SDN in the WAN: Service Provider Opportunities & Challenges

EXECUTIVE SUMMARY

In just a few short years, software-defined networking (SDN) has risen from relative obscurity in academia to become the most transformative business and technology trend in telecom in decades.

The term "software-defined networking" itself originated in an MIT Technology Review article entitled "Software-Defined Networking," in the March/April 2009 edition. The term was initially used to describe the use of OpenFlow on routed campus networks – specifically the routed networks being built by Stanford Professor Nick McKeown and other Stanford researchers. Since that time, however, the SDN term has rapidly broadened considerably to include:

- OpenFlow-based *and* non-OpenFlow-based uses and definitions.
- New and existing technologies being co-opted, meaning that there are new standards being developed for SDN, including extensions to OpenFlow itself (i.e., the work of the Open Networking Foundation), but also some existing technologies can reasonably be folded under the SDN umbrella, as they have attributes of de-coupling forwarding and control, software programmability and (in some cases) control centralization.

Most significantly for Heavy Reading's telecom research, SDN has moved beyond the confines of its data center origins and into the wide-area network (WAN), for use by service providers of all types. Google is responsible for resolving the question of whether SDN *can* be applied to the WAN when it introduced its home-grown G-Scale WAN, controlled by OpenFlow, beginning in 2011. With that live network introduction, Google proved that it can be done – and with great benefits in costs and efficiencies.

Since that time, the industry has witnessed an explosion of service provider activity around SDN applications in the WAN. Participants include ISPs, OTT service providers, innovative CLECs, large research networks and major Tier 1/2 telecom providers around the world. Application status ranges from proof-of-concept (PoC)-stage experimentation to live and revenue-generating commercial networks. And although the applications themselves cover a very broad spectrum, the common thread can be summarized as: "How can SDN help service providers to fundamentally transform how their networks are built and operated, as well as how services are created, customized, delivered, monitored and monetized?"

The initial technology hype stage has passed and, as operators put rubber to road in PoCs and limited commercial introductions, they are now grappling with the hard questions that come with actual implementation.

SDN in the WAN: Service Provider Opportunities & Challenges seeks to get beyond the vast industry SDN hype to provide a realistic assessment of the opportunities and challenges for service providers as they migrate their network architectures to the agile, software-driven networks of the future. To reduce the hype as much as possible, we went directly to the service providers themselves through a combination of global network operator Web surveys and one-on-one interviews with key service provider innovators.

The potential scope of SDN is broad and reaches nearly every aspect of service provider organizations. For this report, we focused on the application of SDN in the service provider WAN – and specifically, Layers 0 through 3 in the OSI stack, including the photonic optical transport network (OTN), Ethernet, MPLS and IP layers. Within carrier or WAN SDN resides the transport SDN (T-SDN) subset, which Heavy Reading defines as the application of SDN to Layers 0 and 1 specifically. The analog nature of optics makes SDN a special case in this part of the network. For this reason, and because the transport layers have been largely overlooked thus far in market research, we analyze T-SDN in detail (though not exclusively) in this report.

The report profiles the three key SDN standards bodies and five service providers that are on the leading edge of helping define WAN and T-SDN globally. In addition to one-on-one interviews with service providers, the research in this report is based on two major global operator surveys that Heavy Reading conducted during 2013. The results of these surveys were initially published in the proprietary multi-client studies "Packet-Optical Transport Networks for the Cloud Era" (June 2013) and "Carrier SDN: Service Provider Perspectives, Transition Strategies & Use Cases " (November 2013), and are here being made available publicly for the first time.

One of the best indications of the progress that is being made on SDN evolution is the focus on use cases: How can SDN be practically applied by service providers and enterprises to solve real-world network problems? There is no shortage of use cases being explored, addressing, in various ways, the different requirements operators have for SDN. The excerpt below summarizes some of the currently popular carrier SDN-related use cases and their benefits to operators. The list is by no means exhaustive, but it aims to take into account the main themes of use cases we are seeing.

Excerpt 1: Popular Carrier SDN-Related Use Cases & Benefits

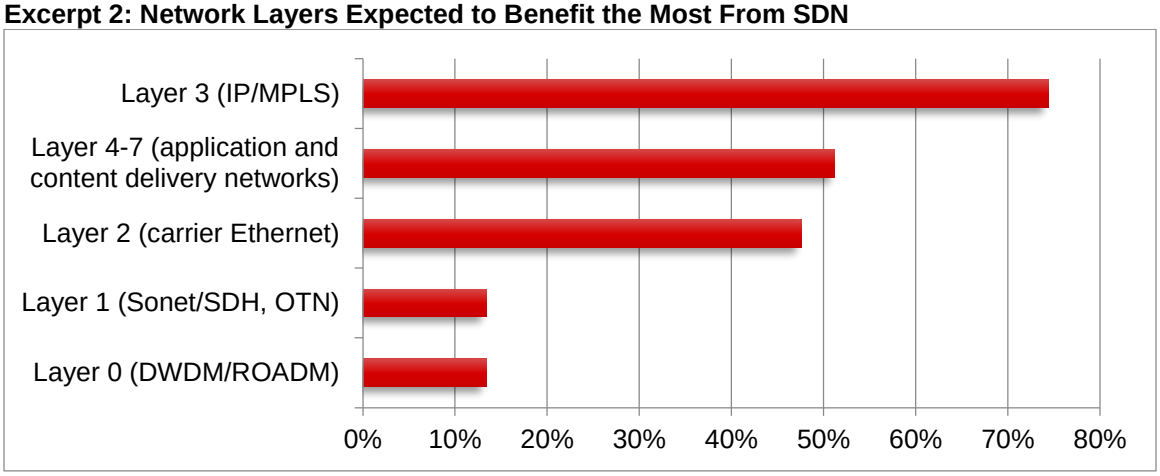
USE CASE	DESCRIPTION	KEY BENEFITS
Multi-layer provisioning	Provisioning across multiple OSI layers (generally router layer and optical transport layers)	Opex savings through automation, as well as revenue generation/network monetization
Bandwidth on demand/ bandwidth elasticity (sometimes called network as a service)	Enabling programmatic controls on carrier links to request extra bandwidth when needed	Revenue generation/ monetization and cloud services delivery
Multi-layer optimization	Allocating resources across OSI network layers to fit overall network needs, based on the global network view that SDN affords	Saves on both capex and opex
Performance on demand	API-driven service in which the network dynamically ensures not only appropriate capacity, but also a guaranteed level of performance	New services and new revenue/monetization
Virtual private cloud	Service provider offers a virtual cloud service within its network that provides enterprise-grade security, performance and control associated with a private cloud	New services and new revenue/monetization

Source: Heavy Reading

We asked respondents to our survey to select the network layers they expected would benefit most from SDN, with results shown in the excerpt below. Clearly, service providers view SDN primarily

as a Layer 3 networking revolution. However, while few operators see the optical layers as benefitting the most from SDN, optical's role may be brighter than these results would indicate: There is significant operator interest in IP+optical integration, in which SDN clearly has a role to play.

Excerpt 2: Network Layers Expected to Benefit the Most From SDN



Source: Heavy Reading; n=82

Report Scope & Structure

SDN in the WAN: Service Provider Opportunities & Challenges is structured as follows:

Section II provides a detailed analysis of trends and market developments in SDN in carrier networks, including the application of SDN to the transport layers. The analysis covers SDN and cloud services delivery; SDN's benefits and applications; and challenges and work still to be done.

Section III profiles three leading independent standards organizations that are driving SDN progress in the WAN: the Open Networking Foundation (ONF), the Optical Internetworking Forum (OIF) and the OpenDaylight Project. Although these organizations do not all exclusively focus on the WAN, we focus on their WAN activities for this report.

Section IV profiles five different service providers that are active in helping define WAN and T-SDN globally. Our primary goal in choosing these service providers was to capture the trends and discussion points included in the report and show how these trends are translating to actual service provider activity. This section analyzes the SDN strategies and activities of AT&T, the Energy Sciences Network (ESnet), Google, Telefónica and Verizon.

SDN in the WAN: Service Provider Opportunities & Challenges is published in PDF format.