REMARKS OF
COMMISSIONER JESSICA ROSENWORCEL
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Good afternoon. It's great to be here in sunny Los Angeles for the 2018 gathering of Mobile World Congress Americas. Everything about this gathering leaves me energized about the wireless opportunities ahead— whether that's the promise of 5G, the advances in artificial intelligence and virtual reality, or the growth of the internet of everything. Just being here makes me more convinced than ever that the future belongs to the connected.

That wasn't always so clear. It was 15 years ago that a bright-eyed Chris Anderson published an article in *Wired* describing the possibilities of the internet in the air. Back then, this was the stuff of dreams. Any one of us might have said, sure, that will be possible when we have things like self-driving cars on the road.

But look where we are today. So I want to take a cue from Chris Anderson's effort a decade and a half ago and talk about the future. Not what's around the bend, but what's far out. In other words, I want to go there. I'm going to be the first Commissioner at the Federal Communications Commission to talk about 6G wireless service.

If you're thinking I'm too early on this one, consider this: a few months ago Google Trends rated the term 6G as the 17th most looked up word in its search engine. On a recent investor call one Fortune 500 company spoke at length about new research into 6G service. And take note: The Minister of Industry and Information Technology in China has already made the official pronouncement that the nation "will be first in 6G."

Of course, you could say, on good authority, that no one knows yet what 6G will entail. Fair enough. I mean, we are only in the early days of 5G service, with the world by and large waiting for its higher speeds and lower latencies to grace us with its presence and foster untold innovation. But that doesn't stop futurists from making predictions. So here are mine.

The sixth generation of wireless service will feature terahertz-frequency networks and spatial multiplexing. To do this we will need an unprecedented level of network densification, so imagine base stations miniaturized and embedded all around us. This will make it possible to have hundreds and even thousands of simultaneous wireless connections with as much as 1000 times higher capacity than what we expect with 5G

service. Finally, while 5G applications are expected to evolve around a single-beam approach to data transfer, 6G could be designed around hundreds of simultaneous beams, yielding much higher data rates.

Got your head around all that yet? It's out there. But getting from here to there won't be simple. In fact, I think it will require Washington to reassess some policies it holds dear and considers tried and true. So that's what I want to spend the rest of my time discussing today. I want to talk about three things we should revisit for the spectrum policy of the future—valuation, auction, and distribution.

First up, **valuation**. Spectrum valuation may be more art than science. But it is clear our airwaves will play a big role in our economic future. However, before we get there I fear we may get waylaid by Washington accounting.

Let me explain. Perhaps the best way to do this is to reference the infrastructure of the past. The Federal Highway Act became law in 1956—a full four decades before the Telecommunications Act. It featured a bold plan to connect the nation with a new highway system to support our economic and national security. It was not cheap. But the billions invested have reaped us rewards for generations.

This system of national roads was the great connectivity challenge of the past. What distinguishes it from the one we will have in the future—with wireless that reaches everywhere—is that the effort to develop a highway system did not require a pitstop at the Congressional Budget Office, or CBO. That's because six decades ago it did not exist.

However, CBO now "scores" every spending bill. That means it takes every big idea about how we use our airwaves and subjects it to a grinding review of its impact on the budget and deficit. This analysis is important. It's useful. But in practice, these estimates can hamper creative ideas about long-term infrastructure investment, including how we can free more of our airwaves to support economic growth.

This is already an issue today. But it will be an even bigger constraint in the future. Over time, it will be especially challenging for unlicensed spectrum to make it through this filter. That's because unlicensed use yields no funds in the scoring process even though we all know Wi-Fi adds billions to the broader economy. But that's not all. This process can harm our ability to identify airwaves for licensed services, too. When auction values are not right, relocation costs are wrong, or assumptions are built into the baseline that don't reflect what is happening—we have a problem. It's a problem that slows our ability to get airwaves to market, create jobs

and offer innovative new services. We need to find a better way to manage these balance sheets. The infrastructure of the future depends on it.

Second, I want to talk about **auctions**. It was more than two decades ago that we took the academic ideas of Ronald Coase and reimagined how we distribute our airwaves. Instead of doling out specific licenses for specific uses based on political cues, the FCC ushered in a new era of spectrum auctions—selling access to bidders and allowing them to use it however they choose. It's difficult to remember now, but these ideas were once mocked by experts, opposed by industry, and dismissed by policymakers. However, in the rear-view mirror, we did okay. The FCC has held nearly 90 auctions, issued more than 44,000 licenses and raised more than $140 billion in revenue. In fact, our efforts have been a model for regulators worldwide.

But past performance is not always an indicator of future success. To be clear, auctions are still the best tool we have for the distribution of exclusive use rights. Yet we are heading into territory where our national providers are bigger and fewer in number. That means the power of using auctions as distributive tool is more complicated—and without changes auctions could devolve into retail sales. In short, our auction playbook needs an update.

What would that look like? Going forward, we need to commit to the idea that successful auctions have many bidders. We need to consider how the size, duration, and set of rights that come with a license can increase the range of actors willing to participate in our auctions. We need to put a premium on auctioning multiple bands at once, rather than offering them to market piecemeal, one at a time. In other words, we need to structure our auctions to increase the universe of spectrum interests if we want this tool to continue to be viable in the future.

One more thought on auctions: our use of reverse auctions should not be confined to the 600 MHz band. Going forward, we need to consider how to use this tool elsewhere. In the near term I think we should explore a *voluntary* incentive auction in the 2.5 GHz band, with excess proceeds used to support internet access for the 12 million students who lack it at home and struggle with nightly schoolwork. That would mean the future of the 2.5 GHz band could reflect its educational use in the past. Call it the Homework Gap auction.

Third and finally, I want to talk about spectrum **distribution**. Our system of spectrum access today has a binary quality. Either it's licensed or unlicensed. Either you have exclusive access or shared access. Either you have federal on non-federal use. But this duality is not the result of physics.

It's an intentional set of policy choices that can create scarcity when there are other choices we can make that create abundance.

That may sound lofty, but it's really just about making sure dynamic spectrum access becomes the norm, rather than the exception by the time 6G heads our way. If we assume demands on our airwaves continue to grow at breakneck pace, now is the time to explore new sharing paradigms that can make it possible to have a whole range of activities in a single spectrum band.

Three years ago, the FCC got this effort started with its work in the 3.5 GHz band. We took 150 megahertz of spectrum and opened it up to a mix of government, licensed, and unlicensed uses. Then we proposed spectrum access database systems to dynamically manage the different kinds of wireless traffic. This multi-tiered approach to spectrum access is not just unprecedented—it's creative, efficient, and forward looking. It permits higher-powered secondary transmission at times when the primary users of the band are inactive as well as better collaboration among unlicensed users to more efficiently share spectrum resources.

This is new. If it works, we need to look for opportunities to export this model to other bands. And even better, we could take it further into the future through new technologies that enable smarter and more decentralized dynamic spectrum access techniques—like blockchain.

Blockchains are distributed databases that can be securely updated without central intermediaries. That makes them ideal for a bunch of uses—and everyone has a blockchain idea right now. So here's mine: Instead of having a centralized database to support shared access in specific spectrum bands, we could explore the use of blockchain as a lower-cost alternative. If the effort succeeds, this could reduce the administrative expense of dynamic access systems and increase spectral efficiency. We also could foster new hierarchies of band-specific rights and new models for lightweight leasing. Plus, the public quality of recording this information using distributed ledger technology could help expose patterns that inspire new technical innovation and even change the way we use wireless.

I'll conclude my futuristic musings here. But let me caution that 6G service is not as far off as you think. A terahertz network with massive densification featuring the use of simultaneous beams may sound like the stuff of science fiction. However, the future has a way of sounding odd when you first hear about it. Remember it was radical when Chris Anderson suggested in *Wired* 15 years ago that the golden age of wireless was coming. Now, more than a decade into the smartphone revolution, no one doubts his clairvoyance. But the task for spectrum policymakers today

is to prepare for that future—and I think the best way to do so is to take a fresh look at some of the practices of the past.

Thank you.