

Can You Hear Me NOW???

LTE Interference, challenges and solutions

WBA Broadcasters' Clinic 2015

Madison, WI

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Nautel



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Overview

- Theory
 - What is Shannon's Theory?
 - Why is it important?
- Legalities
 - Discussing the CFR
 - But we're grandfathered – first in, right?
- Solutions
 - Things to consider when buying new
 - Suggestions for fixing existing sites



Shannon's Theory

- More accurately known as Shannon-Hartley theorem

$$C = B \log_2 \left(1 + \frac{S}{N} \right)$$

- It builds on the Nyquist theorem (the minimum sample rate for any signal is twice the maximum frequency of the signal).
- Effectively Nyquist for digital
- C= Channel capacity
- B= Channel BW
- S= signal power (average over BW)
- N= noise (average over BW)



Why Shannon's Theory is Important

In short, the lower the noise, the more data that can be transmitted for a given power level and bandwidth.

Cell companies have a vested interest in using as few towers as possible – so the noise limit is being pushed... hard.



Photo courtesy of www.michaelhugo.com



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Legalities

§ 73.317 FM transmission system requirements.

(a) FM broadcast stations employing transmitters authorized after January 1, 1960, must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least $43 + 10 \text{ Log}_{10} (\text{Power, in watts})$ dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

<http://www.hallikainen.com/FccRules/>



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But We Were Here First!!!

- There's still the risk of civil litigation
 - There are a variety of legal theories regarding nuisance which might entitle an aggrieved party to damages or relief from interference circumstances created by a newcomer.
 - Upgrading equipment (transmitter/antenna/etc.) makes your station the “newcomer”



Photo courtesy of www.wvud.org

Solutions

- When buying a new transmitter
 - Insist on CE compliance
 - If performing FAT, ask if cabinet radiation measurement can be done (this may involve added cost, so ask during the initial quotation stage).



Solutions

- One of the biggest RF leakage points are the ventilation ports – both intake and exhaust
 - Care must be taken NOT to restrict airflow
 - Hardware cloth is a low cost solution



Photo courtesy of Walker Sisson

Solutions

- Another big leakage point is plastic meters
 - Example of hardware cloth “cage” built to shield meter openings



Photo courtesy of Walker Sisson

Solutions

- Other potential leakage points must be investigated and sealed
 - Brass stock from hobby shops can be useful

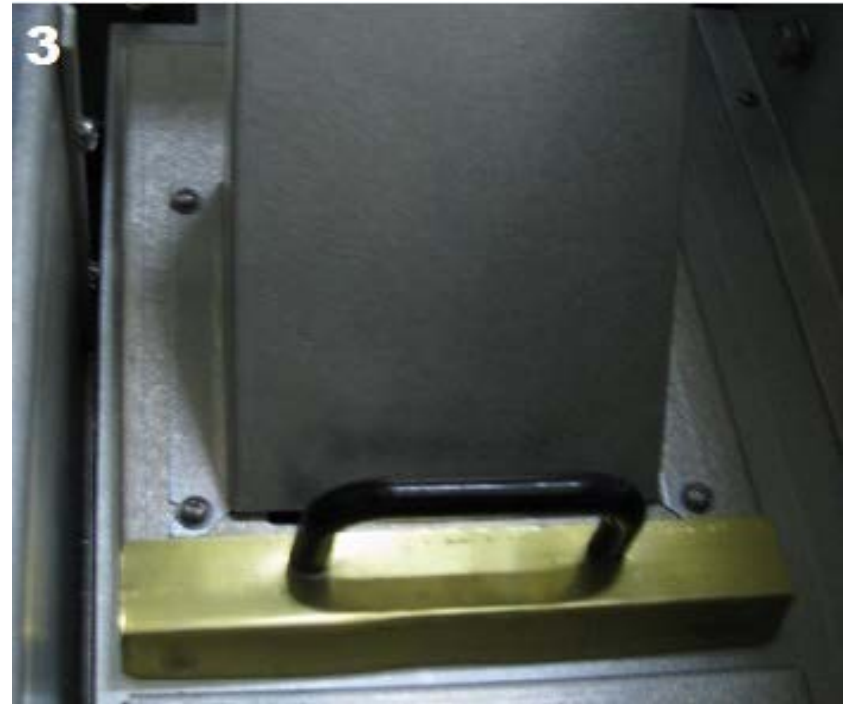


Photo courtesy of Walker Sisson

Solutions

- For relatively small cracks and crevices, copper tape is an option
 - Can also be used to provide a conductive way to secure hardware cloth
 - Note that copper tape is available with conductive and non-conductive adhesive.



<https://www.adafruit.com/products/1127>

Solutions

- When shielding the transmitter isn't enough, conductive paint to shield the entire transmitter room may be an option
 - Creates a Faraday cage
 - Can be painted over for aesthetics



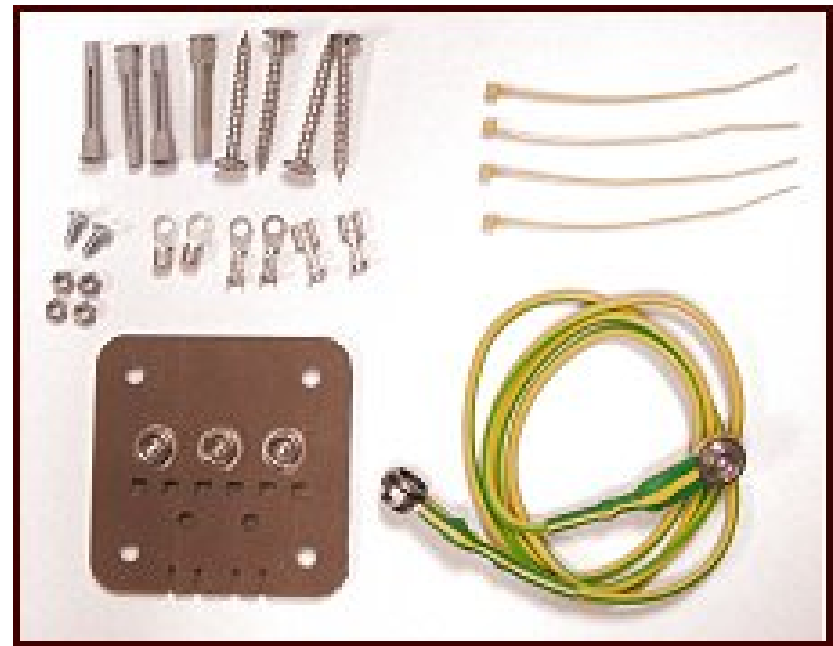
<http://www.lessemf.com/paint.html>



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Solutions

- If shielding a room, remember to ground the shield
 - Ground kits are available from several sources, or roll your own with copper strap and screws
 - Paint over ground connections with conductive paint



<http://www.lessemf.com/paint.html>

To review:

- Shannon's Theory is being pushed to the limit
 - Noise floor requirements of -108dB
 - Sites being co-located or nearby existing FM sites
 - Existing infrastructure, with potential loose connections
- We need to carefully manage to ensure we're not put in an adversarial position
 - Working with the cell company has a lot less potential risk than trying to fight
 - Most cell co. reps will realize this as well and may cover costs.
- Shielding is critical
 - But don't restrict airflow!



LTE Interference

- CE specs are stricter than FCC specs for cabinet radiation.
- LTE receivers typically operate very near noise floor.
- It's a good idea to contact your FCC attorney if you receive any complaints from an LTE provider.

Credit for link for conductive paint goes to Curtis Flick, via www.lists.radiolists.net - Broadcast forum



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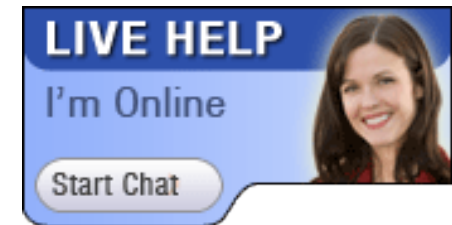
Resources

- www.nautel.com/support/tipsntricks/
- www.scottbaxter.com



Learn More / Stay in touch

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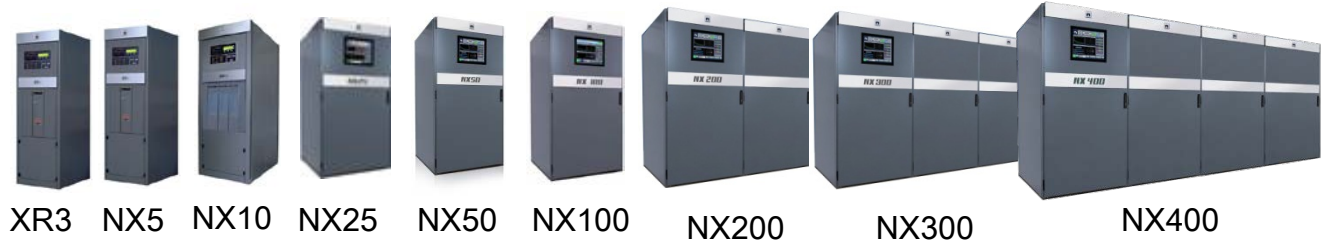


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Nautel Major Product Families

XR and NX Series
AM transmitters

3kW – 2.0MW



VSSeries FM

300W – 2.5kW



Advanced User Interface (AUI)



GVSeries FM

3.5kW – 88kW



NTSeries DTV

150W – 1kW



NVLT Series FM

3.5kW – 10kW



"The most intelligent transmitters ever designed"

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Thank You



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