Roundtable on Cloud, Fog, Networks and Related Technologies

Moderator: Joe Weinman, Author, Cloudonomics and Digital Disciplines, Cloud Economics Editor, IEEE Cloud Computing magazine; Advisory Council and Program Planning Committee, Pacific Telecommunications Council

Participants:
Margaret Dawson, Global Product Marketing, Red Hat
Jim Fagan, Director, Cloud Practice, Telstra
Stephen Ho, CEO, CITIC Telecom International CPC Limited
Tim Horan, Managing Director, Oppenheimer & Co.
Will Hughes, Global Technology Consultant
Chih-Lin I, Chief Scientist, Wireless Technologies, China Mobile Research Institute
Ivo Ivanov, Executive Board Member, DE-CIX
Jonathan King, Head, Portfolio and Strategy Solutions, PA Cloud Systems, Ericsson
Eric Klinker, CEO and Co-Founder, Resilio, Inc.
Kireeti Kompella, CTO, Juniper Development and Innovation, Juniper
Simon Lee, Managing Director, Sapience Capital Partners
Ryan Servatius, former VP, Business Operations and Strategy, Salesforce.com
Mark Thiele, Chief Strategy Officer, Apcera
The Pacific Telecommunications Council – a non-profit dedicated to variety of ICT technologies – is about to celebrate its fortieth year. Earlier this year, a far-reaching “executive insight roundtable” discussion reviewed the intersection of emerging trends in cloud, fog/edge, IoT, and networks. Participants spanned a variety of industries, including cloud SaaS, PaaS, and IaaS firms, mobile and landline operators, colocation and interconnection firms, open source software companies, and industry and financial analysts and investors.

What follows is a condensed, edited transcript of a 75 minute roundtable. Some of the narrative has been reorganized for clarity. Among the insights: a distributed edge will complement a consolidated cloud; a shift in focus of IT from internal to external is one of the reasons for this; AI is the ultimate driver for edge computing, because the edge captures data that can then be consolidated in the cloud for machine learning, insight, and action; network topologies and network management become more complex, driving aggregation at intermediate layers such as colocation facilities; and innovative new business models and architectures will be needed and enabled, such as edge computing in repurposed carrier facilities such as switching centers and pay-per-use services.

**Consolidated hyperscale or dispersed IoT/fog/edge? Or both?**

**Joe Weinman:** Cloud providers traditionally have built a relatively small number of geographically distributed hyperscale facilities and consolidated and statistically multiplexed all workloads into those facilities. I wrote in Cloudonomics\(^1\) five years ago about trade-offs between consolidation and dispersion and how I thought that the hyperscale card was overplayed because there were obvious benefits to distributing functionality including latency reduction, backhaul network cost reduction, backhaul traffic reduction, business continuity, data sovereignty and so forth. There are exact mathematical characterizations for capacity utilization and workload smoothing through statistical multiplexing when you’re in a centralized location, and to the extent that you’d distribute that out, you get less multiplexing and, therefore, there’s less smoothing, lower utilization and higher unit costs. Because of these trade-offs, I believe that the future is the hybrid multicloud fog.\(^2\) It’s hybrid in terms of both private and public and that’s provable to be economically optimum. It is multicloud due to a variety of reasons including service provider specialization, preventing lock-in and the order statistics of price optimization across multiple clouds that all have dynamic pricing. And it’s a hybrid of cloud and fog because there are things that should be done in a centralized fashion and things that should be done at the edge. So let’s start by asking about the potential hype or potential reality around tens of billions of things by 2020 and what the implications are for architecture.

**Mark Thiele:** There isn’t a single answer. We’re going to need edge, centralized, public, private, and hybrid. Edge computing will serve many needs, and that opportunity will continue to grow. Data sovereignty rules still drive centralization from a country standpoint. Scale offers ability to offer new services. So, there isn’t one thing we should be considering doing. We have to look at the entire spectrum of opportunity for the enterprise. And unless you’re talking to a company that’s only two or three years old and they’ve built everything they have and they’re just running it on Amazon, they’re going to have legacy apps.

The average enterprise only spends a few percent of their IT or engineering budget on externally facing IT. That means that 97 percent of their focus is on the 1,000 or 10,000 or 50,000 employees that are their internal customers. What happens when their external responsibility becomes 500 million or a billion external customers or even, for that matter, 10 million customers? That’s an exponential increase in demand for what they have to deliver and how they have to deliver it. Our customers are trying to make this innovation change—they need to free up enterprise time and resource and thought leadership to focus on external activities and things that drive innovation for the business.

**Eric Klinker:** There’s a lot of power that currently sits unutilized at the edge. It really is going to be a game of how we squeeze more efficiency out of the investment that we’ve made. And I think you’ve got to look...
at all the capacity that is just sitting there whether it’s uplink bandwidth that’s not used or whether it’s all the CPU that is probably sitting idle 99.9 percent of the time anywhere you look. If you thought of the Pentagon as a data center, it’d be the world’s largest data center [due to the number of people and thus desktops] and it’s not utilized very well – every desktop sitting there, empty, wasted.

**AI / cognitive and the link to cloud / fog**

**Kireeti Kompella:** Talk about the pendulum swinging: we went from centralized computing to distributed computing and we’re now going back to centralized with the cloud and back, again to distributed with the fog and edge computing. We’re not looking at this right. We’ve left classical physics, Schrodinger is coming to the equation and it’s actually going to be both. There’s this wonderful piece by Peter Levine where he talks about the end of the cloud. And sort of in the middle of his presentation he said, “But actually it’s still going to be there,” and that’s important. It’s really important for machine learning / AI that you actually have a centralized location for all the data.

**Jonathan King:** What happened last year is that “big data” started to be much more focused artificial intelligence and machine learning. The 20, 30, 40 billion things from a machine learning and artificial intelligence standpoint are effectively going to be connected and running as a big computer. And the type of network that is going to be required to drive that and power it in a 5G world is going to be very different.

**Ryan A. Servatius:** Our belief is that the convergence of big data, mobile devices, artificial intelligence, and IoT is going to come together in a massive way. Our approach has been to look at specific scenarios that are driving the customer toward an offering that they’ve envisioned to drive an offering that we can support. Edge computing is a component of that but the scenarios are specific in our view. So, this is one of those things in which we’re very much letting our customers tell us what they need and being able to support this with the correct kind of technology for what they’re asking for. You’re going to see a lot of companies building erector sets for AI, like Alexa, Cortana, or Einstein.

**Tim Horan:** To me it’s all about artificial intelligence to make technology predictive: for example, when I show up at a hotel that they have the exact hotel room that I like, or when I call up Verizon they should already know what my problem is before I called them and they should be able to come and fix it automatically.

**Jonathan King:** Kevin Kelly wrote a really good book recently called *The Inevitable* and he talks about 12 trends that are going to play out over the next 30 years. The first two are “becoming” and “cognifying”. “Becoming” is that we expect to have a digital device and we expect it to always be updating, always be getting better. He thinks about cognifying in the coming years like we underwent electrification in the last century. Everything that is around us is going to cognify. You’re going to have a distributed edge and distributed computing that has different attributes than we’ve had in the past, which means you then need to have different network function and SDN type of capabilities. You also need privacy, data protection, ethics, and digital borders. You have to have a topology-aware system to know where and when and how you can place things because we’re going to be cognifying everything.

**What are the network implications of a hybrid of cloud and fog?**

**Jim Fagan:** Connectivity to clouds is now very much in the forefront. It’s not just about connectivity, high levels of security, and how much data can you move; it’s starting to get application and use-case specific. We think about it differently than just big-pipes latency—we really started thinking about how we actually tailor our offerings for these different use cases.

**Mark Thiele:** Most edge computing will actually happen in your car; your house; in discrete units that aren’t necessarily in data centers, and that data will give you responsiveness from your vehicle. That vehicle may be fed data from other places that could be localized, that could be remote in order for that vehicle to respond better. Most of that transaction is still going to happen somewhere else and be backhauled.

What’s really changing is how much data will be coming upstream over the next few years; that’s going to have a real serious impact on how all of our networks are designed and the infrastructure that runs it.

**Ivo Ivanov:** From the perspective of the Internet exchange operator, customers logically ask for this whole ecosystem where they can start serving their end-customers through interconnection fabrics...
working together with carriers and other integrators. The whole value chain will not be able to manage the complexity of the connection without an aggregation point. Today you see changes in how our customers and networks connected to the exchange focus on topics such as cloud management, aggregation, machine-to-machine traffic, security, reliable interconnections. We see a huge demand in the market from classic carriers but also new networks like enterprises who were not typically present in the Internet exchanges of the past.

**Margaret Dawson:** We are absolutely seeing some changes in data center architecture in terms of how IoT and some of the other analytics and distributed systems are driving smaller, more local data centers that are using more software-defined technologies. And I think the ‘software-defined data center’ is a trend that we’re seeing very strongly, especially software-defined networking and storage. But the bulk of customers, I think we’ve got to remember, are not where we are from the thought leadership perspective or even the technology perspective. 80 percent are still addressing mainframe technologies they’re trying to modernize or migrate or just other legacy infrastructure and applications that they’re trying to modernize and make applicable in the digital era. So we’re spending a lot of time working with how can you take legacy applications, for example, and leverage things like containers or more distributed technologies to just bring them up to speed or create a more cloud-native front end or something to give your customers—whether they be internal or external—speed and dynamism.

**Will Hughs:** With the transformation to microservices and the change in bandwidth profiles to be more symmetric with this hybrid multicloud environment, how does the SMB or the enterprise manage all of these traffic flows? It reminds me of another type of internet but for private services and bespoke services that have implications on data sovereignty and security at different levels. So how does an enterprise or SMB manage it without going all in with a Microsoft or an AWS? And, are our traditional interoperability protocols, i.e. Internet Layer 3 protocols, fit for purpose for this new generation of a plethora of services?

**Ryan A. Servatius:** It’s a great question; how are you going to manage this complex network topology if you’re an enterprise and you’re forced into this kind of digital domain, which every enterprise is going to be in the next five years? It’s just simply not something that individual enterprises are going to be able to do themselves given the scale and complexity that’s going to be in play.

**Jonathan King:** I agree. I think there’s actually going to be a renaissance in network managed services because of that complexity, either with carriers stepping in with offerings to fill that void and/or or even some of the independent companies that are out there. It is a major challenge. I think the SMBs are going to default to what they get as part of their overall Azure / Office 365 experience and only when they start operating global offices and have other dependencies that are network-specific will they go out. One of the pockets of growth amongst operators is cloud interconnectivity because it’s complex and is only going to get more complex. But given the DNS-related botnet attacks on Dyn and others that’s an area to be looked at. And optical mesh is going to really push the borders of that from an architectural standpoint.

**Simon Lee:** In the last few years we’ve seen a lot of companies offering software-defined products and services that have gained a fair bit of traction. There’s a lot of technology that’s been built. The ability to point and click and set up a network in minutes solves some of those things. Portals allow the customer to independently make those choices, bill automatically and even use a credit card to pay for it. Some of them have also operated in the IP realm so Layer 3 security is an issue. The newer ones tend to use AES256. They switch out keys every few hours so they become very difficult to hack and they’re essentially setting up MPLS networks within minutes.

**Jim Fagan:** We have been focused on deploying SDN/NFV capability. You draw your network; it deploys within two minutes; you pay for what you use; connect it to clouds. When you’re moving legacy applications to the cloud, who’s going to manage that? You’re going to have this ever-changing network topology that you have to manage, and I think that’s going to get really complex.

**Joe Weinman:** Isn’t the right answer to this ultimately some mix of policy-based orchestration and deep learning that says that the job of the network administrator goes away and there’s basically a free app with in-app purchases of tokens that will run your whole network for you. Is that the ultimate answer and if so what are the implications for telcos, for jobs, for skill requirements, et cetera?
Jim Fagan: With SDNs that’s always been the Holy Grail, the whole idea of this application-aware network where the application tells the network what to do and manages it. You can talk all you want about serverless, fog, and everything else but at the end of the day there’s still needs to be real infrastructure capacity. You have to have the demand curves right and the same from the customer side as well. They have to be with providers who will provide outcomes that can actually handle that as they go through peaks and valleys. But I really don’t think you’re going to get to this point where it’s going to be just this 100 percent outcome-based completely software-driven approach.

How should networks, applications, cloud, and fog interrelate?

Joe Weinman: What do SaaS providers need from network service providers in terms of APIs and flexibility?

Ryan Servatius: As a SaaS company, the network is obviously the most complex, the most challenging and sometimes the biggest roadblock to making changes. So the more that the evolution of networks makes something seamless and easy and takes a lot of the network administration out of the equation the better it’s going to be.

Simon Lee: Application-aware networks are certainly becoming real, but the networks are also starting to learn. Recent software-defined innovation uses applied machine learning, picking up data even on the access networks and always learning. In a world where there are many, many billions of devices with IP addresses, that becomes more and more critical. There’s no question that there’s a lot of intelligence that’s being built into the network that previously didn’t exist.

Chih-Lin I: We can have application-aware networks or network-aware applications. For example, we have green applications: a lot of the time a particular application, say, a mobile game may be very inefficient in its use of network and device resources. So, we developed a program to help make your application aware of the network and related resources so that it can operate much more efficiently. We have a huge network, and it uses multiple standards: 2G, 3G, and 4G. And for each network, there is more than one different equipment vendor. However, we’ve managed to develop a plug-and-play software solution where we can dynamically recon-
figure our network every 15 minutes. We basically treat the 2G, 3G, 4G multivendor network as one system by making use of crude data analytics, historical data, traffic, interference conditions, etc. We are looking at how to make use of big data analytics and artificial intelligence in the long-run to design, optimize, deploy, operate and maintain any system that we have.

Stephen Ho: With the evolution of the fog, it becomes like the 20-year-old saying, the network is the computer and you don’t care if you’re on the edge or not because of these proliferations of IoT devices, like Fitbits. We have put in everywhere a cloud computing platform, whether it’s hybrid or a private platform, to do a lot of customers’ networking or customers’ applications. We’re also implementing our NFVs into these platforms so that we’d be able to deploy certain functionality when the industry allows us to do so for the benefit of customers.

Joe Weinman: How should safety-critical tasks for edge devices like autonomous vehicles be managed when connectivity is not ubiquitous? Presumably the right answer must be that there’s safety-critical functionality that’s fully autonomous and doesn’t require connectivity. And then any connectivity provides better real-time functionality, such as routing around congestion, inter-vehicle collision detection across blind corners, and so forth?

Jonathan King: A good example is Google, which has made it possible to download Google Maps. Technology always moves from centralized to distributed to centralized and distributed. No safety regulator is going to allow a self-driving car that doesn’t have on-deck controls even as basic as just stopping, but such a model is not going to be bought by anyone, so you’re going to have to add local mesh networking. You’re going to have “on-prem”-like processing capabilities so there’s going to be a swing back to the edge. In addition, you’re looking at multiple mechanisms to build connectivity in remote places, for example, government programs and funding.

New vendor and provider strategies enabled by and aligned with fog

Joe Weinman: What are the business implications of fog/edge/IoT, for customers, users, vendors, and service providers? How do they need to think differently about budgeting, architecture, strategy, organization structure, and partnerships?
Margaret Dawson: What we have to do as IT leaders is change the way we’re thinking about the impact we have on business, how we deliver services to our internal and external customers, what that means in terms of the infrastructure we’re providing for highly scalable applications, and what we’re doing with mobile or developer environments. We have to be much, much faster now. At the end of the day, I don’t think it matters whether the intelligence the business needs is from the edge devices or from some other application.

You can expect everything to become much more modularized, so that you can actually just use things that you need as opposed to the entire platform. How we architect our technologies and who we partner with across the telecommunications industry is probably one of the biggest areas for us. If you think about companies we used to work with, it was just Linux whether it’s HP or IBM or whatever. Now those next generation OEMs are all here and how we’re leveraging our technologies together to deliver solutions for customers and clients has really changed the way we both do things internally technically as well as how we go to market.

Jim Fagan: It changes the way we have to think about not only how we design and build our products but how we offer them to the market; modularization is absolutely key. If you look at the world of IoT and big data, I doubt that anyone’s going to provide value throughout that whole ecosystem and chain. Where’s that spot that you really differentiate yourself and you can build off and add value. All the POPS, data centers, edges, and access, backhaul, and mobile networks is really where the value prop comes in. But that also changes the problem, the talent we need, how we think about it, the return cycles on those business cases and that’s a big shift.

Ryan A. Servatius: SaaS companies at their core are effectively sales organizations, which is really to say they’re customer organizations. If you look at the split of revenue across the various expense items, you’ll never see the R&D line at more than 20 percent. At the end of the day this is really a simple formula and it’s a hard one to get right: what’s the customer need? What’s the cost? What’s complex about edge computing in my view is this other question about security and privacy because it introduces a different set of complexities into how you deliver and what you do at that edge, right? A lot of SaaS companies don’t have super-specifically latency-intensive interfaces. I don’t have to get there in 25 milliseconds. Most SaaS companies aren’t building something for self-driving cars, right?

Joe Weinman: What changes if there’s more stuff at the edge? Do you need more interconnection facilities or a different architecture like leaf-spine? Where do you need to focus?

Ivo Ivanov: What is happening is that the broad market and the top tier of network operators have started re-looking at the interconnection ecosystems which had been created around Internet exchanges of the past. Today we have different types of traffic flows. They require different SLAs. They require different security levels. It starts with communications and it ends with the customer experience quality at home or in the office. How can we make sure that the applications and special traffic flows in the future will be delivered with the highest quality possible and cost-effectively? Internet exchanges are becoming interconnection ecosystems.

Margaret Dawson: The one thing we didn’t bring up specifically was consumption models and pricing and packaging. One important topic is your internal services and how do you provide IT as a service through chargebacks or are you actually providing services that can compete with the public cloud so that your developers and businesses aren’t leaving. Or if you are more externally facing, how are you changing the way that you’re allowing your customers to use and pay for your services in a more metered consumption model, which is the way everybody wants to use technology? And that’s fundamentally changing the way we do business, not necessarily from an architectural perspective but from a go-to-market and business model perspective that we all have to change. It’s even influencing the vendors all the way up through the supply chain.

References