The 5G effect on the Off-Air UHF

T-Mobile has the exclusive rights in the US for their cell phones to operate in the lower portion of what used to be part of the off-air UHF band

Through attrition the UHF band has shrunk, which used to be CH14 – 69. Through the auction it is now CH14-36, using what used to be CH 37 as reserved (not assigned to anything). T-Mobile's carrier occupies (old UHF) CHs 39 through CH44; that's 30MHz of continuous bandwidth and the carrier is not always the same power. The strength of their carrier varies with the amount of cell phones that are attached to that tower or towers so it changes 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., so the strength varies over time.

So, what is happening to the UHF TV channels?

Many of the UHF antennas deployed are typically broadband CH's 14-69, (unless a specialty antenna has been purchased for chs14-37). So, what happens is the gain of the 14-69 antenna is being applied to the 5G/UHF signals, as well as, the broadcast UHF signals.
Installing 14-69 UHF bandpass filters is not the answer because the UHF broadband filters CHs14-69 just pass the 5G/UHF through to the transport system and 8VSB receivers!

Here's the problem in trying to figure out what is happening.

1. 5G launches throughout the US have been delayed and sporadic and no one knew what the effect was because I think everyone was so focused on the 5G repack for satellite they pretty much blew this part.
2. 5G 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 carrier varies and here is where it becomes tricky troubleshooting this.
    a. In the old days of analog an 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 5G and 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 the 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.

Example
MHz was called to do some troubleshooting in a Tennessee location in February of this year. The issue was a UHF channel that was being process through an optical transport system, and nothing added up. The signal level was too high on the input to the optical transmitter because I couldn't balance the link out. Did some homework and out of frustration purchased the 5G/LTE filter. Took the filter and placed it on the input to the optical transmitter and like magic, all indicators went green, bam. Problem solved.

Example 2
Without proper filtering, when needed, once the UHF signals pass to the 8VSB receiver, which has limited to no additional filtering, the energy from the 5G/UHF 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.

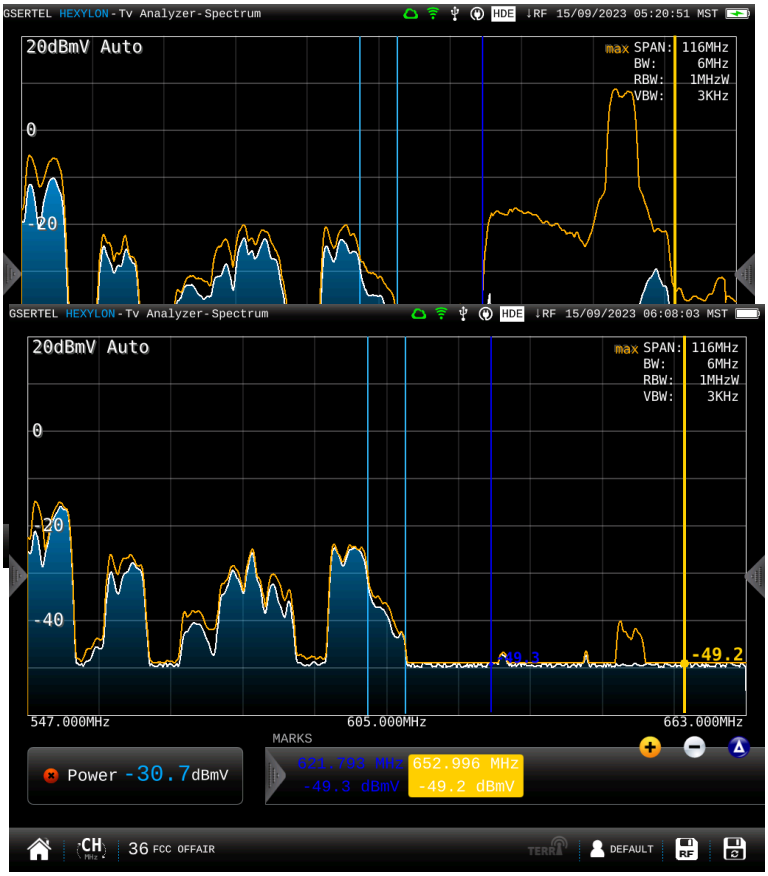
This was the case up at XYZ in late July. They spent weeks (months) trying to figure out why they would lose their UHF channels intermittently and when they exhausted their resources, they called us. So, we mounted up and I went out there. The install was good, clean. The line of site looked good. They 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 a 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, were just talking about the area and cell phone coverage, not related to what we were trying to solve and the light bulb went off. I took my test equipment and tuned it out of the TV band and wow the 5G/UHF carrier was kicking butt. Grabbed my 5G/LTE filter I bought on amazon for $20.00 slapped it on my meter and magic no strange readings. Placed it on the input to the UHF filter and like magic not a single error on the UHF channels and to date (I check in every now and then on this) not a single event to date from July 25th.

Now let me say the $20.00 filter is not the answer, this is consumer equipment and you cannot control the specs for one and the through loss through the filter is about a 5dB minimum hit of the input to the 8VSB receiver.

Recommendations
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 that operators have typically used.

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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