

SDN: LESSONS LEARNED FROM A TOP IP PROVIDER

Most advances in network design happen, for better or worse, at a relatively sedate pace. So the hype that continues to surround the evolution of Software Defined Networking (SDN), a once-in-a-generation leap in innovation that will strip all the intelligence out of network hardware and put it in the hands of a new breed of ultra-clever computers, is as perplexing as it is frenzied.

The essence of SDN is that these software-based controllers will oversee every aspect of the network, allowing operators to develop code for entirely new services without ever having to physically access any of the hardware out in the field. It should generate huge efficiencies by helping operators optimise traffic flows, but it will also spur new advances because applications will take days, rather than months to develop and test. Indeed, so vast is its potential that some analysts believe it could reinvigorate the wholesale telecoms segment, offering those players facing a commoditised future as a provider of dumb pipes the chance to develop a range of new higher-margin services.

But it is not without its controversies.

In one camp lurks a band of sceptics that claim you are more likely to come face to face with Elvis than set eyes on a fully fledged end-to-end deployment of SDN technology. In the wrong hands, they argue, total control of the network might be a very dangerous thing indeed. More importantly, they urge, it must surely be disingenuous to throw decades of hardware innovation out with the rubbish, when it is both tried and tested and more than capable of playing a useful role in future network design.

In another, sits a vocal group of industry representatives who maintain that the telecoms world will fast become a place where those that have an SDN capability will squeeze those who do not out of the market altogether. Why buy expensive state-of-the-art routers and switches capable of carrying a huge amount of proprietary software that locks you into a specific equipment vendor for years at a time? Why not transfer all that intelligence to a bespoke computer that is ultimately limited only by the imagination of the software programmer writing the code for you, they ask.

The more the debate rages, the more it polarises and amid the clamour of vested interests the voice of reason is getting harder and harder to pick out.

Which is why NTT Communications has chosen to share some of its experiences in developing an SDN-type architecture for its award-winning global IP network.

The tier-1 network, one of the largest IP backbones in the world, links 31 markets on five continents with dual stack access (IPv4 and IPv6) and comes with some of the most demanding service level guarantees in the market. Consistently ranked among the top 3 IP networks by Renesys, the data provider, the network has been evolving for

more than a decade.

And from the very start, its designers embraced the principles of what we have come to know and love as SDN. Shawn Morris, manager of IP-Development at NTT Communications takes up the story: "This has been a very long journey for us – we didn't go to the board with a pitch for a huge multi-billion dollar investment plan." Instead, he says, the initiative was inspired and driven by the company's engineers in their constant drive to improve quality of service levels. "Slowly, over the years, more and more applications that needed to be configured in the network were pulled into our system until we eventually got to the point where we effectively had fully automated control of everything." These days, no one makes a change to the network unless they do so through the control system – it is the beating heart of NTT Com's IP network and one of the key reasons why the operator consistently tops the wholesale ranking charts. "In the North American region of the network, we have swapped out just about every customer-facing 10G Ethernet port twice in the last two years after we moved first to a new platform and then made revisions to the line cards on that platform with greater density", explains Morris. "All those customer migrations were essentially done by just one person and we have no recorded instance of an outage linked to configuration error in a single one of those migrations."

In a world where margins on IP traffic are under constant compression, such an achievement is notable for three reasons: Firstly, an automated control system keeps staffing requirements and therefore operating expenses low; secondly, by reducing the chances of a catastrophic outage being triggered by human error, it is possible to build in higher quality of service guarantees; and thirdly, the benefit to customers bears fruit quickly through faster and consistent service delivery. "Automation is the future", vows Morris. "Our experiences leave us in no doubt that provisioning at the service level is a game changer in what we expect to be an increasingly competitive environment."

In other words, the SDN genie is already out of the bottle. Intuitively, most carriers have got to the point where they would probably agree. A recent survey by one equipment vendor suggested that the annual spend on SDN equipment will range from \$25 to \$35 billion by the end of 2018. The survey went

on to conclude that the number of companies offering an SDN solution has grown from nothing to more than 220 over the last three years and that the amount of venture capital flooding into the sector has grown fifty fold over the same time scale.

Indeed, there are few critics of SDN per se: in recent years, the telecoms sector has grown very comfortable with the concept of virtualisation, both in storage and in servers. It was arguably only a matter of time before engineers applied the same principles to the physical network itself. It is perhaps ironic then, that the network has been its own worst enemy in this respect: the sheer complexity of



current-generation routers and switches makes new network applications almost impossible to configure without a root-and-branch overhaul of the operating system. If SDN architectures take hold, network hardware will no longer be a hamper to innovation.

The real issue now, is how to deploy SDN technology to greatest effect.

And here, NTT Com's experiences are perhaps most poignant: "There is no magic bullet", says Morris. If carriers are waiting on the sidelines for the time when they will be able to buy an off-the-shelf solution from a vendor, plug it in, and turn up a raft of SDN applications, then they are going to be waiting for a very long time. Even in a market like IP, where services are relatively plain vanilla, no two networks are the same: a seamless telecoms landscape embracing an SDN ecosystem is therefore a very long way off, if it is achievable at all.

For one thing, you must embrace what Morris dubs the "PeopleSoft" conundrum. "If you opt for an off the shelf solution then you are going to have to conform your own business practices to the operating system that your chosen solution supports, or you are going to have to spend a lot of money tweaking the product to make it fit your processes and hope in the long run that it all works."

Either way, says Morris, there will always be a significant amount of in-house development work to undertake. But that is a good thing, he stresses, provided that customised solutions do not become white elephants with spiraling costs: "We are constantly looking for new ways to enhance the control system. In particular, some of the work that we have completed recently will allow us to spin up new network related services for customers very quickly – but we can only do this because we have extensive visibility over the entire network."

NTT Com can already mine a raft of network telemetry for internal analysis thanks to its own SDN-like control tool. This is particularly useful when contracts with wholesale partners come up for renewal because the company's relationship managers can get a very clear handle on what traffic flows are being generated where. And because everything about the network sits in a centralised system, it is particularly efficient at ensuring customers are billed appropriately. "Every time we turn up a new interface for a customer, it is automatically configured in our control system which means that it is also automatically populated into our billing system. No human intervention is required at any point during the process."

Such automation might make for significant efficiencies, but it also comes with a very human cost.

Some carriers are grappling with the huge shift in culture that adoption of SDN architectures will necessarily require. Among rank and file engineers, automation might be seen as a euphemism for job cuts and SDN systems bring with them the promise of automation in spades. At least one large North American carrier has outsourced its entire SDN development effort amid fears that its own engineers would frustrate the work in order to hold on to their own power base within the organisation and guard against potential job losses. Another has stated publicly that, while it is capable of implementing the technology within a matter of months, the cultural gap that SDN will open up within the company will take years to close.

But while Morris recognises that some people are bound to look on the negative side, he notes that there are upsides as well



Engineers at NTT Com's Global NOC in Dallas, Texas, monitor the SDN-capable Global IP Network.

as potential downsides when it comes to staff morale. "The more we automate the network, the more we free up engineers to enhance existing services and develop entirely new ones."

Nowhere is this more apparent than in the process of configuration reviews. Current best practice dictates that network operators spend weeks peer-reviewing potential network configuration changes in order to minimise potential outages. "We peer review as well. But the process is built into the control tool. Once a configuration is programmed into the tool the system handles the rest – an operator doesn't have to spend days peer reviewing the changes to know that it is going to work – he can get on and do it in a couple of hours."

The next big challenge at NTT Com is to tighten up integration between the company's operating software system and its controller. "At the moment, some data lives in both systems. The goal is to get to the point where the operating system feeds off the network and vice versa so that you end up with a virtuous circle in which one system continually learns from the other."

"It's a long term goal", says Morris. "We are at least 12 months away, maybe 24." In any other sphere of wholesale, that would resonate in the here and now. It says much of the SDN community that such a timeframe is considered to be at the very edge of what is currently achievable.



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