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Thank you Nick for that kind introduction. I very much appreciate the opportunity to discuss a few high level spectrum issues today.

The full promise of 5G will not be realized until we have robust, low-latency, high-bandwidth, high-power, high-reliability 5G networks everywhere. While 4G provided new consumer capabilities and fostered a new world of sophisticated applications, 5G offers far greater promise in expanding industrial, public safety, agricultural, health care, and logistics capacities. Powerful 5G networks are the force multiplier that will let software break free from isolated, individual machines. 5G, and the technologies it enables, will bring our advances in the world of bits into the world of atoms at long, long last.

The FCC, NTIA and other agencies should continue to work closely and urgently to identify, and bring to market, spectrum bands for commercialization—and we must continue to try to make as much licensed mid-band spectrum available as possible. This will only happen if we have better coordination among federal agencies with a stake in future spectrum allocation decisions. Better coordination, and stronger relationships among federal agencies, will ensure that agency efforts to identify mid-band spectrum for commercial use are harmoniously aligned and urgently pursued—not conflicted and half-hearted.

Beyond identifying new commercial spectrum in the U.S., the FCC should take the lead on coordination with ITU, and other global organizations and agencies, to ensure we achieve holistic, international, harmonization of mid-band and other spectrum wherever possible. This is critical to America's competitiveness. We can't win 5G or the next technology war on our own; we need friends to help us create the best technology for the world market. We cannot ask allied nations looking to their own technology transitions to join us on a technological island. It is not feasible to build for the American market alone, however vast it is.

Harmonization is therefore the foundation for the economics of the 5G ecosystem and other emerging technologies, as it drives costs of devices and infrastructure.

As many of you have heard me say many times before, the Commission and industry should take another hard look at receiver standards. In an era of densely-packed mid-band spectrum—critical to 5G—fully functional 5G networks are vulnerable to not only cheaply-manufactured edge devices that power various applications, but also, as we've seen with the C-Band, outdated aeronautical safety systems.

5G and the next-generation of wireless technology is vulnerable to the disruptive effects of ubiquitous edge devices in a spectrally dense environment that have cheap, poorly-made receivers. These receivers will make it much more complicated, if not impossible for base stations to avoid interference with them. That's all there is to it. And, through no fault of the engineers who have carefully designed technology standards or the carriers who have worked diligently to implement them, we risk creating an underwhelming perception of 5G and future

technology capabilities. In today's globally competitive marketplace, industry and government cannot afford that.

Another concern floating around my office is ensuring that we secure wireless devices and equipment against signal layer attacks. Cybersecurity risks, such as recent ransomware attacks, are not unique to wireless networks and are likely to be addressed by agencies other than the FCC. However wireless networks are inherently open to attacks at the signal or device layer in ways that wired networks are not and we need a solution for several new and emerging technologies, such as industrial IoT devices, automated traffic control, and implanted medical devices, which are under an even greater threat risk because of their vital functions. We are no longer talking only about consumer devices—or a bunch of 10-year old kids streaming YouTube on their iPads. And more importantly, addressing signal security is fundamental to the FCC's role in spectrum management and is outside the competence of other regulatory agencies (think spoofing, jamming, sniffing and unauthorized interception). This is another space where FCC guidance may be necessary, alongside close coordination with industry and agencies such as NIST, DHS and CISA.

Working with industry to set standards for signal layer device security that can be incorporated into the FCC's rules I think is a good place to start. It's arguable that 5G won't be a success in any industrial or private networking applications unless and until we can deliver more credible security for these new networks.

Lastly, let's talk about my concerns about the now suddenly very popular spectrum sharing bandwagon. A topic that the DOD is very fond of and that a few from industry are beginning to support.

There's nothing wrong with spectrum sharing and it's probably the way of the future. But, I am almost certain that full power, exclusive use licenses are the only feasible model to fully power 5G. Full power, exclusive use licenses provide operators with the stability of operations and the protection from other operators they need to make long-term infrastructure investments. The CBRS band is an interesting experiment, and I expect a lot of learning to come from it. And, if we learn that the model works, I would support expanding it at increased power levels. But it isn't the solution today. We need to keep our eye on the 5G ball as China and the rest of the world deploys it over a licensed model for IoT and other critical infrastructure technologies. Doing short of that threatens U.S. abilities to remain competitive and ahead of the curve in technology deployments that drive global adoption.

Thank you for the opportunity to speak today.