Conference Transcript

Spectrum Hall of Shame: The Worst (and Best) Radio Policy Decisions

Silicon Flatirons Center
University of Colorado Law School
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(Version 1.00)

OPENING KEYNOTE

Jessica Rosenworcel

Commissioner, Federal Communications Commission

[00:00:00]

Pierre: All right, ladies and gentlemen. I know you come here for the conversations, but I think we'll start with another conversation. And I will just keep talking for a little while until people notice that there's somebody else with a bigger machine talking than they are, that can bring everybody to order. That's one of the wonderful things about these conferences, is that the most exciting conversations are in the breaks, and that's actually saying something because the panels are always very interesting conversations too.

Good afternoon, my name is Pierre de Vries. I'm co-director of the Spectrum Policy Initiative at Silicon Flatirons alongside Dale Hatfield. Welcome to our annual spectrum conference called Spectrum Hall of Shame: The Worst and Best Radio Policy Decisions. I wanted to just say a few words about why we're having this conversation, what we thought when we were setting it up we might get out of it. Silicon Flatirons' tagline — there it is — is "Know What's Next". And as a history geek, I'm always reminded of that famous quote that those who can't remember the past are condemned – or are doomed — to repeat it. So, the purpose of today's conversations is to try and learn from these past policy decisions, and to try and do better in the future. Now we framed this in terms of good and bad, to some extent – I have to confess – to actually make people come and listen to the conversations. It makes for a good headline. But as I hope everybody understands, good and bad is in the eye of the beholder. There is no single policy that everybody will agree is good or everybody will agree is bad, and so what we're trying to do is to learn lessons about how things happened in the past, and to try and do things a bit better in the future.

Before we start I just wanted to flag two resources that we have for this conference we are trying out. There is a handout; if you didn't get one when you checked in at the registration there are plenty of them still on the desk. This is sort of a compilation of about 20, 21 spectrum policy ideas. And what we tried to do here is to just give you 200 words to give you a quick intro. Probably the panelists will talk about these things, they will define what they mean by them, but this is just a quick reference, and there are also references in there. If you want to look up these things online while you're sitting here on your laptop (I hope that's the only reason you'll be using your laptop) it's on the event website in the righthand rail. These things are not authoritative, they're not trying to be authoritative. They're just to help you follow along.

The other thing that we thought we'd try is... Let's see if this works. Yes, this works. So, we created this unscientific poll. It's up on SurveyMonkey; if you were registered you got this in email yesterday. If you haven't voted yet, please vote. If you are trying to get access to your 3G network and it's not working because it's indoors, there is free Wi-Fi access, UCB Guest. And actually, when I put in "Please only vote once" a couple of days ago, the last time we tried the poll my hacker friends in the room (it was a different

piece of software) they very rapidly said, "Can I break this? Can I vote more than once?" and the answer was Yes. And even here, you can vote more than once, but please don't. If you've done the poll, or if you do the poll, you'll see we're just giving you 12 very, very short descriptions, very cryptic, very vague, very ambiguous, and asking you to rate them as either awful, bad, good, or awesome. And the idea is just to get you thinking about what you think about these topics, and then you'll hear the panelists and see whether they changed your mind about that.

I thought it might be fun to just give you a snapshot of the results so far. This is what I was looking at earlier this morning. This is the SurveyMonkey page, these are the results, these are the 12 questions that were asked. You'll see that there've been, at this point when this snapshot was taken, 76 replies. The way I've scored these is from minus two is awful, minus one is bad, plus one is good, plus two is awesome. And so, if you do those things and you calculate the weighted average, you'll get some numbers. There are two things that actually jumped out at me when I looked at these numbers. The one is that there really isn't consensus. If you actually look at the scores, if there was complete consensus that something was awesome, and everybody voted plus two, the answer would be plus two. Or if everybody agreed it was awful, it would be minus two. Actually, the score is about point five. And given that we only have 76 results here, and it's a totally unscientific... Who knows what the errors are? They're huge. The thing that struck me was looking at them there was not a single one of these where we didn't have people who thought it was awful, and other people who thought the same thing was awesome. And that's probably because you can look at each of those things and say, well, exactly what does that question mean? I hope that's what we'll get to. The other thing that struck me was that people actually care about this stuff.

[Laughter]

[00:05:59]

Pierre: As a spectrum geek, I don't assume that anybody else would care, but we actually had ballet stuffing on this poll, believe it or not. When I went to bed last night there were 32 votes; when I woke up this morning there were 63. And essentially all of those were in one category, and almost all of them thought that in the "cellular next to GPS brackets, LightSquared," it was awesome. That just gives you a sense of this is very unscientific, you should not draw any conclusion from this and listen to the panelists.

A few things before we start. I'd like to thank our sponsors, our supporters, our wonderful supporters. If you have the program, please look in the back, there's a list of our supporters. If you are a supporter, thank you so much, we couldn't do this without you. If you're not a supporter and you meet a supporter, please thank them. I'd like to thank the law school and Dean Jim Anaya for all the support we get, this wonderful courtroom to do this event in. I'd love to thank, and I really am very grateful to, our speakers: the keynote speakers, the panelists and moderators. They've put in an enormous amount of work preparing for this event, traveling here and actually spending at least half a day if not more with us here today. A special shout out to Bryan Tramont, he actually planted the seed that led to this, this event. And I'm very much looking forward to it. And last but not least I'd like to thank the Silicon Flatiron staff and the

Silicon Flatiron student group who are the folks outside there, and in the room here, who've been working very hard to make all this a success.

A couple of announcements. This event is being livestreamed, it will be archived on YouTube, you will get those links and the links will be up on the webpage. This event is open to the press. If you have a Twitter habit, we are hashtag Silicon Flatirons. In order to actually move to the conversations, we've asked the moderators of the panels not to actually give you the exhaustive resumes (which are very impressive). You can read faster than they can talk, so please, if you have a question, if you don't know who somebody is, please look them up in this little booklet. The last thing: for those of you in the room who are introverts and who get overloaded by too much conversation — thank you, at least it's not just me — we have something called the Introvert's Refuge. There's a little courtroom just on the other side of that wall. So, if you need a break, go there and the rule is No Communication: don't talk to anybody there, don't talk on the phone. It's just a place for us introverts to decompress.

With that we now get into the really good stuff. I'd like to introduce our keynote speaker, but before I do that I need to try and remember how I make this screen go away. And I remembered. Our opening keynote is by Jessica Rosenworcel. I'm going to break my own rules and I'm going to give you a bit of an introduction, because I can't resist. I guess it's convener's privilege. She's a member of the FCC, has been since 2012 — with a little hiatus last year. Obviously, she's really knowledgeable about communications issues in general, but very knowledgeable about spectrum in particular. Obviously, she knows and understands the politics and the public interest, but she's also very knowledgeable about the technology and the idea. For example, she's really interested in experimentation, innovation. She's been looking at blockchain for spectrum management. So, lots of very interesting things. Another impressive thing for me about Commissioner Rosenworcel is she actually cares about the right answer, which is something that's important to us here at Silicon Flatirons, and that's what we're trying to do. In these hyper-partisan times it's really striking when somebody will actually go against their chairman on the FCC on some issues, or when they actually collaborate with a commissioner from the other party on issues. And Commissioner Rosenworcel has done that.

Last but not least we have very local collections. She and Phil Weiser, I actually learned today, went to law school together, worked together on the incentive auction. And also, she has very good judgement, she actually hired one of our alums, Travis Litman, and that's probably the biggest gold star. So, please join me in welcoming the Honorable Jessica Rosenworcel.

[Applause]

[00:10:53]
Jessica: Thank you Pierre and good afternoon fellow spectrum geeks. You might not think you
             are, but by the end of this day. It is great not to be in Washington.

[Laughter]

[00:11:08]

Jessica: And be here, of course, in beautiful Boulder at this Silicon Flatirons conference. It is a treat to kick it off because you really do know how to start a party, calling it the Spectrum Hall of Shame. And I admit, I spent some time considering whether it's an honor or a slight that you asked me to get this conversation started. But I actually think we can learn a lot from shame. I think owning up to our mistakes is powerful, it provides us with the opportunity to do better, and in fact I think there's a deep undercurrent of optimism in studying what went wrong, so we can figure out how to make it right.

I feel like at the outset, though, I have to point out that a lot has gone right with our spectrum policy. In fact, it's really hard to overstate the audacity of the United States when it comes to spectrum policy, because over the long arc of history we've done so many unconventional things, and we've done them first. 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 we ushered in a new era of spectrum auctions, selling access to bidders and allowing them to use it however they chose. It's really hard to remember now but these ideas were once mocked my experts, opposed by industry, and dismissed by policymakers. But in the rearview mirror it's kind of worked out okay because the Federal Communications Commission has held nearly 90 auctions, we've issued more than 44,000 licenses through auction, and we have raised in doing so more than $140 billion in revenue. As a result, our efforts have become a model for nations worldwide.

We also pioneered the use of unlicensed spectrum. We took this handful of underused frequencies known as garbage bands, that everyone else thought was junk, in the 900-megahertz, 2.4 gigahertz, and 5.8 gigahertz bands and we decided to test a new model. Instead of dismissing these airwaves and just calling them garbage, we decided to set technical parameters, and then we did something that was totally radical. We have the public access to these airwaves. This was really edgy stuff. And it was a move away from this government command and control spectrum policy, but this was a wild success because in time a standard was developed known as 802.11, and that's the spectrum where Wi-Fi was born.

More recently, we blazed a trail with spectrum incentive auctions. Our two-sided broadcast incentive auction that we just held was the first of its kind worldwide, and we tested the proposition that existing spectrum licensees might voluntarily relinquish their rights in exchange for a cut of the proceeds from the subsequent reauction of their airwaves for new commercial use, and so far, so good; that auction ended late last year, and regulators globally are taking note.

But of course, and you knew this was coming, our audacious good works have not been without their equal and opposite counterpart: failures. We have no shortage of initiatives that did not go as well as planned. Pioneer's Preference anyone? Or maybe spending more than a decade on 800 megahertz rebanding. You get the idea. So, today, in the spirit of learning from the past and building a brighter future, I want to focus on two specific spectrum bands where I think we can do a lot better. And that's the 5.9 gigahertz band and the 2.5 gigahertz band. And I want to walk you through their history,

and then provide ideas about what we can do right now so that we take these airwaves from the stuff of shame to spectrum success.

All right, first idea involving the 5.9 gigahertz band. And I'm going to start by saying it's hard to avoid the buzz about driverless cars. You can question if these vehicles are ready for primetime, and you can quibble with the changes they require to our roadways, and even our civic life, but you can't deny that a lot is riding, literally, on the future of how we drive. But here's the thing, enthusiasm for autonomous vehicles is not new. In fact, if you fall down the internet rabbit hole far enough looking into self-driving cars, eventually you'll land on Francis Houdina and the American Wonder. You see, way back in 1925 Francis Houdina founded a radio equipment called Houdina Radio Control Company. From the get-go, this company was focused on reinventing transportation. In fact, as best I can tell this company built the first radio-operated automobile. Here's how it happened.

Houdina took a 1926 Chandler Sedan — they don't make those anymore — and he rigged it with an antenna. Then he set it up so that the radio signals it received operated small, electric motors that controlled speed and direction. And a crew trailing close behind in a second car maneuvered the remote-control Chandler. He cherished this makeshift effort, and he called it the American Wonder.

Now the American Wonder was the first driverless car to roll down the streets of New York City. Of course, Houdina made sure to take all the appropriate precautions. And by that, I mean he clung to the running board of the car ready to take the wheel in an emergency. This demonstration, maybe you guessed it, it did not go well. As the *New York Times* recounted, the radio car careened from left to right, down Broadway, around Columbus Circle, and south on Fifth Avenue, running into two trucks and a milk wagon.

[Laughter]

[00:17:59]

Jessica: At 43rd Street, after a crash into a fire engine was barely averted, the police put an end to the experiment. But here's where this failure succeeded. This demonstration captured the public's imagination. We still swoon at the prospect of autonomous driving, and we still marvel about what it could mean, and we still experiment, just not on the streets of New York City.

And so it was, in 1999, about two decades ago, when the United States set aside 75 megahertz of spectrum in the 5.9 gigahertz band for dedicated short-range communications, or DSRC. And DSRC was designed for cars to talk to one another in real time, so that they could avoid accidents. And as the FCC has acknowledged, DSRC would improve the safety of warning by warning drivers of an impending dangerous condition so that they could take steps and corrective action. But you know, in the nearly 20 years since the FCC allocated this spectrum that really hasn't happened. Today, autonomous vehicles have moved beyond DSRC to get around and communicate, and whether that's with things like radar, lidar, cameras, sensors, onboard mapping tools, or cellular and Wi-Fi networks. Of course, testing of DSRC continues, but right now we have just a few thousand vehicles on the road with DSRC capability, and that's out of the roughly 260

6

million cars in the United States. So, let's be honest, our bet on DCRC didn't pan out the way we thought it would. In fact, the National Transportation Safety Board has said it will be up to three decades now before the majority of vehicles on the road have DSRC capability, which is what is needed for this technology to be effective. And if you ask me, 50 years from spectrum start to finish is a long time, and i don't know about you, but I'm hoping at that point we will have flying cars, or at least being tested.

Let me be clear, we need to support automobile safety; however, our spectrum policies supporting safety need to be current, so we should speed the way for our thinking about DSRC to be up to date, and when we do, let's acknowledge that other countries are doing this using far less spectrum than the 75 megahertz that the United States has set aside. In fact, only a small portion of those airwaves were actually set aside by the FCC for basic safety messaging. So, it's time to take a fresh look at this band and see if we can update our commitment to safety and also develop more unlicensed opportunities for Wi-Fi. And this is a subject I've worked on extensively with my colleague Commissioner Mike O'Reilly. It's important because Wi-Fi today is congested. Right now, there's over nine billion Wi-Fi enabled devices. And by the end of the decade, we will see as many as 50 billion new devices connecting to our networks through the Internet of Things. Add this up and we are going to need a significant swath of new unlicensed spectrum to keep up with demand. And the thing is, Congress actually saw this coming. Earlier this year Congress asked the FCC to identify 100 megahertz of spectrum below 8 gigahertz for unlicensed use. And to meet this threshold, we need to take another look at the 5.9 gigahertz band. It's the ideal place to explore Wi-Fi expansion because it's adjacent to existing unlicensed band. And that means we have the opportunity to introduce new wideband channels, channels that will take advantage of new standards and deliver speeds even faster than a gigabit per second. In other words, this is where we have the potential to develop gigabit Wi-Fi.

Good news, this effort is already underway, because back in 2013 the FCC started a rulemaking to study the opportunities for more Wi-Fi in the 5.9 gigahertz band. And in 2016 the FCC developed a test plan in close coordination with NTIA and the Department of Transportation to determine the feasibility of DSRC and Wi-Fi sharing. And that first phase of that test plan, which involved tests in the FCC labs, is complete. I think it's time for the FCC to release the results of that testing, but we're going to have to do more than just make our work public. We need to update this effort. That's because our existing approach emphasizes cochannel sharing when I think the momentum now would be for a solution that segments that band. So, our test plans need to be modernized to reflect these changes, and we need to move our testing out of the lab and onto the road for real-world conditions.

So, in sum on that, there is no shame in correcting course. And I think it's time to be ambitious and find a way forward that puts the 5.9 gigahertz band to fuller use.

All right, my second idea is let's rethink the 2.5 gigahertz band. In his 1960 campaign for president, Senator John F. Kennedy described television as having the potential to teach more things to more people in less time that anything yet devised. I'm struck by how those words about the educational power of television sound because to me they sound so much like the ones we use today to describe the delivery of broadband to our schools

and students. And back to that in a moment. For now, it's important to know that this enthusiasm for educational television did not end with the presidential campaign. In 1962, President Kennedy signed the Educational Television Facilities Act which provided the first funds for noncommercial broadcasting. And at the signing ceremony — you can go look up the picture — he is accompanied by Newton Minow, his handpicked chairman of the FCC. You might remember that name because Newton Minow famously had his doubts. A year before the passage of that law he called television a vast wasteland. But the year after passage, Chairman Minow set out to make educational television a reality. Under his leadership the FCC introduced what was called Instructional Fixed Television Service, or ITFS.

ITFS made its home in the 2.5 gigahertz band. Licenses were distributed to educational institutions committed to delivering instructional services to schools. It was a grand idea, use the power of broadcasting to teach. Remake education. But history shows that even with all this enthusiasm for instructional television, many ITFS licensees were just not able to make full use of their license. So, over time the FCC permitted educational licensees to use these airwaves in another way. In essence, they gave up on educational television, and they allowed them to lease them out to other spectrum interests, for commercial use.

Fast forward to 2004, the FCC took another look at ITFS. It renamed it the Educational Broadband Service, but of course it did more than just rename these airwaves, it wanted to reimagine the possibilities of their use, and so it encouraged licensees to use them not just for instructional television but for educational broadband, and some truly promising efforts to ensure online access for students followed in communities as diverse as Albemarle County, Virginia, and Desert Sands, California. But not by any means did every licensee find a way forward; most of them were not able to put this spectrum to the educational broadband use the FCC intended, and continued to lease it out.

So that brings us to the present, and the FCC has, you guessed it, another rulemaking to address the 2.5 gigahertz band. But with the passage of time this spectrum is now considered prime. It was Siberia at the point that the Kennedy administration set it aside, but today these airwaves are considered to have the choice mix of propagation characteristics and capacity capabilities to make them part of what is essential for widespread 5G deployment. So, what are we going to do? I think the educational history of this band is important. I think it should inform our actions going forward as we seek to put this band to greater use.

So, here's my idea. Today, 7 in 10 teachers assign homework that requires access to broadband, but FCC data show that as many as one in three households do not subscribe to internet service. And where those numbers overlap is what I call the homework gap. According to the Senate Joint Economic Committee, the homework gap's real. By their count there are 12 million school-age kids in this country who do not have access to broadband at home, and for students in households without broadband getting homework done is hard. I've seen it firsthand in rural areas, urban areas, and everything in between. You see kids sitting in parking lots late in the evening just to get a free signal to do their nightly schoolwork. You see students sliding into booths at a fast

food restaurant and typing their papers with a side of fries. You see parents cobbling together connectivity with trips to the homes of friends, relatives, and libraries with reduced hours, just to help their children get their assignments done. I don't think it should be this hard, and we should do something about it, because to have a fair shot at digital-age success every student needs online access, not just at school but at home. For this reason, we need to move beyond the status quo in the 2.5 gigahertz band, and we need to find a way to honor the educational history of this spectrum and make more effective use in the present.

We have an open proceeding that asks lots and lots of questions, but I think we need a more focused plan. Like with the 5.9 gigahertz band, there is no shame in admitting the 2.5 gigahertz band has not lived up to its potential. Now I think what we have to do is take steps to change that. The FCC has unused 2.5 gigahertz licenses in its inventory. That's the equivalent of sitting in a regulatory closet, licenses ready to go. It also has the authority to hold other voluntary spectrum incentive auctions. Now in this case, doing so would require addressing license size, long-term leasing, and other issues that are unique to this band. But if we were able to combine these two sources of 2.5 gigahertz spectrum, we would be able to hold a substantial nationwide auction for new, flexible commercial use of key mid-band airwaves that are essential for 5G service. Then the funds in excess of those required to run the auction and pay for spectrum contributions from existing licensees could be turned into a homework gap initiative. This initiative could help fund the connectivity needs of those 12 million students who lack broadband at home through things like library loans of Wi-Fi hotspots and any other creative ideas we can come up with to ensure that no child is left online.

In short, we can honor what President Kennedy and his allies tried to do decades ago when they sought to spark educational use of technology using the 2.5 gigahertz band. We have an opportunity to now take a nod to that history but do it a way that is thoroughly modern and helps make sure every student has the connectivity they need for their schoolwork. I think we should explore it.

I'm going to end my two-band musings here, because no matter where you stand on the bands I've discussed today, I hope we can all agree that both provide some opportunities to learn from the past. Our spectrum history features amazing innovative triumphs, it also has a lot of airwaves that have become afterthoughts, but it's within our power to change that, and conversations like the one you're having here today is a terrific place to start. Thank you.

[Applause]

[00:32:01]

Pierre: Thank you very much to Commissioner Rosenworcel. If anyone has things they want to follow up on with her or questions, she will be around the back of the room, so please do that. I'll ask the next panel to come up and get seated, and we'll start in a few minutes.

PANEL 1 – DEFINING SUCCESS AND FAILURE

Bryan Tramont — Moderator

> Managing Partner, Wilkinson Barker Knauer, LLP

Michele C. Farquhar — Panelist

> Partner, Hogan Lovells

Thomas W. Hazlett — Panelist

> H. H. Macaulay Endowed Professor, Clemson University

Julius Knapp — Panelist

> Chief, Office of Engineering and Technology, Federal Communications Commission

Peter Mannetti — Panelist

> Formerly Managing Partner, iSherpa Capital, LLC

[crowd conversation]

[00:00:01]
Pierre: Alrighty, welcome back, everybody. The first panel is going to be moderated by Bryan Tramont, managing partner of Wilkinson Barker Knauer, and a wonderful friend of the Silicon Flatirons program and CU in general. The scope for this conversation is to help us just start setting the ground rules; what does success and failure mean? That tees up the discussions we're going to have in the next few panels. Over to you, Bryan.

[00:00:27]
Bryan Tramont: Great; thank you, Pierre. And, thank you all for joining us here this afternoon. We have a terrific panel, and I think Commissioner Rosenworcel did a great job of both identifying some successes and failures, identifying a few things we can learn from I, but also starting to put, sort of the intellectual flesh on the bones, if you will, of how to think about successes and failures. And, this panel is supposed to be a continuation of that discussion. Namely, what defines a success or a failure? What vectors matter the most; is it economic? Is it scientific? What are the things that ... is it about the decision being a good or bad one at the time it is made or in retrospect? And, how do all these different things fit together. SO, we have a terrific panel to discuss that; we have Julie Knapp from the FCC who has taught us all more about Spectrum management than we could ever than him enough for, and we appreciate that. Tom Hazlett, he's recently come out with a groundbreaking book on

Spectrum management that is a terrific read, for those of you who have not had a chance to buy it yet. I've bought it for many plans around town. And, Peter is also joining us, bringing in the economic perspective, the financial perspective to our debate. And then, Michele Farquhar from Hogan Lovells, former wireless bureau chief at the FCC who brings both the private sector and the public sector into perspective as well. So, I want to start with the fundamental question which is, how should policy makers define whether a Spectrum policy is a success or a failure? And, as I previewed in our pre-conference conversations, just take two or three minutes to kind of walk through how you think about that problem. And, we'll start with you, Julie.

Julius Knapp: [00:01:55] So, maybe a little different answer than you would expect [Laughter], because I think there's a temptation, when you look back on Spectrum decisions, and you look at the marketplace and you say, "Well, this thing took off," or, "That thing didn't take off." And, I don't know that's really the appropriate way to think about, well, what was successful or not? At least to me, success… I know for folks that worked in the government, or the FCC or in congress, you feel successful when you finally get something across the line; that I think it's about creating opportunities and not having the government decide whether your idea is going to be successful or not. SO, one measure of success, at least in the way I think about it is, have we created a fair opportunity for providing access for Spectrum, whether that is licensed or unlicensed, flexible use, and so forth. And, there are lots of different models that we've applied through the years. But, I've always looked at it as, that's our job is, we've got to make sure that people have a chance to get out there; let the market decide. Secondly, the old, do no harm rule. Ya know, if you engage, or have been engaged in commission proceedings, you know that there's a lot of back-and-forth, often discussion about disastrous consequences if we take an action. Incumbent services are going to collapse and so forth. I would venture that instances where there's been any harms have been rare.

Now, we have an obligation to make sure that the incumbent services, and I think this is on both sides of the house, whether it's federal or non-federal, and so forth, are protected. It's a lot of debate about what constitutes protection, but overall I think things… we've done a pretty good job in making sure that there aren't harms. Something I criticize sometimes is that we've been too conservative, and that a service might have been more successful if we allowed ten watts instead of four. So, that's something you always weigh in the trade-offs.

Just a few more points; sometimes I think the policy decisions, and I don't mean to be critical of any one, particular thing, drive us to, for example going back to the mid '90s, identify 225 megahertz to transfer from federal use to non-federal use. And, some of it wound up being terrific, and some of it wound up being what we called cats and dogs. Five here, 15 there, and so forth. And, I think it kind of plays into how we set things up at times. And, I don't know it's a problem just with numbers because that can be a good driver. But, looking at the value that we're able to create with Spectrum rather than just a number. Can you really do something with five megahertz that's going to promote investment?

And, I think specifically for example, is this band of 1670 to 1675, which we ended up auctioning. And, people tried to deploy a service in the market; it was not successful from a business standpoint. And, we're still wrestling today with what to do with it. So, I think being mindful of not just the numbers, but what is the value? And, while I'm at it, just one other point; the 100 megahertz, for example, that the federal government came up with at 335... 3,450 to 30... excuse me; 3,550 to 3,650; they add on to the 50 we had already. So, when we started out it was lemons; it was exclusion zones. And, folks were like, "Thanks, but what are we're going to do with this?" Fortunately there, we were able to make lemonade. But, it's an example of where sometimes, you're hitting a number; I gave you 100 megahertz, but with all the strings that are attached can you really do something with it? And, we did work that through I think, successfully working with the federal government and the industry to completely turn that around into something positive. Last point; the old maxim, you can find a lot of failures on the road to success. So, you might look at any individual decision and think, well gee, that didn't really go anywhere. But, when you start to look at the trail of where it led to, it often was the lessons learned that came out of it that led to something successful. I'd leave you with, Edison didn't get the light bulb on the first try. We didn't get to the moon without some bumps in the road. So, I think the worst thing that we can do on the Spectrum side is not try to tackle the hard problem.

[00:07:31]
Bryan Tramont: So, just one follow-up; Commissioner Rosenworcel touched on this. But, at what point is it appropriate to say something didn't work, and move on?

[00:07:38]
Julie Knapp: And, here... yeah, that's a great question; I was going to save it for later. But, here is... it is tough, trying to figure out, well, at what point do you say it didn't work? And, let me give you a couple of examples: DBS... there's a little... allocation in 1981, 1982; 12-gigahertz band.

[00:08:01]
Bryan Tramont: Explain what it is?

[00:08:03]
Julie Knapp: Direct-broadcasting satellite. The idea was, we're going to transmit TV signals from space. And, some might remember people with three-meter dishes on their front lawns or yards. And, I still remember a lot of folks, later '80's; "What a terrible decision that was. Nobody's using it and it's not going anywhere." So, what changed? The technology changed. Suddenly, we could do higher-powered satellites, which meant we could use smaller dishes. And, when we got to the '90s, it took off. So, you're always asking yourself. I come back to the provisions in Spectrum in 1985, and there's a whole trail of history on the license rules. But... obviously just a lot of this, I lived it. First five years, hardly anything happened.

And, into the early '90s it was all about frequency-hopping technology. There were other things that happened along the way; the U-NII rules came along which said you can use any kind of digital technology. Different bands, five gigahertz; we

opened up some additional Spectrum. I said, "Just do digital." So, it was the first generation of Wi-Fi, the b standard, that actually used a true-spread Spectrum technique. And, after that first-generation folks came back and said, "Can't we use any digital tech?" All the succeeding generations were based on OFDM. So, the explosion, it might have happened anyway. But, there were things that happened along the way that got us there. So, all comes back to your question, how long do you wait? And, that's two other maxims; if you ever want to know whether Spectrum is being used, just propose to re-allocate it. Suddenly, you'll have folks coming out of the woodwork you had no idea were there. And, second maxim; if you're sitting on Spectrum that is not being used heavily, you can rest assured somebody else is looking for it.

[00:10:32]
Bryan Tramont: Alright. Tom, same question; how do you define whether it's a success or a failure?

[00:10:38]
Tom: Well, apparently I'm having trouble with this because I listened to Pierre about the Survey Monkey that I took; I believe I took the same survey. And, I thought it said awesome to amazing – excuse me; awful to amazing, not awesome. Was it awesome? I thought it said amazing because that was my go-to answer. It says TV white spaces; that was amazing; amazing they didn't listen to me.

                 [Laughter]

[00:11:10]
Tom: So, whoever the surveys… if they really have a monkey and they're interpreting my results, I'd like to actually get the print-out because it would explain it to me and everybody else. Ok; so yeah, this is a very easy question to me because I keep reading Ronald Coase's 1959 article where he explains this. We don't want to minimize an appearance, we want to maximize welfare. We want to maximize the sum total of the gains; the net gains. And, be a lot of interference in that kind of a world, hopefully. Zero interference, obviously not optimal. So, you want the most activity, and when you look at the process, how Spectrum allocation works, one of the things that jumps out is that there's a lot of focus on the next idea; the application that's on this margin. But, the next margin, the one that's just around the corner, and of course there's always one around the corner in this space; how do you even know what the next margin is? Because the next corner is coming, and so much dynamic change. And, you want, obviously, some kind of process that can deliver that flexibility. And of course, we have had so much experience with rigidities, and spending years to do stuff that's obsolete. And, we just had a talk about this in 5.9; we had rigidity put in in 1999, about how this would happen, how much Spectrum would be utilized, what the application was, what the rules were. And, we're inching towards Bethlehem and the whole world has moved. So, now what do we do here? 1962; TV's a no-brainer. Of course, we need TV for education. Let's have educational institutions get TV rights. What could be wrong with that idea? It leads to a lot of… I remember being at the FCC some years ago. And, I got on friendly terms with a Catholic priest who was very interested in that television allocation for…

[00:13:23]

Bryan Tramont: The biggest holders of the educational broadband service is the Catholic church

Tom: For higher purposes than mere terrestrial wireless.

Julie Knapp: I got up to the bishop.

                   [Laughter]

[00:13:42]

Tom: So, these things take on a life of their own; this is what happens in any regulatory process; any business process as it winds its way through the market, through technological stops, and consumer evaluations and so forth; competition in the marketplace. You want to put into place, a process that is flexible, and can discover from moment to moment, and generation to generation, what the optimum is. And, to look at the world and say, "That, that's a great idea. Let's do that," and not pay attention to the process by which it can be fixed, and it will have to be fixed; that's what we know. We've learned that, but we haven't really learned about how to put the flexibility in, and it's not just to open it up and throw caution to the wind; it's to strategically put rights in the marketplace that allow for the re-valuations, and the discoveries, and of course the experiments that reveal all that new information, and then allow the deployments to take place that allow bargaining to facilitate gains from trade, so that you don't have the rigidities that keep us with 75 megahertz that seemed like a good idea at the time, but the world has moved on.

                   By the way, I do have a paper that I gave at some meeting in March; I should do more with that paper where I said to go ahead and give General Motors and BMW the 75 megahertz; then you'd find out very quickly how out-moded that DSRC is for the autonomous vehicles. If you had actual, responsible enterprises in the marketplace who had the ability to reallocate it, and as I also know from Coase, it wouldn't make a difference which those parties were as long as they had that ability. So, one of the great failures in the marketplace that I think was a huge success was the liberal allocation; there were all kinds of other problems. But, to the extent that some licenses to re-use TV Spectrum got out in the early 2000s and were auctioned off 2002, '03, '04; and you had some ability to experiment with channel 55; UHFTV, channel 55. And, you had a company like Qualcomm say, "Here's a good thing to do with a billion dollars; it's called media flow. And, they got some of these licenses, and made some deals with TV stations that were adjacent, and so forth and so on. The marketplace was allowed to work on that; MediaFLO was a huge success with seven or eight people.

                   [Laughter]

[00:16:28]

Tom: And, Qualcomm, by 2010 was looking at the situation and decides to go ahead and re-allocate the Spectrum. Now, it's very interesting; with those flexible rights, they're able to do that. They're not re-allocating the actual use in terms of mobile

TV to mobile TV: it goes to AT&T that does mobile TV and needs more Spectrum to do mobile TV. But, it's a different way of doing it wrapped into a different network environment, different technology. All that gets to take place with flexibility assigned to the rights that were now in the market, and the subject for gains from trade. So, you get this kind of very nice allocation. Last summer, there was a 5G notice that was put up by the FCC. And, I was just… I noticed how remarkable it was, how terrific and how terrible the same notice could be. And, I thought the disappointing parts were standard FCC boilerplate; please, the FCC is very interested to have all the parties reveal exactly what the technologies are, the service models, and what the future businesses will be in this 5G space, Ok? Now, with all due respect to every lawyer in the audience, that's a bad program for society, Ok? I understand this is bread-and-butter; you can keep that argument going on for decades. The great part of that allocation, where it says… it asks about certain rights, and how certain rights can be re-allocated to the market with flexibility; that's where the discussion should be. How could we set up a platform on which the new discoveries take place in cooperation amongst all the players that might have incentives to cooperate, and the ability to use capital markets, technology, and laboratory experiments, and experiments with customers; actual people buying services, how all that ecosystem is facilitated. And, questions about the most efficient way to do that are exactly what regulators should focus on. So, we've made strides; Commissioner Rosenworcel so very eloquently summed up many of the strides the United States has taken on that; I think we know a lot about where that world should be, and I think we should focus on that and not just the very next margin. What we can see; what is visible for the moment.

[00:18:53]
Bryan Tramont: Okay. So, a couple of things; one is, for the students in the audience in particular, one of the great things about Spectrum management is its interdisciplinary nature. So, we've heard from the engineering perspective. The middle two panelists are about the economics. And, Michelle and I, unfortunately, are the bookends on the law. But, Tom, you talked about maximizing consumer welfare as sort of your lodestar, if you will. How does that translate into defense department operations, or radio astronomy, or other things that don't lend themselves to that kind of traditional consumer welfare assessment?

[00:19:22]
Tom: Right. So… and, just to correct myself, when you are thinking about welfare maximization, it's not the situation that you want to download the actual welfare calculations to government agents because it's… again, that's an open-ended road to nowhere. What you want is you want some understanding of where efficiencies lie and how they can be facilitated by rules that really assist cooperation. Now, when you come into that with certain constraints, including, say Department of Defense, you do have to be creative and you have certain objectives. One is to put a price on things, not just have other government agencies talk about what the DOD defense costs are, because the DOD can certainly calculate their benefits. But, you want other agencies to really, from a unique or different perspective, to try to put opportunity costs on. In fact, I was just thinking about this the other day; how

interesting would it be if we went to all government agencies and said, "What spectrum can you do without?"

[00:20:48]
Bryan Tramont: It wouldn't be very interesting at all.

[00:20:50]
Tom: It wouldn't be interesting. No, we know that; in fact, that's why we have the department of congress involved in this. That's why we have other institutions, OMB for example. That's why we actually look within the public sector for different perspectives, because self-interest is a gravity. And, it's extremely useful; economists should be aware of that fact, and I don't want to be mistaken. We love the self-interest of the... in fact, I'm not at all being facetious; I want the Department of Defense executives to take their mission seriously and not to give quarter. But, I want other agencies to... and, private sector institutions to do their part to point out what the costs to society are. And, we want to open up, to the greatest extent possible, the analysis, discussion, and as to cite Commissioner Rosenworcel, even bring in private enterprises with hunting licenses or some other mechanism to actually get rights or secondary rights, to access DOD and other spectrum because these self-interested positions will force a different perspective, a different discussion, and a different result in terms of how we can really rationalize the use of these frequencies, which is very difficult. This is why you're giving me the question saying DOD; we want the DOD to do its job, and yet we want them to do it efficiently. And so, that comes from this diversity of access to the information, and to the discussion, and ultimately, to the resources; to the access to the spectrum by say, private bidders that have opportunities that they can exploit, that the DOD can't, and yet there can be, perhaps, a meeting of the minds; gains from trade that is so common in private sectors with good, established legal institutions, but is very difficult when you don't have the property rights and the legal institutions in the public sector.

[00:23:05]
Bryan Tramont: Alright. Peter, how should policymakers define a success or a failure from your perspective?

[00:23:10]
Peter: Well, I'm learning a lot here tonight. I remember when I was a kid growing up as a good Catholic boy; I had to watch Bishop Shane. I didn't realize he had a piece of the action, so that's...

[00:23:25]
Julie Knapp: I was educating you.

[00:23:26]
Peter: That was news to me. I go back to wireless auctions, to, I think the very first ones, when A&B were awarded and I participated in the D&E auctions, and was trying to start a company. And I think a C-block were a few, but the nationwide providers, if I remember. That's 20-some years ago; that's a long time ago. But then, my opinion, I

think, was pretty much the same as it is today, that successful auctions are the ones that sponsor innovation because you cannot track or guess what the technology will do with that spectrum. I've been on some boards, using unlicensed spectrum and I'm just amazed in terms of how technology drives the use of spectrum that were not considered to be necessarily viable. When I started this business, people talked about the spectrum and the A&B licensing having been broad enough. It was at 900 megahertz; we were bidding on some unknown stuff at the 1.8 because it had no penetration. So, what was interesting to me was the people that own the lower bands were pretty convinced that they had stymied every other competitor in there, and that's the way they viewed it. So, I viewed spectrum as, if it can sponsor innovation, and I think now with bands, we're using guard bands or maximizing the efficiency of that; it's what drives innovation. Technology stays a step… or, two steps ahead of what people are thinking, and there are hundreds of examples throughout history of people thinking that their old technology is going to win. Conversely, my definition of a spectrum that is poorly allocated; I'll use that phrase, poorly allocated, is one which benefits just a few either advantages or disadvantages; other players. So, that's my perspective on what would make success… what drives success.

Bryan Tramont: So, you used the term sponsor innovation. So, to what degree should the government put a finger on that in promoting innovation? So, I remember 1670-75, we had people come in and they said, "I remember…

[00:25:56]
Julie Knapp: It was Marty. [Laughter]

Bryan Tramont: Yes, it was Marty Cooper, but there were a number of people who came in and they said they had this innovate… there was a dog-tracking one, too; that they were going to track everyone's pet in 1670.

[00:26:05]
Julie Knapp: That's IoT.

[00:26:06]
Bryan Tramont: Yeah, that's the reality. But anyway, to what point do you say, "Ok, there's an innovative use coming; we should set it aside for invaders… innovators, sorry. And, maybe keep out incumbents. Or, we should… we hear that IoT is going to be a big thing. So, to what point… where does government put in its thumb, if at all, on the sponsoring innovation?

[00:26:24]
Peter: I'm kind of in favor of not putting your thumb in; I think it's hard to figure it out. I'll tell you a little, crazy story that's true; when we were looking at bidding on those original auctions, we had already… and my background, I had come out of a company that had just developed the first network for the Blackberry before I came here to build the wireless company, the cellphone business. And so, I was kind of intrigued with this whole notion of sending e-mail and doing some of those things wirelessly, which were not very popular or even well-known at that time. But, I sent

my staff home for the weekend and I said, "Your job is to come back on Monday and come up with a couple of ways in which people who use cellphones are now talking." I was just [INAUDIBLE 00:27:13]; I had… a lot of people had some cellphone businesses, and we had been in the analog business, and so forth. But, they came back with some very interesting notions like, just the way the cellular networks worked then. It was like; you could listen to a college football game from your hometown back in New York, in Denver. It was very easy to make that happen, and being able to do that. So, innovation comes from everywhere. It's nice to… some people say necessity is the mother of invention. I used to say, lack of money is the mother of invention; you finally get these things done. But, I think if you try to put your finger on that, you're going to miss it a lot.

[00:28:00]
Bryan Tramont: At least when it's the government, I heard you say.

[00:28:02]
Peter: The government; yes.

[00:28:02]
Bryan Tramont: Michele?

[00:28:04]
Michele: You already referred to my role as a lawyer, so I'll actually start with the Communications Act. In section one…

[crosstalk 00:28:12]

[00:28:13]
Peter: I'm going to argue with you now.

[00:28:14]
Michele: Okay, okay.

[00:28:14]
Peter: Because this is my expertise.

[00:28:15]
Michele: Okay. The Communications Act states that the role of the FCC -- the core mission -- is to make available, so far as possible, to all people of the US, rapid, efficient, nationwide and worldwide wire and radio communication services with adequate facilities at reasonable charges. And, that's not a bad measure or metric for success when you think about it. The speed and extent of deployment, the scope of deployment, and the number of participants is certainly a valid approach. And, including deployment in rural areas and the cost of the service (if it's a consumer-oriented service), is a good way to measure success. Certainly, there are different types of services that are needed, and the more different and innovative types, probably need different metrics. But, it's one way to look at it, and probably a straightforward measure for the many services.

One problem is that some elements needed for success are outside of the FCC's control. For example, other parts of the world handle equipment or service issues differently, either through 3GPP, or through different licensing regimes, and equipment problems emerge. And, as these issues get more complicated, there are fewer things within the US policymaker's control, and they have to take these other variables into account. Also, it's just not a static world on the spectrum side, and things that seemed like great ideas 30 years ago have had to be changed many times over. So, you can't look at it the static way.

I thought both Tom and Julie mentioned some good ways of looking at this problem, especially in terms of building flexibility into the system. And, how you do that effectively, not just in terms of the substance, such as ensuring flexible use under Chairman Reed Hundt's administration. But how you establish a flexible process is really a wise way to look at it. Because if the process isn't flexible, you're going to have a waiver-by-waiver, step-by-step approach, which might be longer and difficult. So, you kind of have to build some flexibility into the system. Now, some countries have actually done it through a more dictatorial approach, where you don't get any renewal expectancy.   This is a tough row to hoe. The government might take licenses back, then re-plow the garden and say, "No, we like it better this way." And then, you might get an opportunity for that same spectrum back again. That's not how the US has done it, but that's another system.

[00:30:46]
Bryan Tramont: So, you talked about flexibility there, and you're a veteran of leadership roles, both at NTIA and the FCC. How does flexibility play a role in inspection management at NTIA, or how should it? And, sort of turning back to the conversation we had with Tom about DOD, and about radio astronomy and what have you, a lot of federal government use is where flexibility gets tricky.

[00:31:08]
Michele: It does get tricky at NTIA because of the cost of the system, and it's just harder; it's not a private marketplace. It's easier in the private market; that is not a private market. And, there are a lot of economic issues that go into that, including how they use their spectrum. Now, they've done a good job over the years and have pushed to consolidate more and to get revenues from spectrum auctions so they can move and relocate government users. It's been a long process, but it's worked and it's been effective. Certainly NTIA over the years has become much more sensitive to the fact that there needs to be more squeezing and compression of spectrum to make more available for other technologies and uses. But, it's a hard process.

[00:31:51]
Bryan Tramont: So, at various times, people have talked about success in terms of... or, failures in terms of time to market; we've touched on a few of those. Economic impact, a few of those. Scientific value, brought a few of those out. Efficient use; you could define success by how efficiently the spectrum is used at any given time. Contribution innovation; Michelle touched on a couple of other ones that are statutory, universal service; they're serving under-served price. Is the answer that we… that the

policymakers should look at all those things at once? Or, would it be appropriate for policymakers to say, "You know, I'm really worried about underserved. So, I'm going to distribute the spectrum to anybody who will say they're going to serve the underserved." Or, "I'm going to have this spectrum be set aside for a low-cost service," Or, "I'm going to have this spectrum set aside because it's going to have the maximum economic benefit." So, are these all just one, big moosh? Or, how do you think about those factors or others in defining success? I don't know; Michele, do you want to start?

[00:32:47]
Michele:

I think you can't do it all at any one spectrum proceeding because you might find that you are hitting the mark with respect to some of those goals already in one type of service, let's say core cellular or wireless service has done a pretty good job there. But, there may be some holes and gaps. So, the FCC had to go back and look at that, and we examine, where are the holes that need to be filled in? And, if it can't be filled in that particular spectrum proceeding or that band, maybe look at other bands. The FCC has actually allocated certain bands for these purposes at different points; there was the BTRS Service at one point, that rural wireless service that probably would not be viewed as efficient or effective today. But, at the time it was introduced, it was viewed as quite efficient or effective. So, I think how you're going to achieve these goals will change over time. And, looking at ways to balance the needs and some of those different goals will also be important over time.

[00:33:45]
Bryan Tramont:

Anyone else want to jump in on that?

[00:33:47]
Peter:

Well, it just seems to me that you talked about three things there, all of which may or may not have national policy interest, right? So, you get to say, "This spectrum is going to be for, underserved is good; we decide that we want underserved and a served." So, all of those things are viable reasons but it starts with a policy at a national level, about what we're trying to achieve as a society and for what purpose. So, I have no objection to any of that. I think probably the most efficient and maybe least likely to achieve those goals is if you just leave it in the hands of people, or businesses who are always going to make it more efficient and drive it towards their own economic benefit, which may or may not line up which those.

[00:34:46]
Bryan Tramont:

Is that unoccupied spectrum always a failure, Tom?

[00:34:49]
Tom:

Well, of course not, I mean any more than un-occupied real estate. I mean, sometimes instead inefficient to develop and sometimes it's efficient to wait; you have option value. And, I'm leaving aside the part; you might say well, you don't want Yellowstone developed, then you might want to leave some spectrum. It's unoccupied in a certain sense but it's useful for other amenities. But, no; there's a rational pattern. So, this is why you want incentives in the marketplace that discover which... when to develop and how much to develop because as instantly as you

get… when you get into these questions about, for example build-out requirement, what is the build out requirement? I just heard a great story this morning that I won't repeat. But…

[00:35:36]
Bryan Tramont: They're way later, for the happy hour.

[00:35:37]
Tom: Let's… yeah. But, there are ways to game the system. What does occupation of spectrum mean? Do you have some occasional sparks emitted from the atmosphere? Well, yeah; you can have… what the actual efficient utilization of spectrum is, is not something you want the government to monitor because it's not clear what it is. And then, you're immediately into a different kind of a process. But just also, in terms of the set-asides and so forth, I mean now you're back into the rigidities of the systems, where you're sort of imposing particular solutions. And, that's not what you want to do; you want to have an efficient, competitive process, you want to have a lot of innovation that comes through the competitive process, and if there are these target areas that you want to hit you say, "Well, we need some extra help on that."

The talk from the commissioner today was quite interesting in that respect, when she argued for kids getting access to do their homework by getting online, and we have some deficiencies there. And, she said, "Let's take this stuff out of inventory, sell it, and get the cash. And, let's shop wisely." She mentioned library Wi-Fi actually; this is interesting because there are a lot of subsidies for broadband, right? We spend $4B a year to subsidize broadband in the schools in the United States. We spent somewhere north of $75B total now, and there really is no good evidence that it's helping education. And, I have done a little bit of work on this; difficult to see, the French are going the other way, by the way. They're banning electronic devices during school time. I don't know if you saw this; they took away all the cellphones. If you're over 15, apparently you can have a cell phone during school hours in France now. I'm not saying be a little more like the French; I didn't say that. I didn't say not to be more like the French. I've got a French mother-in-law; I've got to be very careful on this one.

[crosstalk 00:37:36-00:37:46]

[00:37:47]
Tom: She never understands anything I say, so we're fine. But, the point is you do want to look at the efficiencies that can be supported with flexible rights, and then a process to get facilities… rights into the market, that you can do all the competitive, and innovative, and discovery process you can do. And then, if you have these targeted kinds of programs, they should be visible and transparent, and cash for what you're buying. You don't want to back-door it through spectrum allocation process, where you bury… I mean, we've seen this in public safety, we've seen it in so many of the public allocations where it's just non-transparent, there are no incentives for efficiency, and it's a big problem to undo it; you're spending decades on it.

[00:38:41]
Bryan Tramont: So, you told me to use spectrum policy to achieve some of those goals, you use a more explicit mechanism, is what I hear you saying. And then, the other thing that you mentioned earlier that I just want to go back to; so, build-out requirements are a mistake?

[00:38:53]
Tom: Oh, I think they… in my book, I advocate that; I want more competition for licensed, and unlicensed, and all flavors of licensed and unlicensed. And, one of the ways to get that is to allow bidding for unlicensed; what would be, people think of it as a business model, unlicensed spectrum. It shouldn't be that way, but if parties in the market want to say, "Here, we're not going to build a network; we're going to have some kind of coordination to use this for unlicensed spectrum," the way we think of it being used today. Why should they have to build a network for that? We want competition to decide that matter. So, I think build-out requirements are very problematic.

[00:39:38]
Bryan Tramont: Got it. What's the title of the book?

[00:39:41]
Tom: It's called The Political Spectrum: The Tumultuous Liberation of Wireless Technology from Herbert Hoover to the Smartphone, available on Amazon. Thank you very much.

[Laughter]

[00:39:48]
Bryan Tramont: Yeah, why don't we just get that out of the way? [LAUGHTER] But, Julie?

[00:39:53]
Julie Knapp: So, there's so much to unpack. One thought come to mind immediately from what Michelle read in the act is, I think our obligation is to ensure that all people get service. And, we've tried to approach this, and I say we, through the years; all the folks working on it. On, now do we make sure that people in the rural areas, which for business reasons, you've got to remember that businesses are out there to make money; if they're losing money they don't stick around too long. So, trying to figure out how we make sure that those folks get service. And, folks who may not be as economically well-off.

[00:40:36]
Peter: Which businesses are you talking about? The provider business, or are you talking about businesses that will use service in the rural areas?

[00:40:43]
Julie Knapp: I think it's a little bit of both. People have to build networks; it costs a lot of money. And, they need to know that they're going to… so, sometimes there are little things we can do, like allowing for higher power in the rural areas, to reduce the cost of

the infrastructure. But, I think we've come at this in different ways trying to achieve that, but it's a goal that I think we have an obligation to meet.

[00:41:11]
Bryan Tramont: Do you have a reaction to Tom's portion, to not use spectrum policy per se to the achieve it? You said one example which is the technical rules, but there are other examples, like M2C or others where you say, "I want the spectrum for free and I'm going to build out in rural areas." Or, "I'm going to give it away for free for service." Does that make you more or less uncomfortable?

[00:41:26]
Julie Knapp: Uncomfortable. I think, first of all I'll come back to what Michele said, about how in each one of these proceedings, it's a different set of factors that enter into it. And, I think it's just… we always go into these; what do we think collectively is the best way to achieve these things? I don't think it's a great result if what's been happening is, we have service for some and others aren't getting it. And, there are some upsides to mandates, and some downsides as well, because it usually works better when people have incentives, and they're going to go out there and provide service, and they'll make money out of it; that usually is a better driver. I did want to say from the engineering standpoint, great believer in flexibility. And, I think one of the best things that the agency ever did was when we… after we got… had the amp standard, the first generation, and a mandate of it. We actually, we had the proceeding that said, "Ok, you don't have to do amps; you can do digital." And, I would contrast this with where that went in the United States. And, the natural revolution from one generation or the next, driven by the market, driven by the technology, driven by the folks who are deploying service.

So, those transactions all kind of happen without the FCC saying, "Ok, here's the next thing." They said, "Yeah, we opened up additional spectrum bands but we never said, 'This is the 2G band, this is the 3G band,'" which kind of, at least in my judgment, got Europe into trouble because they auctioned bands for 2G service or 3G service. And, as the technology evolved, the folks who had paid money for 2G spectrum said, "Well, what about us? How are we're going to compete with the 3G folks?" And, you've artificially tied your hands so there's no technical reason. One last point on the… when do you wind up getting some constraints that don't give you the full flexibility that you're thinking? I don't know that this is exclusively true on the federal side because it happens as well as on the non-federal side. The technical characteristics of systems and how things are going to be deployed, matter, relative to sharing. So, you're faced with this tension between total flexibility and the true analysis on the technical side. So for example, when you look at what happened with AWS3 and the freeing-up of spectrum, the reason it worked is, the carriers worked with the OD and said, "Here are the characteristics of our system. WE could do all the analysis that said, 'Here's how far apart things have to be. Here's how we might be able to share during a transition,'" and so forth.

And, I couldn't remember the part of the spectrum frontier's item that we might have asked about the specifics. But, I'm guessing part of it was driven by… remember, some of those gains [ph 00:44:24] were shared at the federal side. And,

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the way they think about things is, "I've got to know what's going to be in there. It makes a difference, whether I've got to have you this far away or that far away," because I think as that agency we've gotten away from generally; here's the technology, here's the… there's one other example; medical body area networks, sharing with telemetry. We… the reason we came to agreement, although that has not taken off, was because the time that you folks said, "Ok, they aren't going to be in hospitals, they're going to be in these places." It's not going to be Wi-Fi in every home, on every street corner. And, we can work something out to allow that sharing there. So, sometimes you can't make it as flexible as you wish you could. But, you have to do that to squeeze more juice out of the spectrum you have.

[00:45:24]
Bryan Tramont: Right. So, you touched on something and I'm going to turn to Michele on this one. Would this all be easier to get the successes and failures and better decision-making related to successes if all spectrum management was under one roof? NTIA and the FCC all under one major roof? David could be chairman, for example.

[00:45:41]
Michele: [Laughter] That's right. I would be nervous about putting it all under one roof, because I think having that division has actually been helpful. I'm glad that the FCC is an independent agency but I'm not sure that, without a separate agency at NTIA, sorting out the interests of the various government users would work as effectively if it was just being done by the FCC. I think that NTIA -- within the IRAC and its groups -- can do a good job of trying to align the interest users, and to find what they need and how they need it. And then, bring that information to the FCC. So, I guess I'm not convinced that the current system isn't working; I think the bigger problem is the incentive system that each of these government groups have.

I think where the FCC sometimes runs into problems is how it can incentivize, say, marketplace players who bought spectrum. And then, for various reasons -- -- equipment problems, chicken-and-egg problems or whatever it might be --they can't build out. They may have bought the spectrum before it was really ready, and that's a good thing; it's flexible-use. But then, how does the FCC encourage build-out and how do you get the spectrum back if they're really not using it, or at all? So, we need more tools there and also on the NTIA side that we haven't even thought about or developed yet. I think Congress will certainly have a role in that, but getting that incentive auction authority was a key step, and there may be more key steps and more tools to come, especially on the federal user side. We could use a lot more incentives there than what NTIA currently has to use. And, I think that would be really helpful. That may be more of an answer than you wanted.

Bryan Tramont: Alright. To Tom, would there be more successes at the NTIA and FCC if federal and non-federal spectrum management was combined under one policy rubric?

[00:47:25]
Tom: Well, there's obviously an issue of gridlock to some degree. But, I think some diversity here is fine. I think out of respect for Herbert Hoover, who had spectrum

management in the Department of Congress before there was an FCC, that some diversity here is proper. And in fact, I would love to see the commerce everything more of a Department of Commerce and push harder on behalf of business; most generally defined, getting access to more spectrum. So, I think that there actually is a fairly constructive division of labor on that; I want commerce to lobby for spectrum being shifted to commercial civilian use. And, I don't think it gets better by leaving everything at the FCC. Obviously, the FCC has various issues as a very industry-specific agency. Lots of discussion and analysis over the years by scholars, lawyers, economists and others that say industry-specific agencies are very normally hide-bound, captured, various other terms. And, commerce has a fairly wide constituency but it's business-oriented. And, we'd like to see that part of the debate, and it is a part of the debate. My only complaint about commerce is not that it's independent from the FCC, but that it's not more independent from the FCC, and that it doesn't push harder. And, not just against the FCC but against the other agencies that need to cooperate.

[00:49:26]
Bryan Tramont: Peter, turning to you for a sec; what do you think are the largest barriers to policymakers for generating more successes overall?

[00:49:33]
Peter: [Laughter] Partisan politics; would that be appropriate to say? I'm not sure.

[00:49:38]
Bryan Tramont: Sure. Well, you're among friends; it's all good.

[00:49:41]
Peter: It's alright; it's okay.

[00:49:43]
Julie Knapp: Did you say this is web-cast? [Laughter]

                   [crosstalk 00:49:47]

[00:49:48]
Peter: Yeah, that's good. I'd just have to[ph 00:49:50] write an anonymous piece to the New York Times.

[00:49:51]
Bryan Tramont: Oh, there we go. Now we're getting rolling.

[00:49:55]
Peter: But, no; I… I think that the policy issues that we talked about several [background noise 00:50:09] the FCC and the NTIA. Those policy decisions are important because they also speak not to the now, but they speak to the future of what your country is achieving. And, that country meaning every aspect] of the country. Private business, government, military, economic legs of the stool. And, there needs to be an overall guidance I think, in terms of that. So, I see that as a very important role that the

government needs to play. Whether it's best played from the commerce department, which I think… I've always had this interesting… or, this thought; whether you're in the FAA, the FCC, the commerce department, you walk a very fine line between supporting an industry that is… needs support to be competitive in a global basis, or regulating that industry. And, those things are really on different… they're certainly the opposite side of that. So, I really do like to think about the policy stuff staying with the government, and the government having a responsible thought about what they want to achieve, but from a higher level. When they try to get down to the real specifics, this little band for that little person, I think that's very hard to make good decisions doing that. But, allowing… having an overall view, it's like even running a company, right? Overall view, everyone understands what their role is, you can achieve that much more effectively.

[00:51:57]
Bryan Tramont: One thing that has come up in other context that investment folks consistently come to is the role of uncertainty. Do you feel like in your experience in this business, the spectrum, on spectrum-based services, that uncertainty has played a role? Or, is that a real fear that people should be worried about, is driving failures or successes?

[00:52:15]
Peter: It's an interesting point you make there; uncertainty is part and parcel of the business, just at any level. I think what you have to think about is what drives… and, which side of the risk you are taking. 25 years ago when people were talking about a 10-megahertz spectrum, they were pretty convinced that they couldn't… that it could not really support a large enough business; you couldn't get the volume on it. But, if you sat and talked to, at that time, Lucent; I remember the name of the companies. Lucent, and Nokia and others, and you saw the amount of money that was going to solve this problem from the private sector, it gave you a high degree of confidence that, that was where you were going to lay… it was a good bet to lay down. So, to the extent that you understand that there are a lot of people coming at this thing from a lot of ways, and the more you understand the dynamic of what you're talking about, what park you're playing in I suppose, you have a much better ability to understand that, what the risk is and how to mitigate that risk, and really , how big of a risk is it?

[00:53:27]
Bryan Tramont: Excellent. So, we're going to open up the questions for the audience after one more for the group. Without naming any specific proceeding, to what degree do you think that failures are the result of good people with good information, but they just end up making a bad choice even though it was well-intentioned at the time? Versus, a political co-op [ph 00:53:48], like Peter said, and the conversation I had with Dale yesterday. Or, a situation where the politics got in the way and drove a bad decision, either because of lobbying or political pressure from somebody external to the agencies? Michele? That's a tough question.

[00:54:05]

Michele: That is a tough question. I think it's more the former. And, some decisions are just very difficult to make, because I think the biggest barrier we have is the fact that when you look at the spectrum chart, it's all colored-in. Incumbency is the biggest barrier that the policymakers have. And, how they resolve that requires some very tough choices. Trying to balance the various interests at stake is difficult, and a lot of the incumbents don't want potential interference or they have other issues that they're going to raise. So, I think it's hard to make good decisions in that context, and especially when there are a lot of different users. The ultra-wideband decision is one example that may be cited down the road, and there are many others. But, "who is your neighbor" is going to be a critical factor in success or failure, more so than the policymakers and how they approach it. They have limited tools and ability to deal with that, so I think maybe it's less the politics and more the fact that you've got a very messy and increasingly encumbered environment.

[00:55:09]
Bryan Tramont: Peter, Tom, Julie?

[00:55:10]
Tom: Well, it's the nature of the process, where… I call it the political spectrum because in the situation, it's not just that the politics get to it late; the politics get to it instantly because you're in a structure where you, as a decision-maker; it wouldn't make any difference if it were me or anybody else who has to make a decision . You're within narrow guidelines, you have a rule-making structure that forced determinations that, in many cases are not susceptible to adjustment by the market. And so, I think it's the nature of the structural nature of the system that's been set up in the 1927 Radio Act to steer a lot of this. Now there has been progress and there has been a lot of literalization. But, it's the tumultuous liberation of wireless technology; it always takes a push, and we still have a resting point for the equilibrium that still gives us all these challenges. So, I really take it as a process problem.

[00:56:24]
Julie Knapp: Do I get to go last? [Laughter] So, I was thinking of the title of the book, and I don't think of this as a political problem in terms of the way most people might think of this as red and blue. And, even in terms of the politics of who's stronger on each side, I think that the problems are generally really hard and they're getting harder. We get into debates that I think, there's a little bit of the element of trust; who do I listen to? Who do I believe? One side is telling me no problem at all, and the other side's telling me that this vital service is going to be wiped out. Who do I believe? I do think that clearly, the commission has got to roll [ph 00:57:21] and in the end we have a responsibility. But, to the extent that we can… we've had some success in getting the parties together. And, sometimes when you get the engineers sitting down at the table, not every time; you can get to an answer that they both can live with.

[00:57:29]
Bryan Tramont: The engineers always think the answer is to get the engineers together.

                    [Laughter]

[00:57:35]
Julie Knapp: They'll still give you the money. [Laughter]

[00:57:39]
Bryan Tramont: [INAUDIBLE 00:57:39]] Students first; questions? Yes, excellent. And, we have a microphone on its way. Obviously for everyone, identify yourself and your affiliation.

[00:57:58]
Sarah Rippy: Sarah Rippy; law student. So, my question is about risk mitigation. So, without hindsight to guide you, how do you balance the risk of innovation yielding inefficient results? Or, efficient results stifling innovation?

[Laughter 00:58:23]

[00:58:26]
Michele: It's a great question but I think that's where you need flexibility; it's a bit like the other side of the coin from uncertainty is flexibility; the positive side. And, that way you can fix the mistakes if they happen. And, if they don't happen that's great. But, mistakes are inevitable, and Commissioner Rosenworcel said that in her remarks; you need to have the tools to be able to fix those, and learn from them, and come up with more tools. And, she's been a great advocate for trying to have more cutting-edge tools and experiment with them. So, I think that's how you rectify the problem. If there's a problem and then you find a way to fix it or whatever piece of the problem needs to be fixed. It may not be the whole thing is bad, but there's one, narrow area. And, that's sometimes called Petitions for Reconsideration. That's why these proceedings can drag out; they try to get it just right to get the whole process to go better.

[00:59:24]
Tom: And, you want there to be competition in the marketplace, not just in wireless services; obviously for everything, for innovation everywhere. And, am I afraid that the innovations might not all work out? No, I'm not. Now, that's not the same position as, all innovation is good. Of course, hearings this week in Washington indicate that people are afraid about some of the things that are happening. Look, you don't get to a better place by saying, "We're not going to have the innovation." Or that, "We're going to have a governor on it so that we can… some council is going to decide which are the best innovations. I want that to be a competitive market; determination by consumers, technologists and capital markets. That system tends to work the best overall; that's what's going to maximize welfare. That's my observation, and certainly when problems arise people should be aware of them. We should, in some cases, come up with new rules to try to address those, which we do. But, stopping innovation, no; that's not the way to get there.

[01:00:25]
Peter: I had one thing as well; you said without the benefit of hindsight. But, in business… I'm in venture capital. So, you see lots of new things, new ideas. But, you always,

always look to see who had a similar business model, which had something addressing the similar market. How did they do it? What mistakes did they make? So, you always… if you look, you have benefit of hindsight in almost everything that you do; you just have to make that a part of your initial scan of the marketplace.

[01:00:58]
Julie Knapp:
And, just… so, on the innovation side and the flexibility, it's always reminding yourself that you don't know what flowers are going to bloom from the seeds that get planted. Whether it's… all of the innovations that have happened on unlicensed, whether it's RFID who thought you were going to be opening your car door with some unlicensed device, and on the license side; the wealth approx., I think [ph 01:01:23] we all think of the smartphones. But, there are so many other things that the industry does on connectivity. And, remind ourselves also that there's hardly any problem we can't fix in the spectrum, and we have. I think if you look back, there were things; we had a service called TD Answer in the 2018, right? It was going to be this great idea in the '80s, of having something that would talk back to your television so you could order a pizza; can you imagine that? IT didn't go anywhere. We had in the mid-'90s, if anybody remembers the Apple Newton. And, we had this spectrum in the middle; unlicensed PCS.

[01:02:04]
Tom:
That was, yeah.

[01:02:07]
Julie Knapp:
Yeah. And it was like… so, we started out with 40, we cut it to 20. And, wow, we need connectivity for mobile things. Well, it didn't go anywhere; we had these very complicated rules which I would argue actually came from industry; spectrum etiquette and said, "So, we can all pack more into this. The FCC needs to adopt these rules in." Well, other than some my office systems, it didn't go anywhere. What did we do? We went back and changed the rules, we reduced the amount of spectrum. We got it back; five is actually still sitting there, potentially to be auctioned. And, for the remainder, it's the decked [ph 01:02:41] phones that you buy in the stores.

[01:02:44]
Tom:
That's what's left. Yeah, Apple blames you for that by the way, because they asked for 75 megahertz of unlicensed for the Newton. And, the Newton's gone but they're still mad at you.

[01:02:54]
Julie Knapp:
That's okay. That's alright, they're not alone. [Laughter]

[01:02:59]
Bryan Tramont:
Let me get some more questions in. Mr. Hatfield, I presume?

[01:03:04]
Mr. Hatfield:
[NO MIC INAUDIBLE 01:03:05]

[01:03:11]
Bryan Tramont: Could you switch the mic, please?

[01:03:12]
Mr. Hatfield: Just, we haven't mentioned experimental programs. I think that's one of the strongest things that the commission… we tend to think of spectrum as all sort of being owned by somebody. But, you can go to the commission under pretty straightforward rules, and experiment. Moreover, you can even experiment… make an economic experience to see if people will actually… the dog will actually eat the dog food, or whatever they say. And also, Julie, I think the STAs are used as another way of giving somebody who has an existing assignment, a chance to change their rules and operate without… with a new technology with that. So, I think we're just a little bit. But, I think we we're just a little bit more negative than perhaps the actual evidence shows.

[01:04:01]
Bryan Tramont: More questions? Especially students; if we got them, if not we'll come down here. I think you're up next.

[01:04:11]
Richard Bennet: Yeah, Richard Bennet. Julie, you sort of… you got really close to the thing that, I think, is maybe key here. But, maybe it wasn't clear to the non-technical people in the audience, that one of the things you look… probably the most important thing you look for when you're making a spectrum allocation is, it's a success if that allocation led to an improvement in the state of the art of wireless technology. So, it's not that… it's easy to focus on the applications, but whenever somebody makes a fundamental advance in wireless technology, that ripples through the entire ecosystem and improves the lives of every user, of every application. So, isn't that the key metric of success?

[01:04:56]
Julie Knapp: So, it is a benefit; I don't know that it's the only element. But, just to jump on the example that Richard… so, we talked about the spread spectrum rules were… and, I had mentioned before, not a lot happened. Well, CDMA was deploying some of those devices before it went into the commercial wireless networks. And, if you look at some of the technologies that have evolved and worked their way, I do think it's a key benefit. Maybe not the only one, but when you… I think we… I mentioned amps. When I started early in my career, the idea was we had to pick the technology. And, what that meant is, every improvement had to go back through a rule-making. The models, I think, that we generally try to apply now is, we're not going to pick the technology and hope that it's going to evolve; that we're not stuck with the technology that we talked about before, that is 20-years-old before it got deployed.

[01:06:07]
Bryan Tramont: Can we do one more question?

[01:06:10]

Tom:	Well, let me just say that the language that Michelle read, from the 34 Communications Act; that was taken seriously. That was… it was the federal communications commission's responsibility to determine what the interference parameters were. And, in the evolving world it's come by backing away from that; backing away from the explicit, 1927 Radio Act and the '34 Communications Act, really has made all the difference. See, the smartphone world is literally impossible to imagine, with all the interference sources, if you don't download that to the market and allow carriers, and application providers, and technology suppliers to actually figure out what the interference is between your Angry Birds download and my Pandora. I mean, that has to be in the market and that levelization [ph 01:06:57] has meant all the difference.
[01:07:00] Scott Fox:	Thank you. Scott Fox; I have 40 years of wireless experience, internationally, domestically, and a few years in the federal government. I just wanted to see if someone could conclude, or give us a conclusion from this panel. I think the objective was to reflect on the past, and identify those key criteria for success that will apply as we look to the future. I heard a diversity of answers, and they all made sense. So, is the answer, it depends?
[01:07:25] Julie Knapp:	Yes. [Laughter]
[01:07:28] Tom:	Say one word; amazing.
[01:07:31] Audience:	Awesome.
[01:07:32] Tom:	Awesome.
[01:07:33] Bryan Tramont:	Alright, so what's… do we have a takeaway on this? That's an interesting question; does anyone want to jump in on that? Is it, it depends? Sounds like it depends. [Laughter]
[01:07:45] Bryan Tramont:	I have one closing question I'm going to ask you all; do you think there are more failures based on a failure to make a decision at all, or making a bad decision?
[01:07:53] Julie Knapp:	Whoa. The way I think of it is not a bad decision, in terms of things that I've talked about before.
[01:08:04] Bryan Tramont:	No, I understand; fair enough.

[01:08:06]
Julie Knapp: Yeah. But, time is tough because I think one of the… our process is inherently slow. Sometimes, if you're an incumbent, you feel that's good because you want to be sure. And, we get into things like testing and so forth. But, if you're an investor and you've got an idea that is going to get out there, and you're waiting for the FCC, your capital could dry up. So, I think we usually get there, not every time. But, sometimes it's such a long period that by the time it's done, it doesn't matter anymore.

[01:08:46]
Bryan Tramont: Tom?

[01:08:47]
Tom: I'm tempted to say I'll get back to you on that after the rulemaking. [Laughter] I am tempted to say, yes; the delay's inherent to the system. You need… on so many grounds, you do need to make decisions, get them out and then if they don't work, to re-do it again.

[01:09:04]
Bryan Tramont: ADTV channels wasn't such a bad idea until it was, right? at the time you could argue that was a fine decision. It was a failure to move quickly enough to [INAUDIBLE 01:09:12]

[01:09:12]
Tom: Well, you want to do things quickly and again, have flexibility within the process so that you don't have to come back and do it all over again. I mean, I do have a chapter in the book, The Thirty Years War. I mean, cellular was on the cover of the Saturday Night… the Saturday Evening Post in 1945; that was one thing I was actually amazed to find out, that it was even before the 1948 date that everybody gives it. But, the FCC chair in '45 is saying, "We'll have those licenses out in just a few years; it's pro forma." And, it was a 30-years war. But, the delay; I'll go with that.

[01:09:48]
Bryan Tramont: Peter?

[01:09:49]
Peter: As an investor, I would say you can learn something from a bad decision; you don't learn much from no decision.

[01:09:58]
Michele: I would agree, yes; delay is the bigger risk.

[01:10:10]
Bryan Tramont: And, with that I would like to thank our panelist for a great panel

[crosstalk 01:10:07]

[01:10:09]

Pierre   Thank you very much to Bryan and the panel. We have a break until 3:00; we'll have a prompt start. See you then.

PANEL 2 – SUCCESSES

Robert B. Kelly — Moderator

      Partner, Squire Patton Boggs

Rob Alderfer — Panelist

      Vice President, Technology Policy, CableLabs

Larry Downes — Panelist

      Project Director, Georgetown Center for Business and Public Policy

David Goldman — Panelist

      Director, Satellite Policy, SpaceX

Charla Rath — Panelist

      Vice President, Wireless Policy Development, Verizon

Pierre: And, you can use your laptops later. All right.

        One of the wonderful things about these events are always the breaks, and I always regret that they're not longer, and I think everybody does, and then I think about the panels, and I think, "But I want the panels, too."

        So, we have our second panel, moderated by Bob Kelly, a Partner at Squire Patton Boggs, and a long time supporter of Silicon Flatirons. We're gonna be talking on this panel about successes. And, just a request for the panelists, as always, please, if you use an acronym, please define it. If you use a reference to a proceeding, please explain what it is for the folks in the room who aren't experts.

        Bob, take it away.

[00:00:51]
Robert: Pierre, thank you.

[Non-Interview Content]

[00:01:02]
        Okay. Well, let's try that. Thanks Pierre and thanks to all of you for spending your time with us this afternoon. We have a tough act to follow if you sat through the first panel, I'm sure you will think that.

Fortunately, we have a great panel who I'm sure is up to that task, and we have a lot of both the public sector experience on our panel and private sector experience, and I hope, and I think we'll have a great discussion.

Without spending too much time in introductions, on my immediate left is Rob Alderfer who is the Vice President of Technology Policy in CableLabs, and has, I'm sure a lot to say, that will be of interest to us. Next to Rob is Larry Downes. He's the Project Director of the Georgetown Center for Business and Public Policy. Next to him is David Goldman who's the Director of Satellite Policy for SpaceX. And, on the far left-hand side is Charla Rath with Verizon. Charla, I'm sorry, the exact title I'm gonna say the Vice President of Wireless Policy Development, Verizon. So, thank you.

Well, having us into that first panel, let me just start our panel off with the first question, which is, we heard a lot about different ways of defining success and failure. I'd be interested to hear how you would define that, and in particular, referring to the list that was distributed earlier, which one you would think qualified the most as a success?

So, I'm gonna put you on the spot, Rob.

[00:02:47]
Rob: Okay. Sure. So, I guess I get the privilege of kicking us off. Thank you Bob and thanks Pierre, and Silicon Flatirons for having us.

So, my view on what success is I think is collared by my formative years working for the White House Office of Management and Budget where we would think of policy really of any type as being successful to submit [Phonetic] its intended purpose, and did so in a way that was better than the alternatives.

So, in Spectrum, we kind of think about that as a success being maximizing economic output. We heard about that from the last panel, Tom Hazlett. And, I think it's possible to one of Bryan's questions earlier that a different objective could be defined, where we've been talking about government use, we might be talking about saving lives as the objective, or monitoring weather and climate, that sort of thing. And, I think still even if you have that different objective, in that case, the criteria for success is still the same, does the policy meet its purpose in a least costly way that maximizes benefits.

So, focusing in on the commercial Spectrum world and getting to your question of what is sort of a leading example of success, I'm gonna echo a lot of what Commissioner Rosenworcel said actually earlier to kick us off today, and say at the top of my list is Wi-Fi. And, the innovation that's been enabled through the policy of unlicensed Spectrum.

And, when we look at Wi-Fi as embodying that success, really, what we see is just a ton of innovation. Billions of devices out there, the Commissioner said nine, I thought it was closer to 10, but what's a billion here or there when you're talking about Wi-Fi? And, we see increasing diversity and capability of those devices. We're really now at the cost of gigabit service over Wi-Fi and still increasing. And, it's pretty intuitive if you think about that success, just imagine a day in a life without Wi-Fi. Tough to do, right?

[00:04:48]
Female: Absolutely.

[00:04:48]
Rob: So, there's some data around that intuition that I wanted to share with everyone today. iPass, which is a Wi-Fi networking company, did a fun little survey around what people think is the most indispensable thing for them to have on a day-to-day basis.

                 And, here's where a list of things came out in order of priority from lowest to highest: alcohol, chocolate, sex, Wi-Fi. It might have been up here. I'm not sure exactly where it was, but sufficed it to say, I think that puts it in perspective.

                 So, when you think about Wi-Fi as a success of that magnitude, you have to ask how did we get here. And, in unlicensed Spectrum policy, I think the defining features of success, what enabled that success is two things. One of which we heard about earlier already and I think we'll touch on more here, that's flexible-use regulation, and another is industry collaboration.

                 So, just to define that a little bit more. By flexible-use regulation, we're talking about, of course, basic rules of the road that don't require individuals, or organizations, or companies to ask permission for what to do or not do on that service, so flexibility on how to use that Spectrum and of all that over time.

                 By industry collaboration, and this is a point that I think hasn't been mentioned yet. What I'm talking about is industries working together to take advantage of that flexibility, to develop new technologies in a way that's iterative, generally through standards, and improving them over time.

                 And, those two ingredients I think are the lessons I take from the success of unlicensed Spectrum and Wi-Fi. And so, that's my one success.

[00:06:35]
Robert: All right. Rob, thanks. Larry, we'll move on to you and I'm not gonna ask you how you would rank those list.

[00:06:41]
Larry: Yes, right. I'm not sure right now. So, thanks very much. So, I was listening to the last panel and I was thinking about this over the course of the week. And, one of the things that keeps coming up, there's a phrase that shows up all the time in discussions about Spectrum allocation and that is best and highest or sometimes highest and best use.

                 Now, I was not able to run this completely to the ground and maybe it's a good student project, but right, I don't know where that phrase originated. It's not in any of the statutes. It shows up all the time in FCC documents, in filings, but it's never sourced, it's never cited. I ask Blair Levin and he didn't know, so that told me it was obscure enough, and I also searched through Tom Hazlett's book, and it doesn't appear once in his book, so he doesn't use that phrase.

But that seems to me the point that people always use when they talk about Spectrum and its importance. And, I think it's the right starting point because we reach the point some years ago around the time of the National Broadband Plan where we really had the… sort of what we referred to as the Spectrum frontier close. That is to say we reached to the point now where it was really all about reallocation of Spectrum.

Now, with the 5G's now, we've now pushed the Spectrum out, the frontier out further. But even now, there's settlers everywhere even in the millimeter wave frequencies. But by and large, we're talking about tradeoffs between uses. And, the way to measure success, well, again, is one use better or higher or better and higher than another use?

And, I don't know how to measure, and obviously subjectively, I get much more out of my LTE telephone than I do out of over the year analog broadcast television. So, clearly, to me, that was taking broadcast analog television, and moving it to LTE that's a better and higher use, but that's subjective.

And so, I think echoing what some of the other panelists said on the previous panels, the only real way to measure success here is economic output or what Coase said, maximum welfare. And then, maybe in a form of more jobs or more consumer surplus or other kind of economic measures, and all of which of course are themselves somewhat subjective, not quite as subjective is the other thing.

And, we really don't have a lot of good data on that. I think what's been encouraging certainly in the last year has been the formation at the FCC, at the Office of Economics and Analytics, sort of bringing all the economists together. Hopefully, that will lead to more of these kinds of measurements, again, and everybody to be perfect, and in hindsight, they're always gonna look right or wrong.

But I think that's really the best way to measure success. And, my best example of success would have to be Coase's proposal for auctioning instead of the more politically-oriented, and sort of the command and control allocation Spectrum, which should happen up until that point. But we have to say, and well, I assume, we'll get to this because every one of the successes that we'll talk about is tinged with a certain amount of failure, and of course, in the case of that example, Coase's essay proposing this was published in 1959, that was the year I was born.

Obviously, it was many, many, many years before it actually took place and in the interim, lots of potential opportunities, lots of potential job creation, and innovation, and lots of that was lost or certainly suboptimal. So, that's my caveat on the success.

[00:10:26]
Robert: Mm-hmm. Thank you. You touched on a couple of very interesting subjects. One being something that may be a success today may not always be a success, and that's something I think we'd like to come back to in a little bit. But let me go over to David to get his thoughts.

[00:10:44]

David: So, I was really hoping that the first panel was gonna be really bad, and, like, I have all prepared of, like, they said all this wrong. But… and I was gonna be really clever and then they said all the stuff that I had. So, I'm done.

No, I, actually, the thing that Julius said first… so, first of all, I should say about three-quarters of what I know about Spectrum I learned from listening to Julie, so, like, not surprisingly, I think that I agree with a lot of what Julie said. The first thing he said when he was measuring success was opportunities. I think that's absolutely right. When you're talking about success, a success of what, is it success of how we're measuring the Spectrum, or is it successful policy?

And, I think a successful policy doesn't necessarily translate immediately into the most pops per megahertz or something. I think that would be the wrong way to look at it, is, when you're on that policy side of it, are you setting a policy that gives the most people the most opportunity to try something and try to develop it? Are you creating incentives to iterate, Rob was talking about this, are you creating incentives for people to iterate and come up with new ideas?

I think that… and a couple of people have mentioned it now, but I think really it bears repeating is good successes gets stale over time. I think there's a tendency in Spectrum because it is so hard to allocate and distribute that it becomes this barrier to entry though, and it becomes a barrier of change. And so, things that were great 10 years ago may be stale and old now, and so policies that encourage that to move on encourage people to iterate the people who are on the Spectrum to come up with new ideas and not just sit on, "Thank God, we're not still on 2G," right.

And, I know Verizon has some of their licenses they use for 2G. They're now using for 4G, 5G, and thank God, that's going on. I mean, that's… so, we need to make sure we have the incentives to do that because we've also can point to examples of where people had been sitting on it for too long that it was a great idea at first, and at some point, it just got… it was old and not the best way to be serving it.

So, going to examples, I mean, honestly, Wi-Fi is such a great one. That is the place. If you think about how do you set up a good policy, is you set up the high-level milestones that you're trying to reach, what are you trying to accomplish. And then, you let and you put in the protection and the interference protections, and whatever you need to put in there, and then you let industry, and you let the innovators go and innovate and try to meet those objectives, and Wi-Fi is such a great example of that. That is exactly what happened.

And, possibly stealing from Charla a little bit, but, like, flexible licenses. It's something in United States that we take for granted and we don't really talk about that much, but when you go overseas, a lot of the failures that you see overseas are because they prescribe, and say, "This is your license for 10 years and you're doing this technology with it." And, flexible licenses are what helps the United States get ahead.

So, I was going through the list now and I work for a company that were doing satellites now, and I only solved one satellite thing, so I'm gonna say that was the biggest one.

And, yeah, now, so I got the hand. And, on top of that, we're a rocket company, so we launch these satellites. So, the policy that led to more satellites, that is awesome.

[00:14:15]
Rob: But I like this. [Phonetic]

[00:14:16]
David: Yeah. So, it's the Open Sky satellite policy. It actually is an interesting story, right, because it's… initially, when we started in space travel, people thought that launching satellites was gonna be too risky, too expensive for any company to be able to pull that off. And so, governments came in, and they were trying to launch their own satellites, and it was gonna be government-controlled, and that anything that we're gonna do is satellites was gonna be… the government was gonna do it. They're gonna own the satellites.

And, through the Open Sky's policy, they moved on. And at first, the first step was… actually, we will let other people in the satellites, but we'll prescribe what they're for. And, we saw an effort to do things like prescribe voice services over satellite, but by the time that it was built and launched, that was already overtaken by events.

And, the more flexible we moved with satellites, the more that we've actually seen more innovation. And, we're starting to approach arguably starting the cusp of the golden age of space and satellite communication because it's gotten more flexible. And, because it's gotten easier, and we've gotten… once again, the government sets the milestones, it says what we're trying to accomplish at a high level, it gives the interference protections and things that we need to do. We got to make sure we'll watch out for orbital debris.

But then, lets the industry go and figure out how to get that done in the best possible way and I think that's where we've seen the biggest successes.

[00:15:42]
Robert: Well, thanks David. And, Charla, thanks for waiting, and [CROSSTALK 00:15:48].

[00:15:48]
Charla: Yeah. Me, too. [Phonetic]

[00:15:49]
Robert: What do you got for us?

[00:15:50]
Charla: So, first, I wanna say thanks to the students who actually put together this compendium. I know Pierre did a lot of the work, but also I understand that several of you in the room probably wrote this, and actually, I was trying to be here before we started, and I thought there were some interesting references, and there are things that I hadn't read before seeing, so it was kind of fun. So, thank you for that.

But I do have a question. In what world is Wireless LNP part of a Spectrum discussion? And, we'll have to have this later and I know that it's not because I've done Spectrum for the last 18 years for Verizon and I was not involved in Wireless LNP, and I know I would have been had it been a Spectrum issue. So, on that basis alone, I think we should check that one out as a shame or fame.

Oh, do I have a…

[00:16:41]
Male: [INAUDIBLE 00:16:41].

[00:16:43]
Charla: LNP, Wireless Local Number Portability, which is in your… it's one of the ones that's… thanks. Thanks for the reminder though.

So, yes, flexibility. Look, it's great. I actually was one of the people who recommended that Wi-Fi beyond there because in part, back, and it's not so much Wi-Fi, it's the unlicensed. And, what the commission was thinking about doing 30 something years ago was we lived in a block allocation system where there was very little ability to actually determine your own fate as a licensee.

So, unlicensed was a fabulous, fabulous innovation because it really allowed people to come in and do that, and I think it still does that. But what's interesting to me is that the license world has moved much more toward the unlicensed world. And, I see Steve up there, and we've had… Steve Sharkey, and we've had conversations about this as they sort of are converging in terms of how much flexibility a licensee has, and how much, you know, more protection for example unlicensed users wanna get. That's a conversation for another day though.

But what struck me though is that we've all talked about flexibility, but there really isn't a section on here that talks about flexibility. So, I'm gonna raise one that for me is the hall of fame, and without discussing this with Julie in advance, he actually brought it up, and that's still digital cellular back in 1988.

It was right about then that I was actually starting in this. I was working for NTIA, and I was given a project to look at the UHF (Ultra High Frequency) taboos, which ultimately led into a project where we did a major report on Spectrum that included recommendations that the commission go after auction authority, but it also have flexible use in there.

And, one of the key things that we noted was the commission's decision in 1988 not to require that, at that point, cellular operators, the two in each market, not to require them to pick a specific standard that the commission would pick. And, Julie and I have talked about this before, and he is going, "We wouldn't even have picked GSMA. We would have picked TDMA."

So, if any of you know the history of that, you know that would not have been a good decision. So, what they did is they allowed, you know, and again, this is me speaking

from a number of years of experience now in the wireless and the terrestrial wireless industry. What that has allowed us to do is to buy Spectrum that has ostensibly been lined up to be 2G Spectrum and we use it for 3G or 4G or whatever G because ignition doesn't require us to come back to them and ask for permission to actually change our thing. So, that's technical flexibility.

But there's also something that was going on during that same period called user flexibility. And, where we saw that, and that sort of is where Fleet called, and Nextel, then Sprint came out of that because the waiver situation, and, somebody here can tell me. I've heard both things and there really wasn't… they weren't given a waiver because they were found to actually be in compliance, and some people think they were given a waiver, but that's almost 30 years ago. Worry about that later.

Well, what they did by the commission saying, "You know what, you can actually compile this and use it for some other purpose." They created a third competitor to cellular. And, that to me, those two decisions really started to move things in a very interesting way.

And, what's interesting to me is that, so those are hall of famers, but it's really hard to actually then say, "Well, this one is good and that one belongs here." Because what the commission has done in this area is they've incrementally, they've done more and more.

For example, we were talking about it at the break. PCS came in, very flexible. It came in the early '90s and it was competitive to cellular or it was purchased by cellular. It were frequencies. And, cellular meanwhile had all this legacy regulation on it that slowly but surely the commission by virtue of a number of different decisions got rid of. And, Erin tells me it's not done yet.

It looks pretty good to me. And then, they did things like allow you to sell your Spectrum sooner than they used to allow you to do it, and they also did things like saying, "You know, you can disaggregate. You can partition your Spectrum." These are all things that pretty much don't take place anywhere else in the world, but here in the United States. I mean, in the rest of the world, you actually, if you wanna sell a Spectrum license in some places, you have to sell the whole company. You can't find individual license.

So, here, not only can I buy an individual license, I can buy a small… it drives the commission crazy. I know this, but I can buy a very small piece, and just coordinate off by latitude and longitude. All that came from my view from what the commission decided to do in digital cellular and some of the other decisions going.

[00:22:09]
Robert: So, let me test that a little bit. We've heard… it seems like everyone pretty much agrees that flexibility has really touched on the success, the success with policy. But I wonder if there are limits to that and I'm interested in the digital cellular example. And, Charla had made… you really both made very good cases why that's a success. What I didn't hear Julie say, and I'm not going to put him on the spot because he's not on the panel, so I'm gonna put you on the spot.

[00:22:38]
Charla: Okay.

[00:22:39]
Robert: Is whether the adoption of the amp standard in the first place was a success.

[00:22:46]
Charla: Yeah. That's a hard one to answer. I think I know what you think and I had never really
               thought about that before. It is a way that when you've got a nascent industry, but I
               don't think we'd have to do something like that anymore whether it was successful or
               not, what did we learn from it? I think we learned that it's probably better not to do that
               even though amps may have been a good thing to do in the first place.

               I mean, it did lead to some, later years, lead to some interesting… I mean, for example, a
               cellular license was determined by the amps contour. So, again, it's sort of a difficult
               thing for the FCC to deal with in ULS, difficult for all of us. So, we had some really weird
               spots where we didn't have service because the PCS and the cellular didn't overlap.

               So, I think I'd be interested in your view because I know you have a view that it actually
               does belong and should be seen in a positive light.

[00:23:51]
Robert: I'm the moderator. I'm not on panel [LAUGHTER 00:23:52]. So, okay. Just, let's say, my
               view is it was needed at the time and it helped because you have so many. It wasn't just,
               of course, the wireline companies that were getting the licenses that was a lot of non-
               wireline companies and we're talking hundreds potentially all across the country in the
               small service areas and you took out I think with the standard a lot of potential issues
               and delay, and you got an interoperable system, and you were able to consolidate and
               provide national services.

               And, to the Commission's great credit, when it was no longer needed, it got rid of them.

[00:24:36]
Larry: Actually…

[00:24:37]
Rob: But anyway…

[00:24:37]
Robert: I'm sorry, [INAUDIBLE 00:24:38].

[00:24:38]
Rob: So, can I pick up on your question of limits to flexibility because I mentioned flexibility as
               an ingredient to success in the context of unlicensed and I think that is true along with
               industry collaboration was my other point.

               Charla mentioned unlicensed users looking for more protection and I wanna pick up on
               that because I think there's a common thread here. Let's think about what was the real

enabler for success of unlicensed in terms of technology development. There was the IEEE, the Institute of Electronics…

[00:25:12]
Larry: Electrical…

[00:25:13]
Rob: Electrical Engineers for the fine acronym.

[00:25:20]
Charla: Yeah, all right.

[00:25:20]
Rob: So, it's a professional society and standards body that developed the 802 Standard, which is Wi-Fi. So, that iterative process were gone through several generations. I don't even remember what generation we're on now. Well, Richard probably knows. That's what really led to this success of Wi-Fi as the embodiment for unlicensed Spectrum policy.

Now, things are getting more complex and that's where I think someone that's on flexibility… I wouldn't quite go there, but I would say at least regulatory oversight of the industry governance process around unlicensed Spectrum. And, I say that because as Charla mentioned, mobile technologies are being developed for the unlicensed bands now and becoming a more complex space. It's not just one industry body that's… or one primary industry body that's developing standards for unlicensed, we now have two, IEEE and 3GPP, and they generally don't talk to each other regularly.

So, when you're trying to use the same Spectrum with different technologies, there's the potential for some ill-intended effects. And, just to make this a little more concrete, let's think about the 5GHz band. This is the workhorse band for Wi-Fi. It's where a lot of the new mobile unlicensed technologies are being developed. We have 802.11ac/ax from the IEEE family then from… and also, from the IEEE family is DSRC (Dedicated Short-Range Communications), which the Commissioner mentioned earlier. From 3GPP, we have Licensed Assisted Access LTE, LAA/LTE, LAA/LTE to LTE/LAA. We have cellular Vita X and we're running out of fingers here, but we also have New Radio 5G unlicensed.

So, when you have that diversity of technologies, that intensive use of the Spectrum, there's bound to be different interest, and that's where I think the FCC can play a supervisory role to monitor how the technologies are being developed because I really think there's… it would be I think a terrible thing for the utility of the unlicensed band to fall victim to a sort of race to the bottom in terms of how aggressive can I be in this space.

[00:27:41]
Robert: Okay. Very good. Larry, let me follow-up with you on something you said. You suggested that you potentially could look at something and some of these as both being successes and failures. Do you have an example of that? I mean, what… and is that a time-related issue or are there other considerations?

[00:28:00]

Larry: So, there's partly time, and actually, a big part of it is time, but yeah, let me… so, I'll go back to that when I was starting to suggest, which was the conversion from analog to digital TV, which, you know, a great success. Who misses analog TV? When you click on the YouTube now, if it's 240 resolution, you're like, "What is that? I can't even look at that anymore."

But clearly… and it freed up all the Spectrum that we're now using for LTE, but clearly, it took too long. And, why did it take too long? Well, they were competing understandings of technology, they're competing political things, but the key was that Congress kept changing the date because they were concerned that somebody would… somebody, one person would be left behind. That somebody there that the analog TV would stop, the digital TV would start, and there were somebody who had not gotten the message, and they hadn't converted their set, or they hadn't update it, or they hadn't already switched to cable, which most of them had done anyway.

And, that delayed it at least a couple more years than was necessary and then, of course, there were coupons for getting the converter box, but if your TV wasn't cable-ready or your… and, it certainly got to a point well before that where it would have been much more cost-effective just to buy a cable subscription for everybody who wasn't already converted, didn't have a TV that could already switch from analog…

[00:29:30]

Rob: And support digital

[00:29:31]

Interviewee: And, obviously, that's not politically feasible, but it's clear that if you… and so, if you set the standard as literally leave no one behind… no… let's make a deal, viewer left behind, that was sort of Congress has approached to it, you're going to not maximize welfare.

And, the real tragedy that was I think, and this might be more controversial is, because that happened so slowly, part of the idea of that transition was that the broadcasters were trading in their analog Spectrum. They were gonna get the digital Spectrum, and that digital Spectrum, because it was more efficient. They could not only continue to broadcast what they already bought, but they could add additional channels in between, they could offer a retail wireless service, they could really do all kinds of things with that Spectrum.

But because it took so long, by the time it happen, the analog broadcasting, it was really struggling. And, I don't think there's really any good examples where they have in fact, you know, any local stations took that Spectrum and were able to use not only for the transition, but to generate new business, and, of course, a lot of them are still in very, very difficult business situation.

So, yeah, I think time is a big part of it, but also just kind of setting a standard, that doesn't make any sense. That's, as you know, we can't let anybody miss a TV show. That really was a poor choice.

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[00:31:02]
Robert: Good. Okay. David…

[00:31:04]
Larry: We were talking… so we're the success panel, but we're already talking about the failures.

[00:31:09]
Robert: Quite often, we'll be a little easy on the last question about the success. So, let me ask you a question. Obviously, you've been in the government and the private sector. Has your perspective changed about what's a good policy decision?

[00:31:25]
David: Coincidently, all of the policies I thought were right before, happened to work really well for my company. So, no, not at all. No, it's funny that you said I was actually… I was just talking to [INAUDIBLE 00:31:38] before I came down here. I used to say all the time, like, I used to be on panels when I was working in the house. Well, people would ask me, 5G panels, and people would start out, all the time that they're asking me is like, "What is 5G?" And, my answer always was, "I'm the last person you would want me to answer what is 5G."

                 If I'm working in Congress, the time from when Spectrum is usually identified to the time that it actually comes out and is being used in the market, I think that the time is getting shorter, but, I mean, it's 8 to 10 years is traditionally where it went. If someone in Congress was defining that, that would be… by the time you got the Spectrum out there, we would have been on 7G. I mean, it wouldn't… that's not the right approach.

                 And, I think… so, I don't… for me, no. I don't think that it's changed. I do think that it should be. I do think getting back to a little bit to what Rob and Larry were talking about, do you think the Commission does take a good approach in a number of these places, like, Rob was talking about with Wi-Fi and LAA coming in. And, one of the things that I think the FCC did well is, speak softly, but carry a big stick.

                 A lot of the approach was kind of… what, I have to little kids, it's what I do with my kids: You guys go figure this out because you don't want me to figure this out for you. And, I do think the FCC does a good job when it takes those approaches. I know one of the things that we deal with on the satellite front in the constellations that we're dealing with is how do we get along with each other.

                 And, one of the policies the FCC adopted there that seems like a smart approach was nobody wants to have to divide… everyone wants that we share. That's the best outcome for everybody. Nobody wants it to be that we segment and divide up, and everyone gets a tiny little sliver that's not really useful for anybody.

                 And, kind of the approach the FCC took was, "Figure this out yourselves or you don't want me to come up and fix this for you." As they said, "You guys go negotiate in good faith and you solve the problem because if you don't, we're gonna put in the thing that

                                                                                                          45

nobody wants." And, that's a better approach. It's much better than the approaches of saying whoever got there first.

And, I mean, if that applies in satellite, I think it applies in a lot of places. This is where you do get people who are using, get to Larry's point of, if you have one customer, then you're there for protected forever. That is what takes away the incentive for someone to ever innovate what they're doing is, if all you have to do is wave around that you have a couple of customers that you're protected forever.

And, I'm not saying that you shouldn't protect the customers, you absolutely should, but the policy should be balanced in a way that also encourages people who were there. They have to share, bring in new people and to be constantly innovating.

[00:34:23]
Robert: Well, good. So, one question for anyone who cares to comment on it. Commissioner Rosenworcel this morning mentioned how the U.S. has been the world's leader in Spectrum policy? And, has some really good examples. My question is, are there examples from other nations that we could learn in terms of what's been successful, and how we can apply them to our decision making? Anyone want to take a shot at that? Recognizing that the Commissioner is still here.

[00:34:58]
Larry: Well, it's... It would be great to be China where you just tell people to move and I'm not just [INAUDIBLE 00:35:04] for the Spectrum, right. You want to put a road there? You put a road there.

[00:35:11]
Charla: Yeah. Yeah, yeah.

[00:35:13]
Larry: In some ways, this compare… and so… and I'm not an expert by any means on international Spectrum policy, but I think they're difficult comparisons because obviously, you have countries that have very different form of government, you have countries that are effectively urban centers, like South Korea and Japan, and so you can do things I think very differently. So, that's all I'd say.

[00:35:34]
Charla: Well, you know, I mean, New Zealand did a lot of the sort of flexible-use auctioning, very open-ended licensing before the United States did back in the '90s. In fact, a lot of the work that was done, the academic work was looking at what New Zealand did, but what was interesting is that we then continue to take it step-by-step further. The only thing… it's interesting we're not really… we're talking Spectrum policy, not auction policy, but I do think that some countries had probably been a little bit more advanced in their approach to Spectrum auctions than we have until we started doing the incentive auction, and things like that.

So, that's been sort of an interesting thing, but it touches obviously on Spectrum, but it's sort of a different issue. That would be the only thing that I would think of. But I

completely agree with the Commissioner. It's astounding to me when I'm in some of these meetings, and I don't do very much international work, but I do get… people ask me to come and speak to groups.

And, I have one gentleman from a country that I won't name, but it was the regulator, and I told them how things worked in this country, and he goes, well don't tell our operators anything about that. So, it's not common.

[00:36:56]
Rob:

Yeah, so CableLabs has members all over the world. I do some work outside of the U.S. supporting our European members, and I'd say, the one thing that we've done right is not letting the states do Spectrum policy here in the U.S. The federal level is much preferable to the European model where you have every member state with their own national regulatory authority. And, lay on top of that, commission level bureaucracy tied up with the parliament and the council. It's very difficult to get things done there.

So, the institutional model we have here in terms of federalism I think works for Spectrum.

[00:37:33]
Robert:

Okay. So, I'm interested… I think we heard a couple of things in the last panel, but I'm interested, when you look at the Spectrum policy's decision, do you have any empirical measures that you can use to decide, "Well, this one work. This one didn't work." And, if you do, what are they or should you use empirical measures at all? Maybe that's a better question.

[00:38:07]
Rob:

I think it's… for me, it's a pretty boring answer. And, they mentioned before maximizing economic output and you can wrap a lot of stuff into that, both sort of time to develop a product, as well as competition, innovation. But I think that's the key metric to look at.

[00:38:25]
Larry:

Yeah. I don't know what else. I don't know what… anything else is subjective and not particularly helpful, but to Rob's point, it's hard to do. And, as I said, that's why it's so encouraging that the FCC has created this new Office of Economics and Analytics. Hopefully, that will advance the science of how do we measure economic output from a particular… this policy decision whether it's Spectrum-related or otherwise. But certainly, it's certainly preferable to the alternative of make it up.

[00:39:00]
David:

Do you have a,] I don't know if I… I don't think I disagree, but just another layer on it is, is some way of measuring spectral efficiency, and I know figuring out how you measure the economics can be squishy and figuring out how you measure efficiency is equally squishy, but trying to go towards that route.

Again, if you start putting in policies where you're actually encouraging people to be efficient with the Spectrum, it starts encouraging the people who are already there to iterate more, you're encouraging people come in who can find newer, higher, better

uses for the Spectrum. So, some way of putting in incentives towards building, towards more efficient spectral use I think is helpful, too.

[00:39:41]
Charla:

Well, and actually, if you go back again to why options with exclusive flexible use were put in place, it was for exactly that reason because then what it does is it gives the individual licensee the incentive to actually be very efficient because if you're more efficient, you actually can have more customers on the same amount of Spectrum. And that it's pretty simple, that actually leads to usually better revenue opportunities, and you have control; you're able to search or manage noise floor—there's a lot of things that you can do, and that is actually the basis for going down in that path. It's incentive to use Spectrum, not just technically efficiently, but economically efficiently.

[00:40:20]
Larry:

Which, by the way, brings up a big problem which we have, which is federal users who have no incentives. In fact, in some way they can't have incentives to be more efficient, either technically or economically. And that's why we have a problem that we do with underutilized or unutilized federal Spectrum. And even where the departments are willing or want to make a deal, in many cases they're prohibited.

[00:40:51]
David:

Because the alternative is actually--I mean, if you think about the alternative is, it's a race to get in there as fast as you can and take up as much room as you can. Because it's not necessarily 'serve as many customers as you can, and it's the best way,' it's, 'take up as much room and keep competitors out.' If you can control the market, you get all the customers even if you're not innovating, so the alternative to keeping efficiency out is-- and this is why the spectral efficiency and economic results are related, because you lose the economic benefit if you're not spectrally efficient.

[00:41:23]
Bob:

I think we'd like to open up the panel for questions from the audience and hopefully a student with the first question.

[00:41:33]
Larry:

How do we know who's a student? (laughter)

[00:41:37]
Bob:

Raise a few hands if you're a student! OK.

[00:41:44]
Dillon Slagle:

Thank you. So, my question is about how we're measuring success. I noticed a lot of arguments about broad economic success, and then specifically to industry or company players, which seems to be at odds with the sort of founding priorities of the FCC: you're supposed to serve the public, and the airwaves are in fact are owned in trust by the public. So, I'm curious about how you're measuring success in broad economic terms or specific industry terms, and not in terms of benefit of the public.

[00:42:16]

Charla: I want to just start out, and a little bit of a history lesson, which is implicit, I think, in some of the things here. One of the reasons that lotteries were adopted was because the FCC tried to apply what was really a broadcast standard to the cellular, and if I remember correctly--and there's got to be somebody here who can correct me if I'm wrong--that the LA license was granted on the basis of like one cell site that actually covered a particular area. And so what happened is Congress went, 'This is ridiculous.' So I think part of asking is a really good question, but ultimately it's also about serving customers, and so getting the Spectrum out there quickly to serve consumers--and I said, "customers," but it's really the American public consumers--getting as much innovation as you can possibly get there. I don't think that's really at odds with what the fundamental purpose of the Act is. And I think the Commission has done, in fact, a fabulous job at meeting the purposes, and has recognized when the way that they used to do things just doesn't work anymore. And lotteries...can I just say this, it's funny, it's one of the things on here that I think a lot of people would probably think of being not a success. And Jennifer and I were talking about this earlier--in fact, what lotteries did is show the economic value of these licenses in stark terms, which is what ultimately led Congress with big support from OMB and the administration at the time to finally adopt auction authority.

[00:43:59]
Pierre: Could you just – for some people in the audience – just back up on just explaining what was the lottery about, and what did it replace?

[00:44:05]
Charla: Basically, it's kind of exactly what you might think it is, because it was... You could actually, for very little money--I think it was around $5,000--there were application mills that would put together an application for you that the Commission would set up a window, and then say, 'You can actually apply during this timeframe.' So you'd have people who would join in, and just sort of put their name on and give in a couple of hundred dollars or something--sometimes more, sometimes less. The Commission would hold a lottery. And they'd hand these people ping-pong balls, and it would come out and you would actually, based on the number that came out of this air-popping ping-pong ball...that's how they picked the winners of the particular applications, so that you'd have cases... One case I think--this is when I was at NTIA, so we were doing a lot of research on this--but the Cape Cod market sold for literally like within months for I think it was around $70 million. Which would be dwarfed by today's standards, but it still was an amazing amount of money for somebody that had maybe put in a couple of hundred dollars to get a license. You could go and you could actually watch it. It was a little bit before my time, because by the time I started, lotteries were still going on but most of the cellular markets had been... It was the top-third earning markets were done by "beauty contests," and then the rest of the markets. They weren't all RSAs, but they were called rural service areas. Not all of them, because the wire-line carrier would get a freebie, and then the other side, the A-side license was then lottery.
            So, I don't know. If somebody else around could give a better explanation, but...

[00:46:07]
Bob: Oh, I think you did it great. I know that the winners of those lotteries define those as 'success.' (laughter)

[00:46:14]

Charla: Actually, I do, because what it was a progression where the public policymakers recognized there was a problem with doing it this way, let's try another way. 'Oh wait, there's a problem with doing it this way, why don't we try another way?'--and that other way has been used now for over 20 years. And I think that other way, while it has issues too, also gets Spectrum out a little bit quicker because you've got this whole tension about getting money into the treasury.

[00:46:47]

Larry: I go back to the question, because I think there's sort of inherent in that--maybe an assumption--that an economic measure is the same as an industry measure. I don't know if you're saying that, but I don't think that's necessarily true, so what the statute says is the public interest. And that, of course, has been a remarkably squishy. largely undefined concept. What I was saying was, that the way I would measure the public interest is, 'Did consumers get good stuff?' And I don't know how else to measure it other than, 'Did it create jobs? Did they get consumer surplus? Did they get innovations? Did it prove the standard of light? Did people live longer?' Whatever the measures are, I think of those as economic measures but I don't think of those as industry measures. I think of those as, 'Did businesses more money?' or, "Did shareholders make more money?'

Now, there is the alternative. David was about to talk about the alternative, which is to talk about much more high-level forms of measurement, like 'Did this decision improve the state of democracy in the country?' 'Did it lead to better educational outcomes?' 'Did it sort of strike us as a more inherently fair, or just way of making the particular decision?' And that has been the basis of a lot of the debate of what is the public interest. And I'm not saying that the latter approach is wrong, but I don't know how to measure those things. And maybe that's just a failing of my education.

[00:48:28]

David: All I was going to say is I think that some of it--I think this happens a lot. I don't think we communicated well in that... I think that everything we're talking about is how to get to customers, is how to get to consumers and get the best possible service to consumers. The problem is that if you start defining it by consumer is that now you actually are prescribing... There's a lot of really cool things done with Spectrum. There's a lot of really interesting products that are out there, there's a lot of interesting services. Again, we launch satellites all the time that are doing just.... This is what I do now! ...that are doing all kinds of--it's earth observation, and where we're now better predicting the weather, than we ever were before because we can do these... Have you ever thought. 'That's using Spectrum in different ways'? And so if you get too specific on how you're serving customers in this particular way, you actually are locking in certain kinds of technology. And I think when we're talking about flexibility--when we talk about it at an industry level--I think what we are thinking about is when you're trying to maximize the economic result, what you're trying to get is the most good uses to consumers. I think that's what Larry and Bob were talking about, is when we're saying "maximize your economic output," it's, how would consumers best served? And that may not always be with a particular wireless phone. It could be in a lot of different ways. And so I think

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sometimes we don't communicate that well, that that's what we're trying to get at. But I think that is what we're all trying to get at is, 'How are we serving customers in the best way?'

[00:50:01]
Rob   Ok, before we come to you, do we have a question over here?

[00:50:04]
Vince DiMichele:Hi! Vince DiMichele, CU law student. So my question is more along the time dimension. So, we know that technology outpaces the policy, and as the curve gets steeper, just do you see any truly superfluous corners to cut in the way of policy so that we can get the right regulation out at the right time?

[00:50:24]
Larry: So one right off the bat, which we talk about all the time, is just improving the robustness of the secondary markets. This is really the flip side of the flexibility is we give you a license, we want to make it as easy as possible for you to get rid of that license if it turns out your technology didn't work out or it's outlived its usefulness--now you can move to a different technology, now you don't need that anymore. So certainly anything that we can do to make the secondary markets more liquid would be great and of course part of it has to do with how the licenses is defined in the first place, how you're being licensed to do and making that as broad as possible, but then also giving you the opportunity to dispose of it on a secondary market and if at any point somebody wants to offer you more than you think it's worth, that's sort of the basis of a contract.

[0:51:23.0]
Rob   Um, ok we'll go to you and then you

[00:51:29]
Audience 3:   So I'd like to ask a simple question of four members of the panel.

[00:51:37]
Larry: [INAUDIBLE 0:51:37], like Congress?

[00:51:37]
Audience 3:   Kind of like that. (laughter) So if you have a choice between getting rid of Wi-Fi or getting rid of 3GPP, which one do you get rid of? (laughter)

[00:51:47]
Charla: I'm not answering that one.

[00:51:48]
David: Why is that a choice, I guess would be my question back.

[00:51:51]

Audience 3:   That's my question. You don't get to question my question! (laughter) Answer it or pass! It's a way of evaluating which has the most value. Which has the most value? If you had to get rid of one of them....

[00:52:07]
David: I think by getting rid of one of them, you would eliminate some value, substantially.

[00:52:15]
Audience 3:   So, he doesn't want to answer. Does anybody want to answer?

[00:52:19]
Larry: It's totally beyond my pay grade. I don't know, honestly; I haven't the slightest idea.

[00:52:26]
Charla: I'm not going to answer that. (laughter)

l0:52:28.1]
Bob: We have a question over here.

[00:52:29]
Audience 4:   Albin Gasiewski, I'm a professor of electrical engineering here. So a question primarily directed to David Goldman: the small-satellite industry right now is burgeoning; you might even say exploding. And my question on--

[00:52:44]
David: Don't say that, actually! (laughter)

[00:52:46]
Allen: Most of your design is really good. Because we want to use yours to get up there. But my question is, is the bandwidth necessary for this industry being identified and allocated rapidly enough, you think right now, in order for the U.S. to maintain a lead in this burgeoning--not exploding--business?

[00:53:16]
David: That is a great question. I think it's one of the things that I actually... As we move higher and higher up the Spectrum chart, there's like a Gold Rush of constantly trying to move up higher and higher and to see who wants it. Somehow everything, when the satellite guys start looking at it and say, "This looks like good Spectrum," 5G shows up and somehow needs it more. (laughter) I think that's a great question. I think it is really true, and I think that's something that the FCC really needs to work on, is we do have a burgeoning satellite market. It is evolving. We're seeing a lot of kind of next-generation communications going on there. And I do think the FCC does need the balance of making sure the opportunities are available for all the technologies to try it out. I take Charla's point, but the measure here shouldn't be how much money you're getting into the treasury. The measure should be, how is it best serving the public, and we should be allowing the market to decide which is the better technology, what they want, where it works in different places. I think there's benefits to each, and so I do think that it's worth it for the FCC to look at and make sure as we're moving it into new Spectrum

bands that we're foreclosing one use or the other, we're not preferring one use over the other. Let's let this all develop, and let's not make decisions prematurely on that. But I think that is something, and I think that is a great question. It's something that the FCC needs to be grappling.

[00:54:58]
Charla: We actually think that one of the best ways to deal with technical neutrality is actually if you pay for your Spectrum. (laughter) You buy it! I know Jennifer would love that one.

[00:55:12]
David: So now we're gonna scrap all the success stuff we talked about and say, "Money for the treasury is the highest, best measure," is--

[00:55:18]
Charla: No, no, best use! There's auction theory in here somewhere. Right, Tom? [0:55:28.1 - pause and laughter} You knew I had to say that!

[00:55:31]
Bob: One more question and then we have to wrap up.

[00:55:35]
Audience 3:   I think there's an element of discussion that hasn't been covered yet. There are a lot of people that, for one reason or another, out of the general consumer economy--there are people who are flat-out poor. In fact, a lot of them. The Homework gap is really a manifestation of economic privation, and there are people who live in rural areas who may have money but they can't really pay what it costs to serve them. So, when the communications accesses all the people of the United States, it includes people like that. And so the whole Coasian idea that market mechanisms and flexibility is going to solve everything, I think really leaves a lot of stuff out. And there actually are mechanisms--there's the E-rate, which is outside the market, and there's rural subsidies for telecommunications, which is outside the market--and there are some Spectrum allocations that are outside the market. And those are important things to do, too. Nobody's talked about any of that yet today.

[00:56:37]
Bob: I don't know that I heard a question, but do any of you have a comment?

[0:56:43.6 - long pause]

[00:56:46]
Audience 3:   Alright, well, thanks to all of you for your...

[0:56:54.2 - laughter, applause]

[00:56:56]
Non-interview: So, thank you very much to the panel. We have another break. We'll be starting again promptly at 4:15; I suggest that we aim for ten minutes past four. Enjoy your conversation.

PANEL 3 - FAILURES

Jennifer Manner — Moderator

Senior Vice President, Regulatory Affairs, EchoStar Corporation

Jim Lansford — Panelist

Director, Technical Standards, Qualcomm

Blair Levin — Panelist

Nonresident Senior Fellow, Metropolitan Policy Program, The Brookings Institution

Erin McGrath — Panelist

Legal Advisor, Federal Communications Commission

Steve Sharkey — Panelist

Vice President, Government Affairs, Engineering and Technology Policy, T-Mobile USA, Inc.

[00:00:00]
Pierre de Vries: So, we are now moving to our third panel, hosted by Jennifer Manner Senior VP at EchoStar. Take it away.

[00:00:11]
Jennifer Manner: So, thank you very much, and thanks again to the Silicon Flatirons for inviting us here today. Jim and I were talking, we decided this is the funnest panel, so I'm putting a lot of pressure on my panelists. We're here to talk about failures. The other groups talked about successes and failures, successes, so we get to kind of bring it home before we go towards the final speeches and the wrap-up and talk about what really went wrong and why. With that I have a great group of folks with me. Jim Lansford from Qualcomm. Blair Levin who's with the Brookings Institute. Erin McGrath who is Commissioner O'Reilly's office at the FCC. And in the cellular seat Steve Sharkey from T-Mobile.

With that, we are going to start with, I have some questions. We're just going to do Q's and A's, and then of course we'll open it to the floor and especially want to hear from the students. But starting with, how would you define a spectrum failure and how do you think it takes to determine a spectrum policy is a success or failure? Because really, I think the other panels touched on this too; how do we make that determination? So, maybe we can start with Jim and work our way down.

[00:01:17]
Jim Lansford:

Okay. First of all, I want to thank Pierre and Dale for inviting me to be on the panel today. It's always a pleasure to be up here. As some of you may know I teach the Wi-Fi class in ITP, so I see some of my former students out there. How many other ITP students do we have in the audience? All right, are you taking Wireless LAN class in the spring? Any of you taking the Wireless LAN class in the spring? Yeah, I know, I've already got them backed into a corner. They're terrified.

Anyway, thank you and welcome. I guess to me, if you talk about failure, I guess I've done three startups, and one of the things that I tell my students is that there is no such thing as failure, only opportunities to learn. And so, within every problem lies and opportunity, and so, within everything that you could call a spectrum policy failure, in fact, you've learned something in the process. I think that has been alluded to earlier in the day, is that sometimes we have to take iterative process, iterative approaches to try to figure out what's the right policy.

During the course of the day here I was thinking about the things I've worked on over the years. I participated in the Omnipoint Pioneers Preference filing, 25 years ago. I was on faculty at UCCS at the time and working for Omnipoint as a consultant, and so helped work on that. Let's see, 20 years ago I was at OET pitching wideband frequency hopping as an alternative to the 802.11b protocol, and we see where that went. I also was heavily involved in the ultra-wideband, I was CTO of one of the ultra-wideband startups. To Peter's point of view, there was over 400 million in venture capital poured into UWB. I'm still working, so obviously I was not able to retire early from that. And I also was cochair of the 802.15.3a standards group that was trying to standardize UWB technology and IEEE. And I think I'm a candidate for the Dr. Kevorkian award for that one. So, it's been interesting.

And, of course, now I work a lot in VITA X, so I chaired the IEEE Tiger team that was trying to come up with Wi-Fi DSRC band sharing, and I found that you can't pack a room full of engineers and always get an agreement.

[Laughter]

[00:03:42]
Jim Lansford:

So, it's been interesting to see the things that some might call a failure but in fact it's part of the evolution of technology that you try things, and some of them turn into successes, however you want to define that, pops per square kilometer or revenue per pop or whatever, and some of them I think you learn what works and what doesn't, and that's sort of the nature of technology. To go back to my first statement, if you're in a startup company you have to realize that you may not make it. Most startups don't make it. And so, you try, and you give it your best effort, and if it looks like it's not working you either shift strategy — and as a startup you want to try to have a nimble strategy — but

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sometimes you have to close up the doors and try a different alternative, do something different.

In terms of spectrum policy, ultra-wideband, for example, was one that was expected to be a huge multibillion-dollar market. And one of the other CEOs and I were talking once, we ended fighting over a zero-billion-dollar market.

[Laughter]

[00:04:42]
Jim Lansford: But it was something, I think we've applied a lot of that to learning how to do underlays and looking at noise for considerations, especially the satellites, there was a lot of concern about how do you do study aggregation and how does that raise the noise temperature at the satellite and things like that. So, we've learned a lot. I can't say that everything that we've done in wireless has been a commercial success. But on the other hand, I think it's part of the process of innovation that you have to learn and iterate and try to advance the technology for the better of society, whatever that means.

[00:05:19]
Jennifer Manner: Blair.

[00:05:20]
Blair Levin: So, Jim gave a stellar perspective. I'm going to give a perspective from having spent a lot of time in the last 20 years working on Wall Street [INAUDIBLE 00:05:28] Wall Street. I'm going to say a spectrum failure is spectrum that no reasonable person can invest in. And if that is the case for the spectrum, that's probably [INAUDIBLE 00:05:40]. Here's what I mean by that; the worst use of spectrum is no use, but Tom was right, there were times where you wanted to hold it, and there are lots of people who invest in spectrum because they believe there's going to be some technology out here, so you hold on to it forever. But if policy — and there were several examples of this when we were talking about some of the policy I've been involved in, but we'll get to that when we talk about [INAUDIBLE 00:06:06] — where you basically put the spectrum in a position where no reasonable person can invest in it because it is a long policy process that is not at all about markets, not at all about technology, not at all about anything other than what a single [INAUDIBLE 00:06:24] or a majority of the Commission decided to do. So, that would be a leading indicator of a bad policy, and I think if you look at where you haven't delivered, as Larry was talking about, kind of economic gains, jobs, innovation, et cetera, it's often because spectrum is tied up in that way.

[00:06:47]
Jennifer Manner: Thank you. Erin.

[00:06:49]
Erin McGrath: Someone who works on the regulatory side, and we were having interesting conversation as to it's easy for us to have hindsight to the back and say that

certain things were failures, but as a lot of people have stated, it was an iterative process. Today, if you told someone you were going to do some sort of lottery, they'd look at you like you were crazy. Back when we did beauty contests and lotteries, nobody knew what wireless was going to grow into. People didn't know that, oh, this...at one point it was going to be this huge luxury item, and today it's something that everybody has. So, what I consider now as we look at spectrum policy, what is a failure is if you make the same mistakes we made in the past. So, what do we look at that we know doesn't work are things where the commissions policies stopped the spectrum from going to the highest use.

As people said in your successes category, flexible use is what we see as being successful. Why is that? Because the commission doesn't have to regulate every time there's a technology change. That was a huge advancement over — I'll throw out some bands here because they're things that we still work on today — things like AMTS, G20, Public Coast. Still not actually 100 percent sure what people were doing with Public Coast licenses. But today, what have we done with those? Through a series of actions, which actually one of them just happened this year where we basically said, okay, you no longer have to get a waiver if you're using it for private purposes. Okay, so what does that do? A whole bunch of these bands are supposedly commercial, they never developed the way they are. They're now, a lot of them are being used by critical infrastructure entities. Our rules actually prohibited that. So, now you start moving the bands that we now with hindsight see as failures towards a more flexible use plan that you have arguments and reasons for that nobody would have ever thought.

As Commissioner Rosenworcel started out with today, my favorite band to say is a total failure is 5.9. Transportation industry came to us and said, "Well, of course, we need safe cars." Nobody is going to debate that we need safe cars. So, we gave them spectrum on an idea. Well, we're going to have this technology, we're going to have V2V, cars are going to be talking to each other. And then there's V2I where somehow there's going to be infrastructure along every road in the country so that you know when the lights are going to change, your car's going to be able to know that, you're going to know where very pedestrian is, every work crew is. Sounds great; 20 years later hasn't happened. You now have a DSRC standard in the rules which is not actually the DSRC standard that people are working on, and then you have C-V2X. And oh, by the way, DSRC and C-V2X, which different car companies are using different models at this point, they don't talk to each other. So, in order for this to really work all the cars need to be able to talk to each other, because even if you're like, oh, well, to be effective you need 50 percent of the cars, until that one car comes and crashes on you who doesn't have DSRC. So, things like that luckily, we've moved away from, especially the idea of we're going to give you spectrum and you're going to have no buildout, you're going to have nothing, you can just sit on it.

An example, and I will add this just because Michele Farquhar is in the room, is what really is different between the idea of DSRC and PTC for trains? So, DSRC...

[00:10:31]
Pierre de Vries: Acronym.

[00:10:32]
Erin McGrath: Yeah, the name is different, and you'll hear from the commission. PTC, of course, is Positive Train Control, so it's the idea of putting infrastructure along the train tracks so they can figure out their incursions on the train tracks, if a train ahead of you is stopped it will allow the train to stop before you have a collision. Congress put that into effect; there was no spectrum band associated. So, what happened, and this will tie my argument together, the railroads went and bought things like 220 MHz and AMTS, bands that were meant for other things but weren't being used that we have turned now to flexible use. So, that has proven to be a far more successful model, even though I'm sure Michele would say that that was probably not the easiest way to do things. But we have moved away from earmarking spectrum for particular purposes, which, because technology like [Agent? INAUDIBLE 00:11:31] and things like that, we moved past them, has proven to be far more successful. So, if we would do something that would earmark spectrum, that would, in my consideration, be a failure.

[00:11:42]
Jennifer Manner: Interesting. So, Steve.

[00:11:45]
Steve Sharkey: All good answers. I think that's what I meant. I guess I would just define success as the spectrum that was being used for some beneficial purpose and the purpose that was either envisioned [INAUDIBLE 00:12:00] by the Commission, or through the market as revenue-generating, and that is not sitting idly after the Commission has made spectrum available, but put quickly to use serving a purpose, whether or not that's the highest and best purpose. There are certainly cases where the Commission makes decisions about how that spectrum should be used. I will say the failures usually come when the Commission is listening to a company with a great idea that just needs a chunk of spectrum to make that happen or carving out special cases that seem like there's maybe something there but in the business case, it turns out to just not work out. Or when the Commission tries to split the baby too many different ways, and it's trying to satisfy everybody, you end up with a suboptimal scenario.

[00:13:02]
Jennifer Manner: All good answers. But a question, you all dodged one of my questions which was timeframes, and especially Steve, you were talking about quick to use, so there's bands that sometimes it just takes time for technology to be developed, so some bands may not be efficiently used. And no one's talked about spectrum efficiency, actually throughout all the panels it's not been a big focus. So, I guess when you're talking about time and efficiency, is there a timeframe where we want to see things happening, or is that not part of a failure?

[00:13:36]
Steve Sharkey: I think it's got to be part of it, right, because it's [INAUDIBLE 00:13:38] the Commission, generally for commercial licenses there are buildout requirements, so you've got timeframes associated with that. Frankly, there's probably more of a cycle for buildout requirements and making sure that people aren't just sitting on the license until the end and that there is progress towards [INAUDIBLE 00:14:00] those are usually at kind of a midterm buildout at five or six years, and then a longer buildout at ten-year, end-of-license. They're building some of the allocation solutions where spectrum's been sitting for 20 years or so. I was going to use an example that hopefully doesn't get me in trouble [INAUDIBLE 00:14:22] in the community, something like 4940-4950 MHz, right [INAUDIBLE 00:14:28] Commission's got something right now to look at changes to that. But that is, I forget the exactly year that was allocated, but that's probably...

[00:14:38]
Jennifer Manner: 2005.

[00:14:39]
Steve Sharkey: What was that?

[00:14:40]
Jennifer Manner: It was under Powell, so around 2005.

[00:14:42]
Steve Sharkey: Right. And so, that's not even, that's over 10 years but [INAUDIBLE 00:14:48] or so. But clearly, there's been not a lot of growth, right. This is a band that was, the idea was you'd have a dedicated band for public safety for kind of low power, really for Wi-Fi types of applications that would be a protected managed band for public safety. It is a very niche market [INAUDIBLE 00:15:08], extremely low use of that band, and I would call that a failure and something that you would look at and say there should be something done to put that spectrum to more productive use. You've got to consider public safety in some way to accommodate them, but this is clearly not it.

[00:15:32]
Jennifer Manner: Well, can we stay on that for a second, though? Because I think Erin and you both agreed putting spectrum aside for a specific use, whether it's utilities or positive train control or whatever, may not be the best spectrum policies. So, the question is, should we still be doing things like making spectrum available for public safety, or is that a special case where — not trying to get anyone in trouble with the public safety community — are there times where that still may be a valid spectrum policy? Maybe it's not focused on public safety, but maybe for utilities or another use. And really going, if you think about it, for those of you who may remember, Tom Titch [Phonetic] always felt there should be, for satellite, a general satellite service, that you shouldn't have a fixed or mobile allocation. I guess just building on that, should we be moving away from these

very specific allocations of spectrum and trying to find ways to generalize them? The differences between fixed and mobile are really becoming one and the same, you can see that with the UMFUS for 5G, right? That's a fixed and mobile service that the FCC's made available in spectrum frontiers. So, just a thought on that.

[00:16:44]
Jim Lansford: I think there's some cases like safety where it's hard to say the shared band makes sense, right? One of the big debates in DSRC, for example, is — and I lived for 18 months doing this — is how do you share Wi-Fi with DSRC when in fact DSRC is sending safety messages between vehicles? You really don't want to have interference corrupting those packets, right, because it decreases range, you're going to have all kinds of issues there. But then the larger question is, so, as there's... Sometimes I say to people, harmful interference is in the eye of the beholder. The FCC has this concept of harmful interference, but in fact the DSRC folks said anything above minus 95 dBm, or minus 100 dBm, is harmful interference to them. It was the same issue in the TV white spaces, anything above minus 124 dBm or whatever was harmful interference. If you're in the incumbent, then there is no...you want to put that floor way down there. And I think that's been the problem, is, for safety sometimes you may really want to protect spectrum from interference, but if it's best effort kind of traffic, I think Wi-Fi is a perfect example of… you should give a lot of flexibility there because it really does create a lot of economic opportunity.

[00:18:05]
Blair Levin: So, I want to say something, but I'm really kind of embarrassed about it. And if you students want to believe that Washington is really a wonderful place, you might want to close your ears for this. I'm going to give you an example of why you might want to give public safety spectrum. When I got to the FCC the first time in '93, one of the big things up was the digital television transition, which, by the way, was then called the High-Definition Television Transition. We changed the name. But it was very clear that the current Commission rule was the broadcasters would keep both sets of spectrum for 30 years minimum, and it was vague beyond that. And it was very clear that the broadcasters intended to keep all the spectrum forever and run on two things. So, we said to ourselves, hmm, we need to have somebody who has an interest in completing the digital television transition, who has political slack roughly equivalent to the broadcasters. So, we hired a very distinguished lawyer to run a Commission on the public safety needs, and lo and behold he recommended that we allocate some of this spectrum that was going to be freed up because of the digital dividend to the public safety community. And who were the greatest allies when it finally came time to actually define an end date not 30 years but 10 years? So that's one of those examples where, I don't know, is it principled? Is it spectrum policy? But it worked, so.

[Laughter]

[00:19:42]

Blair Levin: That's an example of when you want to give the public safety community spectrum.

[00:19:46]
Jennifer Manner: And it was a success, not a failure.

[00:19:47]
Blair Levin: And it was a success in its own inimitable fashion.

[00:19:51]
Jennifer Manner: Yeah. Erin or Steve, anything to add?

[00:19:54]
Erin McGrath: Obviously, we've gone through several manifestations of providing spectrum to public safety uses. Some of us were there for the D-block auction, that was not I think we would consider to be a success. And now we have FirstNet, so that is supposed to take care of a lot of the needs for the public safety community. Of course, it is not quite up and running yet, so I think going forward [INAUDIBLE 00:20:25].

[00:20:27]
Steve Sharkey: Yeah, and I think that's the... The point is, because it's the same thing we struggle with, with federal agencies, right, it's how do they do their mission and make sure you adopt policies that ensure that they can achieve their mission, not necessarily give them a chunk of spectrum and let them... That's not necessarily the best way to do that. In the case of public safety, they've traditionally built their own systems. Those systems last for 20 or 25 years. The technology doesn't change. It's not a particularly efficient way to run that. So, if there's a better way to make sure that they can get the service they need, with assurance of that they don't get interference, they get priority, but they get the latest technology. And obviously that's the idea of FirstNet, that you've got a more commercial model applied to it with a company that will upgrade the system and the technology and make sure that they've got services. So, I think that approach, yes, but it's difficult. And I will take Blair's point on public safety and clearing the 700 megahertz, and that is what gave an end date to the DTV transition and was critical to having that. That whole longer debate really resulted in a failure of a band plan for 700 megahertz. I know Charlotte disagrees with me on this, but the US has got a very...

[00:21:59]
Charlotte: I disagree the band plan is bad.

[00:22:01]
Steve Sharkey: Okay.

[Laughter]

[00:22:03]

61

Steve Sharkey: So, the US has a unique band plan for 700 megahertz. And that spectrum all came out of TV broadcast spectrum, and so we had analog television, digital technology was adopted, digital standard was adopted in 1997, and there was an opportunity to free up a lot of spectrum. The FCC originally identified a portion of that, but then went back and figured out we could clear a lot more than they had originally identified, 108 megahertz. But in the meantime, Congress had looked to it to help balance the budget, so they started to find dates for when that spectrum should be auctioned. You had a public safety allocation that was kind of put in the middle of it, and all of these factors. We were looking at it and saying, this is a terrible band plan. You ended up with a bunch of guard bands to protect between public safety, to protect between upper 700 and lower 700. I think if we went back and looked at that, or at the time could have looked at it without all the competing forces that were there, we would've ended up with a very different band plan.

In fact, the rest of the world ended up with a very different band plan that looks at all that spectrum and just has a very clean allocation, which Mexico adopted, and now we've got a big interference problem with Mexico because they use that under a band plan that conflicts with the US band plan, that when they looked at it they saw nobody in the rest of the world — other than Canada — going with us, and so we've developed into a long-term problem that continues to this day.

[00:23:55]
Jennifer Manner: That's a great lead in to my next question which is on process. How important is process to avoiding spectrum failures? What you just said was Congress got involved and we ended up with a less-than-ideal band plan, but thanks to Blair in part we had incentive auctions which turned out to be very successful and that did require a legislative change, the FCC got original authority for auctions; we've heard today that that was very successful. We've seen other things, FirstNet certainly come out of statutory requirement, the jury's still out on how successful that will be. But from a process standpoint, and then there's things, 700, where it wasn't terribly successful...at least the band plan, we have a difference of opinion on some issues but the band plan there is agreement that that was maybe not as perfect as could be. So, in terms of process — I don't really mean process in that you file pleadings, but — how important is process in all of this, in making spectrum decisions?

[00:24:54]
Jim Lansford: Well, I think it's very important because, the last panel kind of said, if the commission establishes sort of the ground rules and then lets the secondary market, gives them some flexibility to play within the rails, that really creates a lot of, I think, a lot more opportunities to move forward, the technology forward. I think back, I spent a lot of time in the 5.9 band, and if you look at the regulations it's very prescriptive. There is an ASTM E2213-03 document that is prescribed for that band, period, end of discussion, you can't use anything else in that band. And it's been very limiting because that spec is actually obsolete now. And so, even IEEE is working at updating the 11p specification because it's

quite old now, it's over 10 years old. And 11p was based on 11a, which is now 20 years old. And so, by hardwiring things into the regulations it really, I think, does create an impediment to successful use of the band.

[00:25:55]
Jennifer Manner: Comments? Erin.

[00:25:57]
Erin McGrath: I would say that in the process of [INAUDIBLE 00:25:59], which is flexible use, plus auctions, plus secondary market is the ideal model for ensuring that spectrum is used efficiently because each company goes in, they have the technology, and they know what spectrum needs and they bid for that. Whereas, take 5.9 again, as you said, and you said talking about chunks of the spectrum, 5.9 is for automobile safety. They have 75 megahertz. Well, there's a lot of debate as to how much spectrum is actually needed for automobile safety, it seems to be somewhere between 10 and 30 megahertz; it's certainly not 75. So, it's a more efficient allocation if companies actually have to come in and bid for what they want.

[00:26:45]
Jennifer Manner: Can I follow up on that as a satellite operator? I can't resist, sorry. In the United States statutorily it's prohibited for auctions for international space stations. So, do you think that's something that...? And there's other services, broadcast television is not auctioned, there's other services that don't have auctions. So, do you think that in those cases we end up with worse decision, perhaps, because of that?

[00:27:14]
Erin McGrath: Well, obviously...

[00:27:16]
Jennifer Manner: You can answer after, Mr. Sharkey.

[00:27:18]
Erin McGrath: Yes.

[Laughter]

[00:27:19]
Erin McGrath: I would answer it this way, that spectrum should go to its highest and most efficient use. And so, what have we seen over the years is broadcasters selling their spectrum in the incentive auction. Satellite companies have decided to switch their spectrum to terrestrial uses. So, are there better methods, probably, to allocate that spectrum? Yes, but those entities are incumbent and that is their spectrum at this point. So, you have to work with the reality that you have.

[00:27:52]

Jennifer Manner: Okay, no, very good. Steve.

[00:27:54]
Steve Sharkey: Yeah, so I do think that auctions have been a good way to allocate spectrum and to determine the use. Actually, in broadcast they do hold auctions if they file for the same market. If there's a...

[00:28:08]
Jennifer Manner: And we do for DVS, too, and DTH, right?

[00:28:10]
Steve Sharkey: Right.

[00:28:10]
Jennifer Manner: So, there are exceptions in satellite.

[00:28:12]
Steve Sharkey: Yeah. I think what — and some of the other panels talked about it already — I think the terrestrial community and satellite community conflict more and more on spectrum allocations as we're both kind of moving up in the bands and looking for more and more. And I think particularly now where the satellite companies are positioning services that compete against terrestrial, right. That is how those systems are sold, as broadband services that are promising gigabit speeds and aimed at competing with both wired and wireless systems. I think it's very reasonable that, if that's the case, there should be an auction for that spectrum under a flexible allocation with some general technical rules, because all too often what we've seen from the satellite community are very big promises with business plans that don't pan out.

                        And Erin mentioned we've had many cases where satellite companies, after getting allocation and not paying for it, there is no business case there, they've applied to use that for terrestrial services. So, we have a track record here and a history of the potential that can happen; so, why do we keep repeating the past rather than moving to an auction to determine the amount? Spectrum Frontiers, we've got gigahertz of spectrum that have allocated to the satellite industry under those promises. And I do think in that case it would've been appropriate to have an auction for it.

[00:29:53]
Jennifer Manner: And Jim.

[00:29:55]
Jim Lansford: But I'll make a ploy for unlicensed spectrum. To what Rob Alderfer said earlier, the unlicensed is also a very important part of spectrum policy. Some of you probably remember, and Julie mentioned, the unlicensed PCS band. There was an idea that they were going to tax every radio for like 50 cents or something like that, and UTAM was the organization?

[00:30:16]
Rob: They had to pay for the relocation.

[00:30:19]
Jim Lansford: Yeah. And so, there was going to be a tax on every unlicensed radio, and all the
                       chip companies said, "No way in hell are we going to do that." If the Wi-Fi
                       companies had to pay to use the spectrum today, that would probably kill...that
                       would be very damaging to the Wi-Fi ecosystem, I'd say. Yeah, unlicensed is also
                       important.

[00:30:37]
Jennifer Manner: Okay, great.

[00:30:39]
Steve Sharkey: That's, I mean, it's a fair point, but I do think for UTAM it was actually successful.
                       There was a device fee charge because there were clearing costs associated
                       with moving the incumbents, and that did turn out to be a success. It's not
                       whether or not you're charging for use of the spectrum itself, it's to make that
                       spectrum available and I do agree with…

[00:30:58]
Jim Lansford: But there was a big pushback.

[00:30:59]
Steve Sharkey: Yeah, and I do agree there's certainly a place, an important place for unlicensed
                       spectrum. But that is different because it's shared equally amongst everybody
                       rather than...

[00:31:08]
Jim Lansford: Correct.

[00:31:08]
Steve Sharkey: ...exclusive license.

[00:31:09]
Jim Lansford: Right, nobody gets priority.

[00:31:10]
Steve Sharkey: Right.

[00:31:12]
Jennifer Manner: So, in terms of things we can learn from failures, we always say look...or your
                       mother always said, my mother always said take a look and see what you've
                       learned from doing this wrong. Can you give me an example and perhaps a
                       lesson that came out of it? And maybe we'll start with Steve and just go
                       backwards.

[00:31:30]

Steve Sharkey: I thought I was going to have time to think about it.

[00:31:32]
Jennifer Manner: No, you did, but I was...

[Laughter]

[00:31:36]
Jennifer Manner: Especially after proposing auctions on satellite.

[Laughter]

[00:31:44]
Steve Sharkey: I think, I guess there is...because I had a couple of failures, we talked about 700 megahertz, and I think just making sure that there's a process in place to have a real look at what's the best decision here that isn't driven by so many external forces. I think we do get a lot of decisions that are driven by the congressional need for auctions and they use it to balance the budget which has got its benefits and downside. The benefit is it does move the process along, there are very few reallocation decisions that have been made without some input from Congress and driven by those auctions recently. But they've also driven some less than desirable results. I think to the extent that, as we're moving forward, not micromanaging some of the decisions. For instance, if Congress is going to say, is looking for a certain amount of spectrum, it works better when they say 200 megahertz of spectrum, find 200 megahertz of spectrum, let's auction that, and then let the agency experts from the NTIA and FCC figure out what the right place is for that and the right balance, to make a service that isn't divided up between competing interests.

[00:33:13]
Jennifer Manner: Thanks. Erin.

[00:33:15]
Erin McGrath: I think this also in part gets back to your original question of, what do you define as a failure? There's obviously bands that we look at and go like, ooh, yeah that wasn't one of our better choices. Besides 5.9 and EVS, BRS, or the original ITFS, MMTS. Some of the things that are out there that we were just like, oh. WCS, that took us decades to sort out. But there are also decisions, policy decisions that are made that don't necessarily make the band a failure, but probably should've been reconsidered because, as we said, nobody likes the 700-megahertz band plan, but does anybody actually consider 700 megahertz to be a failure? No. Cellular lotteries; cellular is very successful. And this is part of auction policy and on the band that was a fiasco, but PCS set aside C-block NextWave installment payments. I'm sure that that just sends some people screaming out of the room.

Those decisions on things like designated entity credits, installment payments, set-asides; we've learned from those mistakes. Obviously, we don't do

installment payments anymore because we were having a problem with bankruptcy. We realized that maybe some of these... Obviously, we do small business bidding credits, we try to help small businesses out, it's in the statute. But what we were originally doing wasn't necessarily helping small businesses, they were getting flipped to other entities. So, over time you tweak things here or there, but that's part of the iterative process. I consider some of those decisions to be failures, but you did learn from them.

[00:35:06]
Jennifer Manner: Thank you. Okay.

[00:35:09]
Blair Levin: Well, all this is awkward because...

[00:35:12]
Erin McGrath: I know.

[00:35:13]
Blair Levin: No. It's awkward for me because I probably was involved with more failures than anyone else in this room.

[Laughter]

[00:35:22]
Blair Levin: Which is usually not a problem, I can talk my way out of it, but except for, we're two weeks from the Jewish Day of Atonement.

[Laughter]

[Crosstalk]

[00:35:32]
Blair Levin: So, I really have to say, yeah, you're right. We really did screw up the C-block. Or to quote *Animal House*, you fucked up, you trusted us.

[Laughter]

[00:35:45]
Blair Levin: But, no, actually your points are all good. But I would say, generally Washington actually doesn't learn anything. It's a curiosity.

[00:35:54]
Erin McGrath: I think we forget.

[00:35:55]
Blair Levin: Yeah. But I'm going to talk about the C-block in a second, but first I just have to make fun of Chairman Pai for a little bit, not for a substantive thing, which we could do that too, but I won't. He went to Oregon the other day with Walden,

Chairman Walden. And they put out a big press release about how they went out to Oregon and they learned all these incredible things. And you know what they learned? They learned that farmers need broadband, and rural hospitals need broadband, and other people living in rural Oregon need broadband. And I'm thinking to myself, how long have you been in this business? You really need to travel cross country on the taxpayer dollars to learn that? I don't think so. But that kind of shows you the way Washington learns.

The interesting thing about the C-block, and we did screw it up, is that there really...

[00:36:43]
Pierre de Vries: Just give a thumbnail of what...

[00:36:46]
Blair Levin: So, the C-block, we did the first really big auctions in '90...started in December of '94 with the A and B block, which went to everybody. And then there was a C-block which started in spring of '95, which went to so called designated entities: small businesses, women, minorities. I would say there were three different levels where you could say. It's kind of like you know it was a murder, it's like the murder happens on the first page of the novel and the only thing you're trying to figure out is what really was the cause of the murder. One way of thinking about it is it's fundamentally flawed to simply have designated entities for auctions. It may have been true if we were doing broadcasting, where you want diversity of voice, that that makes sense. But in a world where, let's face it, this is a scale business, what are we talking about here? You could look at that set of failure, that's an interesting debate. I don't think we've really had that robust debate.

The second thing is the way we allow the small businesses to be financed. Basically, if you have rules that keep them truly small businesses, you cut off their access to capital and then they don't succeed, and then you give them access to capital and it turns out that it's either Dish or it's AT&T who's paying for it. So, we go through these cycles, so that would be the second thing. I don't think we've solved that problem yet. I think with every auction we go through that.

The third thing was the installment payments, but even there I would argue — and this was enormously painful — the failure was...the bankruptcy thing, that actually could've been solved, we screwed that up too. We screwed up a long of things in the C-block. But the A and B block was so good. Anyway, it's a really interesting point, and I think where we failed was the game theory of it. In the A and B block, if you overbid for spectrum because you were with a big company, if you overbid, you lost your job. For the C-block, if you did not overbid, you lost your job. That is to say they had an incentive to bid as high as possible because otherwise they were out of business, because they were all new companies. And when we gave them basically a 90-percent bidding credit, we just gave them all the incentive in the world to just run it up. If it had been a 50 percent,

or maybe a 30 percent, it might have worked. We're never going to run that experiment again, so we'll never know.

But my point is, really the mega point is one of the things that Washington does worst is learn. One of the great joys — and Jennifer worked with me on this on the National Broadband Plan — was we actually had the luxury of sitting there and going, okay, we're going to look at it from — we did this in 2009 and '10 — we're going to look 10 years out, and then work backwards. What are the problems we want to solve that we can foresee easily today? And so, we actually did get to study, we actually had wonderful people on the team doing it, but it's very rare. And it's even more rare in Washington these days that anyone will say, "Look, we didn't get this right. What can we learn?" Everyone's in there just throwing stuff at each other, so it's really hard to actually, to learn.

[00:40:11]
Jennifer Manner: Thanks. And Jim, and then we'll open to the floor.

[00:40:13]
Jim Lansford: Okay. What can we learn? I was just thinking that your idea, having been an entrepreneur it's like deal flow, right? If you're a VC, you want to see lots of deals come in and you try to pick which ones you think are going to survive and which ones won't. Sometimes the past is not a good indicator of the future, and sometimes it is. In fact, we were talking during the break that if you'd gone back 35 years ago and asked, what's the economic value of the ISM band? You'd go, "Eh." Plywood heaters in the 900-megahertz band that dry out plywood at a plywood plant. And yet now you'd look at the economic value of Wi-Fi and say, "Wow, it's phenomenal." So, it's really hard to predict, so you know you're going to make some mistakes in the future because you try to learn from your mistakes in the past, but you probably...the future is never exactly like the past.

But I think this idea of flexible use, for those of you who had my class we talked about the Shannon capacity limit, right? And this was the best spectrum efficiency you could hope for, is the Shannon limit. And then MIMO came along and blew all this out of the water. I used to say, one of my famous sayings was that Moore's law doesn't apply to spectrum, and yet now what we have is, with MIMO, it's not quite Moore's law but it does allow us to pack a lot more capacity into what we thought was a fixed pipe. You can't bet on those kind of innovations, we can't anticipate those.

[00:41:42]
Jennifer Manner: Well, thank you. So, we're going to open the floor up, open the mic open for questions with students first, preferably. Okay, you were first. Let's wait for the microphone, please.

[00:41:53]
Female: Sorry.

[00:41:58]

Blair:	Thanks. I believe it was the last panel stated that state regulation...
[00:42:03] Jennifer Manner:	Could you introduce yourself?
[00:42:04] Blair:	Oh sorry, I'm Blair. I'm a 2L here. That state regulation is ineffective due to the threat of interference. And today you all mentioned that we now have interference happening across borders. So, my question is whether we should be moving towards more international band regulation, and if so, what that might look like and how we can learn from our mistakes in implementing that.
[Laughter]	
[00:42:30] Jim Lansford:	There you go.
[00:42:30] Erin McGrath:	Well, there's a ginormous can of worms.
[00:42:32] Jim Lansford:	Here's the ITU expert.
[00:42:35] Jennifer Manner:	So, we do have... There is an organization in Geneva, Switzerland, where I just spent 11 days of my life.
[00:42:42] Jim Lansford:	That you won't get back.
[00:42:44] Jennifer Manner:	That I will not get back.
[Laughter]	
[00:42:45] Jennifer Manner:	The International Telecommunications Union which is responsible for spectrum allocations globally. It's a nonbinding treaty organization, it's a part of the UN. And to be honest, I think — though I'll deny it if anyone ever quotes me — the ITU does a very good job at what it does. And countries, to be honest countries have an incentive to ensure that there's not interference, so in the case of 700 megahertz where we have differing band plans, Mexico and the United States spend a significant amount of time trying to reach agreements. So, overall, we try to harmonize spectrum, and harmonization is something that I think is critical on a global level, both for non-terrestrial satellite and other non-terrestrial technologies, and for terrestrial technologies. We get a lot of benefits, economies of scale, we get limits on harmful interference. But at the end of the day, a lot of that is done on a bilateral basis across borders, and so I

don't think you'll ever get away from that because there's an issue of sovereignty in countries, to be sovereign. We were just talking about planes flying over China and how, when you fly over China, you can't use the Wi-Fi on airplanes. And that's because they're a sovereign country, it's not that any satellite operator stops operating, they just don't provide the service.

I don't think you'll ever get to a binding FCC internationally, nor do we want that. So, hopefully that answers your question. I don't know if anyone...

[00:44:14]
Jim Lansford: WRC is an opportunity for you to have fun in that sandbox next year.

[00:44:19]
Jennifer Manner: It's the World Radio Communications Conference, which is a four-week treaty negotiation where you usually want to shoot yourself afterwards.

[Laughter]

[00:44:27]
Jennifer Manner: And then the FCC gets to implement the decisions.

[00:44:30]
Erin McGrath: Well, yes, obviously there are things that the ITU... Especially Jennifer's world will be a little bit different, probably, than what Steve is going to say when it comes to ITU because, obviously, satellites are in space, they can serve Europe, they can serve the US. Whereas when you're talking about wireless you are, obviously, in a smaller geographic area, and that is where violence really does come into play, because we're lucky, we've got Mexico and Canada. Being a regulator from Europe would probably drive me nuts because they have 70 borders, and that is a place where we've run into problems with the ITU because, I'll use the 600-megahertz band for example.

Obviously, we have auctioned the 600-megahertz band, the former broadcast, which will now in part be used by wireless. We also made it clear, hey, we have broadcasters here too. That was vehemently opposed by most at the ITU. The United States did it anyhow because we had that ability to work with Canada and Mexico to make it work. Part of the reason why 600 megahertz was not really looked at by the ITU is because people were protecting their incumbent businesses. And so, what did they adopt in part with the argument of interference was what created a domino effect, which was in order to support what the United States wanted for 600 megahertz, which it was to be able to reallocate towards wireless, you needed to get the signoff of your neighbors. Therefore, what happens, everybody starts playing games because I'm going to protect my industry, I don't care about your wireless industry. Oh, by the way, Europe is behind us in 4G deployment anyhow, so they're protecting their past investments too. So, why should I upset my broadcast industry to maybe go for 4G when my guys are still trying to pay off their 3G investments?

So, while the ITU does have a role to play, and obviously they do serve a purpose, it's not always nice and as clean cut as it sounds.

[00:46:53]
Jennifer Manner: Okay. Steve, do you want...?

[00:46:54]
Steve Sharkey: I think they covered it. We're lucky that the US is a large country with scale for markets and has limited borders that we have to deal with, but we all support harmonizing, the international harmonization of spectrum. It helps all reasons that Jennifer talked about; the scale of equipment, being able to deploy quickly. We do look at what's going on in other countries and whether or not that spectrum can be made available because... And there is a little bit of push-pull. Sometimes we're the leader in making a band available and the rest of the world will follow us. Sometimes we look at what they're doing, and we'll tend to follow them because it does make sense for the satellite industry to align around those allocations, and for the defense industry to try and align around some of those allocations, so there's a tendency to kind of coalesce. And it's not a perfect process, but I think we do a pretty good job of it in most cases.

And 700 megahertz is actually, I think it's more of an outlier that we have such a different band plan than the neighboring country, and usually that wouldn't happen.

[00:48:03]
Jennifer Manner: Jim.

[00:48:04]
Jim Lansford: I'll just add real quickly, as a chipset company having these really complicated band plans around the world just gives us migraines. It just really makes our life really hard to try to build one chipset that can cover...

[00:48:16]
Jennifer Manner: Well, I think that that was going to...my final remark on this was going to be the growing importance — and not to sidetrack — of 3GPP, which someone asked a question: What was more important Wi-Fi or 3GPP? But 3GPP is a standards body, for those who don't know, who's working on the 5G standards, and their work is driving, in a lot of ways maybe becoming as important... And it's a private standards body, so it's not a treaty-based organization, but in a lot of ways that's driving a lot of what's being considered at the ITU. And I think at WRC '19 that's going to be one of the issues, is a lot of what's happening is 3GPP is ahead of the ITU on some of the standards work, and so it may be driving what's going on.

[00:48:58]
Jim Lansford: And as a company that makes both Wi-Fi and cellular chips this gives us migraines. We're having to deal with different parts inside the company, you're

trying to do the spectrum grab. And the 6 gigahertz band coming up is going to be a classic case of that. So, we have some very interesting internal meetings.

[00:49:15]
Erin McGrath: [INAUDIBLE 00:49:15] ranges.

[00:49:17]
Jim Lansford: Yeah.

[00:49:18]
Jennifer Manner: Which is another question.

[Laughter]

[00:49:20]
Jennifer Manner: Yes, sir. To break up this conversation.

[00:49:25]
Scott Fox: Thanks. Scott Fox again. I wanted to ask, there's been a lot of...most of the conversation has been around success criteria, or successes and failures. There's been some discussions around the appropriations as stimulating the movement of the process. But I was thinking of an example, the AWS-3 spectrum auction that occurred in 2015, I believe it was, that brought in $45 billion. I'd love to hear conversations around that side of it. That $45 billion, $7 billion of that went to fully fund — or it wasn't quite 7, but — fully fund FirstNet. So, are things like that appropriate to consider in the success or failure criteria of a spectrum policy process?

[00:50:11]
Jennifer Manner: Thank you.

[00:50:15]
Steve Sharkey: The FCC is not supposed to consider how much money will be made in an auction. The foundation of the auction was supposed to be to put the spectrum to the best and highest use. The reality is it becomes a factor. And Congress looks at that, $45 billion is a lot of money, and when they're trying to balance a budget it becomes a factor. And I think that's what really happened, once they start to see how valuable that spectrum is it became of more interest to them.

[00:50:47]
Erin McGrath: Well, it's also different when you have a statute that basically says you have to fund something.

[00:50:51]
Steve Sharkey: Right.

[00:50:52]

Erin McGrath: There are a whole bunch of our auctions that don't necessarily come with that criteria.

[00:50:56]
Steve Sharkey: Right. One of the good things that's also come out of auctions, too, is a lot of that money will end up going to relocating incumbents. Like AWS-3, a lot of it goes to moving the federal government out of there and making sure that they've got new systems and that they can move to other spectrums, so it helps that transition.

[00:51:19]
Blair Levin: I would only add that, in the mid to late '90s when we were very close to balancing the budget and then did, spectrum played a role because the budget people, they would call me up and say, "We're just short like $12.5 billion. Can you say that this band is worth $12.5?" So, there was that kind of game going on. I think if you're looking at the kind of deficits we're looking at now, really, who cares? It's just not, it's not going to play the same role.

[00:51:48]
Jennifer Manner: Other questions. Yes, sir.

[00:51:53]
Audience Member: It's a great conference. It's really good to hear people talk about UWB because I worked on that and it was really fun, but utterly painful, and it failed because Wi-Fi got better. I think that's really what it comes down to. I'm kind of wondering...

[00:52:07]
Jim Lansford: It's hard to beat, right?

[00:52:08]
Audience Member: Huh? Yeah.

[00:52:08]
Jim Lansford: Four-by-four MIMO and eight-by-eight MIMO, you can do a lot with that.

[00:52:11]
Audience Member: Yeah. And you guys got the 802.15.3a standard wrong, too. That didn't help.

[Laughter]

[00:52:21]
Jim Lansford: I still have PTSD over that.

[Laughter]

[00:52:25]

Audience Member: But I was kind of disappointed I didn't hear as much badmouthing of white spaces as I thought there was going to be, because to me it's sort of the poster child for policy failure. It's what happens when you get a bunch of lawyers to design a network instead of engineers. But just to be a little contrarian, most people...

[Laughter]

[00:52:47]
Audience Member: Because I never do that.

[00:52:49]
Blair Levin: You, contrarian?

[00:52:50]
Audience Member: Yeah. Everybody's pretty gung-ho about 5G right now, except Silicon Valley kind of isn't.

[00:53:01]
Blair Levin: Neither is Wall Street, by the way.

[00:53:02]
Audience Member: Yeah, yeah. I think part of that, it's probably going to succeed just because of the sheer number of companies that have bought into it, the number of countries that have bought into it, but some of the goals are kind of screwy, like the extreme...like millisecond latency. That's just ridiculous because that's not something you can...you can't engineer around the speed of light. But is it possible that, say, in the 10-year anniversary of this conference, is there any scenario you can envision in which 5G is regarded as a policy failure?

[00:53:43]
Blair Levin: Well, there's a bunch. We could have a whole conference on that. And I don't mean to trash 5G, and again this is just reflecting stuff I do on Wall Street. Number one, you don't see, when you look at the models or the companies you're not projecting new revenues coming off of it, and these are not models that are like 20 years out or 10 years out; these are 2, 3, 4, 5. It's not at all clear what is the incremental revenue that is not simply the cannibalization of 4G. Yesterday — and I don't want to comment on anything since Erin's here that would cause me to file an ex parte, I'm just noting that yesterday there was a lot of discussion of a plan which, or a document which says the companies are going to save $2 billion. Putting aside whether or not that's true, putting aside the point that that also means city coffers that pay for cops and fire are going to lose $2 billion, because that's where the money is coming from, that's less than one percent of what the projected costs are, and it's not all clear. You got to do incremental CapEx versus incremental revenues. I think it's not at all clear, other than — and this is a good thing — often competition to cable in areas where you have sufficient fiber in density to be able to do that.

But I actually, I don't think it's a spectrum problem. I don't think we'll look back, because I have confidence in Erin, I don't think we'll say we screwed up in spectrum; I think there are conceptual errors of the way... It is funny how everybody uses 5G to justify the thing that they would've justified anyway, but it's... When we look at 5G leadership and we say, "What is the real metric for it, what are we really trying to achieve?" It's not at all clear that people in Washington have articulated that well. So, I don't think there's really a strategic plan, there's just a bunch of impulses and political machinations, and I think that's where we'll look back, but it won't really be about spectrum policy.

[00:56:07]
Steve Sharkey: I think the one thing we've seen though is that, when we make capacity available, people use it and they use it for new things and different things.

[00:56:15]
Jim Lansford: New uses and new users.

[00:56:16]
Erin McGrath: But I...

[00:56:17]
Steve Sharkey: So, the thing about 5G is that it is more efficient, and it will provide greater capacity, and part of that is going to be new spectrum allocations. When we look at the demand, and look out to 2024 or so, the majority of the demand is driven by applications that we meet today, and a lot of its video. But we continue to see tremendous growth, we have to grow that network to do it. And then you add a layer on top that's augmented reality, or virtual reality, or some of the other really neat things that are talked about, and it's a relatively small layer at the top of that but that current technologies are not really suitable for. Whether or not those are cases that drive the huge demand and migration of 5G or not, there are other advantages to 5G that will drive its adoption. There were doubts about 4G and 4G LTE and how quickly that would take off, and whether there would be demand there; that took off much faster than any of us anticipated. You wouldn't have things like Uber where nowadays applications are developed just because there is an assumption that there is a network available anywhere in the world.

[00:57:48]
Audience Member: Because you can.

[00:57:50]
Steve Sharkey: What's that?

[00:57:50]
Audience Member: Because you can.

[00:57:51]

Steve Sharkey: Because you can. Well, but they're beneficial and they're changes that can't be anticipated. The millisecond latencies are not getting around the speed of light, but it is a fundamental redesign of the network, and those are not going to be at the beginning of 5G but they're going to come as points are distributed closer to the edge, and you don't travel those kinds of distances as you're delivering that data. I hear the skepticism, but there was a lot of skepticism on 4G. And I think as the demand continues to build we'll see that take off. Although, clearly, there are a lot of applications, and LTE has a long life left in it and a lot of these applications can be met by 4G technology.

[00:58:38]
Jennifer Manner: On this I've been told our time is up. I think we're ending on a very interesting note, and I'm hoping that Pierre will invite us back in 10 years to come back and talk about this. I'd like to ask you to join me in thanking the panelists.

[Applause]

[00:59:00]
Pierre de Vries: This is your last break. What I'd ask folks...

PANEL 4 – SO WHAT?

Pierre de Vries — Moderator

Spectrum Policy Initiative Co-director and Executive Fellow, Silicon Flatirons

Robert B. Kelly — Panelist

Partner, Squire Patton Boggs

Jennifer Manner — Panelist

Senior Vice President, Regulatory Affairs, EchoStar Corporation

Bryan Tramont — Panelist

Managing Partner, Wilkinson Barker Knauer, LLP

[00:00:00]

Pierre de Vries: Thank you. So we have a wrap-up panel, the So What? panel. If those folks could just come up, we'll start. So, we're just gonna run straight into this last panel. And let me, while folks come up and check that they are plugged in, let me just say a few things. What I want to do with this panel. Usually, we always have a panel discussion and then we have questions at the end and discussion.

What I want to try is an experiment. So, for the people with the microphones, I need you to listen to this, if you are still here. I want to start with the questions and not end with the questions. And there are not going to be questions and we're not going to go on for very long. But what I would like everyone to think about, and anybody can volunteer and we'll go from one end of the room to the other. I want to get one sentence, from anybody who has a sentence to volunteer, what they think the takeaway is for them from today. So while you think about that, this to me is these are the stars

The moderators, as those of you who've organized conferences know, spend an inordinate amount of time wrangling panelists, thinking about questions. They are probably among the most expert people. And then they have to sit there and then just try and manage traffic. And we never get a chance to hear what they think. And so this is our opportunity to hear from them what they think.

So I've asked them to think about what were the key takeaways, what makes spectrum allocation good or bad. And given what we've learned today, what should we do going forward. They're going to have the last word. Before I get to them, let's just go around the room to hear from anybody who has a sentence or two for us, what do you think the takeaway is? Anybody up in the gallery there? Nobody in the gallery? Ah, we have one. So let's start over there. Just give your name and then give your insight.

[00:02:10]
Participant: Rob Alderfer with Cable Labs. I think the FCC needs to rethink their DSRC policy and provide Wi-Fi access to 5.9 GHz.

[Laughs]

[00:02:23]
Participant: That was like a homer to start it off right there.

[00:02:25]
Pierre de Vries: That was a shocker. Alright. Okay. So we have the gentleman in the front here, please.

[00:02:30]
Participant: That's funny.

[00:02:33]
Pierre de Vries: Just wait for the mike and we get it on the recording.

[00:02:37]
Participant: I just think we need... I mean, first of all, the takeaway is--It's hard. So those that have been involved in things that didn't go so well, some forgiveness is due. But as we look to industry to solve some of the technological problems, it occurs to me that some of the fault lays there too, as well. Standards bodies where perhaps people did not have the best of intentions to make something work smoothly.

[00:03:05]
Pierre de Vries: Thank you. Any other insights? We'll get to Richard. We always get to Richard. Let's go around the room.

[00:03:19]
Participant: Hi, Mark Lofquist, student here, ITP, PhD candidate. Work at MITRE, NIST, NASCTN, DoD, etc. One of my big takeaways was failures are okay because of lessons learned and potential. And inaction, there's nothing to learn from that. And that was one of the notes I took.

[00:03:38]
Pierre de Vries: Thank you.

[00:03:47]
Participant: I was able to talk to Pierre about this earlier. Matt Larsen from Vista Beam. But about 4 years ago, Pierre introduced harm/claim threshold as a new idea in spectrum policy. And after reading it, I feel like it should be the foundation of all new spectrum allocation. They're a big part of the thought process that goes into developing that policy. And I told him, it's kind of at the end of Raiders of the Lost Ark, when they put the ark in the box and stuck it in the back of a warehouse. It's

kind of like that. So that's my takeaway after listening to all these complexities. That something so simple could probably change a lot of this for the better.

[00:04:28]
Participant: And Dan again, and I just wanted to footnote this. In 2012, I was the Vice-Chair of IEEE USA's Committee on Communications Policy and we did a white paper on harmful interference and I was gratified to see that it was referenced in the student's compendium and that was nice. And in that regard, I just wanted to mention that I'm taking away from this conference that as I think a lot of us know, spectrum policy is an immensely complicated process. Where, to quote Tom for a moment, when he was up at the front of the room, he said, "Self-interest can be a big motivator." And as long as that self-interest exists, you're going to have... Well, what's the best way to put this? You're gonna have economic versus other kinds of mission goals, always in opposition. And it suggests an interesting thing to consider that the PCAST report from the prior administration is sort of hovering in the room, if you will, as a result of pointing out the monetary value of spectrum. That's a great step in the right direction and there's a lot of opportunity in front of us, so.

[00:05:53]
Pierre de Vries: Very good. Next one.

[00:05:57]
Participant: Jordan from CU Law again. I think one of the most frequently used words today was flexibility. And I think one of the major takeaways is not to pigeonhole our policy based on specific services and technologies because those will always be changing. So we need a more adaptive and generalized policy in order to account for those complexities that come up over time.

[00:06:20]
Pierre de Vries: Mm-hmm. Thank you. Richard and then Sarah.

[00:06:27]
Participant (Richard): Yeah. I like this format, dude. It's like bullpenning in baseball where you start with your relievers and you don't even have a starter because like, "What do we need band laws for?"

[Laughs]

[00:06:38]
Pierre de Vries: It would make conferences a lot easier to organize, yeah.

[00:06:42]
Richard: Yeah. [INAUDIBLE 00:06:43] paper cutouts or something like that. It occurs to me that in the fullness of time, essentially every system that has ever been designed to use spectrum, and therefore every policy behind it, became obsolete, useless and had to be replaced with something better. So from a certain point of view, every policy, every spectrum initiative is a failure. [Cell phone goes off] And, see?

[00:07:10]
Participant: It's a [INAUDIBLE 00:07:10].

[00:07:11]
Richard: Yeah. I mean, we can't control these devices. And so perhaps a key parameter in designing a spectrum initiative is to conceive of the transition at the end of it. When that approach runs out of steam, which it inevitably will, because they'll be new technology, how to do the handoff to a new generation of spectrum systems.

[00:07:38]
Pierre de Vries: Very good. Thank you. Looks like we have, actually one more, and then we'll go up onto the gallery. We've got two questions there.

[00:07:46]
Participant: Just to key off Richard's last point, that there is always going to be a new challenge and a new technology to try to overcome and maximize. The thing I take away from this conference is we're doing an amazing job of spectrum management. Generally, you have enormous expertise both at the FCC and at NTIA. The number of person-years of experience probably gets into centuries. I think to my last question, it's so important that these agencies get sufficient funding so that we can have that expertise from these students into those agencies for the long term. It's not a money-making proposition. But boy, there's passion, there's expertise and it makes such a huge difference to the economy and the well-being of this country. So I would just urge whenever we have an opportunity, to urge for that funding to Congress and the White House to make sure that we do that.

[00:08:54]
Bryan Tramont: While we're transitioning to another person, I do think it's worth noting, it is a money-making exercise actually, right?

[00:08:59]
Pierre de Vries: Pause the microphone.

[00:09:00]
Bryan Tramont: From a pure revenue perspective, spectrum management makes money for the government.

[00:09:03]
Participant: Absolutely.

[00:09:04]
Bryan Tramont: And not a single tax dollar goes to it because between reg fees, auction revenue and then before you even get to enforcement, fines. You get a lot of revenue. So it is actually worth investing in because it's net, net a positive.

[00:09:16]
Participant: To start funding from spectrum auction whatever but just...so, thank you.

[00:09:21]
Pierre de Vries: Just pass the microphone up, I think we've got a couple more up top there. Blake and Slate.

[00:09:28]
Participant (Blake): Well, first of all congratulations Pierre. This conference is always a highlight of our year and I think this year no exception. I have to say, as our... Blake Reid at Silicon Flatirons. As kind of a resident cynic, I was really excited for this conference this year because I saw "Hall of Shame". I wanted to see some real car crashes and yet, when pressed to dwell on that, we had panel after panel of folks talking about successes. And we heard so much that spectrum policy has done to make the country a better place, to bring innovations into our lives. And so the takeaway for me is, that for all of its individual and isolated failings, that spectrum policy seems to work pretty well and the folks who contribute to that, I'm sure want to be proud of that.

[00:10:24]
Pierre de Vries: And Slate gets the last word.

[00:10:30]
Participant (Slate): Fantastic. Mine's short. I'm Slater Herman, the University of Colorado Law School. I think one of my biggest takeaways is that one of the key qualities of a failure is how long it's taken us to call it a failure. And I think something that we focused on is moderate success. We don't learn as much as we do from a big failure. And so I think, whether it's DSRC and we are still doing that now, it's been a long time. Sometimes calling something a failure early out of the gate can stop it from becoming a huge failure.

[00:10:57]
Pierre de Vries: Fail fast. Right. So thank you very much, everybody. And the folks who didn't speak, thank you very much for just participating. Over to you guys. Let's start with Bryan and move over just what were your takeaways? What, first from your panel and then from the event in general.

[00:11:14]
Bryan Tramont: Well, I think the audience picked up on a bunch of things that I thought were really important and interesting. I do think the idea that making mistakes is okay is really important. And trying to draw the lessons from them and consistent with what Erin said, not repeating them, is very important. I think that the role of experimentation in public policy, I do worry sometimes that our policy makers are reluctant to take those risks. I mean, David touched on this, too. And you have to create enough political space for people to take risks and have them not work out. And I think that's really important.

[00:11:45]
Pierre de Vries: So that's near to my heart. So tell me how one does that. Because, and my impression is, if you're a public servant, there is no upside to taking risks, there is

only downside. So why would any public servant take risks? They do. I don't know why. I'm glad they do but...

[00:12:01]
Bryan Tramont: Right. I mean, I think a couple things. I mean, I think Commissioner Rosenworcel talked about the idea of regulatory test beds in different contexts and I think that's a powerful way to think about it. I think there is, there has been, political momentum around experimentation in public policy for spectrum. For bands, quite frankly, that don't have the same political... Or the same market demand as others do. And so I do think there's some. That gives some people some room to do it. And the fact that we historically have not been hyperpartisan in this space has also allowed people to be more... It's not been as clear that the White House is gonna call you and say you're making a huge mistake, because it doesn't tend to break as much along political lines. So I do think that's why people do it.

[00:12:44]
Jennifer Manner: So just building actually, I would also say one of the big takeaways in this is just building on what Bryan said, who said a lot of good things as did the audience, is flexibility. And the need for flexibility in regulation. And I think that, too, allows a lot of experimentation. If you're not dictated by which technology you're gonna use, it does give you some flexibility from a technical perspective to, yeah, fix things or adjust things. And I think, I mean, I think I've been giving a satellite example in the 28 GHz band, which is where our broadband satellites today operate. Originally, our satellites were very slow. We were just starting to... You know, you'd used it, you'd say 5/3, that's not... 5/1, that's not broadband.

And today we're offering speeds above 100 megs. And a lot of it's because rules weren't so constrained that we could design a system that would work in a spectrum in a way that would better meet users' and consumers' needs. So I think flexibility is a great one. I also think a light touch, which wasn't specifically talked about, but I'm channeling my old boss, Commissioner Abernathy, who always talked about a light touch to regulation. And a lot of what you're hearing here, is that the lighter the touch, the more flexibility, the better off you are. And I think the other thing was Bryan started beforehand talking to the students about property, using property as analogy. But I think a number of folks brought up that you can't just have a one-size-fits-all. There needs to be unlicensed and both licensed spectrum and that the unlicensed goes back to the experimentation. That's where a lot of the experimentation occurs, as well. So those were my major takeaways.

[00:14:19]
Pierre de Vries: I'd like to unpack the flexibility a little bit because as we've heard, it was one of the themes. One of the things that I think came up on your panel, Bryan, was is it flexibility in rights? Which is what I think you were talking about here, Jennifer, and what Tom talks about a lot. But it's also flexibility in process. What kinds of flexibility are we talking about? Flexibility in what?

[00:14:43]

Jennifer Manner: Well, it depends. So I didn't really think process. And I didn't really think property rights from the licensed unlicensed, but I was thinking more technical flexibility and the ability to make choices. So I think someone brought up and it's a great example. If we had dictated what cellular technology looks like we would have chosen TDMA and we would have been a failure, right? And Europe actually sent a letter to the United States complaining because we didn't pick their standard, which still would have been a mistake because I think that's actually held them back for awhile. So I think it's the technological flexibility, the ability, you're protecting against interference but you're not dictating this.

I'll give you an example. E911, which isn't a spectrum. There was no 911 capabilities or location accuracy in cell phones. And the FCC had to choose how to implement this. And the commission very wisely didn't say, "You're gonna use X technology or you're gonna use a network technology or you're gonna use GPS." It turns out that GPS ultimately won. And actually I would say because of that Commission decision we actually have incredible location-based apps today, that probably would have taken another 10, 15 years to develop. But it's largely because of a decision but it's a decision that allowed the operators to choose what technology, not saying, "You should use X or Y."

[00:16:12]
Pierre de Vries: Great. Thank you.

[00:16:14]
Robert Kelly :   Well, number one, keep the microphone higher. Number two, I think my main takeaway from this is it's a very, very important discussion to have. That there's a lot to be learned and the decisions are getting harder. As you talk about Federal spectrum shared with private spectrum, I think there probably wasn't enough discussion of public safety today and the uses of public safety and how that really affects all of this. So I think it's a discussion that needs to continue. I think it's a terrific forum and I congratulate all of you for putting this on. Yeah, obviously for my panel, flexibility was a major.

[00:17:00]
Pierre de Vries: Could you just sketch what a conversation about public safety might look like? What are the kind of things that one would look at?

[00:17:07]
Robert Kelly: Well, I think and David mentioned FirstNet, that obviously has to play into it. I think what I'm really suggesting is that, and I get nervous and I have to admit I get nervous when everyone seems to agree on everything, on things. Because of the flexibility, for example. It's a great concept. But I think within that, there still needs to be some room to provide for some kind of overriding policy. Light touch as it were. But public safety communications, the need for them to be accommodated in the spectrum, maybe not just with FirstNet. FirstNet's unknown right now, but maybe that'll solve all the problems. And so flexibility is great and I'm all for it. But I think there's got to be a little bit of tempering of that with the understanding that there's other issues that have to be dealt with in spectrum policy decisions. Otherwise, why do you need an FCC at the end of the day?

[00:18:20]
Bryan Tramont: Can I say one other observation? I do, and it went through a few people's remarks today. But I wanted to come back to it because I think that the notion of being able to figure out when there's a failure and act more quickly, and whether or not we need to have a more systematic review of when something's not working, so that we can fix it. Because some of the mistakes we make do metastasize in ways that really create cascading public policy problems. And people touched on the garage door openers. I think of our friends the radar detectors who mess with the VSAT antennas. There are a bunch of examples. I mean, you could argue GPS receivers. But even White Spaces, I think you can argue that the Commission, that the institutional structures in place to do spectrum management, don't respond quickly enough when something doesn't work. And that there may be a need for a more systematic audit, if you will, on whether or not things are working. Because I do think sometimes mistakes linger too long and they can create cascading public policy issues for us.

[00:19:18]
Pierre de Vries: Yeah. I mean, and in fact, I think this takes me to a question that you raised on your panel. Which I think was--which is worse? Not to make a decision, or to make a bad decision? And so what I'm hearing you say now is what we need to be able to do is to recognize when we have made a bad decision. Absent the ability to do that, maybe making a bad decision is not the right answer.

[00:19:46]
Bryan Tramont: I tend to think that 9 times out of 10 that the agencies are gonna make the right decision. And even if they're off, it's only going to be by a little bit. So I generally favor or I'd rather have them make a decision than not. And we had some, Blair was gracious in accepting some dogs that were his. I think every Commission, that everybody who's worked on a commission, could go through a litany of things that they got wrong. But I think net-net, everybody's preferred to have made the decisions than to let them sit there.

[00:20:11]
Pierre de Vries: So are there some mechanisms? What mechanisms would you suggest to actually once, A, to recognize that something has gone wrong and then B, to roll it back. Because once you create an allocation, you create interests, they vest, and then you can't change things.

[00:20:26]
Bryan Tramont: I mean, I'm completely spitballing this. But you would do something that looks like a 5-year review, where you go through all of your allocations to assess whether or not things are working or not. And you would not... And that the problem a little bit is the agencies rely on private parties, in large part, to move, before they start looking at whether something works or doesn't. And I think it would be, one answer would be that you would institutionally look at it yourself, and that would be a catch on things. And maybe, and the sunsets would do that as well, if you were to say that a certain licensing regime would sunset after 5 years or have to be re-

promulgated. There might be ways to do that. Especially for new things. Now I don't think, do we really need to go back and reassess the CMRS rules every 5 years? I don't know that that's as necessary. But at least for the first 10 years of a new decision or something, you have two audits. Maybe there's a path there.

[00:21:17]
Pierre de Vries: Does the FCC have the money to actually do that?

[00:21:21]
Bryan Tramont: Well, that's a serious point. There's every...they should. And there's no reason the country, if there's ever a place to invest money where you get a return on your investment, it's the FCC and NTIA. So, I think they should. It's hard to say what that would look like in terms of what the cost would actually be.

[00:21:38]
Pierre de Vries: I mean, one of the things that struck me, one of the lessons that I would take, what are the questions that came up in other countries? So in the U.K., Ofcom for example, has had a budget to actually fund independent... It's great to be an engineering consultant in Europe because you get a lot of money from the government. When you propose that kind of thing here, what I hear is essentially lawyers who used to do the adversarial processing, "No, no, no. I like having people argue out in front of me. I don't need to fund Julie, you know, to actually do it himself or to pay other people to do a study." So absent that kind of funding... And that's not a lot of money. So do you think that there's a way to get that on the agenda to get that kind of work funded?

[00:22:23]
Jennifer Manner: I actually have a slightly different view than you, though.

[00:22:26]
Bryan Tramont: Oh good. Let's hear that. Yeah.

[00:22:27]
Jennifer Manner: So actually what Brian says kind of scares me from a private sector perspective. And one thing that wasn't talked about, I thought enough, was certainty. And different businesses have different risk analyses and different certainty requirements. But I'll give you an example, I'm gonna go back to 28 GHz and satellite. Which actually has been very successful in terms of getting broadband out to rural areas. That band, I was very young when I started, so don't be set off when I tell you. But that band was really put to use for satellite in 1995. It was the first conference where they really foresaw kind of… it was then high speed data, it wasn't even broadband. It was the first conference where they made that spectrum available at the international level, because you had Craig McCaw and Bill Gates, largely, and a number of companies that put in mind who wanted access for these new high-speed data systems that were gonna revolutionize things.

It was 2008 before the first high-speed satellite was launched, and that was 13 years. When you're designing for space, it's really rough. First off, you're putting a

satellite that you can't send a repair truck out to, right? And maybe they'll be on-orbit servicing which would be terrific. But the technology's very difficult to develop. And maybe 13 years is too long. But using that with an audit system and deciding that would be problematic, and then you have people making long-term investments. I get worried too. I think Richard brought up maybe you plan for sunsetting. Well, if you have enough flexibility in the rules, there are certain things you want people to reinvest. Steve talked about how they've moved. And I actually just saw something today. One of the companies, was it Ericsson? Has a software that you can put into cell sites to transition from 4G to 5G. So I do get a little worried. I don't think it's wrong but I would hate to say that there's a standard approach.

[00:24:26]
Bryan Tramont: There can't be one approach for the 5-year. That's fine. Okay.

[00:24:27]
Jennifer Manner: Right. For the... And so that's the one issue that would be a concern. But I think on the monetary side, I do think the government is terribly underfunded in these areas.

[00:24:36]
Pierre de Vries: Good. So I think we're done.

[00:24:40]
Pierre de Vries: Good? So I think we are out of time. So I don't want to stand between you and the reception. So we're coming up on the reception. It'll be in the room through there. If you're a student please go and talk to a practitioner. If you're a practitioner, please welcome a student. You'll be getting a survey in the mail about the conference. Please tell us what we need to do better next time and what you liked about this one. Upcoming events. On the back of your program, there are events that are coming up in the future. The one that I'm particularly personally looking forward to, there's a conference on the Law and Economics of Data, which is 1 pm on Wednesday, November 14th. Going to be talking about privacy, cyber security, antitrust and content. So I'll see you then or I'll see you next spectrum conference. Thank you very much and thank you to all our speakers today.

[00:25:33]
All: [Applause]

CLOSING KEYNOTE

David J. Redl

Assistant Secretary for Communications and Information and Administrator, National Telecommunications and Information Administration

[00:00:01]
Pierre de Vries: It's really good to have a professional AV assistant.

[00:00:05]
David Redl: Not my first rodeo.

[00:00:05]
Pierre de Vries: Yeah. Not his first rodeo. So, actually, this is...it's wonderful to see the hardcore and it's wonderful to see that the hardcore Spectrum geeks that are actually quite a large group of people. So, what we have today now is the highlight of this conference. Closing keynote. David Redl, Assistant Secretary for Communications and Information at the Department of Commerce aka Administrator of the NTIA.

I first met David when I was testifying on the Hill for the first time and he... it was a committee...the hearing that he was running as Chief Counsel, and he came over to me and he said, "You know, I'm really a Spectrum geek," And so, that endeared me to him forever.

He's obviously got lots of real achievements, like, you know, the Broadcast Incentive Auction, all the legislation he worked through. But again, you know, we focus on the smaller, more local things. One of the great things that David's done and actually, some of the other people in the room too, has taught with David...taught with Bryan and Dale. There's the Spectrum Management class. He took one of our Hatfield Scholars over the summer, and actually, this was a student who had an amazing experience just shadowing David in his day-to-day job, and that's really learning how the sausage is made, [audience laughter] and it's the kind of relationship between leaders and students and doing his best not to put them off Spectrum that we really respect. So, the Honorable David Redl.

[00:01:39]
David Redl: Thanks, Pierre.

[applause]

David Redl: Thanks, it's great to be here in Colorado, especially since I checked the weather and it's 90 plus degrees back in Washington, and humid yet again today. So, nice to be here where it was 65 and cool today.

Yes, thank you for the nice introduction, Pierre. We did take a Hatfield scholar over the summer and the first piece of advice I gave him, I am completely ignoring today which was, he showed up and I said, "Do yourself a favor, dress for the meeting you want to go to." And so, he wore a suit all summer, which was great because I can take him to meetings, but I promptly ignored my own advice today. Although to be fair, this is the meeting I want to go to. And you don't have to have a tie.

It takes a special kind of failure to end up in the Spectrum Hall of Shame. And you've heard, you've heard a lot of them today. And I want to spend my time not, sort of, re-hashing all of them because you've heard a lot about them today, although I will touch on some that you've heard about and some that weren't covered as much today. But I want to pick up on a thread that Commissioner Rosenworcel started, which is to talk about that for nearly every one of our shameful... I use that term loosely, Spectrum policies, you can point to lessons that were learned and those lessons were learned because, as a country, we were willing to take risks. And we've been a country willing to take risks on Spectrum policy and they've reaped really great dividends for us.

We're all familiar with the Silicon Valley start-up mentality of a failing fast, or failing forward. The idea is you can learn more from failure than moderate success. And making mistakes and learning from them is what has led to some of our greatest innovations.

I think it's important to remember that where we have failed and we will continue to fail. We're going to continue making mistakes as we go forward. We've learned something...we've learned something that has helped us drive forward and make us a more competitive country internationally, but also to produce the kind of Spectrum innovations this country has become known for. It's because we are pursuing innovative approaches that no one else has tried before.

Classic example, that you've heard about some today and I won't belabor the point, the 800 megahertz band. An effort to implement a new channel plan, that would ease interference issues for public safety operations, ended up taking more than a decade because of cost issues and technically is still ongoing, and because of cross-border coordination issues with our northern and southern neighbors. But, ultimately, we learned a lot about how to negotiate those issues with our border neighbors as well as how to ease potential interference between public safety and mobile services. And those lessons will pay off in the future for us as we're looking at the 800 band, but also

at 700 and 600 as we drive forward.

Or consider one that's a classic that has not been brought up today, surprisingly enough, at least not that I heard, is the case of the automatic garage door opener, which is one we've all loved to tell over and over again. If you lived near a military base in the early 2000's, chances are one day you woke up and your garage door opener didn't work anymore. And so, you did what anyone would do in that situation, you called your local news station and complained. It was a public relations disaster but the quick turnaround for consumers came when regulators collaborated to fix the problem.

These mistakes are unfortunate downside of taking risks, but they're risks that have paid big dividends for the United States. Because most of the time we do get things right.

This is why the United States is the world's leader in Spectrum policy. Creating innovations that are studied and sometimes imitated by governments all over the world. How do we build this type of leadership? Risk-taking, making mistakes, learning from failures, and creating successes. The wireless industry today, sports nearly five million jobs and contributes about a half a trillion dollars to the economy. It's benefited from Smart Spectrum policy and regulatory tools that enable new services and technologies to develop in a competitive market.

A look at the history of Spectrum Management shows that the innovative spirit can flourish even in the most unlikely of places. You've heard a lot about the mid-90s and the PCS auctions. As they say, "The PCS options are the first and the rest is history." It's an obvious example of a risk that worked out so well I won't dwell on it. It's hard not to mention it in any discussion of risks that paid off. And these traditional options were a stepping stone to the novel and complex voluntary incentive-auction, that you also heard about today, that took place in the UHF TV band.

I was lucky enough to work on that legislation and the implementation as a member of the Energy and Commerce staff when I was on Capitol Hill. And I can tell you that it was by no means a foregone conclusion that that would work. There was a lot of risk in what was being put forward. There was risk that broadcasters wouldn't show up to participate. There was risk that the wireless industry wouldn't be interested at the prices you needed to clear broadcasters in the band. There was risk that the FCC wouldn't have the resources to get it done. And yet, here we are today with a successful auction behind us and we're taking a look at some of those market-based mechanisms, and frankly, the whole world is looking at those market-based mechanisms, and saying, "What applicability did these have to other bands?" You heard Commissioner Rosenworcel bring one up earlier today. We're certainly looking at what we can learn from that as we look at federal Spectrum use and NTIA. Could

include the ability to lease Spectrum to non-federal users out of the federal bands. It's something that we're particularly interested in looking at. It's a risk, but it's one we think is worth taking a look at.

Congress also created the Spectrum Relocation Fund, the SRF, to promote more efficient use of Spectrum and better address how we compensate federal agencies. This too is a risk and it, quite frankly, is an example of a moderate success, that had a little bit of a failure in it and has caused it to evolve.

The SRF has seen a couple iterations over the last 15 years. At first, we had the challenge that the Spectrum Relocation Fund required federal agencies to support the costs up front of their own relocations and then they would be reimbursed on the back end. Or they'd have to do all the planning up front, and foot the bill themselves while they waited for Spectrum auction proceeds to come in.

Congress rightly took a look at these challenges and addressed them. And I'm happy to say that the Spectrum Relocation Fund has been humming along and is the reason that we at NTIA are able to continue investing in looking at ways to bring more federal Spectrum into the commercial domain. Most recently, NTIA, at the end of last year, announced that 3450 to 3550 megahertz would be a candidate band for potential reallocation. And we're excited about the prospect of what we can do once we've done our due diligence in that band. So, note these tools haven't always worked perfectly... but the result is a healthy and creative dynamic that values innovative solutions.

As a government, our work on finding innovative Spectrum solutions is ongoing. A major chunk of that work happens at NTIA. Through our Office of Spectrum Management or OSM and right here at our research lab in Boulder, NTIA's Institute for Telecommunications Sciences or ITS.

ITS produces independent research that informs policy decisions and ultimately helps the ability of Spectrum users to deploy advanced telecommunication technologies. For example, ITS has been a leader in developing, validating, and freely disseminating radio propagation models. These models allow government and industry to plan, develop, and implement communication systems to minimize interference and maximize Spectrum efficiency. For the Spectrum geeks in the room, if you've heard of "Longley-Rice", Longley and Rice were both ITS employees.

The irregular train model, first developed at ITS in the 1960s, is still one of the most widely-used propagation models. ITM software is available free of charge from ITS. It's also been implemented in many commercial and open-sourced software packages used to plan wireless networks. ITS has pioneered gold-standard systems for measuring accurate and repeatable radio frequency measurements and has created Spectrum

occupancy measurements that provide investors and regulators baseline assessments of Spectrum usage and sharing feasibility. And ITS's measurements of device emissions are providing critical support for advancing new technologies in a shared environment.

Thanks to the work being done at ITS, we have new options for exploring new approaches and technologies for Spectrum sharing. It's an increasingly vital in an era of many demands on Spectrum, that's more constrained and more contested.

These are some of the things we've gotten right. And I'm clearly proud of the work that we've done at NTIA on Spectrum policy. But let's look at the few areas where we missed the mark on Spectrum policy in the country. And some of these were touched on, some haven't been. In the early 2000's Dynamic Frequency Selection, DFS to many of you in the room, was developed as a mitigation technique to protect existing radars for wireless local area networks being introduced in 5 gigahertz UNII-band. DFS had problems right at the start. There were issues with enforcement of equipment standards that were embodied in the FCC rules, in some cases, stemming from illegal equipment modifications. As a result, some Wi-Fi equipment began to interfere with incumbent systems in the band, including Doppler Weather Radar Systems operated by the FAA. We clearly failed. When you think about what constitutes success in federal Spectrum Management, it's often defined by non-events. I'll come back to that in a little bit.

Radars working as designed, planes landing safely, so causing problems with FAA radars is about as bad as it gets when you're a federal manager. That seriousness, however, meant that the issue had to be addressed head-on. We were able to improve both enforcement and interference mitigation, which enabled increased sharing between radar systems and LANs in the growing Wi-Fi market in the 5 gigahertz band.

Now, let's look more closely at the faulty garage door openers. This issue stemmed from the Department of Defense's decision to increase usage of 380 to 399.9--A band that was used for trunked land mobile radio systems on US military bases.

I'm glad I'm addressing a Spectrum conference because this is the part where people usually start to lose focus.

[audience laughter]

Inadvertently, these systems triggered interference with unlicensed part 15 devices. The garage door openers, owned by thousands of consumers and neighborhoods across America. Let's be clear, DoD had every right to use its existing assignments. And the garage door users had no rights to protection from the interference under the Part 15 rules. But, nevertheless, consumers complained to anyone that would listen,

including reporters, congressional representatives, and the FCC. NTIA and DoD worked together to calm the crisis by avoiding some of those commonly-used garage door frequencies. The agencies also worked with the FCC, which issued a public notice explaining the cause of the interference and urged manufacturers to replace some of the garage door remotes.

This was an early example and a lesson for us on how federal operations might co-exist with unlicensed services, and a prime example of how federal agencies and NTIA need to work better with the FCC to diffuse an issue or, even better, head it off in the first place.

For a final example, I want to look at two failures that have paved the way for the forthcoming National Commercial Service in the 3.5 gigahertz band, known as CBRS. In 2004, the FCC and industry began to enable so-called 'White Space Operations'. So, whoever earlier said "We haven't had enough about White Spaces," I give you some White Space talk. In the UHF TV band, which was allocated to broadcasters, but because of the way broadcasting works, there are power levels and there are geographic distribution-- it was unused, in many locations. Despite best efforts, mass-market services have failed to emerge from this experiment. However, the efforts to document available White Spaces in basic databases, provided a key lesson for development of the Spectrum Access System, or SAS technology, which is now being tested right down the road at our ITS labs and will be deployed in conjunction with the tiered-access approach, the CBRS band. Another key innovation that will drive CBRS in 3.5, are dynamic protection areas.

When NTIA first studied this band for potential repurposing, it initially recommended protecting military radars in the band by imposing static exclusion zones along the coasts. It's a common approach at the time, for mitigating this type of interference, but you really can't have a nationwide service if you don't serve the coasts. Industry and government collaboration came together and the older static model of exclusion zones are being replaced by a dynamic sharing model that will allow multiple Spectrum uses across time and geography.

Along with SAS and the ESC, which is what we're talking about for dynamic protection, the Environmental Sensing Capability technology, we're now putting systems in place that can allow CBRS to flourish. We'll see over time how truly effective this model really is, but I expect it will influence our efforts in other Spectrum bands, if this turns out to be one of our successes and not one of the members of the Hall of Shame.

I mentioned earlier that non-issues are often the definition of success and as we've been sitting here today, I'm going to take a moment to, sort of, think through how that is completely true in our daily lives. And I think we take for granted some of the most

interesting successes. Everybody thinks about the things that we do every day. Of course, we talk about commercial mobile radio systems. We talk about, you know, the FAA's radar systems, but take for example the simple act of checking the weather on your phone. In order to make that happen, we had to have a robust launch vehicle take off, have radio communications between the launch site and launch control, you had to have telemetry data over a wireless link to get that satellite into orbit. The satellite providing you with an overhead view has to actually work, it has to be able to get its information from orbit, back down to an earth station. And then ultimately your phone has to be able to connect wirelessly to your carrier's network in order to pull down those radar images.

It's stunning to think how much work actually goes in on a Spectrum-based system, the number of systems that have to go in just in making it so that you can see how long it will take for the thunderstorms over DIA to clear, so you can actually get out of here. As he says, having been delayed three times this year coming out of Denver.

[audience laughter]

The other two that I came up with when I was sitting here, I think are interesting, are things that we don't think about that are just everyday occurrences. How annoyed are you when you get on a flight now and don't have an internet connection option? That's not that old a technology achievement for us, right? I mean, this... the fact that we have satellites and we have effective mobile antenna systems on top of aircraft to provide us with the ability to message our families while we're at 35,000 feet is a relatively new development, and it's one we don't think about, but it just occurs. And for the students in the room, I would ask you, how many of you have ever been to a toll booth? You're welcome, that's wireless technology at work, right? The days before EZ-Pass, you actually had to stop at them. And to be clear, none of these things happened without risk. There was a significant amount of risk that any of these could have not been successes but yet here we are, and we take them for granted. So, as we look at successes, alongside our failures, let's not forget the ones that are part of our everyday life and we just take for granted.

Our willingness to take risks, turn around failures, and invent new solutions is a direct result of this lineage of US Spectrum policy decisions that, while not always perfect, have propelled us forward in expected and unexpected ways.

This willingness to act, to be bold, is vital going forward as we face increased competition and security challenges in the global economy. It's imperative that the US maintain its technological leadership and Spectrum access is a key component of the formula to achieve this. As such, we need to leave no stone unturned, in seeking new ways to make better and more efficient use of this incredible resource.

Fortunately, we have a strong foundation in place through our work with stakeholders across the federal agencies, the FCC, Congress, and industry. There's a wide recognition of the need to weigh federal and non-federal priorities, to best serve the public interest and a consensus around maintaining US leadership in wireless technology. From 5G broadband to unlicensed technologies to satellite and space systems, the US is leading across the board.

Finally, we're looking forward to guidance we expect to receive soon from the White House on developing a national Spectrum strategy to further shape and inform our work. A framework for a longer-term, sustainable ,and flexible approach to Spectrum policy-making will help us preserve and extend US leadership and prepare us to meet the nation's future Spectrum needs.

I'm confident that across this administration we're driven to make lasting progress and enhancing Spectrum efficiency and maximizing its use.

I thank you so much for having me here. I always enjoy visiting Silicon Flatirons, and I look forward to answering your questions.

[audience applause]

[00:18:39]
David Redl: I'm getting off easy.

[audience laughter]

[00:18:42]
David Redl: Ah, Dale, of course.

[00:18:51]
Female Speaker: Sorry, I'm coming.

[audience laughter]

[00:18:59]
David Redl: Every time Dale starts with the questions it makes me nervous. Lawyers answering engineering questions is always challenging.

[00:19:04]
Dale Hatfield: I want to be brief, but all this additional reliance and everything becoming wireless and we've talked about interference and, of course, that's, as we say, "the fundamental

part of Spectrum Management is the interference issue." But what worries me when I hear talk about systems that need very, very low Signal-to-Noise ratios...a very low noise to be able to function properly, it leads us into this issue of "What if some bad person wants deliberately... I'm talking about deliberate malicious interference, and if we're all wireless are we okay?...are we okay in terms of the resilience of the networks? And I would ask our enforcement behind that.

[00:19:57]
David Redl: So, out front, I think it's important to say where you can use a wired use, use a wired use. Right? Let's make sure that where there is... you're using a right tool for the job, and I'm certainly not a proponent of using wireless just to use wireless. Use the right tool for the job. That being said, Dale, I share your concern, and so does NTIA and ITS.

Interestingly Keith Gremban, who is the director of the lab is here today and he would be I'm sure happy to talk in more engineering detail about it than I'll be able to. But two of the things that we've been looking at it, right, are questions of, what does the proliferation of devices mean for the noise floor? We've had this conversation internally, which is we've talked a lot about enabling more devices, enabling more uses, densification of networks, but to go back to one of your favorite subjects, like, what does this mean for the discrimination of receivers? What does the noise floor change mean for the way we look at Spectrum policy? We don't know the answer yet, but ITS is doing some good groundbreaking work to try to take and look at that. Perhaps more interestingly, we're also looking here in Boulder at what the use cases look like, what does Spectrum use look like? There isn't really a baseline measurement for what Spectrum usage looks like day-to-day in a college town. Frankly, having gone to school in a town, not unlike Boulder, but out east, with fewer mountains, you know, the Spectrum used varies wildly.

A college football Saturday is not going to look like, you know, a summer weekday in Boulder. And so, what we're trying to do now through some of the work at ITS is look at putting together what these baselines will look like. What does our actual Spectrum use in this country look like?

So, we share your concern. Again, I will defer to Keith, in terms of the details, because I've learned that I should not talk about engineering when I have engineers here, so. Oh, no, Kreilein.

[00:21:54]
Alex Kreilein: Oh no, it's fine.

[00:21:54]
David Redl: Be gentle.

[laughing]

[00:21:57]
Alex Kreilein: You'll be...you'll probably be fine.

[00:21:57]
David Redl: Be nice.

[00:21:59]
Alex Kreilein: So...

[00:22:00]
Pierre de Vries: Identify yourself, please.

[00:22:02]
Alex Kreilein: Oh, sorry. Alex Kreilein, former ITP student. So, David, question for you on, kind of, the disciplinary nature of infrastructure as it relates to how we go about looking at policy, not just Spectrum policy. So, I wanted to get a quick thought experiment. So we have...We've got a number of systems that have been attempted to be deployed. A case example would be DSRC, for autonomous vehicles. From a Spectrum Management perspective in, like, 1740, when they decided to allocate that Spectrum for cars, it was 1996 or whatever. The...It seemed like a good idea at the time, but it's predicated on a bunch of things that have absolutely nothing to do with wireless systems working all correctly, right? You need encryption management systems to work correctly. You need to have certain chipset systems to work correctly. And none of that really has anything to do with Spectrum policy, but we make a Spectrum allocation on the basis that we think that all these things can work, right? So, what extent do changes, not on the wireless side, but on the infrastructure side, need to start getting married with policy for Spectrum Management?

[00:23:13]
David Redl: So, I think your premise is fundamentally correct, and I would note that I think what we're seeing is a microcosm of that with 3.5 GHz because 3.5 is a systems engineering problem. 3.5 is not a spectrum policy question alone, it is not a software engineering question alone, it is not a hardware question alone, it's a systems engineering problem, and if you're not looking at those things holistically you're going to end up with one moving on a track that doesn't line up with the other. That's a failure.

                   I think what we've learned over the last couple of decades, frankly, is that the Spectrum industry, Spectrum-based industry, people who, that is what they do for a

living, that their business is reliant on Spectrum, are advancing at a pace that is significantly faster than most traditional industries.

We saw this with the analog shutdown in wireless, right? We still had, for those that are not familiar--analog cellular was required by law to be perpetuated for a specific period of time. When it became time, the wireless wanted to shut it off, it was the auto industry that didn't want to! And OnStar, actually was pushing hard at the FCC to retain the requirement that you maintain a deprecated (at that point), analog network solely to support those devices. And I think you're going to continue to see those kind of upgrade mismatches, right? Where you have changes in technology that will require a wholesale swap outs of equipment. And in some cases that's going to work and in some cases, it just isn't, right? We saw this in television also, it's why we ended up with the DTV converter coupon program. But we've seen different approaches to how to address those concerns. None of them are perfect, but each iteration we learn something new about how to make traditional industries who are now Spectrum-based, line up with the upgrade cycle of this industry.

I will give one more example, only because it's something that I worked on when I was a legislative staffer. I wish Commissioner Rosenworcel was here, she did too, which is FirstNet. The entire premise behind FirstNet is to bring the commercial upgrade cycle and economies of scale of the wireless industry to bear on a small but very important user base. Relatively small, it's, you know, it's more of a million subscribers, but it's a relatively small compared to population of the United States.

I think we're seeing that play out now. You look at the NIST list of devices that have been certified for First Net and they're not old devices, they are modern broadband devices. So, I'm cautiously optimistic that what we're learning from that experiment in bringing in industry who had trouble keeping up with the economic...or, excuse me, the technological curve forward through economies of scale that will learn something there that will continue to bear on this challenge.

[laughing]

[00:25:58]

John: John Schoppert, 3L here at Colorado Law. So, I heard you talk about preferring, you know, wired connections when available, and that's not the first time I've heard that today. However, taking a step back and just looking at the trajectory of communications, you know, you can't ignore that it is becoming increasingly wireless. And so, do you think the kind of the PSA of, you know, being wired when you're able to is going to be enough to, you know, circumvent some of the problems that Dale brought up in terms of interference and the complications of wireless communications?

[00:26:34]

David Redl: No. I mean, short answer's, no. Let's be clear, right? The future is wireless and mobility. I think that's clear and everyone sees that that trend is going to continue.

Another thing I meant with using wire where possible is that, you know, there is an impetus to use wireless just because you can, and I can appreciate that. I like toys as much as the next person. I enjoy making systems work together in my own home. But I ultimately decided to wire my house. And it was a strange decision because mostly because I wanted to make sure I was maximizing the Wi-Fi availability for my devices that I didn't want to wire. But I think, you're absolutely right, that wiring is not going to change the fundamental nature of the fact that our connections are moving to wireless in general.

[00:27:29]

Jordan: I'm Jordan Regenie. CU Law. As the wireless ecosystem continues to become more saturated and congested, it seems inevitable that, at least on the commercial side, market forces will lead to greater improvements in receiver technology and, kind of, alleviate some of the interference problems. How do we achieve similar results from the federal government side without those same kind of market forces at play?

[00:28:00]

David Redl: So, it's tough to paint the entire federal government with one brush, to be clear, right? You know, when I look at bands we have very different challenges when I'm talking about FAA radar systems or NOAA's satellite systems versus precision-guided munitions, right? These all have very different system characteristics, and frankly, they all have very different priorities and influences and imperatives. I think everyone in the federal government gets that we should be using these resources as efficiently as possible.

Like any economic experiment, it depends on whether you have the resources, the time, and whether or not you can continue to maintain your mission readiness if you're a federal agency while making these changes.

We spend...almost half of the employees at NTIA work on Spectrum-based issues. We spend a lot of our time working with federal agencies and their Spectrum folks to say, "How can we help? How can we make you more efficient? What do you need from us?" I think everybody in the government gets it, but you're absolutely right, in that government incentives and commercial incentives are *very* different. And, again, I think it's very difficult to paint them all with one brush. So, I don't have a very good answer for you in terms of, "Will this work?" It'll work to varying degrees, is the answer.

[00:29:26]
Male Speaker: [Inaudible 00:29:27]

[laughter]

[00:29:29]
Female Speaker: I can't walk that far.

[00:29:30]
David Redl: Very active corner of the room.

[00:29:34]
Dan Lubar: David, thank you. My name is Dan Lubar. I'm with Relay Services. I just want to pick up
                  a thread from earlier today, with Tom up on the front of the room here and the
                  question was asked, "What do you think of the future of US Spectrum policy in IRAC,
                  and is there a more active role for the Department of Commerce? Love to have you
                  comment on that.

[00:30:05]
David Redl: I mean, did anyone working in a job ever say "No, I'd like less authority and fewer
                  resources?" I mean, of course, I like what Tom had to say about the Department of
                  Commerce being more active.

                  I appreciated what Professor [Inaudible 00:30:19] said, in terms of the outlook that
                  Commerce has across the entire economy. And I think, you know, Secretary Ross, I
                  know takes that view and I certainly take the same view that it is imperative that we
                  look not just at one little piece of what we're doing. I often tell people specifically when
                  it comes to Spectrum policy, you know, I have a dual mandate. Congress has told me at
                  the same time, I have to protect government incumbents, make sure they can do their
                  jobs, and I also need to make more Spectrum available for commercial services.
                  Usually, these are mutually exclusive. You know, finding those areas where they are
                  not mutually exclusive, is a difficult task. Very few government Spectrum bands are
                  used by one user. That's a...usually a really complicated mix of time, geography, and
                  frequency that allows our government users to do the things they do every day, most
                  of which you'll never know about or will never pay attention to. So, it just occurs and
                  you don't think about it. All of the FAA's radio beacons that they use to keep our traffic
                  control system working right--It's something you don't pay attention to, you just
                  assume that your aircraft are going to get there on time.

                  I take very seriously the notion that we have to look across the US economy. And when
                  we took a look at how we could do more in this space, one of the first things we said is,
                  "How do we bring together..." and this is something that we're working on right now.

"How do we bring together the views that we take from our advisory committees inside the US government our Commerce Spectrum Management Advisory Committee and how do we bring those two groups together in a way that produces the kind of give and take that we're hoping for?" It's an ongoing process, but I appreciate what Professor [Inaudible 00:31:59] had to say, and certainly love to take a more active role across the US economy. I think I'm being given the high side [phonetic]. This has to be the last one, so.

[00:32:18]

Allen Magnusson: I wanted to ask...so, earlier in the second panel where you're talking specifically about how economic output is one of the few objective metrics for Spectrum policy success. How do we use that metric when measuring what might be considered more intangibles on the fed...or...in the NTIA side of things? Public safety, DOD/defense, these are things that might have... they're harder to assign a dollar value to maybe than a build-out of a network or how many devices are flowing around the market.

[00:33:01]

David Redl: Sure, so to be clear, I think economic output is a great metric for commercial licenses. I'm not sure it's the most effective metric for government licenses. And again, to go back to my earlier comment, it's very difficult to paint the US government with one brush or even with a broad brush.

You know, so, when I look at the FAA, right, your metric for the FAA is, did they get the planes where they need to be safely? Right? Did the system work, to make sure that every aircraft in US airspace got where it needed to go without incident? That's a metric that I would assume the public is happy to see that the FAA is doing a great job on that front. But it's not a metric that really is measurable in terms of economic output.

You know, same thing goes for some of the things that we see with respect to our law enforcement agencies. How do you measure the efficiency of the FBI's radio equipment? Is it the number of times that their radios, worked? That's not really an economic measure but I can assure you that the FBI agents who are in dangerous situations trying to save people's lives, want to be very sure that their equipment is going to work as they expect it to work. So, we've spent a lot of time and, in fact, the group I touched on earlier, the Commerce Spectrum Management Advisory Committee, spent a lot of time on this, as has most of the federal government on what are the incentives in the US government? What are the things that are objective measurements of how efficiently we're using Spectrum? It's hard to come up with metrics for that, mostly because the uses are so widely varied. Sarah Morris is sneaking one in at the end.

[00:34:41]

Sarah Morris.   Thank you, David. Sarah Morris, iHeartMedia. I want to flip that question, which I think is a really good one...

[00:34:49]

David Redl: No, fair NTIA-alumni asking questions. It's...

[00:34:51]

Sarah Morris: NTIA and FCC.

[00:34:53]

David Redl: [laughing]

[00:34:53]

Sarah Morris: So, you know, we've seen both sides. And that's a question too, how is NTIA getting along with the FCC always, you know? But I'll leave that for the cocktail party.

[00:35:04]

David Redl: [Inaudible]

[00:35:05]

Sarah Morris: No, so my question is, given the continually limited resources that federal government agencies have over the past ten years, obviously the FCC's resources have just been, you know, going down every year. NTIA and all of these agencies who, not only require Spectrum for their missions and their uses but also have to be continually modernizing their equipment so that they are carrying out those missions well. How is that impacting your job in Spectrum Management and assisting these agencies to do their... carry out their responsibilities?

[00:35:46]

David Redl: So, it's really my predecessors that had to deal with that, more than I am. And I would point to the fact that, you know, Federal Spectrum Management went from "Do the same with less," to "Do more with less," and now, thanks to what was in RAY BAUM's act, which came out of Congress as part of the 2018 appropriations, we're looking at, "Is there a way for us to share, to do more potentially with more? Or to do the same with different?" Bi-directional sharing is one of things that we've been told we need to take a look at. And whether or not that's a viable option...we will be responsive to Congress, we will do the report we were told to do. We're working with the FCC on that. We're working on what unlicensed is going to look like, and whether our options for unlicensed to share with federal users, and whether federal users have other ways to achieve their missions than the pure assignments that they've always had. It's a really interesting time to be the head of NTIA because there are so many varying things

that we're being asked to consider, not the least of which being, 'What does FirstNet mean for us?' Right? Now, that FirstNet is up and running, what does FirstNet mean for federal users who have radio needs?

So, it's a very interesting time to be the head of NTIA. I think I've got it a little easier than some of my predecessors in that respect, in that there are options for us to look at and we're going to explore them going forward.

[00:37:12]
Pierre: Alright.

[00:37:12]
David Redl: Thank you.

[audience applause]

[00:37:14] End Audio