MEGA HERTZ

The Cellular 5G effect on Off-Air Broadcast UHF

T-Mobile now has the exclusive rights in the US to operate cellular service in the lower portion of what used to be part of the off-air UHF TV band.

Through attrition and auction, the UHF band has shrunk from what used to be CH's 14 – 69, to now CH's 14-36 (470 MHz to 608 MHz), using what used to be CH 37 as reserved (not assigned to anything). Some of T-Mobile's carriers occupy (old UHF) CHs 39 - 44 (620 MHz to 656 MHz), that's 36 MHz of continuous bandwidth. Added to this issue, is the fact that strength of their carrier varies over time with the amount of cell phones that are attached to that tower or towers when someone is surfing, taking a call (permanent users in that node) traffic driving through that area and they are handed off to that tower, etc.

Here's the problem to trying to figure out what is happening at any location:

1. 5G cellular launches throughout the US have been delayed and sporadic. No one knew what the effect was because I think everyone was so focused on the 5G C-Band repack for satellite.

2. 5G cellular launches have been not fully transitioned and now they are catching up with full time usage where it was partial usage while the system was being "tweaked" and now their loading them up with bandwidth.

3. The power density of the 5G cellular carrier varies and here is where it becomes tricky troubleshooting this.
    a. In the old days of an analog headend, if you remember we had to do signal proofing/testing and part of the tests were for composite triple beat, second order distortion, etc.

    b. Well, we engineers knew the math, composite triple beat, second orders, etc. were static and we knew where they were going to land within the band. So, it was easy to measure and make sure that the "beats" didn't affect the channels easy math.

    c. With the 5G carrier constantly changing in power (amplitude) and bandwidth (frequency), these intermods are not static and will float through the useable UHF TV band (constantly changing in amplitude and frequency). So, you really never know when it will hit the channel being decoded and then causing an 8VSB receiver to lose lock and then eventually returning.

    d. No math can help here since these beats are not predictable as they were in the old analog TV days.

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Example

MHz was called to do some troubleshooting in a Tennessee location in February of this year. The issue was with a UHF TV channel that was being process through an optical transport system. I knew, the signal level was too high on the input to the optical transmitter because I couldn't balance the link out. Did some homework, purchased the 5G/LTE filter placed it on the input to the optical transmitter and like magic, all indicators went green, bam. Problem solved.

Example 2

In July a customer spent weeks (months) trying to figure out why they would lose their UHF channels intermittently and when they exhausted their resources, they called us. So, we mounted up and I went out there. The install was good, clean. The line of site looked good. They had what looked like a building that was newly constructed that may be creating new reflections. So, after changing the antenna out, replacing the RG11 transmission line the problem quieted down. But it didn't go away.

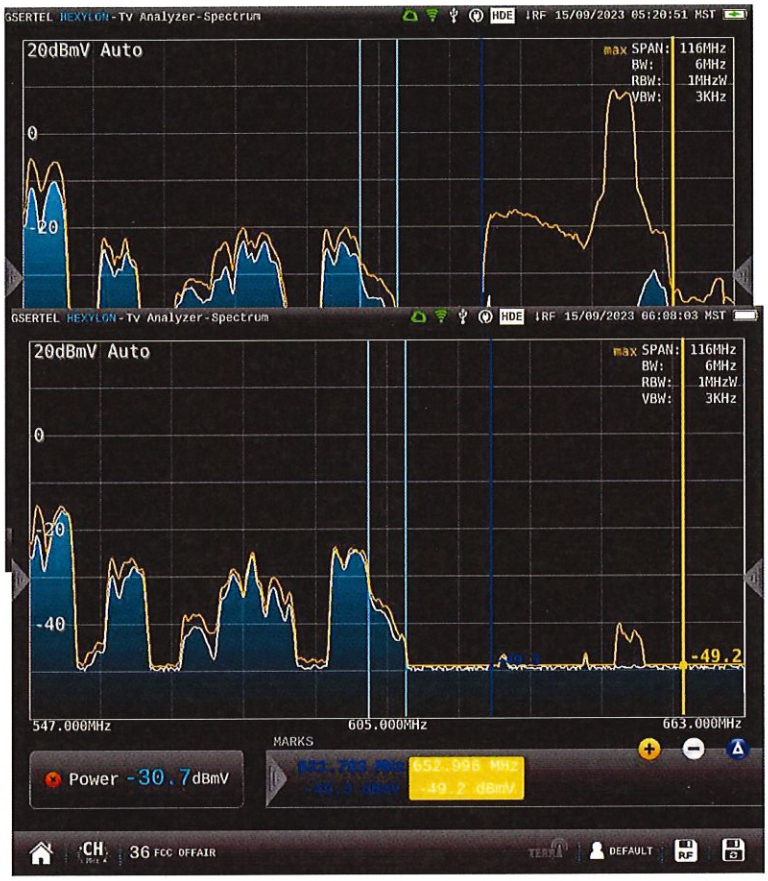
So, I took it to the next level and did what I would normally do for an onsite signal survey, and my equipment said the channel was just fine. Well, you know what happened next, everyone was blaming the 8VSB receiver as being bad. I contacted manufacture to discuss the situation. With no ideas or suggestions from their Engineering team, as we wrapped up the call, we were talking about the area and cell phone coverage, not related to what we were trying to solve, and a light bulb went off. I took my test equipment and tuned it out of the TV band and WOW, the 5G/UHF cellular carrier was kicking butt. Grabbed my 5G/LTE filter and slapped it on my meter and magic no strange readings. Placed it on the input to the UHF bandpass filter and like magic, not a single error on the UHF TV channels. To date, (I check in every now and then on this) not a single event since July 25th.

Conclusion & Recommendations

So, this is what is happening: The gain of 14-69 broadband antennas is being applied to all signals in the 14-69 spectrum; 5G/UHF Cellular signals, as well as, the Broadcast UHF TV signals. Without proper filtering, when needed, once the unfiltered UHF cellular signals pass to the 8VSB receiver, which has limited or no additional filtering, the energy from the 5G/UHF cellular carrier has mixes with the UHF TV carriers, creating "intermods". This ends up hitting the channel being demodulated and the intermod is so strong the 8VSB receiver loses lock on the channel and the operators picture tiles, goes out and then may come back 3 seconds, 10 seconds later. This cycle will continue and the amount of out-time varies on the number of users that are using that cell node.

So, a "commercial grade" filter (CH's 14-37) should be used to replace any existing UHF broadband filters (CH's 14-69) in place. (Note, let me say a $20.00 consumer filter is not the answer! With a consumer filter, you cannot control the specs for one and the through-loss of the filter is about a 5dB minimum hit to the input of the 8VSB receiver.)

Below is a graphical representation of the 5G/LTE carrier, over on the right side of the screen shot I have markers showing the area of the 5G/LTE carrier, the orange line is a peak hold of the carrier so you can see the carrier without a filter and with a filter.



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