Pipeline
Technology for Service Providers.
www.pipelinepub.com Volume 13, Issue 8

Carrier SDN Simplifies Complexity in the Cloud Era

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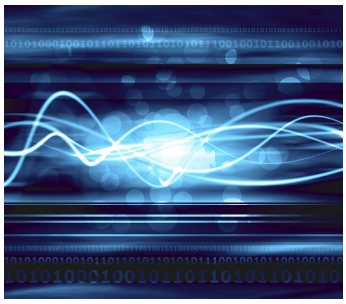

To support the cloud era, network service fulfillment must evolve to become on-demand, agile and able to rapidly scale operations. This requires moving to a carrier SDN-controlled environment that simplifies network complexity by abstracting it and enabling automated provisioning to IP/MPLS, carrier Ethernet and optical network services delivery. Moreover, to make on-demand operations profitable, carrier SDN needs to identify the best use of available network resources and meet service requirements, including service assurance, through network-aware dynamic service provisioning.

The cloud makes life so much easier for enterprises and consumers. Scale your business as demand grows. Choose the content, services and products you want, whenever you want and experience near-instant gratification. And yet, ironically, while making everyone else's life easier, the cloud puts extraordinary demands on the network and, by extension, network operators. All this scaling up and down at web speed, especially in a global marketplace, creates enormous and unpredictable fluctuations in network traffic.

The telco operating environment wasn't traditionally architected to be this agile — anything but. In fact, the major innovations in networking required to meet the challenges of the cloud era started in the data center LAN. The tremendous fluctuations that occurred as servers were spun up and down with globally trending demands, especially in web services, also had to be matched by the local area network capacity in the data center. The two principle innovations that were made in order to adapt to the demands of cloud services were virtualization and software-defined networks (SDN).

In essence, instead of running on dedicated network hardware, the internal data center network or LAN was abstracted as a software-layer and hosted on commercial off-the-shelf servers (COTS) as virtual machines (VMs), usually running Linux and VMware or the equivalent. These were, of course, the same virtualized servers on which the data center was running all its operations, so this wasn't a big leap from an operational perspective. If a global-level spike in demand required spinning up hundreds of virtual machines as web servers, the network that supported all this traffic could be spun up too, on a different set of VMs. Routers are, after all, purpose-built network computers and can be virtualized.

This was several orders of magnitude simpler in a data center LAN, but the principle is identical when applied to the carrier WAN. To achieve this kind of agility and scalability, SDN can and is being applied to the wider network as "carrier" SDN. Similarly, virtualization is also being applied to network hardware as network function virtualization (NFV) — adding excess, rapidly scalable capacity to the existing networks using software-based abstractions of the network's central functions, again running on COTS.

The important difference from the purpose-built data center LAN is that NFV in the WAN will, initially at least, mostly provide additional capacity for rapid scaling. The legacy optical, switching and routing network infrastructure will still be with us for a long-time. Thus it is SDN more that NFV that is having the biggest effect in the telco world. Carrier SDN can abstract and orchestrate all the various network functions, whether they are "virtual" (being hosted on COTS-based VMs) or "physical", as with dedicated network hardware. Carrier SDN has to be able to apply across both virtual and physical network resources.

This is an enormous undertaking for network operators precisely because of the complexity of the

WAN infrastructure. It is very much a work in progress and will take years to complete. It would in many ways simplify the task to start all over, but the size of investment in the current infrastructure prohibits it. Thus, the industry is in the midst of a massive effort to abstract the network, mostly as it currently exists, capturing in a software layer all of the virtual and physical network objects, flows and connections so that it is possible to fulfill network-based services in a matter of minutes and hours, not days and weeks.

While implementing carrier SDN is the first step in achieving the agility and scalability to support on-demand cloud-based services, another step needs to be taken quite quickly. The problem, operationally, is that having abstracted the virtual and physical network resources as objects, flows and connections, it is now the operator's IT team that has to deal with the very same complexity that slowed down the network operations teams previously. Some speed has been gained because they are setting up the services in software, but some of that same speed has been lost because the IT teams don't fully understand the complexity of the underlying network elements.

The answer to this operational dilemma is policies. This is one of the most compelling aspects of SDN, the ability to template services as policies. Policies are a higher level of abstraction by which a set of underlying virtual or physical network objects, flows and connections is pre-engineered and packaged as a single function more closely aligned to the intention of the person provisioning the service. This is especially helpful when the service provisioner may not understand the underlying network elements, but does know what effect they want to achieve.

For instance, a nightly backup service for a financial enterprise customer might be created as a policy specifying that latency is not important, but bandwidth cost is key and least-cost routing essential. A daytime service for the same company connecting the company's trading floor with various securities and commodities exchanges where they have co-located their equipment might use a very different policy. For this policy, latency is critical, service up-time is key and cost is not an important parameter.

Where this approach shows its true power is when policies can also be engineered to be dynamic, that is, structured to include automated decision-making. For instance, if the trading floor's real-time, low latency, premium bandwidth service encounters network congestion, the policy contains programming that instructs the underlying network to re-route the connection to back-up links and maintain specific QoS parameters. In this way, the service requirements are maintained because the software is network-aware and can dynamically provision and re-provision the service in a completely automated way in the background. The IT person who provisions the service doesn't need to know any of this detail, neither when the service is fulfilled, nor during its operation.

Network awareness derives from assurance capabilities that can be built into carrier SDN. The analytics, KPIs and correlations that drive assurance can be integrated with the SDN controller so that they can trigger automatic changes to the network — for instance, in the example above, actions at the network layer to avoid network congestion. Flows can be redirected, new IP/optical paths established, and existing IP/optical paths can be resized dynamically, all driven by KPIs, analysis and correlations from both the IP and optical layers as well as physical and virtual domains.

What this means in practice is that assurance parameters are built into dynamic service policies. The analytics, KPIs and correlations are used to define the policy and establish the dynamic decisions and automated actions that will be driven by the policy. The "intentions" of the service provisioner are not only reflected in the creation of the service, but in the ongoing "assured" operations.

This automated, dynamic characteristic of policy-driven service fulfillment is important to meet the fluctuations characteristic of on-demand cloud-based services. Moreover, it is also essential for keeping operational overhead down using automation so that these services can be profitable for telecom operators. Somewhat as a welcome side effect, policy-driven service fulfillment also accelerates the time to market for new services, making service innovation not only possible but responsive to rapid shifts in market demands.

In summary, the cloud era imposes new requirement on network service providers. Their service

fulfillment processes must evolve to become on-demand, agile and rapidly scalable. This requires moving to carrier SDN for the control of physical and virtual network resources. Network complexity needs to be simplified through a policy abstraction layer that provides fulfillment personal with a simplified language to accurately capture their intentions. This makes possible a highly agile, policy-driven provisioning system that automates service delivery using IP/MPLS, Carrier Ethernet and optical network resources.

Fully implemented, a policy-capable SDN will not only make on-demand operations possible, but also, profitable. By dynamically identifying the best available network resources to meet service requirements, carrier SDN will enable assured, network-aware, on-demand services ready for anything the cloud can throw at it.