

Carriers Plan NETCONF/YANG for SDN/NFV Automation and Service Agility

October 9, 2015

Anyone familiar with SDN (software defined networking) and NFV (network functions virtualization) has heard of YANG and NETCONF. In this CRS, we:

- Explain the roles of YANG and NETCONF
- Highlight our global survey data indicating a majority of carriers want NETCONF/YANG
- Report our research about telecom equipment vendor support of NETCONF/YANG as configuration tools in routers, switches, optical gear, security devices, and more

HOW TO WIN WITH QIN

The first great emperor of China, Qin Shi Huang, unified a number of warring states into a single country around 221 BC. He did not just create a military-ruled set of subject provinces but created a vast empire that still operates as a single country today. Emperor Qin imposed a single currency, a legal system, a single script language, a uniform set of weights and measures, and even standardized the length of cart axels to allow efficient transport on a system of roads. These uniform standards for currency, law, written language, and weights and measures facilitated a more efficient kingdom that could be ruled and administered centrally and brought benefits to the inhabitants, though harsh consequences for subjects that did not adhere to the rules. Communications among the people and provinces improved, an economy was initiated and grew, and walls and roads were more easily built. Qin's legacy due to his obsession with living forever is the terracotta soldier army guarding his tomb near Xi'an. In spite of his desires, Qin died, but due to his visionary administrative structures, and perhaps an extreme desire for power, China lives on in its 2nd millennium.

QIN, YANG, AND NETCONF

Qin's key ingredients were centralized control, common laws/weights/measures, a common language to push commands down to the smallest unit of population, and enforcing cooperation among each citizen lest they be no longer part of the population.

In a similar manner, YANG (yet another next generation) and NETCONF (network configuration) play roles to help automate carrier networks where SDN/NFV principles are used for central control. YANG is a set of rules defining devices and services, and NETCONF is the common language used to communicate a desired set of YANG rules to orchestrators and carrier network equipment.

YANG is a data modelling language—it is a standard codification scheme to describe the configuration details of multivendor equipment, including routers, switches, and optical gear. YANG is also used to describe/define network services, such as IP MPLS VPNs, Ethernet E-LINE/E-LAN, and many others. YANG is like a standard system of laws set up centrally and administered locally.

NETCONF (network configuration) is the protocol most frequently used to communicate YANG services and configuration models to network equipment. NETCONF is a common language that multivendor equipment speaks. Just as languages adapt to events and conditions around them, NETCONF may be supplanted by RESTCONF in the future.

The main property of SDN is a centralized view and dynamic control over a network domain, across multiple domains, or across the entire network. As each domain can have different functionality, different types of equipment, and multiple vendors, it is crucial to have a common way to codify services and equipment configuration parameters (YANG) and a common way to communicate those (NETCONF) to the network equipment. The primary goal of SDN and NFV is automation of network services—and this rests on agility that can only be achieved with some codification of services and equipment.

DATA MODELS ARE CRITICAL FOR SERVICE AGILITY AND AUTOMATION

Operators tell us that a primary goal going forward is automation of their networks at initial provisioning time and dynamically during operations. To achieve this, they need to develop programmable networks, made possible through use of SDN and NFV. In our conversations with operators and vendors, operators want to have centralized control and orchestration by 2020, with a view of all the services running on their network, as well as overall visibility into their entire network hardware.

To achieve that global view of services and network equipment, operators need to ensure their network is organized with tables or constructs or “laws”—called data models—that describe all the services in the network. Without such data models, there would be no practical hope of achieving network programmability and, therefore, no hope of automating much of network operations, no hope of dynamically ensuring QoE of customers in real time, and no hope of dynamically altering traffic flows to avoid congested hotspots and achieve higher utilization of the network.

In order to program the network, data models such as YANG are needed to describe the network services and then protocols such as NETCONF are needed to provision them in the network. But it is very difficult to translate a service that is going to run across different domains in the operators’ networks and over equipment from an array of vendors. As a result, operators needed to standardize data modeling, and the language the industry is coalescing around is YANG.

Here is a good definition of NETCONF and YANG from Carl Moberg of Cisco's Tail-f group:

“NETCONF is the standard for installing, manipulating, and deleting configuration of network devices while YANG is used to model both configuration and state data of network elements. YANG structures the data definitions into tree structures and provides many modeling features, including an extensible type system, formal separation of state and configuration data, and a variety of syntactic and semantic constraints. YANG data definitions are contained in modules and provide a strong set of features for extensibility and reuse.”

WHO WANTS NETCONF/YANG? TELECOMS DO...AND GOOGLE, FACEBOOK, AND CABLE MSOS

The first time I heard of NETCONF/YANG was in December, 2012, when DT announced that it had live network traffic running on SDN in its TeraStream project in Croatia. DT used NETCONF/YANG in that deployment, on which it was initially partnering with Cisco and a little Swedish company called Tail-f who supplied the NETCONF/YANG. For that pioneering project, DT explained that it needed data modeling to achieve automation and leveraged NETCONF/YANG to achieve it.

AT&T announced its Domain 2.0 program in 2013 and the initial 4 vendors in early 2014. Domain 2.0 describes AT&T's plans for changing the way it designs and operates its network using SDN and NFV. Tail-f was among the first 4 vendors involved in this transformation, showing the importance of NETCONF/YANG to AT&T's vision of their future.

AT&T also joined the OpenDaylight Project, which is open source SDN controller software to enable network automation and programmability. AT&T has been using OpenDaylight since its first release and continues to incorporate it into production for its Network-on-Demand services. The company also submitted its customized YANG Design Studio Tool into open source through the OpenDaylight community to enable developers to create services that fit into AT&T's software-defined framework and any YANG-driven implementations.

Traditional telecom operators are not the only ones interested in YANG. Google is one of the major players in the OpenConfig working group, which also includes AT&T, British Telecom, Microsoft, Facebook, Comcast, Verizon, Level 3, Cox Communications, Yahoo, Apple, and DT.

OpenConfig is refining and extending YANG as an industrywide data model standard by bringing together a variety of parties to resolve problems relating to a lack of common interfaces and APIs for managing complex, heterogeneous networks. The focus here is on the need for vendor-neutral APIs for declarative configuration, modern, scalable monitoring solutions, and adoption and native support on vendor platforms. The goal of collaboration under OpenConfig is development of strategies that reflect a variety of uses cases and consolidate requirements across multiple customers in order to simplify the support required from vendors.

Continuous Research Service

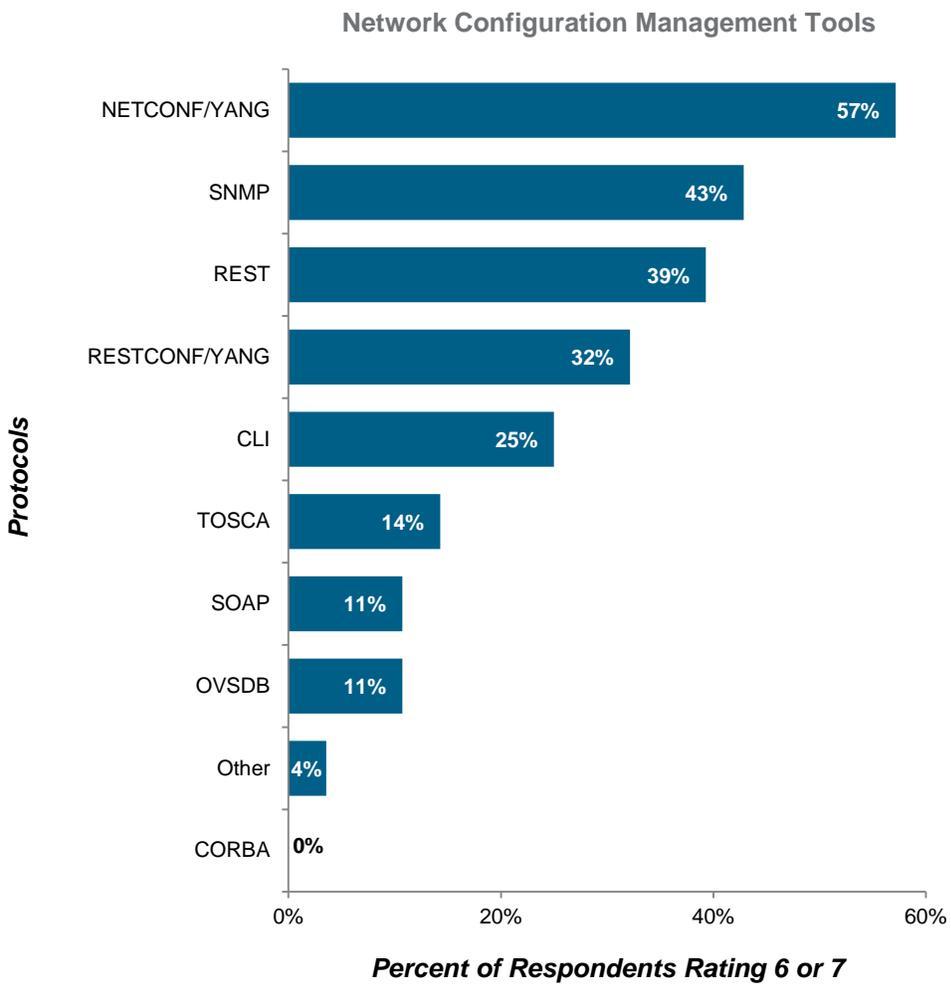
This is a paid service intended for the recipient organization only; reproduction and sharing with third parties is prohibited.
© 2015 Infonetics Research, Inc.

SURVEY: CARRIERS WANT NATIVE SUPPORT FOR NETCONF/YANG ON NETWORK EQUIPMENT

In our research, it is clear that operators around the world are moving toward SDNs (see IHS Infonetics *SDN Strategies: Global Service Provider Survey*, July, 2015). They believe that SDNs will fundamentally change network architecture to increase agility using automation in a way that results in much faster time to deliver new services and gain new revenue while simultaneously increasing operational efficiency and capex savings. We've all heard this by now, but how do we get there?

To automate services in the network, operators need a standardized way to describe services and network equipment. YANG has been growing as the preference of operators to describe the services and the equipment, including edge routers, core routers, customer CPE, optical gear, DSLAMs, etc., as shown in the exhibit below. Such an industrywide model enables SDN and NFV orchestrators and controllers to configure multivendor equipment in a common way. NETCONF is the usual protocol used to “push” configuration changes based on YANG down into the equipment, with RESTCONF growing in popularity.

For our survey, we interviewed 28 service providers who have evaluated or deployed SDNs in their networks or plan to do so in the future. Respondents rated the importance of various network equipment configuration management protocols in their future network operations; 57% rated NETCONF/YANG 6 or 7, or *very important*—indicating it as the top network configuration management tool. The long-used tools, SNMP and vendor-specific command line interfaces (CLIs), are the methods most network equipment is configured with today, and operators still view these as important. But we now see the growing popularity of newer protocols as REST and RESTCONF/YANG are high on the list, as many operators are using the popular REST as well.



Source: IHS Infonetics SDN Strategies: Global Service Provider Survey, July 2015

Continuous Research Service

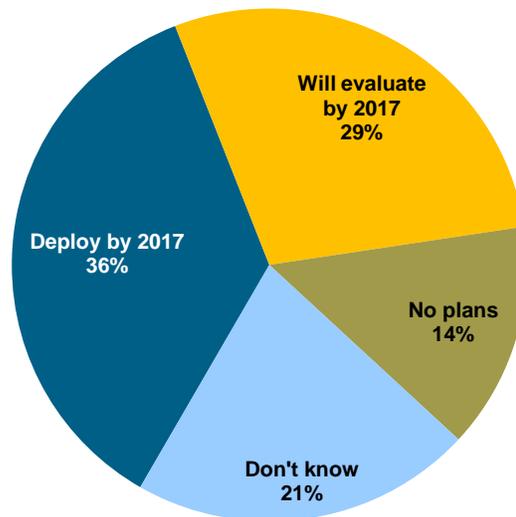
This is a paid service intended for the recipient organization only; reproduction and sharing with third parties is prohibited.
 © 2015 Infonetics Research, Inc.

MAJORITY OF CARRIERS PLANNING TO DEPLOY AND/OR EVALUATE NETCONF/YANG BY 2017

In the survey, we further examined NETCONF/YANG, finding that 36% plan to have deployed NETCONF/YANG by 2017, with another 29% indicating they will evaluate it by 2017.

In the exhibit below, we show the operators' expected status of NETCONF/YANG in 2017.

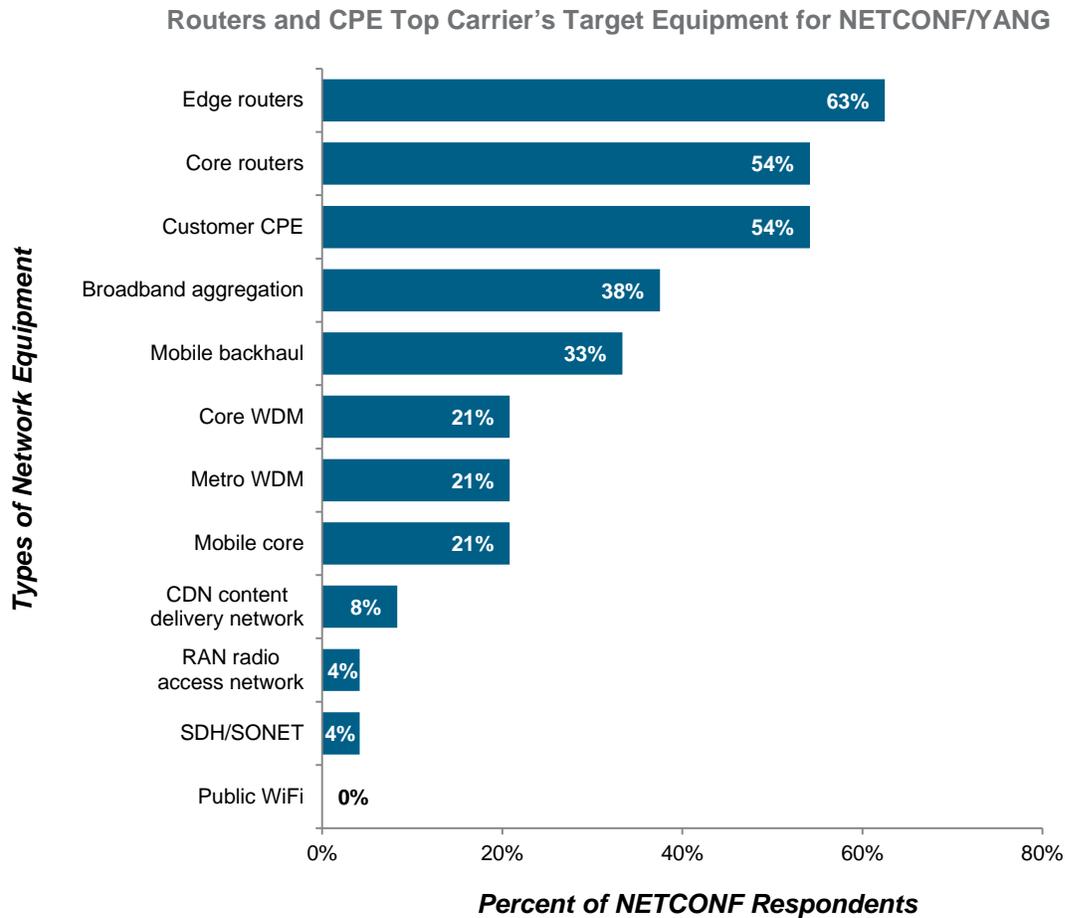
NETCONF/YANG Status in 2017



Source: IHS Infonetics SDN Strategies: Global Service Provider Survey, July 2015

We investigated further to see what equipment is or would be targeted to configure using NETCONF/YANG. We asked the 86% of respondents (100% minus the 14% with no plans in the exhibit above) who have deployed NETCONF with YANG or plan to deploy or evaluate it by 2017 to tell us the types of network equipment for which they are deploying, planning, or evaluating NETCONF/YANG. We label them "NETCONF respondents."

A majority of NETCONF carriers indicated they will use NETCONF with YANG on edge and core routers, as well as customer CPE. There is much smaller interest at 21% today for NETCONF/YANG for WDM transport equipment, whether core or metro.



Source: IHS Infonetics SDN Strategies: Global Service Provider Survey, July 2015

GROWING NETCONF/YANG SUPPORT BY TELECOM EQUIPMENT MANUFACTURERS

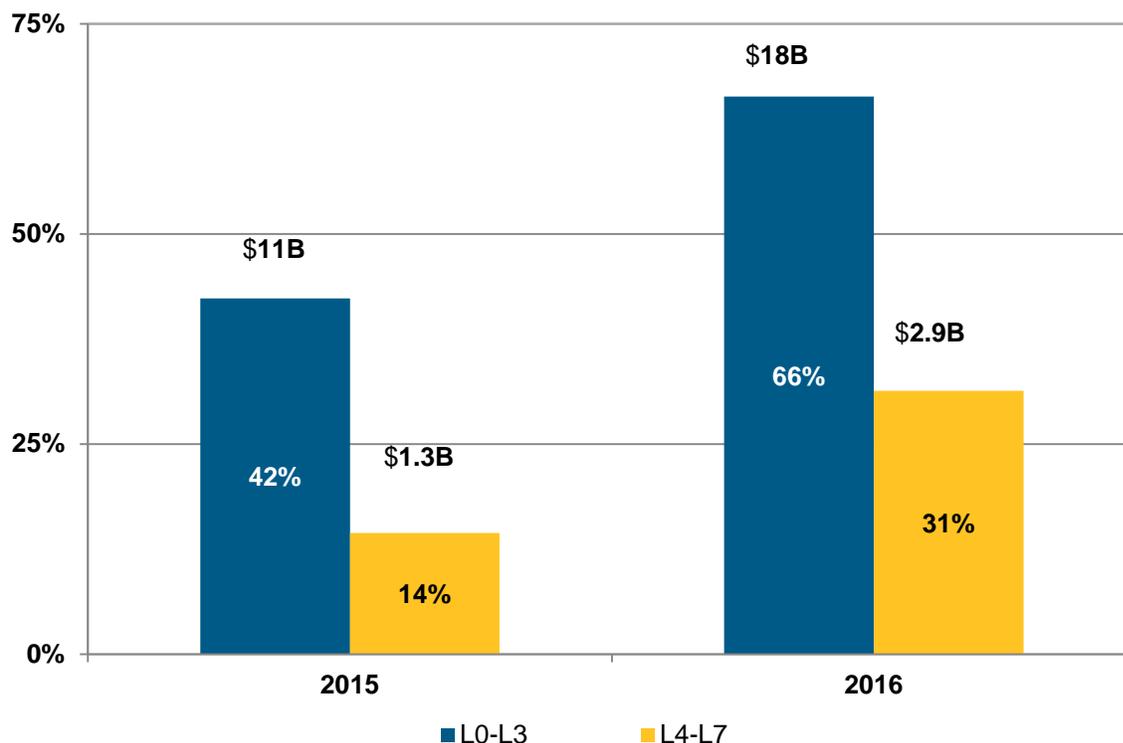
Many, though not all, manufacturers have added NETCONF/YANG tools this year or have indicated that they will be added in the future. The front runners are router vendors, which are closely in tune with operators' demands to have NETCONF/YANG tools for routers and carrier Ethernet switches. Operators and DC owners, however, have not yet made NETCONF/YANG configuration tools a top priority for Layer 4-7 products, so manufacturers of that type of equipment are not as interested in moving forward and are tending to wait on the sidelines to see if demand materializes before developing those tools.

Continuous Research Service

This is a paid service intended for the recipient organization only; reproduction and sharing with third parties is prohibited.
© 2015 Infonetics Research, Inc.

In 2015, we queried manufacturers about their plans for NETCONF/YANG and other configuration tools. Manufacturers indicated that 66% of their Layer 0-3 products (\$18B of the \$27B expected to be sold in 2016) will include NETCONF/YANG configuration tools. These products include edge and core routers, carrier Ethernet switches, and WDM gear. On the other hand, 31% of spending on Layer 4-7 products in 2016 will have NETCONF/YANG configuration tools available.

Manufacturers Plan NETCONF/YANG for 66% of L0-L3 Products in 2016



BOTTOM LINE

Similar to the centralized control over standardizations of law, currency, weights, measures, and written language from which was born the country of China, YANG and NETCONF play important roles in standardizing and automating operations of carrier networks under SDN and NFV. Operators see the need to employ service and device data modeling of YANG and NETCONF to achieve the automation and agility they expect to achieve with greater use of SDN and NFV.

Based on actions in the market—from early moves made by DT and AT&T to open source collaboration in the OpenDaylight Project and OpenConfig working group—the industry appears to be homing in on YANG as the standard configuration modeling language and NETCONF (or RESTCONF) as the communication protocol for the configuration of network devices. These network programming tools can be used at initial provisioning time and also dynamically on live traffic.

Continuous Research Service

This is a paid service intended for the recipient organization only; reproduction and sharing with third parties is prohibited.
© 2015 Infonetics Research, Inc.

In fact, our global carrier surveys indicate that 57% of providers strongly want NETCONF/YANG available for their network equipment, especially for edge/core routers and CPE. Manufacturers are in tune with these carrier desires and plan to have NETCONF/YANG configuration tools available on routers, switches, and optical transport gear. In fact, manufacturers will offer NETCONF/YANG on equipment that represents 66% of carrier spending on those products in 2016.

As always, I welcome your feedback.

Michael Howard
Senior Research Director, Carrier Networks
+1 408.583.3351
michael.howard@ihs.com
Twitter: @MichaelVHoward

Continuous Research Service

This is a paid service intended for the recipient organization only; reproduction and sharing with third parties is prohibited.
© 2015 Infonetics Research, Inc.