COAX ATTENUATION

Two years ago, when the Institute was setting up the network of spectrum sensing nodes in Logatec, we required a set of antennas to cover the TV broadcast band. Based on the frequency range of VESNA's receiver, I chose to buy several Super Scan Sticksfrom Moonraker. The 50 MHz - 900 MHz range we were intending to use them for was well within the Scan Stick's specification and it was also very reasonably priced compared to some other offers for broadband antennas we got at the time.

Since then this antenna proved to perform reasonably well compared to others we tried. For instance, the hand-held MRW-210 we have on some nodes because of its small size is practically useless. However, all work so far has been done above 470 MHz and it doesn't look like that will change in the future. In hindsight it would probably be better to choose an antenna that performs better at higher frequencies.

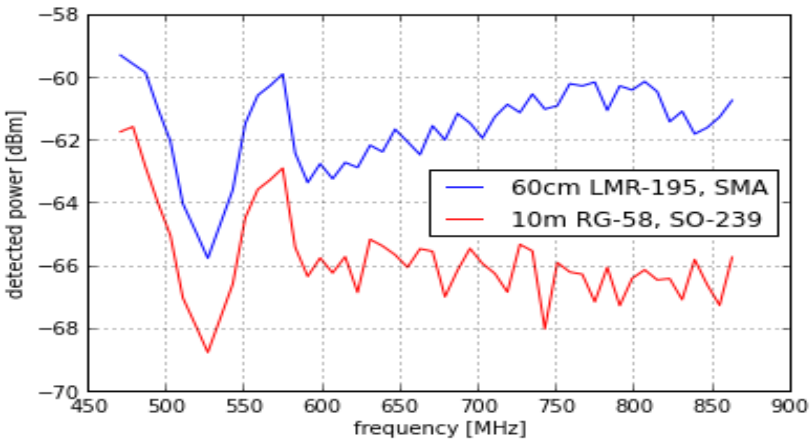
I was recently reminded of that when it was pointed out to me that even the connection between the antenna and the sensor might be causing significant attenuation in our setup.

The Scan Stick has a (non-replaceable) SO-239 connector and we bought each antenna together with a matching 10 m long RG-58 coaxial cable.

I overlooked that at the time, but neither that cable type, nor the connectors were designed with frequencies much above 400 MHz in mind.

Lately I have been preparing a handful of new receivers for deployment. The way you're supposed to wire a panel-mounted SO-239 (left on the picture above) to an internal coaxial cable was another reminder that this setup was not made with high frequency signals in mind.

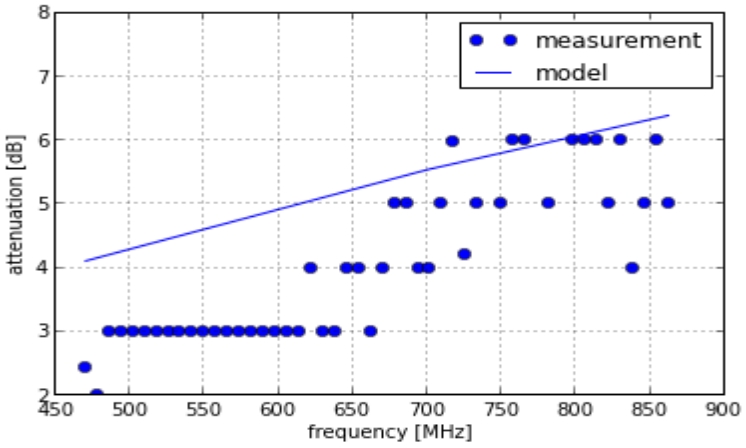
Unfortunately I don't have equipment necessary to measure the characteristics of the antenna itself. However to get at least an estimate of how much signal power I'll actually be losing in the cable, I conducted some measurements with just the cabling. I connected the receiver through the pigtail shown above, 10 m of the RG-58 cable and a SO-239-to-N-type adapter to our Rohde&Schwarz SMBV vector signal generator. Then I swept the frequency of the generator and measured the detected power on the other end. As a control, I performed the same measurement using 60 cm of a LMR-195 cable with SMA connectors and a SMA-to-N-type adapter I had laying around.



As you can see, the difference between the cables is significant, while not exactly show-stopping. The big variation in detected power between 500 MHz and 550 MHz is due to variation in detector sensitivity.

There are some typical attenuation figures versus frequency for both types of cable available on the web. LMR-195 supposedly has less than .2 dB attenuation at 60 cm length on these frequencies. On the other hand, 10 meters of RG-58 has around 5 dB.

This suggests that the attenuation in the short LMR-195 cable is insignificant compared to longer RG-58. To get just the attenuation in the RG-58 cable and ignore changes in detector sensitivity, I subtracted the measurements with LMR-195 from those with RG-58. In the plot below, I compare this figure with the typical attenuation versus frequency for RG-58.



From this graph it seems that RG-58 is performing better than expected. For lower frequencies the attenuation is actually a good decibel lower than it should be according the cable model. I also did not take into account any return loss, so the attenuation in just the cable must be even lower than what I measured. The SO-239 connector is pretty bad at keeping correct characteristic impedance above 400 MHz, so I'm guessing the reflection becomes significant at higher frequencies.

In the end, 6 dB loss means only one quarter of power at the antenna reaches the receiver. In the context of radio that might not be as bad as it sounds, but it definitely ruins the otherwise good noise figure of VESNA's receiver. We're running out of our stock of Scan Sticks anyway and I'll be looking into new antennas and cabling for future deployments.

Source: https://www.tablix.org/~avian/blog/archives/2014/11/coax_attenuation/