SCTE CABLE-TEC EXPO '13
OCTOBER 21-24 / ATLANTA, GA

UHF SIGNAL LEAKAGE AND INGRESS

UNDERSTANDING THE CHALLENGES

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UHF leakage

Frequencies	Signal leakage limit (micro volt/meter)	Distance in meters (m)
Less than and including 54 MHz, and over 216 MHz	15	30
Over 54 up to and including 216 MHz	20	3

A more common problem than many believe

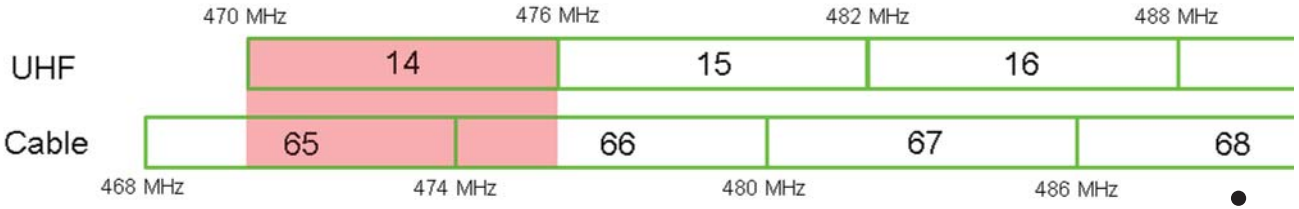
- The cable industry for decades has monitored leakage in or near the 108-137 MHz very high frequency (VHF) aeronautical band
- During the past couple years cable operators have become aware of ultra high frequency (UHF) leakage, largely because of interference to long term evolution (LTE) services in the 698-806 MHz spectrum
- Existing leakage equipment doesn't work at UHF
  - The good news: commercial UHF leakage gear now available
- Limited industry experience dealing with UHF leakage

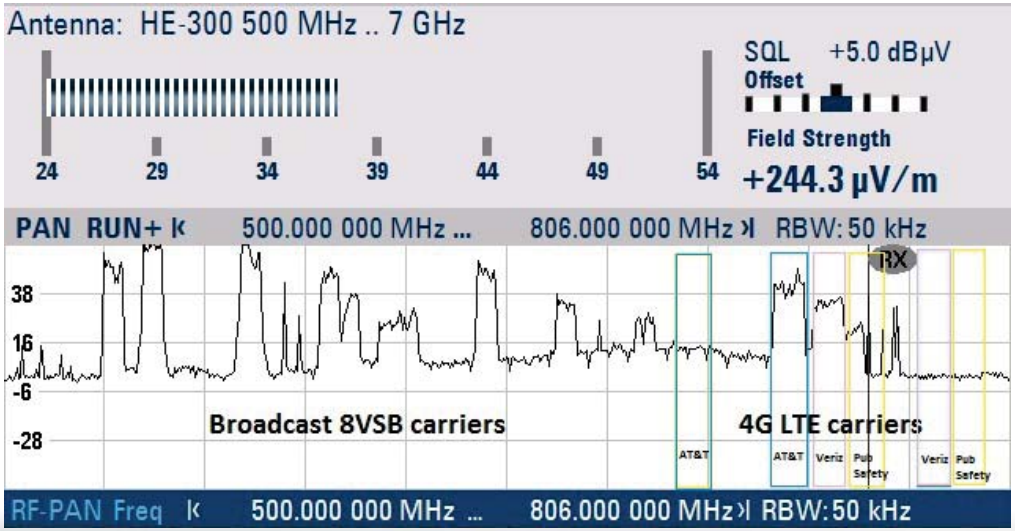
The challenges

- Harmful interference to over-the-air users may occur
  - Leakage-related harmful interference MUST be fixed promptly per §76.613, regardless of field strength
  - May result in FCC enforcement action ($$)
  - Cases of safety of life and property may result in forced turn-off of signals until repaired
- Ingress and direct pickup interference
  - Service degradation or disruption
  - Subscriber dissatisfaction
  - Impact on performance of new technologies such as DOCSIS® 3.1

What's in the affected spectrum?

Frequency reuse lets us share the spectrum





- 470-698 MHz:
  UHF TV
- 698-806 MHz:
  LTE tower-to-user equipment (UE), LTE UE-to-tower, public safety
- 806-902 MHz:
  Cellular, trunked 800 MHz radios

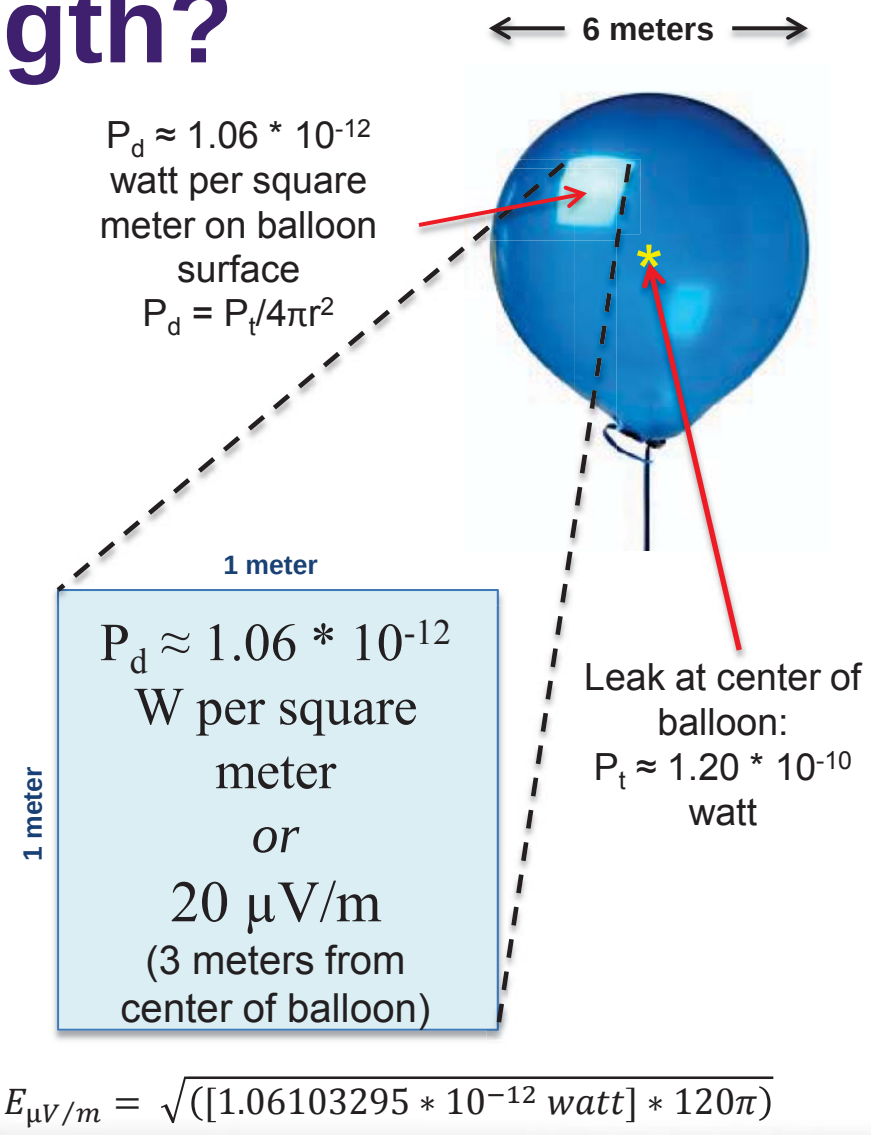
The two-way street

Leakage, ingress, direct pickup

- Leakage can interfere with over-the-air services
- Ingress from over-the-air signals can interfere with cable signals
  - Some operators have abandoned affected frequencies
- Direct pickup interference can affect customer premises equipment (CPE) and other devices
  - Older CPE usually more susceptible, newer CPE has better shielding. Poorly shielded “retail” cables and components can offset the benefits of good CPE shielding.
  - Some headend equipment susceptible to direct pickup

What is field strength?

- Field strength is the RF power density P_d in a 1 meter x 1 meter square (in free space, in the air, on the surface of an imaginary balloon), expressed as a voltage – hence, the “volts per meter” or “microvolts per meter” designation.



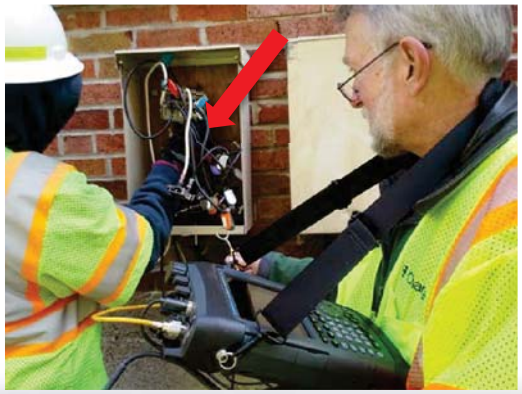
$$E_{\mu V/m} = \sqrt{([1.06103295 * 10^{-12}\ watt] * 120\pi)}$$

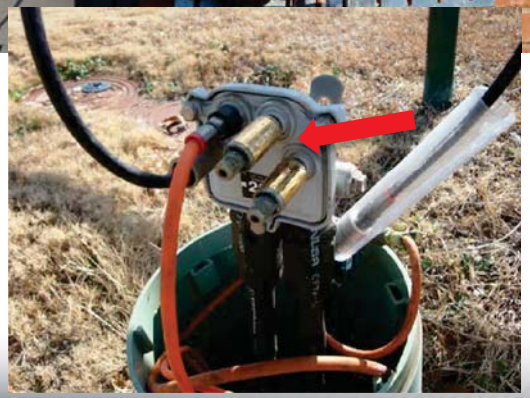
Lack of VHF and UHF correlation

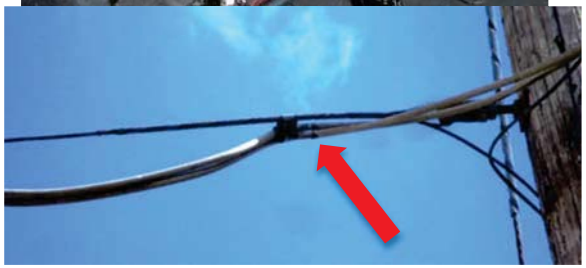
Tight plant at VHF? That's not enough!

- Field studies have shown there is little or no correlation between VHF and UHF leakage field strengths
- The plant might be tight in the VHF aeronautical band, but leakage can be significant at UHF
- Further complicating UHF leakage detection and measurement is the antenna factor difference between VHF and UHF antennas. This difference effectively reduces sensitivity at UHF.

UHF leakage mechanisms







What can be done?

LTE service provider relationships

- Respond immediately – do NOT delay
- Schedule techs ASAP
- There could be substantial UHF leakage even if there is no VHF leakage
- If UHF leakage detection gear is available, use it
- If you don't yet have UHF leakage gear, a home-brew combination of equipment might work for confirming the presence of UHF leakage
- Fix the problem
- Provide system point-of-contact info to LTE engineers
- Notify customer service reps to direct inquiries to appropriate person
- Document everything

What can be done?

Commercial solutions

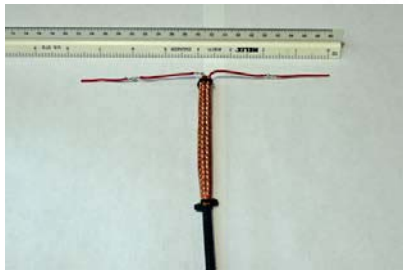
- Several manufacturers now are shipping digital-compatible UHF leakage detection equipment
- You should be planning near-term implementation of a UHF leakage monitoring program
  - The FCC has already taken enforcement action against cable operators for UHF leakage >15 µV/m at 30 meters, as well as for harmful interference to LTE services

What can be done?

"Home-brew" combinations

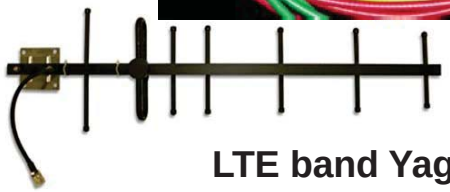
- Possible short-term solution until commercial gear is obtained at system level
- Preliminary test results with home-brew solutions were mixed
- Certain combinations of spectrum analyzer, preamplifier, and high-gain antenna can be used to at least confirm the *presence* of UHF leakage

UHF TV antenna



750 MHz dipole

Spectrum analyzer



LTE band Yagi

Leakage Mitigation

VHF *and* UHF leakage

- Finding and repairing leakage
- Preventing future leakage
- Best practice strategies used by technicians today
- Recommended best practice strategies going forward
  - SCTE's Network Operations Subcommittee Working Group 1 (NOS WG1) is developing recommended practices

Summary

The challenges are solvable

- UHF leakage, ingress, and direct pickup must be taken seriously NOW
- Significant risks and liabilities
- Approach from several directions:
  - Implement a UHF leakage program with your existing VHF leakage program
  - Avoid future leakage problems
  - Adopt best practice strategies for today and tomorrow

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