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Round-Table Session II – Follow the money: who's investing in what?

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Manek Dubash

Okay, ladies and gentlemen. Let's crack on with the next session. We're going to do a very similar format on this. We're going to be talking about following the money. And I'm going to invite my panel to come up, please, Dan, Chris and Amit. Take a seat. So let's try and get rid of this dreadful picture of me.

I'm going to give a quick five-minute presentation using data that Current Analysis have kindly allowed us to use, just to set the scene. And then Dan Pitt from the ONF is going to come up and do a presentation from them. And then we'll talk about the issues of the day.

So this, as I say, this is some data from Current Analysis. First of all, let's talk about current and planned use of cloud services from the enterprise side. The question they asked was: 'does your organisation currently use or plan to use any cloud-based services in the next 24 months?'. And unsurprisingly, most of them either use or plan to use. None of this will be a surprise to you, I guess.

A very similar idea, private cloud, which we're now seeing as the on-ramp to the eventual goal of a hybrid solution. Once again, this backs up certainly all the research data that I've seen over the years.

Currently concerns about moving to cloud. None of these guys have seen these slides before, of course. This is the cloud panel. There's a lot of cloud in this. There is a degree of overlap between the two, I have to say. So, yes, concerns of moving to a cloud-based strategy, clearly security and reliability top of the list there. Once again, that backs up all the research that I've seen.

So as we can see there, what this means is that hybrid is the goal. Security is the issue. Engineered systems. What they mean there is things like cloud in a box. And what we're seeing as well, of course, because of hybrid cloud, what we're seeing is multiple cloud vendors being used by enterprises. As we can see at the moment, the one bar is high, but that's for all types of cloud. But certainly we're moving into a multi-cloud environment which has certain ramifications for how you buy cloud, how those cloud vendors and services interoperate, how they compete or do that co-opetitive thing. I really hate words like that. Which then of course also speaks to technology such as SDN and NFV, which help to tie the whole thing together.

And speaking of SDN, your company's primary driver for SDN/NFV deployments, to support existing services, service enablement, cost savings, are kind of equal really. And I'd like to explore how, at some point during the debate, how you see that changing and whether or not that's actually what you're seeing on the ground, as it were.

And finally, there's only one more slide after this, I think, what we're seeing is use cases for SDN, right now, it's faster service rollout on mobile backhaul. But that will change over time. The green bars are 24 to 36 months. The red bars are 12 to 18 months. And the list as we see going down right now, it's faster service rollout, mobile backhaul, service personalisation, virtual cloud, data centre automation, which I'm actually surprised about because I thought that would be higher now, automated service, chaining and datacentre interconnect.

So I think that's it from me. So that's a bit of scene setting now as to what's happening with cloud and SDN. And I'd like to invite Dan to come and do a bit more scene setting for us. Dan Pitt from the ONF. Thank you very much.

Dan Pitt, Executive Director, Open Networking Foundation

Thank you, Manek. My talk, and I'm basically going to break it down into operators, vendors and the ONF. And most of what I say is based on experience I have with our members, both operators and vendors, who are demonstrating where they're investing by actually investing their time and their people through the activities that we oversee. And when I say operators, you'll see that there are different classes of operators. But I use the term very broadly.

So operators I see as the service providers, the OTTs and the enterprises, OTTs being the datacentre, especially the web-scale datacentre operators. And you'll see these are

fairly commonly known examples of the hot SDN use cases. But personally where I see the telcos investing are in the public and private clouds, where they want to host enterprise services, starting with elastic cloud provisioning to enable offload into their clouds. And they will either host a private cloud or host a public cloud. And they're experimenting with this.

And what I've seen in the rollout of SDN technology is they will start a new greenfield business with new technology to offer an enterprise-class cloud that's technically a little bit separate from their current network. And so that's how they're getting experience. They're starting small.

The question of NFV is an interesting one because it starts out as a CapEx saving but it really turns into an OpEx saving. And it will eventually turn into a way of gaining new revenue. And one of the ways of doing that is to open it up to third-party offering of virtualised network functions or VNF. Now some carriers are in the leading edge of this, like NTT. Others like Verizon say I can't even think about that possibility of opening my network up to third parties offering those services on my network.

The question of DevOps and IT comes up when you start to ask who's running the network. And it is gradually shifting from the network engineering folks to the IT folks. So as they learn from the IT side of the house how to run software, how to get services and how to have essentially a reliable end-to-end customer experience and quality of experience as opposed to a quality of box performance, they're going to shift more to doing things in an IT fashion. And there are those that say that the central office is becoming the datacentre.

Finally, telcos, service providers are investing in training of their people because they have a large engineering staff that is doing a lot of things they're not going to need as much of. AT&T is sending 110,000 of their engineers into AT&T university, offering them short courses in everything about the new technology, focusing, as John Donovan has said, on real-time distributed software.

So the datacentre web-scale operators, where are they investing? They're investing in white box and bare metal solutions for servers we see in storage and now for networking in terms of switching and in terms of routing. And we're actually working with some of them to build some product-type examples of that.

They're also very interested in monitoring and increasing their link utilisation and doing their own home-grown traffic engineering. The most successful deployments we've seen of SDN are where they are using it to do in-house traffic engineering that they can do independent of the infrastructure. They can test out new traffic engineering algorithms. They can flip a switch and turn them on and they can achieve very, very high utilisations on their network as a result of their in-house traffic engineering with an SDN underlay.

Enterprises are the slowest ones to get involved in this. And where they're still doing it in-house, not yet going to cloud, and that's a different sort of trend, they want to automate things. They're less concerned with the forwarding play. They want to automate especially things like firewalls. And if they can do automation and

orchestration, reduce their OpEx dramatically, that's where they're going to see their savings. They're not so much about creating new services because they're an in-house operation, but they are looking to reduce their costs.

And enterprise IT has always been a cost centre. Whether it will turn into a profit centre, I don't know. But it will enable what they do to be more directly tied into the business priorities that the upper management truly is concerned about. So you're going to see a change in the role of the CIO as a result of SDN into more of a business strategy role.

So where are the vendors investing? So the first bullet is interesting. Semi-proprietary switching and routine. Everyone here is, oh, SDN is the big thing so I have to be on the bandwagon. I have to go to my customers and say, yes, I've got SDN solutions. But if you dig a little bit below the surface, you'll see there's still a lot of proprietary technology there. Some of it is necessary because there's a lot of brownfield installations and their customers cannot change as rapidly as the technology might change. But they're starting to introduce some of the new technologies. And there are new players. And because of the horizontal layering of networking for the first time, it's enabled new entrants and players to come to the table with new technologies and new products that break the mould of having everything vertically integrated. It's like the PC industry in 1981.

There's been a lot of investment in packet optical integration. The carriers love it. The optical vendors are doing a great job with this. They're still using some of the legacy protocols through existing equipment, but they're also putting in new OpenFlow controls down in their control plane. And in a few cases they're taking it down to the optical element itself.

A lot of vendors working purely in software, and we have networking start-ups now that don't require \$200m in venture capital to build a chipset. And they're often in some aspect of virtualisation. There's been a lot of success in virtualising a network, offering an overlay solutions as an easy way to get started. That's still very popular. It is not the endgame, but it's created many new opportunities for software companies, both existing and new.

And vendors are investing their people and their money in open source projects, and I'll say more in a moment.

There's also been an investment in hardware for software-defined networking, which is not what I expected to happen with SDN. And it's this year the theme is hardware OpenFlow. We've had 1.0 OpenFlow but it had single table and it's a little bit limited and it's given good experience. Been a long delay in getting hardware support of multiple tables and very flexible deep packet inspection that's now coming to the market. We've been involved in a lot of aspects of that. We'll be demonstrating how you've got portability between OpenFlow implementations now. And it really does horizontalise the network architecture, abstracts the forwarding plane into this match action paradigm. And it gives a lot more flexibility at how you treat different flows for different revenue and business purposes of your operation.

So we have a variety of silicon solutions now, starting with the traditional merchant silicon ASICs, after the customer ASICs that are dominant in the incumbents, to something new called flexible match-action ASICs. They can look really anywhere in a packet to do a match and then take the prescribed action. No penalty in price performance apparently to the fixed-function ASICs.

A lot of work going on in network processing units (NPUs) and even FPGAs to do, again, deep packet inspection very easily. There's also a lot going on in CPUs only, mostly at the edge. But if you're going to have spine switches on top of [X], which is you need hardware processing these packets. But with SDN and the separation of forwarding and control, you can build really high-performance packet processors using a variety of technologies that bring different types of solutions to the customers with which to build best-of-breed solutions.

There's been some openness in the chipset hardware extraction layers, so the publication of their software development kits. It's not an open source world there yet. We're making progress. The open compute project SAI, the switch abstraction interface, is a good step in that direction. And it's enabling us to essentially free the controllers and the applications from knowing the details of the chip hardware pipelines. Believe it or not, I didn't think that was required, but it is. And that's coming along. And a new world of packet programming to really tell a chipset how to configure its pipeline. Very novel stuff. And investments by venture capitalists backing chips.

So open source. A lot of investment by companies. I call this the other OTT, where in this case OTT means opener than thou. Everyone is claiming we're open. We're more open than you are. So why is open source so popular? Well, because it's developmentally efficient for the vendors that don't want to develop a whole solution themselves because it's expensive and it's complicated for certain elements that do not require vendor differentiation. These are some examples. But the network controller space for SDN is a prominent one. It's complicated. It's not easy to do by yourself. And it's better if you have a community of contributors doing it, each gives a little bit and everyone can take all of it back.

Typically it gives you better-quality software. It certainly gives you faster iteration on improvements of the software and feedback from the customers who are also deploying it and contributing to it from their laboratories. And typically if there is a security flaw, it gets fixed very quickly, much faster than proprietary software ever has. And the most successful projects are ones that have a lot of community support.

So there's a whole lot of stuff in the networking world for open source software. It might make you wonder what's left. And is there any room for innovation? Any room to make money as a vendor? There's lots of room. And in fact, what's left is opportunities to make a real difference for your customers instead of everybody building the same cookie-cutter infrastructure component.

So I've given some examples here. The exciting part, of course, is the new services because that means new revenue. Some of the things I mentioned are on here. There's plenty of opportunity for how do I now abstract the network and get a network map of

it? What do I do about building an inventory of all of my components? How can I automate that? How can I turn that into a provision of network functions virtualisation, where I've taken stuff out of hardware appliances? I've virtualised it. I've put it together and then I've used that as a component of a deconstructed OSS.

And finally, where is ONF investing as an organisation? We've been doing architecture and standards for a long time. We have gotten a lot of traction in what we're doing in northbound interfaces, because this is where the application writers want to have some commonality. We're coding them up. And in service chaining, well we work with ETSI and [Avit] to use SDN to facilitate service chaining, which I think is a great step, but only an intermediate temporary step before the full de-whatever of the OSS.

We've been working with a number of major operators on how do you get there from a brownfield today to a greenfield tomorrow and to provide carrier-grade services through an SDN underlay. We're very active investing in OpenFlow. And a lot has gone on in the packet optical integration, also in wireless and in datacentre networking and in the interoperability that has been so elusive and the portability of OpenFlow implementations and hardware.

And we're investing in open source in key places that help bring it together. Most of our little protocol projects have a coding outcome. We're doing some selective integration of these major components. We'll have more to say about that in about a month's time, in June. And we're helping to build community, working with these major investments that the other companies are making. I've listed them here. We have round tables with the leaders of these. Our members are working in them also. And we're trying to bring the best solutions together for rapid deployment and experience by network operators.

We've been accused of doing PDF-defined networking. Everything we produce is in PDF. And you can't digest it very well. So we want more consumable artefacts from what we do. So we're on what we call a journey from PDF to Python. Whether it's Python or Java, I don't really care. But how do you get stuff out there? It's changing the world of what even networking standards are all about.

So in February we launched a portal called opensourcesdn.org. We put some of our projects there. Community is starting to put some projects there. That's where we'll have our big launch next month. It's the place to watch for news. And it's really the hallmark of the way in which the industry is coming together to move faster to bring solutions into the hands of customers very quickly. That's where I think those are going.

Thanks very much.

Manek Dubash

Thank you, Dan. And I'd like to pick up actually and, before we get onto the actual topics, I'd like to introduce Chris Rezentes, who's the only person who's not been on the panel yet and not spoken yet. So Chris, and of course Dan, who's the Executive

Director of the Open Networking Foundation. I should have done those introductions earlier. But welcome.

I'd like to pick up on the open source issue. I know this is often propounded, the open source. And I'm a bit of a proponent of open source myself. But just to play devil's advocate, can you give us a concrete example of open source software that's so much better actually in deployment? And I'd like to ask either Chris or Amit to provide some real-world examples.

Chris Rezentes

So you're talking along open source software, to get it deployed out into—?

Manek Dubash

In terms of running the network, in terms of providing true customer benefits.

Chris Rezentes

Sure. I think Dan hit on some very good points in his presentation in terms of what you see as a focus, changing from network to IT, right. And one of the things, very common to hear in our organisation now, is we need to hire more IT people. When you talk about on the software level, we're doing it very slowly. I think you see components of SDN in the new products that we're launching, like the secure cloud interconnect product that my team manages in Asia. You see these smaller components like use space building, things like that, that weren't common in older products.

And then from a global perspective in terms of Verizon, we had only just recently, I think a month ago, announced an SDN strategy for our entire company, where it's encompassing not just one or two, which is very important to note, it was five, at least five vendors that we were having come in and discuss and work with on our strategy itself.

So I wouldn't say that there's any one specific software strategy, if you will, in our company. I think you would see it in any new product offerings that we have. There are going to be small components here and there. Could be from a virtualisation of the network function itself or it could be more of a customer-facing revenue opportunity from that perspective. If that answers.

Manek Dubash

Yes. Thank you. Amit, did you have any?

Amit Sinha Roy

So, yes, in terms of our public cloud offering, which was call InstaCompute, that's built on OpenStack software. So we've created a solution which is business-quality in terms of its availability, in terms of scalability, orchestration, on open source software, which is available on pay-per-use basis on our cloud solution. So that's a specific solution I thought I'll bring up in terms of how we're using this.

Manek Dubash

Thank you. Any further thoughts on that issue, Dan, other than what you've already said?

Dan Pitt

Well what's tended to be the foundation of all of these things is Linux. It's running the servers. It's running the switches now more and more. And that really became a successful open source operating system by the business community, and promoted mostly by IBM initially. So it's a good lesson there.

Manek Dubash

I'd like to pick up now on a point that I made in my presentation from the current analysis data, which is that security is still top. We always talk about security in NetEvents. It can't be avoided. It's a critical issue for everyone, for customers and for service providers alike. Will there ever be a time when we're not seeing security at the top of that list of concerns when it comes to enterprises putting their data into the cloud? Thoughts. Any one of you.

Amit Sinha Roy

I think the concern will only increase. I don't think there will be any time where we can rest assured that everything that we have in the network is fully secured. With the nature of the information that we're putting up becoming more and more critical, be it design elements, patented data, personal data, data that is protected by regulatory laws and so on and so forth, that whole complexity as it increases more and more the layers of security that is required to protect that increases, starting from access, who has access to that data, to how are they accessing it, what are the kind of connectivity that is being provided to access that information, to who can change that information, who can download it, so on and so forth.

Then going to the datacentre itself, how is it stored? What is the protection mechanism, the security, even the physical layers of security which is there in the datacentre? Sometimes we forget about that. But physical layers of security is probably one of the most important areas that needs to be covered. So there are standards, of course, which are there, which allow datacentres to adhere to certain security norms.

But having said that, so there's security at every point, right, from the time who is accessing, their identity, to the device, to the network, right up to the datacentre. And as we keep increasing the critical information store and the applications that are allowed to access this, I think the concerns will only increase.

Manek Dubash

And particularly presumably also in a multi-vendor, cloud vendor service provider.

Amit Sinha Roy

Multivendor cloud then multiplies the concerns many-fold. Yes.

Manek Dubash

So what can you guys do about that?

Chris Rezendes

Yes. I was just going to agree completely with what Amit was saying. I think we're still in that reactive stage right now. Verizon's DBIR report still showed very few, if you see the incidents of hacking and things like that going on, we're just not up there. You still have those folks out there that are still steps ahead, and they probably always will. You implement some security and they figure out a way to get around it.

So what do we do about it? I think one thing that we've started doing in Verizon is establishing this DBIR report that actually works with our customers and, well actually works as a service for us, for our customers if they choose to select it, where we would actually test their networks and have reports for them, establishing examples of you had all of these incidents happening that you weren't even aware of and your system didn't even catch.

So I think we keep improving on that level. But to your first question, will we ever reach that point of never worrying about security? I can't imagine with the folks, the intelligent people out there that can actually figure out ways to get around security.

Manek Dubash

Well perhaps not so much not worrying about it, but not being always at the top of that list.

Chris Rezendes

Sure. Sure. I would still say I think we're a long ways from that happening.

Dan Pitt

So I think that Amit and Chris have just illustrated the great paradox of security, which is that it is both the driver and the impediment in the move to cloud services. It's the impediment because, well, I'm afraid will the cloud services provide the security I want? And that's based on, I think, that you can provide better security yourself. And that's where the driver is, that it's going to be harder and harder to have the latest security tools basically and skills in your own enterprise. And when you have the economics of scale of a cloud provider, they can afford to get those skills and to have those tools. And so I think the keeping it in house because you're afraid to go to the cloud leaves you perhaps more vulnerable than you realise because whether it's a physical security or the information security, there are more traps than there are people to close those traps.

I think we are hopeful that some of these new technologies, SDN being one, will provide much better tools for isolating security threats before they can spread, because you can react very quickly and you have great control over whether it's individual flows, individual people accessing the network. This is what some of the early adopters of campus SDN are using it for is to mitigate security threats.

Manek Dubash

Dan, do you see regulations catching up with that issue yet in terms of the way that the enterprise, the CIO are responsible for that security and particularly obviously in the financial industry and similar areas?

Dan Pitt

I don't think regulations do anything but react to market realities. So they never really keep up. But they are a pretty good motivator.

Manek Dubash

Okay. Any thoughts, questions out there? Okay. We saw, as I mentioned in the presentation of that data from Current Analysis, that the primary drivers for SDN and NFV deployments were to support existing services, for service enablement and for cost savings. Now they were all pretty equal on that pie chart. Do you see that changing? Any thoughts?

Chris Rezentes

I think in Verizon, I don't see that changing. Like I was explaining earlier, I think we have the new products that are coming out that have components of SDN that you'll see in there that are just as important for new revenue as the virtualisation of your network functions to save on cost and be more efficient in your processes. So I think what you'll see in our strategy is pretty much even across all three of those. Yes.

Dan Pitt

I disagree. I think that it will change because I think what that chart reflects is where different organisations are already on the learning curve. And the ones that are earlier are about existing services. And the ones that are in the middle are about cost savings. And the ones that are further along are already past that and they're into new revenue production.

Manek Dubash

Okay. Amit?

Amit Sinha Roy

I'm caught in the middle.

Manek Dubash

You certainly are.

Amit Sinha Roy

So I think the whole aspect of moving to SDN/NFV was primarily around driving open architectures, driving open systems, moving away from proprietary and then the cost savings. Balance that together with some of the complexities, specifically when there are changes in the datacentre. So that of course adds to the cost as well.

But looking at how the evolution is happening as well as the adaptation is happening, clearly that is the way of the future. So moving away from proprietary systems to open systems to be able to be more flexible, use standard hardware, have the flexibility to change, adds the complexity. And I'm sure there's more technologies that will speak about that, simplify that complexity. But that's the way it's moving forward.

Manek Dubash

It seems to me that one of the hardest things inevitably is the development of skills. I think Dan touched on that quite well. How hard are you finding it, Chris and Amit, to find people to help manage this stuff, this brand-new technology?

Chris Rezendes

I would say we're in that learning curve right now.

Manek Dubash

It doesn't sound good.

Chris Rezendes

Right. It's not. You want to be at this point right now, but it's the change from building network to now IT solutions that you still need those network experts that know the network, but you need also those folks that have the IT experience that are going to be making things more efficient and reducing your cost and having the new ideas for revenues. So, yes, like I said earlier, I think we are lacking in the resource of that as well. And it impacts where investment is going as well. I don't think you're going to see – at least in Verizon we're not seeing as much investment in global networks. We have the global network out there already. So you're seeing a shift away from that to more of the IT solutions and internal investment on that area.

Amit Sinha Roy

So to answer your question directly, it's very difficult to find the resources. And one of the organisations I worked for in the past, which was a leading network provider, [eco-point] provider, had an amazing programme with the educational institutes to actually certify, to have engineering institutes to have courses on networking. So maybe that's a way forward in terms of being able to actually plug some of these into the curriculum of engineering institutions and colleges to be able to build that next

wave of engineers, because today we have, like you mentioned, there's a network specialist and there's an app specialist and the OS layer and then of course you have the firmware guys who are developing at the ASIC level. But then to have a blended capability, I think that's not there today. And perhaps maybe one of the areas would be to build it into an educational system as well.

Dan Pitt

You're absolutely right. If you look at what network engineers do, they work on software, but they're not computer scientists. If you look at the application and computer scientists, they actually don't understand networking with distance and latency and distributed state. And so neither one is really ideal. So my friend, Jakov Stein from RAD in Israel, gave a talk at a symposium we had in Tel Aviv last month. And he said we need a new discipline, and it blends these two, and it's called computation. So that's what we need to put in the curriculum, Amit.

Manek Dubash

Is there a sense in which that skills gap, which presumably also exists within the enterprise as well, is actually driving people towards the service providers, towards the cloud?

Dan Pitt

If the cloud providers can make a good case that they have those skills, and frankly the ones that are getting that reputation are Amazon and Google.

Chris Rezendes

I think, well our experience when we've been meeting with those application providers, the Microsofts and like Amazons, I think they were explaining that they're running the same situation that we are. So the solutions that the carriers are partnering with these cloud providers on have – so we have the experts that know our network and they have the folks that know their cloud applications.

And merging the two together and actually going to market, what you're finding out in the discussions that I've had with the folks here in the region is that it's very difficult to sit in front of their cloud team and explain: here's Verizon's network offering, secure cloud interconnect, and it has all these features and functions for the customer, go offer it. And they're going to look at you with a blank stare. And then the same thing on our side, it's like, okay, you want to connect to Microsoft and we pretty much have to give a call to Microsoft to bring them into the customer meeting. So yes.

Dan Pitt

So let me ask you a question then, Chris. How possible is it, do you think, for the traditional service providers to partner with these new cloud providers or are they really going to be in competition?

Chris Rezendes

Right. You know, Dan, I have my view and I think Verizon's stance with some of the leaders is a little different. But I think it's very possible. I think like what Jim focused on this morning with the APIs, almost of a resell model, like those discussions are happening today. But there's some complexity in that because when you start talking about reselling cloud with network or vice versa, your sales people don't just sell anything for free so you get the complexity of the commissions and things, and the knowledge of understanding all these different cloud providers. But to answer your question, I think it's very possible in the future, for sure.

Amit Sinha Roy

So, Manek, to answer your first question what we're hearing from enterprise is that they want to actually focus on the business logic and get away from all the complexities around infrastructure. That's what driven cloud, right? So they want to push out the infrastructure as far as possible, as far as regulation and security allows and as far as the confidence they have in their service provider, be it the cloud or the network for a telco. So that's one thing which is critically driving because the enterprise is facing the same issues, and more, of getting the people who can perhaps maintain and grow and drive that system, and even design and architect the solution. So I think that's something that's going to keep driving forward in terms of offloading and investing further into these relationships.

Dan, just to cover of a little bit more in terms of the telco and cloud collaboration, we've been doing that now with the solution we recently launched. We've got Microsoft as your connectivity through their platform, and Amazon through Amazon Direct into our network. And we can be the one-stop service provider to an enterprise who wants to connect to multiple cloud service providers, be it Google as well, sales force and so on and so forth.

So we see that collaboration is happening. If tomorrow the cloud providers become telcos, that's a different point in question. But we don't really see that.

Dan Pitt

Some are taking some steps in that direction, but it's a big business to bite off.

Amit Sinha Roy

Yes.

Manek Dubash

Okay. Questions.

Anthony Caruana – CSO

Thanks. Anthony Caruana, CSO Australia. Security is fundamentally about a hierarchy of trust, I think. Everyone trusts all the different bits that they build things on top of. But the last couple of years have proven to us that we can't trust the

fundamentals any more, Heartbleed, the CCS injection vulnerability last year that was inside [unique] kernels that everyone was relying on. We've got now word that agencies in the US are intercepting hardware as it's being delivered in order to put their own spying equipment into the hardware that people have.

I don't think we can trust anyone any more. Shouldn't we be actually approaching this from a trust no-one and assume everything is compromised before we start point of view? And if we take that view, how do we actually do anything productive?

Amit Sinha Roy

I wanted to add to that list that all the smartphones now, after you do a wipe, it can be recovered. So there's a bug there as well. So any device that you put out there's got all the personal data in there.

So I think instead of having that view of everything's bad, but if we say that anything that we put on the internet can and perhaps will be accessed by others, I think we come with that point of view, I think then we could build a system that would perhaps be able to mitigate some of those risks. But clearly if there is very, very sensitive data and information, I think enterprise still keep it in house. Yes, there are issues even in terms of securing in-house data, but we've seen that that continues as a practice.

Dan Pitt

So I remember growing up reading Mad Magazine, Spy versus Spy. That's sort of what's going on here. Now you can actually get a lot of mileage out of encrypting everything. But number one, it really breaks a lot of software-defined networking, deep packet inspection stuff and treatment of flows. And number two, it's really limited by government regulation. The government desire to have to spy on everyone for the finding of a few terrorists purportedly. That's a tougher nut to crack because that's not a technology problem; it's a policy problem.

Manek Dubash

I'd say there's another issue with encryption, which is actually key management, which not many people raise. The more I hear about this is it's your security guy goes on holiday or moves to another company, where are your keys?

Chris Rezentes

Yes. I would just add on, I think there's a cost component there as well. You still have a lot of customers not even – is the internet safe? Because they haven't been hacked yet they're willing to go with public internet and no security or firewall. And when they're hit, then it's oh, wait, now we need to change our way of thinking. So I think we're still a little bit in that phase, although there is more awareness on the security side. But companies need to be willing to invest. And that's a big chunk that is the risk there for them to invest in that? And that may be the million-dollar question really.

Dan Pitt

And for a while we thought that the mathematical complexity of Bitcoin made it impossible to corrupt, and we don't think that any more.

Manek Dubash

Okay. More questions?

Neil Holmquist – Spirent

Neil Holmquist, Spirent. I think, Manek, you mentioned the complexity and the need for new network engineers. And the question is more of the future of open source in deployment scenarios. And I see more and more companies either, A, customising OpenFlow and the open solutions to solve their need or just doing something completely proprietary because of business needs. And I heard Chris and Amit mention that you don't have the skillset yet. And do service providers and cloud providers have the time to build that skillset up or are they going to start investing more and more into that vendor lock-in, the Cisco APIC or the Juniper Contrail solutions, or whatever it may be. I see that happening more and more right now versus investment in deploying the open source solutions.

Dan Pitt

I think what's going to drive investment in software skillsets, whether that's open source or not, is going to be competition from others in your business sector. And there are a small number of traditional telcos that have invested a lot in software, are ahead. Others aren't quite sure what to do. And some of the vendor solutions are comfortable, at least in the short term. But they don't provide a competitive advantage, and I think that's going to drive it.

Certainly we've seen that some of these open source projects get embedded in the products that are made proprietary. And they've had extensions. They build stuff around it. And you don't get a free SDN controller. You have to pay for one. Others are saying, okay, I'll give it to you. It is free and I will sell service and support. I don't know which is going to win out.

But there's a whole transition in really how the operators will procure and the relationships they have with their vendors. That takes time to change because there's a human component to that.

Chris Rezentes

I would just add, I think we have to take in mind the flexibility that's going to be needed in the future. As Dan said, what works now may not or may become obsolete going forward. So you need to have the right vendors to be able to adapt and make the right solutions.

When it comes to open source, I think deployment, we have a massive global network. And I think this is partly why our stance is to deploy that globally, all it wants is a huge investment. But I think what we would do is take the stance, okay,

we'll work on that angle, continue to work on open source, getting that into the network, NFV. And then these new customer revenue ideas, the new products that come out would also have some SDN components as well. And one of the reasons why I think we get five vendors is so that we have a variety of ideas. We have the flexibility. And the competition amongst them, of course, works out well for everybody from a revenue perspective for all companies. So that's why I said earlier I think that's why Verizon, as a whole, has taken that approach.

Amit Sinha Roy

Just to add to that, I think the key drivers, they're basic. It's interoperability and cost. If there's a lock-in and if it's proprietary and you can't speak to other systems, other network, other telcos across enterprises, then that's an issue. And there's a high cost associated with it. That's an issue. So I think that's the basic driver and that's what's driven towards the open source. So you can customise it a bit if you need to, but it's available. It's interoperable. And there's a cost advantage.

So to come back to that, if the proprietary vendors were to make systems that are interoperable in that sense and I have a cost performance which compares, then they will be on a level playing field.

Dan Pitt

Frankly operators still need products that are supported. And they're not going to be – some operators say we're turning into an IT company. That's really a lot to ask. Mostly the operators are good at a variety of different things and they're going to end up, I think, focusing on what they're really good at and procuring the rest from people who are better at that.

Itzumi Miki – IT Media Japan

Itzumi Miki at IT Media Japan. I'm very, very much interested in what Dan-san said in your presentation around your open source-related efforts. Could you explain a little bit more? Are you trying to embrace other technologies than OpenFlow? Just OpenFlow? You embrace things like Open Daylight, other encapsulation technologies like VXLAN and things like that? And what are you trying to add as a body on top of those various open source projects?

Dan Pitt

So we embrace way more than OpenFlow, because SDN is much larger than OpenFlow. But we don't embrace a lot on the southbound side besides OpenFlow. We use NETCONF and YANG for a configuration protocol, because it's a configuration technology. And we know that people use tunnelling solutions, like VXLAN, where they have to. But that's not really part of what makes SDN special. So they need to do that, migrate, that's fine. We are promoting what really makes it of high value.

When it comes to the open source projects, where do we fit in? We will do some things that complement those. We will turn a lot of the work we do into hopefully

consumable open source code that could fit into that chart of where there's still room for innovation, whether it's proprietary or open source, to solve some of these problems, whether it's in automation or in routine, or whatever it might be. We are looking for opportunities to fulfil our mission, which is to accelerate the adoption of open SDN.

Itzumi Miki

For example, what does Open Daylight lack in implementation?

Dan Pitt

Well we are not, as an organisation, doing anything inside Open Daylight. What we are doing is working on, for example, some northbound interfaces for the intent-based framework that is an Open Daylight project. Actually it's also becoming an ONOS separate plug-in. So we're looking at how to take something that's a standalone controller and help it on the top side and help it on the bottom side. All the OpenFlow stuff comes from us that goes into Open Daylight through the vendors that contribute the code.

So our job is more to fill in some of the gaps. They all have big focuses and these are big projects. And we're not that kind of an organisation. But they're not delivering an integrated solution, for example. And so we want to help get things more easily into the hands of operators.

Itzumi Miki

So what are you going to announce next month?

Dan Pitt

I'll tell you next month when I announce it.

Manek Dubash

Good question. Any more questions? Yes?

Haifeng Huang – Communication World Weekly

Thank you. Hello. I'm from Communication World Weekly. My name is Haifeng Huang. My question is that how do you think of the relationship of ONOS and [ODR] and their future development?

My second question is Chinese companies, such as Huawei and China Mobile, they contribute more and more in SDN and [inaudible] [study]. How do you think of their future chance, their future contribution? Thank you.

Dan Pitt

To whom do you address your question?

Haifeng Huang

All of you. Thank you.

Chris Rezentes

Could you repeat the question again? I didn't catch the last part.

Haifeng Huang

The relationship in ONOS and open DNAND, ONOS and ODR.

Chris Rezentes

Are you using Huawei as the example or—?

Haifeng Huang

I think Huawei or China Mobile or China Telecom contribute more in SDN and NFV. So I want to know that how do you think their future contribution become?

Chris Rezentes

The cooperation? Okay. So yes, well we touched a bit on that earlier and the need for cooperation amongst the vendors, when we talk about the equipment vendor level. If you're talking about somebody that is proprietary, which there will be customers out there for those vendors that would be looking for a proprietary solution. And those companies may get away with that, I think probably for a short term. But thinking long term, when we talk about the change happening in our industry, which is so quick or so often now, you need to have something that's less proprietary, which means those vendors need to be able – well if you're talking about customers that use a multi-vendor approach, which Verizon is one, the vendors need to be cooperating with one another when they're developing their technology and that equipment.

Dan Pitt

I can talk a little about ONOS and Open Daylight. These are the two most prominent open source SDN controllers. So they come from different origins in that Open Daylight really came from some vendors, more of an enterprise focus. It's got a lot of contributors. It's got a lot of pieces, a lot of lines of code. ONOS is more centrally architected, with a goal of having scale out and high availability and high reliability for service provider networks exclusively, or primarily at first.

They're viewed as competitors. I think it's too early for anybody to settle on one. But I think eventually you'll see things converging. We had an interesting experience in the last six months. We developed this definition of an intent-based framework for the northbound interface. And our members were active in Open Daylight so they took it there. It was accepted as a project and the coding is starting.

But then we thought why do we have to write it specifically to Open Daylight? So now we're writing to have the application an open-intent engine and then separate run times for Open Daylight and ONOS. So this hopefully will be an example of how you

can write an application once and have it run on both controllers. As an organisation, we are neutral to controllers like we are to vendors. We've learnt a lot from Ryu, the open source controller coming from NTT in Japan. And that's actually gaining some popularity, but they haven't tried to build community with it.

So I think it's very early days. And I think it's great to see people experimenting and investing in different approaches to the open source controller space. Five years from now I think it'll look different.

Manek Dubash

Okay. One final question just there. And brief answers, if you will, gentlemen, please.

Gagandeep Kaur – Independent Telecom Journalist, India

Hi. I'm Gagandeep Kaur. I'm an independent telecom journalist from India. I have a question for Mr. Pitt. You mentioned in your presentation that SDN is leading to investment in hardware as well. Can you elaborate a bit on that?

Dan Pitt

Just that there are venture-funded start-up companies building switches and chips for SDN. We've seen it in China. We've seen it in Taiwan. We've seen it in the US. We've seen it in Israel. And we've seen it in Canada. These are specific examples I know of. And it's a surprise. But they're able to focus on something very particular and the development costs are still reasonable and the market size is large. So there's a big opportunity there.

Manek Dubash

What are the advantages?

Dan Pitt

The advantages? It differs from case to case. I see a way of taking a technology to a particular customer vertical, say, or a particular application use case, whether it's carrier or enterprise or top of rack or spine or core network or something. I'm going to go for a particular price performance point. But I can now build in this way and I can leverage control software that other people are doing. And I'm going to build a high-performance forwarding plane or a low-performance low-cost forwarding plane, whatever it might be, and I will take it to market. So this is worth investing in if you've got the right business case.

Manek Dubash

With that, I think we're going to have to call a close to this panel. I'd like to thank Dan, Chris and Amit very much for your contributions.

[End]