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ASIA PACIFIC REGIONAL INTERNET GOVERNANCE FORUM
MACAO 2015
EVOLUTION OF INTERNET GOVERNANCE:
EMPOWERING SUSTAINABLE DEVELOPMENT
1 JULY 2015
ROOM 1
13:00 LOCAL TIME
SESSION 59
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>> I think it is time to get started.

A brief introduction -- the main reason is, at the same time I think that -- this is a big task, right, we have all of the details. At some level we have to understand what is this. You hear a lot about it. Yes, you do.

There is a community, a Civil Society, academia, the current experience, it is -- we'll start today's panel and we'll talk about the countries, the islands, and his experiences, and then we'll go to Jonathan that will talk about his experience in New Zealand and policy and regulation and use of spectrum there.

Then we'll go to Ulrich Speide from Civil Society. He has key points on what is this meaning, what is coming up.

We'll go ahead and start.

>> Thank you.

I'm from LIRNEasia, a think tank, and we started about ten years ago, now we recently are in the Telecom more -- recently are more in the Telecom. Previous to that, we started to look

at how users actually are experiencing -- what is their use experience. You see with a lot of countries, we have some connections. This is the charts. India, a lot of cities, main cities, Bangladesh, Sri Lanka, so on. You see the performance, and you are getting to the rational science. A standard that we have been recommending, it is the 300 milliseconds and in most cases we're not approaching that. You see that from 8:00 in the morning until 11:00. You're not getting to the 300 milliseconds in a large number of the countries.

The issue is, how do you address this and what is this problem caused by? If they use it, if the user doesn't get a good experience, every time you go to reach a website, if that website is not located in your country or generally from small economies somewhere else, you get less process and you won't actually get anything back in response so these people are frustrated and technically, you know, most people, they have their experiences with their own country, that context.

Now, on the other side we would say that one of the main issues with the Internet access is the price, affordability. The country that I live in, Sri Lanka, and we're some of the lowest retail Internet prices in the world, but that doesn't seem to reflect into the kind of connectivity, into what we should expect in the low to middle income country, lower than it should be. We argue that there is a whole lot of factors that have a bearing on this issue, what is price, what is performance, another is availability of the appropriate content. There is a whole ecosystem, not like in the old days. With voice, you simply pick up the phone and dial the number or press a button, that was it. We do recognize all of these factors, yeah, we think a critical thing is this problem with international connectivity.

A country like us, for example, we have many undersea cables coming in, we have two more being built. Why is it that we still have this? The reason we still have this is the regulatory problems, the cables, they are still effected by market poor, poor regulatory oversight but more than that, it is just the issue, we are working on this front and overall in Asia, the IP concept prices, they're very hire than in Europe and others, six times as high. What happens is when you have low retail prices and high -- you think about it, the highest, you have to pay for the highest, the IP, that's an input that's a challenge. What they do, they basically go from IP which means latency problems and we'll talk about that.

We believe that we need to address this problem, that is to address the international connectivity, international backbone problems and really working with the U.N. economic and social for the Asia-Pacific to get the attention of the economies, the

regulatories and all of the other parts so that we could be getting more redundancy, more networks, cables that will work underwater as well as others. Asia, although it is a huge continent with land mass, it seems to be -- up until three, four years, Bangladesh, it is completely surrounded by India and was actually connected to India only by a undersea cable, one undersea cable. It was not connected to other things at all. This kinds of issues have to be brought to the relevant departments and it is not an easy task, we're dealing with one side and silos so now it is perhaps the highest priority, it is for the Asia-Pacific information super highway. They're now emerging, that community and ICT community so that in the future the highway, a road network, that will include permissions for conduits that will carry fiber. It is not simply about fiber but also about the regulatory and policy aspects that there should be open access to that people can use it economically efficiently rather than giving it over to providers in each country. We had it in regionals, N EPA l, India, the money is being spent on building cables, the cables have not been built for the most part, even when being built for example in those regions, they are not useful because the authorities that are given charge are the local Telecom monopolies, formidable markets.

I would say that's a serious issue. We have the policy and regulatory issues and there is also technical solutions. That is it.

>> ROHAN SAMARAJIVA: What we're going to do is I would invite Ulrich on stage for his presentation.

>> ULRICH SPEIDE: I was listening to what was just being talked about, I was thinking about Fiji, we were incredibly angry with the government at the time because they simply refused to see this requires much, much more much a connection to the local network and information at the time to be reasonable. We have the use of video, audio, so anyway, that's what we have there.

Basically I was going to introduce you from the work that we have been doing in the Pacific. Basically why we do this work, the responsibility, accessibility is an issue, and there's a long reach and these prices, they do not include New Zealand. People are -- they have the -- they don't quite have the networks. We're dealing with the bottle next so we're connected and unfortunately, it is conditional. This is a picture of the projection that we get, this is basically all of that. So we have ran into this completely and then we see a drop. The practical effect of this is what I won't quite name yet. This was a satellite and as a ballpark, you can expect a few hundred dollars for that.

(indiscernible). Here we have free Internet capability for everybody. It is free for everybody on the island. Everybody can get the wi-fi, but you have to get it to work with the signal and I can tell you it is difficult to get this to work, this sharing.

So Tuvalu, it is a place where we have Internet connectivity for somebody that's in the network, then they try to connect and we try that.

So given that we have this problem with the commission, it is working very well, we were thinking about, well, you know, what could we possibly use for alleviating this. Of course, you know, where is the low-hanging fruit we can pick and we were thinking of why not get into the selection and look at IP packets. We looked and came across this possible network coding and I'm pretty sure most of you will probably remember mathematics by symbol and probably when you come across it, and then the algebra and then the linear fractions, so this is how it works, basically any IP that we see on the Internet, it is justified, you can modify it by another number for the coefficients and echoes that. What we have basely done, we have taken the packets and we multiply those 10 randomly coefficients and end up with the result and then we send all of those in the new packets and have that combination packet. The other packets we stop at the place we encode and then we choose another set of coefficients, you have the coefficients here and then we'll send another code packet with those and basically what we do, we generate just a little bit over in the combination packets, all we need to generate is the large packet because we cannot afford to lose any number of these on the national packets with the receiver and we'll still be able to solve that system of innovation with the original numbers. When we do that, we can basically use the original IP packets, whatever they are, and therefore we can basically mask from the receiver that we have on the island what their packet was and see what happened so that receiver are continue to operate and not slow up. The benefit there is that we go -- if we're able to keep the overhead grounds, this is still the same acrider, we decide what and when slightly more protection to take up the bandwidth anyway. The receiver also has combination and the TCP, it is faster, it is not backing off as quickly. You can run this so it is completely transparent to that side and they don't even realize it. The set-up is basically like this, you have this setup and then basically you're watching, you know, all of the packets, you have them with the island hosts, the island benefiting from the coding, it is initially to an encoder, decoder which is then to a sat gate and then it goes to another sat gate with the code of traffic and then it is up and then

coming down, going to the encoder, at which point it goes to another IP, to the TCP/NC encoder and passed on to the host there. Essentially we're running that and we can afford to lose a certain amount of packets with that on the island.

An example here, this is Rarotonga, they have 160Mbps inbound as early as to 15 and they are at 332Mbps, in January, early February, what we saw, it was -- these dots, the packet dots, what we have here, this is the 20 megabytes her point, so quite efficient for those points. We have a larger pack available but what we can see, is that oftentimes this is around this curve. It doesn't need monitored all the time but we have the packet loss, you see that here in the beginning of the execution period, you can see basically a few isolating TCP and then we have to look at the network code and keep going on --

This is what we saw earlier. Then we have twice the original bandwidth and what we have now, it is hardly -- even with the performances here, the coding here, with the current TCP, but we're able to get back up to the original figures again but we have more numbers on the island, they're trying to access, another thing we find, we have a lot more packets and also we find is that during the day while we're looking at this, it is quite substantial and we also see with the coding, we're at least able to keep this alive and get them to a different place. You may be able to see this, it is covered completely, this is 20 megabytes and then for other times you see -- okay. So this is a bit on the shoulder sometimes. The view, for example -- sorry. Okay. We have a little bit of an effect as you see here most of the time. The problems we have, we're doing these experiments, one is across the only operational -- only operationally into the islands. If we do that, that tunneling, we can say well it looks good with this isolation, in that scenario in the Pacific and then it shouldn't ask how many times faster but this really, this is a question of -- we don't have the answers yet. I have not been able to display any of the telcos to basically say this is our code and there are some logistical issues involved, most are around the IP information, that sort of stuff because essentially what it means is that they can set a gateway that's on the island and IP number with this front, from the different systems and IP numbers that you're serving.

Once we get this, we're sharing that channel of unencoded TCP I actually expect that I'll get this to do a lot better than that. Basically currently what we have worked on, what we have seen universal, the effects, even if the model is completely lost in the satellite link, and also we have the Aitutaki islands, and then we'll go to the next, and the other thing we're working on is the times with these points.

That's pretty much it for me.

>> Thank you. That was very interesting. We appreciate it. We're looking at ways to smoothen out this.

We have heard about network coding and now we'll go to the process of spectrum.

>> JONATHAN BREWER: I'm Jonathan Brewer and we're talking wireless and the Internet provider.

I have ran into a lot of technical, regulatory problems when working on this business. I have been doing consulting in countries, in a resource center, teaching some of what I have learned in my journey here. We'll talk about this and fixed wireless access for New Zealand. Here we go.

This is a chart from Communication Resources Canada. This is showing complexity and cost with the Y access here and the population density. This is quite important. It makes you want to use some technologies like fiber optic, the modals, ASL in rural areas and they want to use fixed wireless and in areas where the population is say less than 50 people per square kilometer you probably want to use satellite. The problem with satellite is the performance, it is very poor so far. You try to stretch out this wireless as far as you can.

I put some numbers up here about New Zealand, these are urban areas, this seems like fiber optic is too expensive but we're going to subsidize that solution and we're actually getting fiber. Immediately for the Auckland region, it really looks like fixed wireless is the least costly complex to use. The average New Zealand, wow, it is satellite. And even in these areas, the satellite isn't working as well. What happens, many of the rural areas, fewer than 4% uses the wireless technologies. We know that the most efficient and at least costly technologies, it is wireless. Why is that? Well, here is what resulted in New Zealand and I have now taken every address in New Zealand, I have said what are the services available in this address and I have said what is the medium household income in this neighborhood, we have had 45,000 region income variations to come up with this chart. This green spot, it is 2%, if it is red, it is 5% or more. Now 5% is what the ITU says is not affordable for Broadband. Across New Zealand rural areas we have out of affordability, this is what you get out of the main towns and it is funny because this follows the rivers, and this same pattern repeats all over the world.

So it is unaffordable, we're not using fixed wireless technologies. Why is that? Number one, we have a history of spectrum porting by the large communication providers. The post office, it was then called Telecom New Zealand, they brought a lot of wireless spectrum but they also are the main provider of media itself. They bought this radio spectrum and went for

decades without using it at all. Same thing happened with this one, Australia's largest communication provider from New Zealand, they buy a lot of radio spectrum and they don't use it. In fact, they never used any of their spectrum and now it belongs to another which bought them last year. Maybe half to two-thirds of the spectrum appropriate for fixed wireless has never used it in New Zealand.

There are some public spectrum available for New Zealand, but much of it is inappropriate, the 900 megahertz band which is somewhat appropriate in some other slides, we can't use it in New Zealand. 700 megahertz, that's new and we're just starting to use it this month. The owners of the 700 megahertz, they're interested in the urban areas and the rural areas with the farmers. They're not interested in going to the communities where poor people are, they're not interested in the coastal communities in places that are hard to get to. They just want to make money, that's their major concern. Rural users are not a commercial proposition.

We have similar problems in the developing world. Licensing restrictions basically prevent the use of radio spectrum in many, many places. In some you can use enough power on your wi-fi to go across the street, maybe. Unless you have a special permission from the government to get one of the two, three telcos, then you can go much higher. In the developed countries we have much. In the Philippines, bank dash, Thailand, most have wireless licenses, you cannot commercially serve customers in wi-fi in Thailand without a license from the government. It is very, very difficult to get a license from the government. The same in Bangladesh, in Bangladesh you have to have a different license for every single part of your business, if you run fiber cable, you need a license, for wi-fi, you need a license, if you want to run a server IP, you need a separate license for that. This see really limits the use of wireless and wi-fi on small operators that don't have enough money or influence to buy the license to use the technology.

We'll talk about spectrum. Here is the typical wi-fi, this is 2.4 gigahertz, all of our laptops and phones have this. 5 gigahertz is up here. This chart says in decibels per meter through the vegetation, through trees, out in rural areas, there are lots of trees, this is the frequency. What this says is that for each meter about -- I would say -- 3-decibels, every 3-meters in this band you lose this much and every 10-meters you lose half your signal. Think of it that way, if you stand there, a tree here, and the laptop is here, you lose half the signal. Half is gone. If you use a lower spectrum, TV spectrum, you don't lose half, you lose 10%. Two trees, you lose 20%. So the TD spectrum for rural access, it allows to you

go through trees, allows you to more effectively use.

I tested this mathematically with some communities in New Zealand. We have a large indigenous population here. A lot of trees. You can't just cut these trees down. The houses, they're scattered through the trees. They're all over, the houses, there is trees between the nearest tower and house. You can't cut them down, they don't belong to you. They're needed for wind. Maybe they're fruit trees. This is a map with the wi-fi access points. We covered 18 houses reliably with wi-fi. Now at the same antenna power, the same antenna sizes, everything else is the same but for the frequency of the radio spectrum when we move into lower frequency TV-wide space we cover 55% more houses. Same electricity, same antenna size, lower frequency, 55% better.

There is plenty of this radio spectrum to go around. In New Zealand we use little. In developing countries, even less.

Here are the bands that are used for cellular up here in red. This is just a bit for cellular. This is all television. This is all television here. We just some of the television spectrum two years ago and turned it into LTE. We gave it to the cellular carriers and still now these are cell carriers and this is our TV spectrum, most of which we don't use. Why? With LTE it is easier to come from the satellite than to transmit from a tower, it is cheaper, the maintenance is lower.

What's the State of spectrum in New Zealand? We have the ability to license some free channels and we can license them for free. I can say that the government would like to use the spectrum in this band and they'll say, okay, we use it for this amount of time, this amount of power.

What about in the rest of the Asia-Pacific? Well, Japan, Taiwan, Singapore, pretty much the same. These are developed countries and their governments said let's try to use this TV spectrum for bringing Broadband to part of our countries where we don't have Internet coverage. You get into here, that's been good, but it is a small country, a very closed country with a cooperative regulatory, you get to the developing countries, here, they have been good, they only allow for a pilot for a company that owns the spectrum already. If you're a country here, you don't own the TV spectrum, even if it is not used you don't have permission to use it.

In Philippines there is a deployment of TV space but led by the Department of Science and technology, part of the government for commercial operators it is still very, very difficult to get a license to do anything requiring that.

What about Thailand, Bangladesh, Vietnam, Laos, no, no pilots, no prospects. These are regulatory problems. We have some technology that's appropriate to use for bringing wireless

to remote communities in the areas of high vegetation, difficult conditions, but so far the regulators in Asia-Pacific developing countries, they're not following the lead of the regulators in the poor-developed countries and it is our challenge to figure out why and how to change their minds.

Thank you. [Applause].

>> (No microphone).

>> NOELLE de GUZMAN: Good afternoon.

I'm from the Internet Society.

Before I go through the project, I would just like to support what was said earlier by Rohan. It was released a couple of months ago, it was a study about the potential of the Internet for economies and basically it -- we have shared the link for that later -- but we found that this is a big carrier for connectivity up until now and really in the low-income areas, the higher prices, and also higher prices, which it is not very -- is not directly caused because of the lack and if we go outside for instances with a lot of undersea cables going live, you also have to factor in how you extend domestically. When using this domestically, you have to look back at that also. That's all we need to say about that.

Just to introduce briefly, this is a rural organization with an intersection of policy, Internet development and Internet standards and there is a lot we do. One, we try to extend -- trying to promote alternative means of access to rural communities especially marginalized communities in the Asia-Pacific. In particular there are -- so far this area, it is -- we just want to -- we want to work within the environment. We have worked with India, we have used this in ten locations across India, it is very remote and we're also trying to pilot the projects like this in Bangladesh and elsewhere. What we're trying to solve in doing this project, this is not an RNB project, we have found that it does work.

So firstly, you have the -- we hear it all the time, there is a lack of local expertise. How we -- well, we make things simple. We have a program called training obtainers, these are people who have power in the community, they have -- they're not professional engineers, they have base literacy and then we're not able to deploy -- we're working with wireless national so we come in, we deploy, we manage these networks but also we train other people to do the same.

The other factor is bringing the costs down. If you have a network, this is a rural community, it is a low-end community and it is bound to be very difficult for them to even able to build or keep it sustainable. One of the training the trainers, having the local engineers, it helps and eliminates or minimizes the staffing loss and also using low-cost equipment and of

course using unlicensed equipment and also the organization that we have worked with, we have used facilities that are immediate information resource centers where these are housed.

The last -- the third one I suppose is a state of the union and one of the most important lessons that we have learned is that we really need to integrate the use with people's daily lives. They have -- we're not just talking about access here, we're talking about meaningful access. One of the ways that we come to promote the sustainability, it is through what we call the village level consumers. These entrepreneurs, they not only offer -- they offer several service, they offer literacy, digital literacy training, and this is managed by own community members themselves as well, but also basically you have the -- for hunting, e education resources and all in all, it is -- it is -- it is really about community ownership where people are able to own -- the community itself, you own, you manage, you operate and benefit from the Internet. This is not only providing access to the Internet themselves but helping to empower and develop the institutional structures with health centers, NGOs, I suppose countries that -- the rural development emphasis.

What did we learn from these projects? We have learned that Infrastructure sharing really cannot be underestimated. This is not just in these areas, but in countries -- I'm not sure where all you're from, but if you have unlimited resources, and you don't -- you refuse to share, then it is more difficult because the efforts and investments, they're duplicative and also they're under license.

The other thing I think that was also discussed by Jonathan already was that sometimes you need to kind of start liberalizing the last-mile service provision. In India we have recommended that they allow for the licensing of rural IPs and basically making commercially viable for different kinds of players to go into the market. The third thing is we need a different thinking of spectrum, Fiji, I was there and Fiji, it provides itself with the 4G spectrum option that it conducted a few years ago and compares itself with the pricing the spectrum just enough for operators to deploy the networks that are needed to deploy.

The fifth -- sorry, the fourth lesson, it is that we do need to streamline and harmonize procedures whether it is getting lease lines from SPs, putting up towers, because the hurdles, it is more costly for everyone. There are some projects that we're forced to operate in because for a certain period of time, we have -- they didn't have the ex continuation and we needed that, that was needed. Governments I think still -- they still -- a lot of their efforts, it is to put

into -- to use the huge, centralized projects, so we also kind of need to think about the smaller initiatives that can make -- we're trying to make a difference in these communities which are isolated, remote and you have to think about alternative ways of approaching it and may be smaller and a more wider level because if you're trying to do this, you can't even get across the road.

One of this, if you're not involved directly in this project, but this is -- what they're doing, at the district -- what do they call it? There are already -- there are communities that invest in the network, and what we do, they hire ISP to operate it, there is a revenue-sharing arrangement going on. Part of the proceeds go to the village, parts go to ISP and so far it seems to be working.

I suppose I will end there.

>> (No microphone).

>> Any questions from the audience for any of the speakers?

>> I just have a question, you said one of the reasons was sustainability but a challenge a lot of places face is (indiscernible). How do you convince the trainers that you just trained to stay in the community?

>> NOELLE de GUZMAN: Well, so far from our experience because they live in the -- it is not a full- time job for them. They have -- they have other things, other (indiscernible) and it is more like them trained as community members, not as employees. I suppose they themselves have a stake in it, they benefit from having it.

I hope that answers your question.

>> Any other questions?

>> (indiscernible).

>> There are a number in Africa. They have shown the compatibility of the technical space in the systems and channels. They have shown the benefits of bringing Broadband into very remote areas. The amount of people covered by the projects, it is very small. Not all regulators in Africa have decided to accept trials. It is really in the developed markets, the regulators have a desire to see 100% connectivity. I guess you're right in that if the regulators can make a change that can improve the Broadband for a large number of people in urban areas, why should they spend their efforts on technology that's more suitable for remote. I don't know the answer to that. Certainly in certain countries where everybody is rural and remote, they should spent their energy on that space.

For countries where there may be instabilities or unhappiness in the rural areas, such as the Philippines, Indonesia, Thailand, you know, it would behoove the regulator, be good for the regulator, the country it they do something to bring service to the remote areas. I think everybody agrees

with that there.

>> Thank you.

An interesting sort of aspect of that space that came do my mind, is that in Taiwan, you mentioned in Taiwan, the government, the United States, which is true, that they --

>> (indiscernible)

>> I mean, right. They're -- in terms of the regulations there, they're fairly conservative and the American chamber, they put a white paper out every year and for a long time one of the recommendations has been releasing TD white space for different kinds of uses. Their primary selling point for doing that is that it would help foster innovation, opening up more spectrum and applications for -- you know, like Internet of Things, whatever, just more spectrum for innovators to play with. There is also that aspect of that space in addition to connectivity which is just interesting. It is -- Taiwan is striving so hard to become a hub for innovation.

>> That's interesting, because the most important developments in radiocommunications in the last 15 to 20 years have happened in an unlicensed spectrum bands. The new west techniques, the highest modulations, the most interesting things have all happened in the band where you don't need a license to operate, that's where entrepreneurs can quickly gain the skill in selling. It is difficult to gain a scale in selling in a licensed to spectrum band because you have limited the amount of purchasers to those who hold the license. So over this space, opening it up, it would be good for developed nations like Taiwan, Japan, because their electronic corporations will have more spectrum and more applications without having a very limited market for their applications.

>> Hi. Just one comment around as mentioned -- thanks for that very clear explanation on how useful the spectrum is. Just two pieces of information, one is that it is true that the regulator has not done anything about releasing that spectrum, but the one thing I think also that happened is that in a recent discussion around releasing the spectrum, it has been said that you're not to touch that space. It is not just the regulator, but also the (indiscernible). There is that.

The second question, around the second question of why Civil Society, how Civil Society can engage more, in this discussion, it is not a very -- it is a very -- it is a subject that's not really well-known. There's a lot more information that needs to go out to Civil Society organizations to be able to understand how it can engage in the spectrum, at least one -- maybe some project that could use that spectrum for a project that looks at that, the sustainability could be one and maybe work with the government around that.

I have one question for Rohan, you said you're working with this development, what kinds of policies do you think or could you influence or that you think could be useful and interesting?

>> ROHAN SAMARAJIVA: Thank you for that question.

Basically in the short-term, as I said, with a lot of Internet use it involves the access network, which involves the space and other things like that, involve the domestic back core network to get to the servers in the Philippines and a lot of it, for example, is somebody using the G mail, things like that, they need to go to the Philippines and then come back. So we're looking at all of these things and the particular activity we're working on, the particular focus there internationally, what we have is -- as I said, Asia is -- we have always been connecting even the continental parts of Asia. If you take Europe, if you take North America, you have a lot of use there as well, antenna use. One thing, it is difficult to get the terrestrial cables in place, you go through the different countries and one country can hold the company hostage. We have to work with the governments where they need the cable under the highways, the railways and then different companies would be able to use it and connect in that space. We understand, we have been working on it for four years, it will be another ten years before this problem is solved because in particular Asia has met a number of bottle next. In the Philippines, there is a place where the cables are cut because of the earthquakes, there is the mine industry where anchors, they break the cables all the time, there is the straits, and now as a result of this conversation a lot of connectivity is going on, people are trying to bypass some of these points and use hybrid cables using others. Things are improving, actually improving more rapidly than what I thought, and ideally you get a few more years for this system to come in.

In the meantime, for improvements, you need the regulatory actions at the national level where we need to go in and contemplate the landing stations, encouraging the building of more landing stations, the public subsidies, whatever, we have to make sure that those are working with the access rules, that many can use it rather than just one operator can keep it and prevent others from using it. There is a lot of things that need to be done. That's the main actions that we're proposing.

>> Can I ask you a question? So in Philippines, it is not just a problem of TV rights, but wi-fi itself, and this last five days I was visiting some projects to bring wi-fi into the neighborhoods and settlements in town and all of the wi-fi were turned off because the government hadn't issued a license. Why is this? Why is it that most places in the world -- not just Thailand, other countries, Bangladesh -- why is it in the

Philippines that they're treated -- it understand the technology, it has millions involved in the technology businesses and the processes, why is it that the wi-fi is turned off?

>> (indiscernible).

>> NOELLE de GUZMAN: It is cuts in the bottom line, think that I -- I think it is one of the main problems. The only -- the Philippines, it is not considered one of the land rights in connections. At the moment, it is the only -- it is the only driver that is making legislators interested in doing something addressing the power of the numbers. They feel that they don't want to be the TK-RB they don't -- yeah, I think that's -- yeah. I think that's -- yeah. I don't know what it is there specifically. There is a specific problem there. We all know that.

>> It is the same problem that's everywhere also, to get a license. They don't want to give the license. The licenses come from them.

Thank you for that. You think it is the incumbents. That's not the first time I have heard that.

>> Obviously, you're looking at the TV spectrum, but what you're doing, you're kind of watching and moving, you know, the whole spectrum access and the last few years, you know, people are using that spectrum, the general tendencies, you know, the frequencies for the technologies, of that kind. My question is would there possibly be -- I mean, looking at this form of TV operators with respect to something like this, you know, where we can basically say we don't want to use the flexibility in the spectrum and all their sessions and space and my question is, isn't there potentially a technical solution, the solution that comes to mind is that it is not regulator, essentially what you do, you say, okay, why having a software-ready units, that some of them connect to the Internet, you know, base clip they get to the server on the Internet, which parts of the spectrum are you using in that particular location and you know, for us, a solution like this, you know, there is obviously a way to go to the authorities and say wherever we need this solved, you know, we'll be able to access the servers so we don't have to wirelessly and they'll tell us, you know, you can transmit in this particular TV channel and, you know, you can use these particular channels and this is what you use. Because we're talking about the software-defined radio here, for the hardware manufacturers, those that are manufacturing this, they have to get it right, you know, with the four batteries, you know, different countries are specialized for that particular deployment that's smaller than available. So my question is, wouldn't that be -- you know, getting that problem, you also

make it a bit of having to modestly part with the spectrum

>> You just described many parts of a standard which requires stations to connect back to a database to find out which are allowed to be used in this given time in this given place. There are five operators of the databases and when those are Microsoft, goggle, a company called spectrum bridge with fiber. . Yes. The future of spectrum is using this access, to use the spectrum dynamically for short periods of time and interchanging with other pieces of spectrum with someone else that institutes that.

The technologies, they're being developed in that you can have a common pilot channel, 2.4 gigahertz on wi-fi and you have another channel, it is discontinued, another channel that I can stack up on top and use. Maybe it is 6 gigahertz because I'm in a room with that 6 gigahertz and I walk out of coverage and I'm on the 2.4 gigahertz wi-fi and you don't have that -- you stepped outside, then maybe you have the TV spectrum that's appropriate.

We'll see different technologies aggregated now into a best standard. I believe we'll see another wi-fi series in 211A. There are all sorts of very, very interesting things to be done with the software with radio and dynamics and innovation.

>> Any other comments?

(indiscernible).

>> Thank you.

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