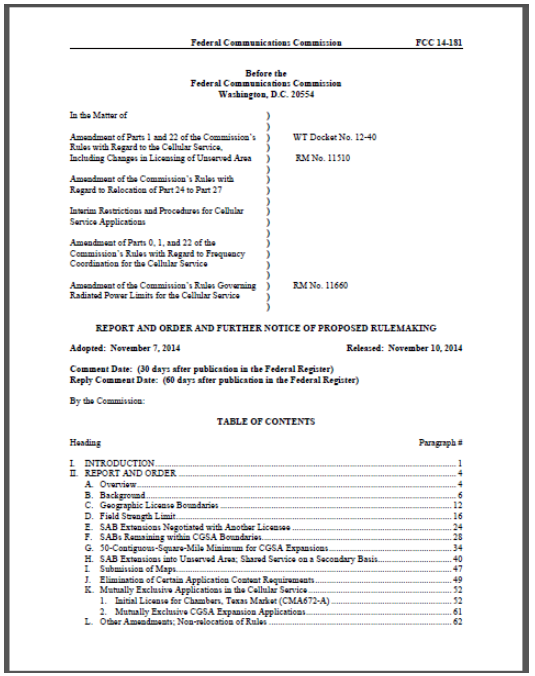
Receivers and Spectrum Working Group*

FCC Technological Advisory Council

Version 1.0 (February 6, 2013)

Trends

- More 4G, More Crowding, More Problems
  - Different Rules
- Better Receivers



Federal Communications Commission FCC 14-181

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Amendment of Parts 1 and 22 of the Commission's Rules with Regard to the Cellular Service, Including Changes in Licensing of Unserved Area	)	WT Docket No. 12-40 RM No. 11510
Amendment of the Commission's Rules with Regard to Relocation of Part 24 to Part 27	)	
Interim Restrictions and Procedures for Cellular Service Applications	)	
Amendment of Parts 0, 1, and 22 of the Commission's Rules with Regard to Frequency Coordination for the Cellular Service	)	
Amendment of the Commission's Rules Governing Radiated Power Limits for the Cellular Service	)	RM No. 11660

REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING

Adopted: November 7, 2014 **Released: November 10, 2014**

Comment Date: (30 days after publication in the Federal Register)
Reply Comment Date: (60 days after publication in the Federal Register)

By the Commission:

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Heading Paragraph #

Questions?

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