

IHS TECHNOLOGY

Data Center and Enterprise SDN

Vendor Leadership Analysis Excerpts

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Executive Summary: The Market Leadership Battle Rages On

This service profiles and analyzes the leading vendors' approaches to and overall activities in the data center and enterprise software-defined networking (SDN) market, to understand how suppliers are approaching this emerging opportunity and gauge the most likely market winners as the market matures. We examine vendors from a number of categories, including the following: Ethernet switch, Ethernet switch silicon, Ethernet switch operating system (OS), and SDN control.

The leaders in the data center and enterprise SDN market are emerging for physical network equipment and SDN network virtualization overlay (NVO), but there is still opportunity; the 2nd and 3rd tiers of the market have yet to be solidified, and perhaps the most innovation-driven part of this market, critical for new revenue (SDN controllers, orchestration, and SDN applications), is still wide open. Many service providers and enterprises will carry out production trials and live deployments in 2016, which IHS expects will solidify this market.

All vendors profiled in this report—Broadcom, Brocade, Cisco, Cumulus Networks, HPE, Huawei, Juniper, NEC, Nokia Nuage, and VMware—bring a unique vision to the market, are providing innovation and thought leadership to support their vision, and will play an important role in shaping the fluid data center and SDN market with their products. This document is an excerpt; please contact IHS for the full report including all vendor profiles.

Exhibit 1 Data Center and Enterprise SDN Vendor Overview

Vendors	Summary
 BROADCOM	Data center merchant silicon pioneer providing SDN-aware chips and developer tools
 BROCADE	Data center fabric innovator providing open source SDN controller distribution
 CISCO	Ethernet switch market leader providing custom silicon-based SDN underlay
 cumulus networks	Ethernet switch OS innovator provider disaggregating switch hardware from software
 Hewlett Packard Enterprise	Early market pioneer with over 30 million OpenFlow-capable ports shipped
 HUAWEI	Comprehensive SDN portfolio innovating with programmability in software and silicon
 JUNIPER NETWORKS	4th largest data center network vendor driving SDN innovation in silicon and software
 NEC	SDN pioneer with successful large-scale and geographically-distributed deployments
 nuagenetworks™	Early market entrant innovating BGP-based SDN network virtualization overlay
 vmware®	SDN virtualization innovator applying software abstraction techniques to network control

Source: IHS

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Market Overview

SDN (software-defined network) has captured the attention of the marketplace because it has the potential to enable automation of the network based on new forms of network programmability. This drives a new high-level architecture for networks and applications. SDN enables coordination between applications and the network, which does not occur in current networks. In the data center (DC), SDN enables integration of the network with orchestration platforms for automation of the entire DC across its 3 essential elements of compute, storage, and the network.

The architecture and taxonomy of SDN includes a data forwarding plane (physical and virtual), a control plane, and network-aware applications. Inherent to SDNs is a method to abstract and separate the switch control plane from the data plane. This abstraction has the potential to drive new efficiencies, enable more scalable methods for defining virtual networks, and simplify support for multi-tenancy. SDNs include a method (APIs and specialized protocols such as OpenFlow) that can be used by applications and external controllers to request network state information, control traffic flows, or request services.

SDN solutions are available in 2 different forms: underlays and overlays.

- An **SDN underlay** solution includes an SDN controller providing traffic flow handling instructions to physical Ethernet switches.
- An **SDN overlay** solution, referred to as a **network virtualization overlay (NVO)**, includes an SDN controller providing traffic handling instructions to vSwitches, and traffic is tunneled through the physical Ethernet switches. With NVO, the solution is agnostic to the physical switches in use.

IHS expects the in-use DC and enterprise SDN market to reach \$1.4B in 2015, growing to \$12.2B in 2019. Not all of the \$12.2B 2019 revenue is new: SDN-in-use Ethernet switch revenue is existing revenue. A portion of SDN-controller revenue is displaced from the Ethernet switch market due to reduced port ASPs as some network operators will select to use bare metal Ethernet switches when deploying SDNs and rely on SDN controllers for advanced control plane features. The SDN market is still forming, and we can expect the top slots to change hands frequently.

Exhibit 2 In-Use DC and Enterprise LAN SDN Revenue Source

Source	US\$B	% of 2019 Market	Categories
New	\$2.8B	23%	SDN orchestration and controllers
Displaced	\$1.2B	10%	SDN orchestration and controllers
Existing	\$8.2B	67%	SDN hardware
Total	\$12.2B	100%	DC and enterprise SDN

Source: IHS

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The following are our definitions of the products that make up this market:

- **SDN-capable Ethernet switches:** Switches providing an Ethernet control plane, data forwarding plane, and an API or SDN protocol such as OpenFlow to support software-defined networks (SDN); allow an external application, orchestration software, or SDN controller to obtain network state information and/or control traffic flows, or request services
 - **In-use:** SDN-capable Ethernet switches where traffic flow is actively controlled by, and/or network state information is exchanged with, an SDN controller, orchestration software, or application
 - **Not-in-use:** SDN-capable Ethernet switches where traffic flow is NOT actively controlled by, and network state information is not exchanged with, an SDN controller, orchestration software, or application (not included in Exhibit 2 above).
- **SDN controllers:** Products used in DC and enterprise networks for control of SDN networks; SDN controllers provide an SDN control plane providing traffic flow control configuration and orchestration for network device configuration; includes northbound interfaces to communicate with SDN-capable applications or orchestration software, and southbound interfaces to communicate with SDN-capable switches
- **SDN applications:** Applications that interface with a switch, SDN controller (via API, or specialized protocol such as OpenFlow, etc.), or with a data center orchestration platform for controlling application traffic flows and obtaining network state information
- **Bare metal Ethernet switch software:** Bare metal Ethernet switch control plane software











Vendors Profiled

In the full report, we include 10 leading vendors selected for one or more of the following reasons:

- Significant (market weight) DC network and enterprise LAN vendors with SDN-capable products
- Significant (market weight) carrier network vendors with DC and LAN SDN-capable products
- Significant (market weight) software vendors with unique SDN products
- Interesting specialist players
- Chip manufacturers with SDN-aware silicon

The following table lists the vendors profiled in the full report and the segments of this market in which they participate; this excerpt profiles NEC only—contact IHS to obtain the full report.

Exhibit 3 Product Portfolios of Profiled Vendors

Vendors	SDN-Capable Ethernet Switches	SDN Controllers	SDN Applications	Bare Metal Ethernet Switch Software
 BROADCOM	✓			
 BROCADE	✓	✓	✓	
 CISCO	✓	✓	✓	
 cumulus networks				✓
 Hewlett Packard Enterprise	✓	✓	✓	✓
 HUAWEI	✓	✓		
 JUNIPER NETWORKS	✓	✓		
 NEC	✓	✓	✓	
 nuagenetworks™	✓	✓	✓	
 vmware®	✓	✓		

Source: IHS

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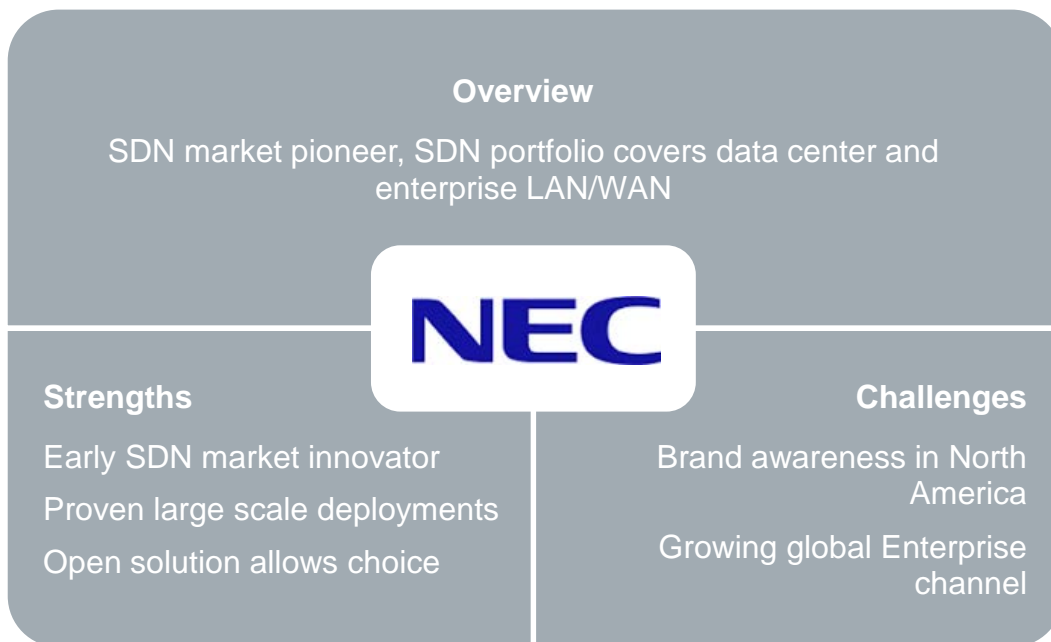
NEC

NEC jumped into the SDN market early with the 2011 release of its SDN controller and OpenFlow controlled SDN-capable switches for the data center and enterprise LANs. NEC conducted some of the early enterprise LAN proof of concepts and live deployments, demonstrating that SDN would go beyond the data center. Continuing to innovate, NEC released SDN applications for automation of virtual data center networks, automation and unification of data center and enterprise LAN management, and management of virtual workloads. Recognizing the opportunity with SD-WAN, NEC maintained its market thought leadership momentum by recently extending its SDN portfolio to cover this new use case.

NEC's SDN solution includes an SDN controller and applications, virtual switches providing an SDN network virtualization overlay (NVO), and physical branded SDN-capable Ethernet switches for the data center and enterprise. NEC was one of the first vendors to deploy SDN in the enterprise LAN, providing a segmented enterprise network with automated and unified management for Kanazawa University Hospital, a large teaching and research facility in Nagoya, Japan. NEC has demonstrated success with large scale and geographically distributed SDN deployments making them attractive to buyers that want open, scalable, proven solutions.

NEC's 2014 revenue was \$29.5 billion, and its 2014 SDN in-use revenue was \$38 million.

Exhibit 4 NEC Profile Summary



Source: IHS

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NEC's Data Center and Enterprise LAN SDN Strategy

NEC's corporate vision is to orchestrate a brighter world by creating an IT enabled society. For SDN, this translates into bringing automation to the data center and enterprise LAN, unifying management of the entire enterprise network. To achieve this vision, NEC brings SDN principles of a centralized and abstracted network control plane with a unified management platform to the data center and enterprise LAN and WAN, and built a robust third-party partner SDN ecosystem integrating its SDN controller.

NEC's SDN strategy in the data center and enterprise is to provide a complete high performance and scalable SDN solution for the data center and enterprise campus. NEC also adds openness to its strategy, allowing customers to choose suppliers by integrating its products with third-party orchestration software, security, application delivery control, WAN optimization, server virtualization, and WiFi networks. Its professional service organization has extensive service provider and enterprise experience, plus success deploying multi-vendor networks.

Longer term, NEC understands that expanding its SDN use cases is how it can differentiate from competitors and continue to innovate. It plans to invest in developing and showcasing SDN applications for IoT and enterprise verticals such as healthcare, finance, education, and retail.

Portfolio

NEC's SDN solution includes SDN applications, an SDN controller (Programmable Flow PF6800 Controller), a virtual switch (PF1000 Virtual Switch), and physical branded SDN-capable Ethernet switches (PF5000 Series Switches) for data centers and enterprise LANs.

NEC's SDN applications include WebSAM vDC for automation of virtual data center networks, WebSAM Network for automated management of enterprise LANs, and WebSAM NetvisorProV for unified data center and enterprise LAN management.

NEC's PF6800 Controller provides unified control of physical and virtual networks. It provides an abstracted and centralized network control plane using OpenFlow on southbound interfaces to network devices. The controller also provides northbound APIs to interact with third-party applications, providing L4-L7 services. It has an integrated management console, allowing users to monitor traffic flows through physical and virtual network elements. Combined with NEC's Unified Network Coordinator (UNC) for improved scalability, 8,000 switches can be managed as a single network.

NEC's PF1000 Virtual Switch integrates with Microsoft Hyper-V and NEC's SDN controller to provide an SDN NVO. Used in conjunction with the PF6800 Controller, it also detects the migration of virtual machines (VMs) from server to server allowing the network to automatically adjust to VM motion. The PF1000 supports OpenFlow and can support 256 VMs.

NEC's PF5000 series SDN-capable physical switches provide up to 40GE switching. They use OpenFlow to communicate with NEC's PF6800 Controller and other compatible third-party controllers. They include NEC's Virtual Tenant Network (VTN) technology, allowing each tenant in a multi-tenant environment to isolate its network traffic flows for improved security.

Markets Addressed

In the data center, NEC's SDN solutions are targeted at enterprises, telcos, and cloud service providers. For the enterprise network, NEC targets education, healthcare, transportation, state and local government, and retail verticals with SDN. It has a strong enterprise channel, and a large professional services organization with enterprise IT and service provider sales experience. In the data center and enterprise SDN market, over 90% of NEC's revenue is from APAC, the remainder is from North America.

Customers

NEC is getting traction with customers requiring improved quality of experience for end users, automated networks with unified management, and scalable and geographically distributed solutions. Customers adopting NEC's SDN solutions include hospitals needing to simplify network provisioning and improve security, and public transportation service organizations needing automated disaster recovery and better quality of service for public WiFi hotspots. Customer examples include:

- JR-EAST Tokyo Station deployed NEC's SDN controller and SDN-capable Ethernet switches, improving the quality of service for station customers, enabling support for new mobile applications, providing traffic prioritization for IP surveillance cameras, and the use of WiFi hotspots and storage lockers with electronic payment cards already used for train fare payment
- West Nippon Expressway Company Limited deployed a 4,000km WAN to support 24/7 expressway operations using NEC's SDN controllers (4 units) and SDN-capable Ethernet switches (136 switches) to provide automated recovery in case of large scale disasters
- Kanazawa University Hospital in Nagoya, Japan deployed NEC's SDN controller and SDN-capable Ethernet switches, reducing hospital network management costs by unifying management of independent departmental LANs, and automating provisioning; time for major network re-configurations was reduced from 9 to 2 person days

Strengths and Challenges

NEC built an SDN market competitive advantage by taking a thought and product leadership position, demonstrating large scale and geographically distributed SDN deployments covering data centers and enterprises. Following the spirit of SDN, NEC provided thought leadership by demonstrating the viability of an open SDN allowing customers the option to build a multi-vendor network, and it has built a strong partner ecosystem with professional services to remove risk for its customers deploying best of breed SDNs. By the end of 2015, NEC had over 250 unique SDN solution deployments; many are large scale and in mission critical environments.

The challenge for NEC is to grow its SDN business outside of Asia, turning thought leadership into traction in North America and EMEA. Although NEC is a known brand, it is not recognized as an SDN player outside of APAC. Hopefully the marketing investment underway by NEC will get the word out about all its SDN achievements.

NEC understands that expanding the use cases for its SDN solution is critical for its success and recognized early that SDN goes beyond the data center to include the enterprise LAN and now the enterprise WAN. It built a comprehensive and open product portfolio, making it a strong SDN contender in the data center and enterprise LAN/WAN market.

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