Feedback
Letters to the Editor

Part 15 Devices: Attributing Interference

Dear Editor,

M. Ryan's article is interesting in its accurate rendition of the USS CARL VINSON interference episode, where hundreds of car keyless-entry devices became unable to function within 8 miles of the carrier. (NARTE News Summer 2002 Vol. 20, No. 2, pp. 6-8, *"Part 15 Devices—A Growing Threat to the DoD's Lawful Use of a Diminishing Spectrum Asset,"* by Mikel R. Ryan)

Basis For Further Analysis:

I think the article misses a true analysis of the interference scenario, which is finally what the incident is all about.

For example, an interference situation consists of: 1) a culprit source, 2) some coupling path, and 3) a victim. Understanding and eventually solving an EMI case implies having some degree of control on 1), 2) or 3). In this Bremerton incident, given that the coupling path is air propagation and can be regarded as unmodifiable, we are left with:

A) Acting on the culprit source.

This source is a licensed transmitter; furthermore, a DOD transmitter whose operation carries a priority of the Nation's defense. Although the justification for operating the transmitter at full power while the ship is at harbour, and beaming its antenna in direction of a friendly city or coastal area could be questionable, we will assume that this item cannot be modified either.

B) Examining the victim's susceptibility threshold.

Automotive electronics are normally (or should be) designed to be insensitive to EM ambients, including the most severe ones like the neighborhood of powerful RF transmitters (AM, FM or Pulse modulated). Responsible car manufacturers require an immunity threshold of at least 100 V/m, some going as far as 200 V/m. Tests are carried per SAEJ1113 or similar industry standard. **So, the questions are:**

1) were the cars' locking/unlocking devices compliant with this mandatory immunity level? or

2) were they some second-source, cheaper "equivalent" items?

If "2" is true, we have an interesting case for suing the manufacturers for installing failure-prone devices. Such cases can feather the nest of clever lawyers, for years.

If "1" is true, we need to check the likelihood of the ambient RF fields exceeding the 100 V/m threshold. We have very little data at hand for this, since transmitting power, modulation index and antenna gain of the specific ships are not provided, and probably classified. But we can play reverse engineering, to some extent.

Regarding the case mentioned in the article— the USS ABRAHAM LINCOLN disruption of vehicle lock/unlock devices from a distance of up to 8 miles:

Assume the actual devices' susceptibility threshold to be ≥100 V/m, as it should be: using free space propagation formula:

$E(V/m) = 1/D\sqrt{30PG}$ where, P=transmitter power, G=antenna gain, D=distance in m where E is needed.

Solving for PG with E=100 V/m and D=13000m (metric equivalent to 8 mi), PG ≥ 56 GigaWatt.

The term PG is the ERP (equivalent radiated power) for the given transmitter+antenna set. Thus, assuming a perfect line-of-sight, lossless propagation, and an antenna gain G=20 to 30 dB, typical of highly directional antennas like radar, the transmitter power must have been 56 to 560 MW to be able to generate 100 V/m up to 8 mi.

Since propagation was certainly not lossless, and the victims not exactly within the 3 dB antenna beamwidth, some provision should be added for multipath cancellation, path loss and off-beam effects, raising the necessary power to 100-1000 MW.

It is very unlikely that such RF power would have been available, or used on a ship while at shore or on her berth. The maximum transmitter power would be more in the 1-10 MW range- a respectable amount indeed- bringing the 100 V/m zone within a 1 km (0.6 mi) radius around the transmitter.

It would hence be expectable that car electronics could exhibit malfunction within 0.6 mi of the ship's antenna. Since at such close distance from a battleship we can expect to be close to, or at, the boundaries of a restricted military area, it would make sense to post some warnings on the area fence.

So, for the A. Lincoln case (8 mi), we are led to assume that the actual field was significantly less, and that the failing unlocking devices were non-compliant.

A Case Variation:

There could be a variation of the "1" case, where the car devices were certified as compliant, while in fact they were not. I have seen many cases where so-called "compliant" electronic car accessories had been insufficiently, or even improperly tested.

There are many occasions of wisecracks about "Murphy" writing an EMC test plan, or conducting a radiated immunity test. For instance, neglecting the proper type of modulation, or not using sufficient dwell time at each frequency step, can give optimistic, if not misleading results.

In the specific case of a car locking/unlocking device (radio or infra-red), a common pitfall is this:

People would check that the RF field does not inadvertently unlock the car door, or enable the ignition. Since there is some software intelligence in such devices, they only obey to the owner's code, and they seem to pass the test.

But nobody bothers to check if, while under the RF exposure, the device still responds to its owner's coding; and sometimes it does not, because its post-processing electronics are "deafened" by a strong, saturating interference source.

I don't question the premise in Mr. Ryan's article, concerning the conflicting use of a limited spectrum resource by DOD and private sector, Part 15 Devices. However, as noted above, it is in everyone's best interest to be sure, by a thorough analysis, that the factual basis for harmful interference is properly attributed.

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The French Say it Best

Dear Editor,

It struck me that, probably without planning it, in the last issue you presented a theme for the NARTE Anniversary issue. Articles in the issue showed how spectrum utilization and frequency coordination are as old as radio (Jurassic) and still in a state of flux today (Part 15), with the hams contributing help from their reserved part of the spectrum along the way.

As the French say,"en plus ça change, en plus le meme chose." *[For a translation, see Don's article on page 10 - Ed.]*

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