

**The Spectrum Perspective**  
**Framing Remarks by Dale N. Hatfield**  
**At the Silicon Flatirons Conference on Evidence-Based Spectrum Policy**

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(As Prepared for Delivery)

Thank you, Rachael, for the introduction and thank you Keith for the opportunity to present some framing remarks for this Silicon Flatirons conference.

In the few minutes I have, I will reflect back over about five decades of involvement in spectrum management and I will do so in the context of the subject of this conference; namely, Evidence-Based Spectrum Policy. In particular, I will focus much of my attention on policy and regulatory short-comings in four areas: (1) harmful interference, (2) receiver performance, (3) noise and interference measurements, and (4) spectrum enforcement.

Before I turn to the first area, I should mention that I am going to talk a lot about radio frequency – or RF – interference. In the interest of time, I won't bother to give a long, formal definition of RF interference – a definition of which I am sure is familiar to most of you. But I am talking about natural and manmade activities that cause the disruption of often vital wireless communications services. Such disruptions can be caused by someone intentionally or unintentionally transmitting on a channel for which they are not licensed, or by someone deliberately jamming GPS for nefarious purposes. Or disruptions could be produced by vagaries in radio propagation that sometimes cause radio signals to travel beyond the intended distances.

With that very brief background, I will now turn to the first of the four areas I want to address – namely, *harmful interference*. One of the most fundamental issues in the spectrum policy realm is deciding what constitutes harmful interference in a given situation. But the truth is we do not have a quantitative definition of that term. Hence, two questions come to mind:

- Why waste a lot of time and effort collecting evidence, when it is essentially useless in making one of the most fundamental decisions in the field? That is, does this measured level of interference constitute harmful interference or not?
- How can we possibly improve spectrum management in an increasingly complex field using badly needed automation and AI/ML techniques without an accepted, quantitative definition of the term?

In short, automated decision-making requires information – evidence if you will – to be quantitative.

Moreover, turning to the second area, *receiver performance*, even if one can decide whether or not a given level of interference constitutes *harmful* interference in a particular situation, how does the governance structure attribute responsibility for interference in an objective way when we essentially have no enforceable receiver performance requirements? Again, two questions come to mind:

- Who is to be blamed (or sanctioned) if the harmful interference is caused by poor receiver system design, implementation or maintenance?
- Why should the operator of a RF emitter be penalized when it is the susceptibility or fragility of the receiving system that is at fault?

While I am addressing receiver performance, I will add, parenthetically, that I strongly support the notion of interference limits as a less regulatory way of dealing with receiving system performance issues.

The idea of interference limits was proposed several years back by our esteemed colleague, Pierre de Vries'. With the significant danger of over-simplifying the concept, interference limits would allow the use of receivers or, more properly, receiving systems, regardless of their susceptibility or resiliency to interference. However, under the concept, an enforceable claim of harmful interference could not be made unless the impinging level of interference energy exceeded a measured threshold.

Despite the significant amount of attention given to it in the spectrum research community – including “real world” modeling of the concept – there has been precious little progress in actually adopting Pierre’s idea, even on a trial basis.

Speaking bluntly and personally, one of my biggest professional regrets is that we have made so little progress in adopting enforceable receiver performance requirements during the many decades that I have been involved in spectrum management at both the FCC and NTIA, in the private sector, and as an academic.

The third topic on my list of four issues is noise and interference measurements. My comment, really my concern here, is that, despite some strong recommendations from advisory committees and other engineers and scientists over the years, the government still does not make, nor have access to, geographically extensive, long-term, accurate measurements of radio noise and interference levels in different spectrum bands. There are at least three drawbacks associated with the lack of such measurements:

- *First*, the lack restricts our ability to determine in general whether the noise and interference “pollution” created by billions of RF emitters is getting worse (or better for that matter). And, if it is getting worse, how much worse? We are focused in this conference on evidence-based spectrum policy, but we lack the comprehensive data necessary to answer a simple question – are things getting better or worse?
- *Second*, if it is getting worse, what systems or devices are responsible either because of their RF emissions or their susceptibility to noise and interference? Where do we focus our time and resources if we don’t know what systems or devices are most responsible for the deterioration? Anecdotal information is useful, but not dispositive.
- *Third*, as I touched on earlier, automation and AI/ML techniques hold out significant promise for dealing with the challenges that are presented by the growing demand for digital capacity that is associated with increasingly heterogeneous networks that now connect over 4 Billion people and 10’s of Billions of devices. However, by their very nature, such techniques require the acquisition and curation of large, comprehensive data sets to be successful.

So to summarize, the lack of comprehensive, well curated noise and interference measurements not only denies us the data sets – that is, the evidence – we need to address foundational questions in spectrum policy and regulation, it limits our ability to develop automation and AI/ML tools. These are the very tools we need to be able to successfully detect, identify, locate, report, mitigate, and remediate intentional, unintentional and incidental sources of noise and interference in an increasingly congested and complex spectrum environment.

The fourth and final topic on my list of issues is spectrum enforcement which includes the identification, mitigation and remediation of harmful interference. Even if one assumes that the first three issues I raised – quantifying harmful interference, establishing receiver performance requirements, and creating and gaining access to properly curated measurements of radio noise and interference – are adequately addressed, evidence based policy making may well prove futile without effective, rule-of-law based enforcement.

But the fact of the matter is that the number of people that the FCC has outside of the Washington, DC area devoted to the technical aspects of interference enforcement has declined drastically over the past few decades. As a result, it is my understanding that only the more egregious cases of harmful interference to public safety services are now pursued on site.

One way of compensating for the decline in enforcement resources and the exponential increase in RF emitters and receiving devices, is automation and AI/ML techniques. However, the full benefits of automation cannot realistically be achieved under current conditions for all of the reasons I just articulated.

As an aside, another way of compensating for the decline in resources devoted to interference management is for the FCC to delegate some of its statutory duties to private entities. Indeed, the Commission has pursued and is pursuing just such approaches in a number of important proceedings, including TVWS, CBRS, 6GHz and 4.9GHz.

While shifting some statutory responsibilities to the private sector may well be a justifiable response to the agency's lack of resources in an area that is so critical to our economic and social wellbeing and to national defense and homeland security, it does raise at least two significant concerns.

*First*, it appears to me, as a non-lawyer anyway, to raise questions about the legality of such a delegation under current statutes and *second*, it brings to mind rather serious questions about transparency – a hallmark of good governance. For example, does the delegation to private entities reduce the ability of the public to access the information (that is, the evidence) used in making important spectrum policy making decisions?

My time is running out and I want to leave time for questions or comments. So I will close now by stating my strongly held belief that pursuing evidence-based spectrum policy may well prove futile, if sufficient resources are not put into the four areas I enumerated at the outset, namely (1) defining harmful interference in a quantitative fashion, (2) establishing enforceable receiver performance requirements, (3) creating, or otherwise acquiring and providing public access to curated geographically extensive, long-term, accurate measurements of radio noise and interference sources and levels, and (4) ensuring that adequate resources – public and/or private – are devoted to spectrum enforcement, including the reporting, mitigation and remediation of harmful interference when it occurs.

Thank you very much for your attention.