

## The DTV Reception Problem: Why and How To Improve Reception Significantly

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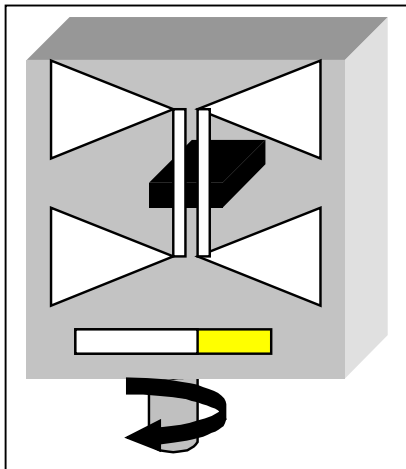
You may recall that TV broadcasters got really enthusiastic about the transition to HDTV when early on, ACATS/MSTV/NAB, promised reliable HDTV service that would replicate Analog's Grade B service. I was a participant in various ACATS committee meetings and the word "replicate" is etched in my memory.

I knew then (and said so in the meetings) that replication would be unattainable because the system engineering was based on unrealistic assumptions as to of rooftop antennas, an unacceptable service reliability and an unrealistic receiver model (more on that shortly). So if you have been following viewers' complaints from around the country and reading the articles describing the outcome of the shutdown in Wilmington, Delaware, let me reassure you. The reception problem is consistent with the system design. There should not be any surprise.

Broadcast engineers are aware of the reality, but their leaders are in denial. Bloomberg quotes D. Donovan, the president of MSTV as having said "You should be able to receive the same number of digital signals that you receive in analog." And TVNewsday quotes K. Martin, the chairman of the FCC, as having said "...we believe that the transition in Wilmington is going smoothly..." In Wilmington, a 125<sup>th</sup> market, approximately 10% of OTA households called to complain. Is that what we want in NYC?

The system was designed to allow the DTV signal to fall off the "cliff edge," where pixellation appears and sound is lost, for as much as 10% of the time for up to 50% of the households. In analog the 10% means the picture quality and sound may be degraded but never lost. Did it make engineering sense to adopt the analog specs for DTV? So why was the system designed to provide poor service reliability? ACATS needed to borrow that time/location specification from analog in order to achieve, on paper, the promised service replication. Thus was born a Table of Allotments with seemingly acceptable ERP for all. The European link budget allows DTV loss for no more than 1% of the time at a maximum of 25% of the locations! They say the time cures all, and eventually the low reliability reception designed into the system was all but forgotten.

If you still think that the designed reliability of DTV service was not a fatal flaw, think about the Emergency Alert System failing 10% of the time at 50% of the locations before you call the Homeland Security Administration.



My own research (available at [tvantenna.tv/papers.asp](http://tvantenna.tv/papers.asp)) shows that at least a 10 dB improvement in the signal to noise ratio at the tuner is required for reliable service indoors at UHF and Hi-VHF channels. The problem is far worse for Lo-VHF channels. My definition is that reception is reliable if the frequency of pixellation and lost sound does not compel a frustrated viewer to switch channels or sign up for cable.

What must and can be done to significantly improve indoor reception? You can't increase the ERP by 10 dB, but by using a smart and *integrated antenna/RF block* you can get 10 dB improvement in SNR at the receiver. Basically we need a new converter box. By designing an active antenna, electronically integrated with a dynamic channel impedance matcher preceding the tuner, we can lower the in-situ noise figure by 5dB. Remember that the noise figure of the actual receiver with a mismatched antenna is more likely to be around 12 dB than the 7 dB stipulated by the FCC's Planning Factors. By using a high-gain dual bow-tie antenna, its preferred angle optimized by rotation at each channel during setup, we can gain 6 dB. By improving the in-situ noise figure and by adding a high-gain optimized antenna the system SNR improvement will exceed 10 dB.



An example of such a converter box is shown here. The small black box is integrated with the bow-tie feed point and contains the dynamic matcher and tuner. The back plane contains the rest of the electronics. The viewer rotates the unit until the lower strips, signal level indicators, overlay each other. That is the optimum signal that was predetermined during setup. This is a simplified solution, not the solution. Space and polarization diversity reception could be added as well as automatic angular adjustment. It will take some money to develop a prototype, but in my opinion much less than that being spent on DTV Education that does nothing to solve the root cause of the reception problem.

