2021 Spectrum Policy Initiative Conference | Frontiers in Spectrum Sharing

Day Two Keynote

Friday, September 10, 2021, 9:05 a.m. – 9:30 a.m.

The Hon. Nathan Simington – Commissioner, U.S. Federal Communications Commission

Remarks As Prepared for Delivery

Good morning. Dale, I greatly appreciate your kind introduction. I'm delighted to have the chance to speak to you all today about spectrum sharing, an issue that will surely define the future of spectrum policy.

People often say that spectrum is congested. This is a good problem to have. It means that spectrum is desirable and heavily used; as such, we have a spectrum congestion problem that we didn't have when we were less developed and lacked the ability to exploit spectrum as thoroughly as we do today. Within living memory, Silicon Valley was farmland, and spectrum was so abundant that the easiest way to connect spectrum to services was just to give every service its own band. And, just as we needed new planning and land-use regimes as cities grew and became more sophisticated, the question of how to handle new demands on spectrum suggests new spectrum-use regimes.

Spectrum congestion for 5G midband is often in the news, but as important an issue as this undeniably is, it is just one example of the new demands on spectrum. I'm going to discuss specific bands and challenges today, but I'm also going to mention general concepts of sharing in some current and proposed regimes; technologies relevant to sharing; and factors tending to cut against sharing. And I hope you'll indulge me if I return now and then to land sharing as an extended metaphor, because spectrum is like land -- they just aren't making any more of it.

There's a recent report, "Taking Stock of Spectrum Sharing" by John Leibovitz and Ruth Milkman, that I would encourage everyone to read. I don't think it's possible to provide a more lucid, thoughtful account of the theory and practice of spectrum sharing. So I'm not even going to try, and instead I'm going to adopt much of its vocabulary and framing today. Leibovitz and Milkman make the familiar point that uses of spectrum are restricted in frequency, space, and time, and in practice also as signal through the use of protocols and techniques permitting massively scaled coexistence in a single band and service. In this framework, the Table of Frequency Allocations (or TFA) is a sharing system by frequency under which licenses distinguish on space and time. The TFA is static at any given time, and only dynamic in that it can be gradually revised. They also furnish a helpful definition of a "sharing policy" and one permitting "multiple overlapping types of spectrum use in a single band and geography."

Automatic sharing regimes promise to go farther than the TFA in fulfillment of this definition. Any static system is going to exclude almost all uses, and whenever it's not in use, the spectrum is fallow. An automatic sharing regime proposes almost the opposite: to enable diverse uses by permitting time and frequencies to be used by multiple services in a coordinated fashion. Leibovitz and Milkman categorize such regimes with two sets of parameters: a regime can be coordinated, informing, or sensing, and centralized or decentralized. In coordinated regime, multiple radio systems plan their co-existence in advance; in an informing regime, one service tells others to be quiet so it can talk; in a sensing regime, services detect when another is talking and hold back. In a centralized regime, there are one or more central agents running the regime, while in a decentralized regime, the users themselves coordinate.

Coordinated, informing, and sensing regimes have their places, whether centralized or decentralized. This diversity of conceptual tools isn't about finding a single ideal approach; like frequency allocations, regimes should be tailored to anticipated uses, the priorities of users, the physical characteristics of the frequencies at issue, and a mix of incumbent and new user perspectives.

Mixing in new uses is a particularly compelling aspect of the sharing model. If the TFA has to be revised every time a new service is conceived, new services face a steeper barrier to entry, both in costs and in time, than under a sharing regime permitting a variety of users at a variety of priorities. Perhaps in the future, increasingly flexible radios and pervasively shared spectrum will allow a given device or network to select optimal and continually varying frequencies from moment to moment, much like an automobile navigation system offering alternate routes based on tolls, congestion, and unforeseen circumstances.

However, there are no free lunches, even in spectrum sharing. A static allocation regime solves coordination problems from its inception at the price of rigidity. A dynamic sharing regime addresses them on the fly at the cost of operating overhead and limiting the functionality of each shared service. The proper weighting between these two factors is an empirical question, and our choices between these strategies in particular bands are path-dependent in two senses: first, we got to our present allocations by a particular, intensely-contested history, and unfathomable amounts of capital have been deployed to build a system arising from that history. And second, while RF radiation may propagate in a vacuum, spectrum policy does not, and our policy options are constrained by government and business realities that may or may not easily integrate with notionally ideal policy in the abstract.

There's a lot of talk about deploying artificial intelligence (AI) and machine learning (ML) to improve systems. Today, with AlphaZero able to learn chess from the elementary to the transhuman level in just a few days of playing against itself, I'd be cautious betting against learning machines. But the rules of Western chess have been fixed for hundreds of years, and the rules of spectrum are a little harder to define. Live spectrum sharing decisioning via AI/ML would require a model based on and searching for optimization of spectral efficiency. If that is what a spectrum sharing model is after—'efficiency' as narrowly defined—then machine learning _may_ indeed prove to be a solution. But anyone familiar with machine learning will tell you that you need a data ocean to train and test a model, and it isn't clear to me where that data will come from. What historical spectrum sharing decisioning will the model train on? But beyond that, both data scientists and domain experts would have to collaborate to determine what 'efficiency' is and should look like. That's a lot easier when such decisioning is done within an organization, or within an industry where there is broad agreement about the subject, not the spectrum sector with its bristling complexity and frequent disagreements. I don't think it's too much to say that good-faith disagreements are incredibly common in the spectrum policy world, and therefore disagreements would also apply as to the criteria, design, and implementation of AI/ML as a method for spot frequency allocation.

What's more, we have data on the comparative valuation of shared vs. exclusive use in two very similar bands in the 3 GHz range. Industry proved willing to pay far more per MHz pop for full-power, exclusive-use licenses in C-Band than for lower-powered, shared licenses in CBRS. This isn't necessarily an argument against CBRS because C-Band was very well-suited to wholesale clearance. Still, it should give us pause. For at least one category, 5G mid-band in the 2.5 to 6 GHz range, industry values full-power, exclusive-use licenses far more than it does flexible shared access. Or, to put it another way, in some industrial zones, industry appears to be much more interested in exclusivity than coordination; some neighborhoods should be zoned for mixed use, but shipyards and nuclear power plants don't want apartment buildings located inside.

American spectrum regulators have faced criticism for not making more of this vital mid-band spectrum available, and this very lack of flexibility in an environment full of incumbents is precisely what proponents of sharing can point to when warning about the future. What if we're setting ourselves up to be short of something else down the road? And that's why I think the real answer is a synthesis. We need both exclusive and shared spectrum today and for the future. We have to think about the future, even the distant future, and not make decisions today that prevent us from getting there. But, while our eyes are trained on the future, we also have to identify how to succeed today, in one year, in five years, and the knowledge of how to do so is highly specific and granular.

To coin a phrase, we may make our fate, but we do not make it how we wish. There is pressure to succeed today in the marketplace for vendors, manufacturers, and designers, whose constraints are immediate. Beyond the pressure to satisfy needs in the United States, they must deploy systems that can run with minimal oversight and a light touch in overseas deployments. As a naturalized citizen, I say this with all love, but Americans love to beat up on themselves. This shouldn't blind us to the depth of our technical and scientific capacities, which may not be present in every country seeking to expand its use of telecom services. After all, the purpose of telecommunication is to facilitate production, increase public safety, and improve social life, not to attain a theoretical ideal of design; ideals are guiding lights more than attainable goals. Implementation matters and, for those looking to build infrastructure or purchase services, immediate upside drives decisions. Some countries may prefer a simple system to a perfect one; that by itself is one reason not to place all our chips on sharing.

Further, there's also a question of regulatory focus. Without denigrating sharing, we face many present challenges that are not easily resolved through sharing alone. I and my team are deeply concerned with the potential for intermodulation interference, desensitization, near-far problems, and spurious emissions as usage continues to densify. The parties whose emissions cause such harms may be acting wholly in accordance with their licenses and may have no way of preventing the harms without voluntarily abstaining from fully exercising their rights. There are also immediate challenges to confront in guard band reduction and signal security, so as regulators, we have to pick our battles.

Thanks very much, and I'd be happy to take questions and comments.