Network Performance and Fault Management Challenges in an SDN and Network Virtualization World

An ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) White Paper
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# Table of Contents

- Executive Summary .......................................................................................................................... 1
- New Network Management Challenges .......................................................................................... 1
- SDN Adoption and Impact on Management Tools/Practices ............................................................ 2
- Monitoring SDN and network virtualization abstractions with HP NNMi ....................................... 3
- The Networking Challenges of SDN and Software-Defined Data Centers ..................................... 3
- Understanding Flow in an SDN World .............................................................................................. 4
- Integration, Automation Keys to Success .......................................................................................... 4
- EMA Perspective ............................................................................................................................... 5
- About HP .......................................................................................................................................... 5
Executive Summary
While software-defined networking (SDN) has emerged to solve many of the network operations challenges faced in enterprise data centers today, the technology is itself disruptive to the network management tool industry. SDN introduces new levels of abstraction and dynamic change not seen before in enterprise networks. Network performance and fault management platforms in particular must evolve to understand these new network abstractions and to both react to and implement rapid and automated change. These platforms must shift from a device-centric view of network health to a more holistic view that better understands application flows and dependencies. This white paper explores these issues in depth and illustrates how HP Software’s Network Node Manager i (NNMi) is evolving to address them.

New Network Management Challenges
Network performance and availability monitoring is a mature, well-understood technology in traditional networking environments. Its ability to model and understand the health and performance of individual network hardware devices has long been the first line of defense for administrators tasked with troubleshooting their networks. However, the growing use of virtualization and software-defined technologies challenges performance and availability monitoring platforms. A decade ago, server virtualization upended the IT industry when adoption accelerated at an exponential rate. A similar adoption curve may be on the horizon for SDN and network virtualization, and network management tools must be ready. SDN and network virtualization introduce a wide variety of new architectures that add new components and relationships to the network, bringing more dynamic change as well.

Hypervisors have introduced virtualized network connectivity that must be managed and monitored. This virtualization has also driven an architectural shift in data centers. The hierarchical, scale-up approach to data center networking (server access, aggregation, and core) has been replaced in many cases with a scale-out, leaf-and-spine architecture that is more complex from a management perspective. Furthermore, SDN, in its various flavors, redefines the roles and functioning of network hardware in these leaf-and-spine environments. In many cases, SDN adds new components to the network—SDN controllers, for instance—that must be modeled and managed. Traditional static network hardware appliances like load balancers and firewalls are increasingly being replaced by virtual appliances and virtual network functions that are as dynamic as the virtualized applications they serve.

Network performance and availability monitoring platforms must not only model and manage these new SDN components. In order to provide a complete picture of network health in the data center,
the monitoring platforms must also recognize and track the relationships between SDN components as well as handle the higher rates of network change and dynamism brought on by programmable architectures.

Network monitoring technologies must adapt by enhancing their abilities to abstract the network, both at a device level and at an architectural level. They must be able to understand how the health of the components on a single network element can affect both the overall network and discrete functions, whether those functions are virtualized or distributed. They must form tighter connections to related management systems, such as HP’s Network Automation network change and configuration management product, that interact with these new architectures. Furthermore, given the dynamic nature of network virtualization and SDN, these monitoring platforms must be more automated in how they adapt to change and alert administrators about network problems. For more information on these related systems, see our white paper, “The Evolution of NCCM Platforms in the Era of SDN and Network Virtualization.”

SDN Adoption and Impact on Management Tools/Practices

ENTERPRISE MANAGEMENT ASSOCIATES (EMA) research has found that the majority of enterprises have some form of SDN activity inside their network organizations. Most enterprises are researching, evaluating, or testing SDN, but a sizable minority has already deployed the technology in production networks. These deployments include hardware-centric SDN deployments (e.g., OpenFlow) as well as network virtualization overlays (NVOs). Sixty-nine percent of enterprises are researching, evaluating, or testing hardware-centric SDN while 66% are doing so with NVOs. Nineteen percent of enterprises have production deployments of hardware SDN in place while 18% have deployed NVOs.

EMA research also found that most enterprises are unsure about the ability of their pre-existing network management tools to support SDN. Only 42% of enterprises believe their availability monitoring tools can fully support NVOs, and only 41% believe their performance monitoring tools can do so. Their confidence is only slightly higher for hardware-centric SDN, with 44% and 43%, respectively. Given that SDN migration will be gradual in most environments, many enterprises will have hybrid infrastructures, with a mix of SDN and traditional networking. These enterprises will not want to install a second management stack for these new architectures. New management tools add more complexity, with time spent on deploying and maintaining the software and training staff to use it. Multiple management stacks also obscure the contextual integrations that an end-to-end management tool can offer.

EMA Recommendation: Enterprises should evaluate the roadmaps of their network performance and fault management vendors to ensure that their existing tools will be able to manage software-defined networks and network virtualization.

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Monitoring SDN and network virtualization abstractions with HP NNMi

Given the wide variety of SDN technologies currently on the market, soon managing a network element by element will no longer be a viable option. Management tools will need to offer more meaningful abstractions to define and manage such networks. With these new requirements in mind, HP is updating and enhancing NNMi with the ability to monitor networks from a highly abstracted point of view, making the platform more adaptable to multiple proprietary and open architectures.

HP is boosting NNMi’s ability to model and monitor abstract components of network infrastructure within both physical and virtual network elements. For instance, HP is enhancing NNMi’s ability to model the individual components and interfaces of a physical device. HP will be able to apply this model to the higher-level abstractions introduced by SDN and network virtualization. This model will serve as the foundation for managing the overall software-defined network, and it will include an understanding of how controllers, physical devices, virtual switches, and virtual appliances work together to create end-to-end network services. For instance, an OpenFlow controller can define an abstract network flow that comprises individual ports on multiple switches. HP’s NNMi will be able to discover, present, correlate, and drive root-cause analysis across such abstractions. HP is enhancing NNMi to support multiple approaches to SDN, including OpenFlow controller-based networks, proprietary SDN hardware architectures, and virtual network overlays.

The Networking Challenges of SDN and Software-Defined Data Centers

SDN is just one of many architectural phenomena impacting network operations and overall data center operations in enterprises today. Many enterprises are also adopting the concept of the software-defined data center (SDDC), an architecture in which all the infrastructure and software elements of a data center are abstracted into pools of resources that can be orchestrated on demand for applications. SDN is a key enabler of SDDCs. Together, both SDN and SDDC architectures present new challenges to network operations that network management tool vendors must address.

According to EMA research, ensuring network performance is the number one concern of enterprises adopting SDDC architectures. Enterprises identified troubleshooting and monitoring across physical and virtual networking as the third biggest challenge in SDDC environments. Additionally, EMA research has found that many early adopters of SDN are struggling with troubleshooting and maintaining visibility into these new networks.

To ensure that network operations teams can support these new architectures, network performance and fault management platforms must be integrated with, and must also be designed to support, SDN and SDDCs. SDDC architectures, in particular, will heavily rely on network virtualization software, and management tools must support them. HP’s NNMi platform is an example of a network performance and fault management tool that is evolving to meet these new requirements. NNMi will soon have visibility into VMware and Microsoft Hyper-V virtual switching infrastructure. It will also add VMware NSX monitoring to provide operational visibility across physical and virtual networks. To date, approaches to SDDC operations have been very server-centric, which can result in suboptimal networking. Network management tools that support SDDC network technologies will give network managers the visibility they need to help optimize the placement and balancing of workflows.

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EMA research, "Obstacles and Priorities on the Journey to the Software-Defined Data Center," January 2014.
Understanding Flow in an SDN World

As enterprises adopt SDN in their data centers, the network becomes a mixed physical and virtual fabric, with Layer 2–7 functions proliferating as pure software. Most network and fault management platforms have their roots in hardware-centric monitoring and management. In a software-defined, virtual environment, these platforms need a clear line of sight throughout the virtual network stack. Furthermore, these management platforms need to understand the application flows that are traversing these mixed physical and virtual network environments. Without this flow intelligence, a management platform cannot map application dependencies across the virtual and physical topology and identify where controls are implemented.

As these application flows traverse both physical and virtual elements, SDN controllers or cloud orchestration systems will sometimes be used to coordinate their paths. An SDN controller, for instance, might use the OpenFlow protocol to program the switch fabric to identify and take action on an application flow. The controller might also integrate with a virtual application delivery controller to insert Layer 4–7 services, such as application acceleration or load balancing, into the flow. Other deployments of these mixed fabrics could be more limited. A network virtualization overlay, for instance, could be able to control application flows across the virtual network elements, but it might lack integration with the physical network elements.

Network fault and performance management platforms must have visibility into both virtual and physical elements, with an awareness of the relationships between these elements and with visibility into the application flows that traverse them end to end. HP has identified these issues as key priorities for upcoming releases of NNMi.

Integration, Automation Keys to Success

SDN and related architectures like SDDCs are specifically designed to bring more automation to the IT environment. This presents perhaps the greatest management challenge of all—keeping up with the ever-changing nature of these new technologies. You can’t monitor what you don’t know is there.

Network performance and fault management platforms need to be tightly integrated with configuration and provisioning systems, which in turn must be able to support these new SDN technologies. This integration will allow automated coordination of scale-in and scale-out operations. These management platforms must also be able to apply policy definitions and policy languages that span both network monitoring and network configuration platforms in order to meet more stringent security and service quality requirements.

HP Software differentiates its network management platforms via tight integration between NNMi and Network Automation (NA), HP’s network configuration and change management platform. After it instantiates new network elements, NA can automatically push monitoring policies to NNMi. Network change events can proliferate from NA to NNMi to provide root-cause analysis correlation. (Refer to complementary white paper for more on NA support for SDN/virtualization.)
EMA Perspective

SDN has emerged as a prescription for addressing the networking challenges presented by private and hybrid cloud and modern application architectures. SDN has the potential to be the most disruptive technology the networking world has seen in decades. While it delivers network programmability and automation, SDN challenges existing network management practices. The tools that enterprises have traditionally relied on to manage and operate their networks must evolve to work with SDN.

Network performance and fault management platforms need to understand these new, increasingly abstracted networks. They must be able to monitor new network elements like SDN controllers and adapt to work with virtualized network elements that previously existed only in hardware form. They must understand the relationships and dependencies within new SDN architectures. They must develop policy languages that can be shared and integrated with other management platforms, such as network configuration management, to ensure network operations teams have a toolset that can provide a complete picture of these automated and abstracted networks. SDN also enables a much more rapid acceleration of technology adoption by disrupting the long hardware-refresh cycle.

HP NNMi offers enterprises a powerful and proven platform that is adapting to these changes. Together with other HP products such as Network Automation, NNMi offers enterprises a roadmap for success as they embark on their SDN journeys.

About HP

HP creates new possibilities for technology to have a meaningful impact on people, businesses, governments and society. With the broadest technology portfolio spanning printing, personal systems, software, services and IT infrastructure, HP delivers solutions for customers’ most complex challenges in every region of the world. More information about HP (NYSE: HPQ) is available at http://www.hp.com/go/nmc.