Cisco's Data Center Strategy Is Built on Openness

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Prepared by:

Zeus Kerravala

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ZK Research
A Division of Kerravala Consulting

zeus@zkresearch.com

Cell: 301-775-7447
Office: 978-252-5314

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Introduction: The Agile Data Center Drives the Need for Openness

The enterprise data center has undergone several major transformations since the inception of computing as a business resource. The computing platform has evolved from the mainframe, to client/server computing and then to Internet computing. Today, the industry is in the midst of another major shift—the transition to cloud computing. The move to the cloud is being driven by the massive push for organizations to be more agile to capitalize on digital transformation. Companies that can become agile, digital organizations will gain a significant competitive advantage over their peers. Those that don't will struggle and risk becoming irrelevant.

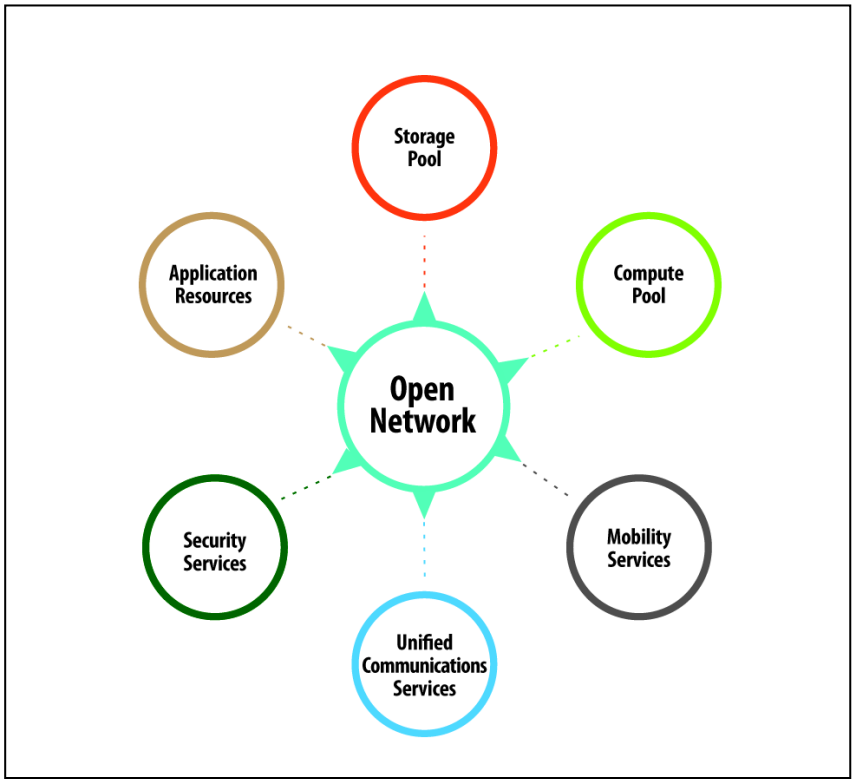
One of the key building blocks of an organization's cloud strategy is an agile data center. However, legacy data centers face some significant challenges with respect to becoming more agile, including the following factors:

- **Closed infrastructure silos:** Historically, data center infrastructure has been deployed in silos on an application-by-application basis. Each application had its own storage, compute, network and other infrastructure required to run it. Although this created acceptable performance levels, the inability to share resources between the silos led to low utilization. Based on historical data, ZK Research estimates that average infrastructure utilization for legacy data centers was in the 20% to 30% range.
- **Wide use of proprietary systems:** The silos of infrastructure were typically built using proprietary technology. This provided the short-term advantage of making infrastructure easier to deploy but also created long-term interoperability issues.
- **Lack of automation:** The proprietary nature of legacy infrastructure made automation difficult, if not impossible, to accomplish. Building an orchestration platform for proprietary technology would have to be done on a vendor-by-vendor basis.

In an agile data center, the application and compute technology evolve into "pools" of resources that are connected by a network (Exhibit 1). The network acts as a virtual "backplane" and can move resources to whichever application requires it as determined by business policy.

The vision of an agile data center can only be fulfilled if the network is open to ensure as broad an ecosystem as possible and for interoperability purposes. Cisco is one vendor that has taken an open approach to building an agile data center and can bring it from being a vision to becoming a reality.

Exhibit 1: The Network Is the Backplane of the Agile Data Center



Source: ZK Research, 2015

Section II: Cisco's Open Approach to the Data Center

Cisco, the market leader in data center network infrastructure, has embraced openness as a strategy and has evolved its data center product portfolio accordingly to be as open as possible. Cisco's open strategy is now pervasive across the data center portfolio regardless of approach and is a core value proposition of the company's application-centric infrastructure (ACI). Because ACI is open, it can operate as a standalone, traditional network or as a software-defined network (SDN) overlay.

One of the primary value propositions of Cisco's open approach is the ability to drive an ecosystem that can interoperate with the company's products easily through the use of open standards. Cisco's ecosystem of partners in the data center includes a number of market leaders and best-of-breed solution providers. Exhibit 2 presents a subset of the ecosystem partners.

Cisco's large ecosystem and its open strategy enabled greater automation of processes in the data center. According to ZK Research, people-related expenses account for 40% of the total cost of running a data center—the largest component. By being able to automate and orchestrate many of the manual tasks associated with provisioning infrastructure, businesses can cut data center operating costs by up to 50%.

Although it's hard to demonstrate "openness," the approach can be presented through the following proof points.

Adherence to Open Standards

Cisco has worked extensively to develop open standards within the open source community. As a result, it has developed the following open standards:

- **BGP-EVPN:** Ethernet Virtual Private Network (EVPN) is a well-adopted standard for multi-protocol address mapping. Cisco—along with AT&T and Verizon—is using the Border Gateway

Exhibit 2: Cisco Data Center Ecosystem Partners

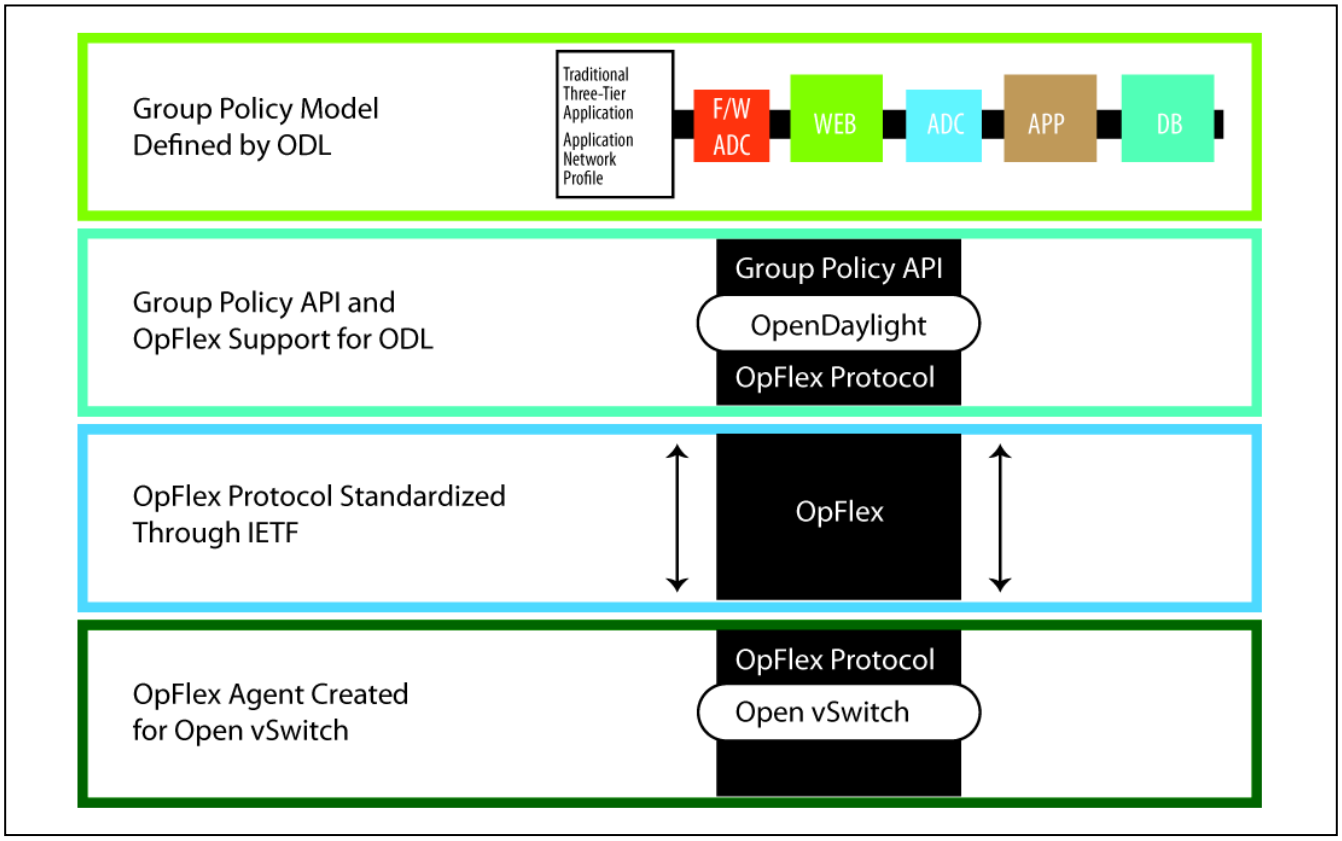
APPLICATION DELIVERY CONTROLLERS	SECURITY	STORAGE	HYPERVISOR	MANAGEMENT	CONVERGED INFRASTRUCTURE	DEVOPS AND AUTOMATION
F5 NETWORKS	Fortinet	Emulex	VMware	Infoblox	VCE	OpenStack
CITRIX	Intel Security	EMC	Microsoft	Computer Associates	Nutanix	Puppet Labs
RADWARE	Check Point	NetApp	Red Hat	BMC		CFEngine
A10 NETWORKS	Symantec	Emulex		NetQoS		Chef
AVI NETWORKS	Sourcefire			Splunk		Python

Source: ZK Research, 2015

Protocol (BGP) as the routing protocol and has combined it with EVPN to enable a control plane for Virtual Extensible LAN (VXLAN). BGP-EVPN for VXLAN can be used to define how the VXLAN tunnel endpoints map the MAC addresses to IP addresses for defining virtual machines on NX-OS–based switches.

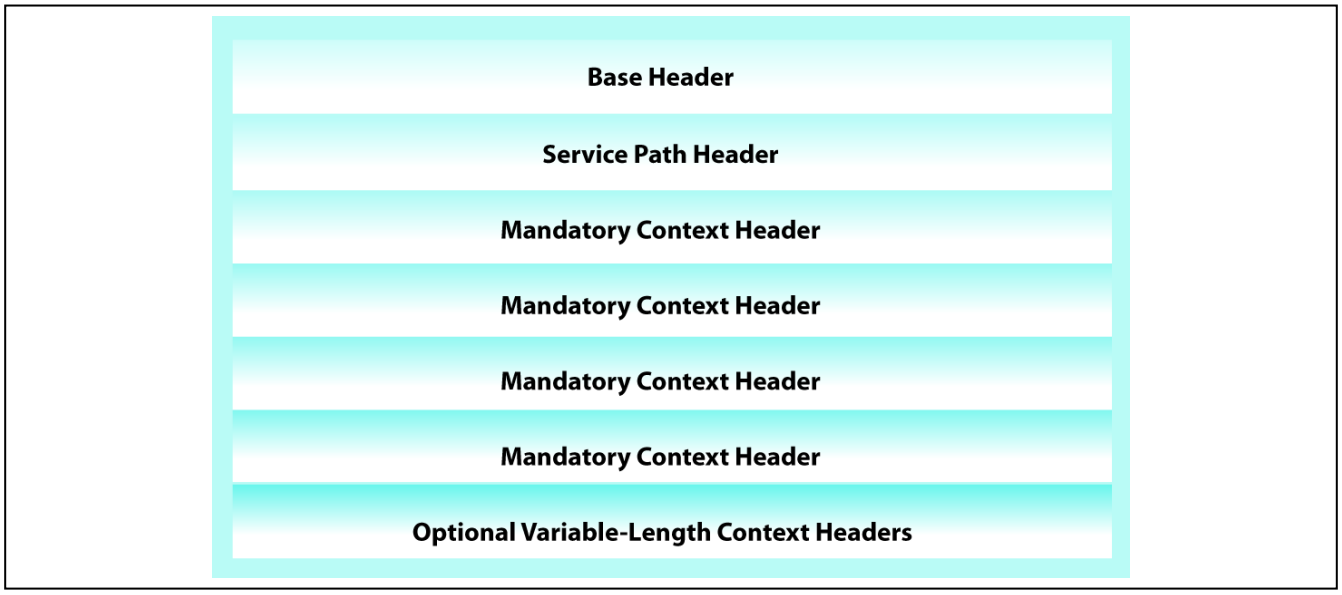
- **OpFlex:** Cisco, Citrix, IBM and Microsoft are co-developing OpFlex. This protocol is designed to exchange abstract policy between a network controller and a set of intelligent devices that are capable of enforcing policies. The protocol uses an information model that is understood by agents that reside in the controller and network devices. This information model is based on abstract policy, giving each device the ability to render policy within the semantic constraints of the abstraction. Because of this, OpFlex can support any device including physical and virtual switches and higher-level network services. Cisco has proposed the OpFlex standard to the Internet Engineering Task Force (IETF) and plans to lead the standardization efforts. In addition, Cisco is working with the open source community to provide an open source version of OpFlex. The OpenDaylight project is also under way to define a policy model that can extend across the data center, access layer and WAN. Cisco is also developing an OpFlex agent called Open vSwitch. Its goal is to offer three standards-based components to the open source community (Exhibit 3):
  - An open source policy implementation
  - A controller-side OpFlex implementation in OpenDaylight
  - A switch-side OpFlex agent for Open vSwitch
- **Network Service Header (NSH):** Cisco has been working with its partners within the IETF on an encapsulation approach called Network Service Header. This protocol addresses one of the common use cases for the generic network virtualization (Geneve) protocol to be applied but does so with a more prescriptive methodology, making it easier to design hardware and ensure multi-vendor interoperability. NSH offers a method to identify network service paths and to transmit metadata (Exhibit 4). The goal of NSH is to create a topology-independent way of specifying service paths. NSH is a draft proposed by Broadcom, Citrix, Intel, Microsoft, Rackspace, Red Hat and Cisco.
- **VXLAN Group-Based Policy (GBP) extensions:** The Group-Based Policy framework is designed to offer a new set of application programming interface (API) extensions to manage standards-based OpenStack infrastructure through declarative policy abstractions. GBP is based on the concept of capturing application requirements directly rather than converting the requirements into a set of infrastructure configuration updates. Recently, Cisco has submitted an IETF draft to create GBP extensions in VXLAN through the insertion of the protocol into a Linux kernel. Exhibit 5 is a graphical representation of the group policy plugin.

Exhibit 3: Overview of OpFlex



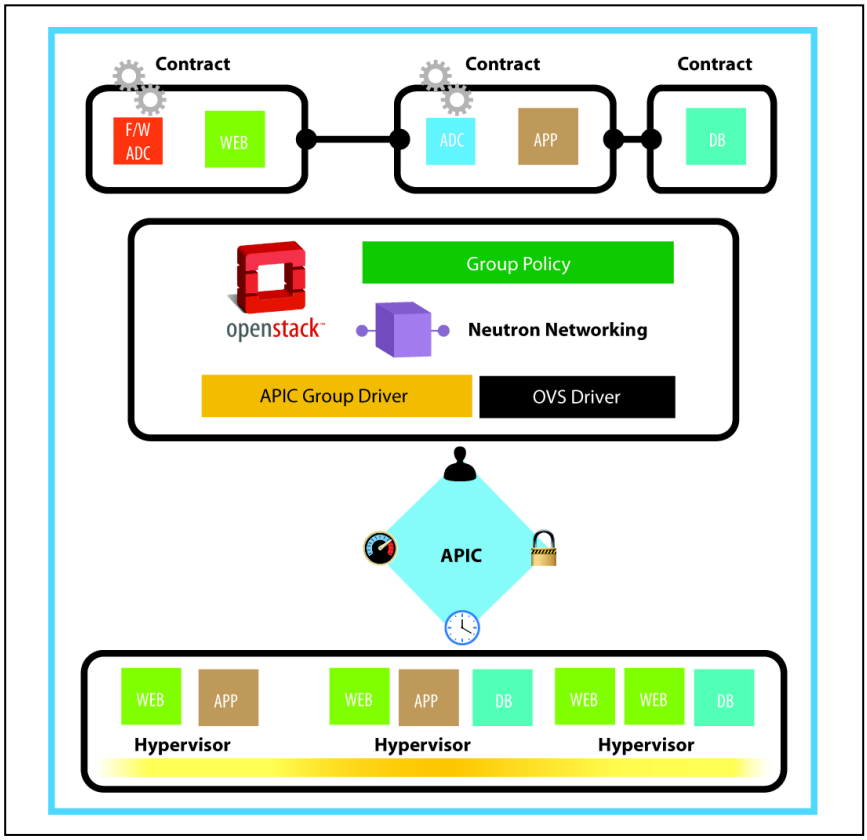
Source: ZK Research and Cisco

Exhibit 4: Network Service Header



Source: ZK Research and Cisco

Exhibit 5: Group Policy Plugin



Source: ZK Research and Cisco

In addition to the previously discussed open standards, Cisco is also expanding the openness of its NX-OS operating system. This opening of NX-OS enables the following functionality:

- Open boot loaders and provisioning to enable Power On Auto Provisioning (POAP) and support of the industry-standard Preboot Execution Environment (PXE)
- Open package and application management, which enables the installation and integration of protocols and applications through Red Hat Package Manager
- Open interfaces to enable access to NX-OS ports
- Open application integration (Cisco enables both third-party and custom integration to allow applications to be written directly on a switch. An example of a use case would be a monitoring application to manage network traffic.)
- Object-based APIs, which enable fluid programmability and full access to the underlying components of the infrastructure using Representational State Transfer (REST) APIs

Open APIs

Cisco has created a number of APIs that enable interoperability with its infrastructure. The APIs span Cisco's standalone technology as well as its ACI framework. The following list details Cisco's API activity:

- **NX-OS integration with external controllers through API integration:** Cisco offers API support for third-party SDN controllers. APIs are enabled through a variety of methods including REST, Puppet, Chef, Python, Extensible Messaging and Presence Protocol (XMPP) and Bash shell, and they have the ability to run securely in a Linux container on a switch.
- **NX-API:** On Cisco Nexus devices, a command-line interface (CLI) is typically used to configure the switch. NX-API improves the accessibility of these CLIs by making them available outside the

switch by using HTTP/HTTPS. The APIs can be used on existing Cisco Nexus CLI systems. NX-API supports show commands, configurations, Linux bash and JSON-RPC.

- **Open, published northbound APIs for ACI:** Historically, applications and networks had no way of communicating with one another. Cisco has created a set of northbound APIs to enable ACI to interface with applications. The API utilizes REST and is based on an open ACI object model, which is the foundation for integration with open source and third-party tools.
- **OpFlex as an open policy southbound API:** OpFlex is a southbound API that is open and extensible. It can enable communications with Application Policy Infrastructure Controller (APIC) and virtually any device—physical or virtual—through the APIs.

Deployment Model Choice

Customers that buy Cisco switches have a wide variety of deployment model choices, including the following:

- Two- or three-tier network architecture (Customers can choose to build a flat, two-tier spine-leaf fabric or a traditional three-tier network with the same infrastructure. Cisco supports customers with standard switching and routing protocols.)
- Deployment through open northbound and southbound APIs provided via the APIC, allowing open integration with tools and appliances
- Programmable SDN overlays with BGP-EVPN via VXLAN fabric
- Open flow runs on the entire line of Cisco Nexus switches, including the 3000, 7000 and 9000
- OpenStack support on the standalone Nexus 9000 switch (Customers can run containerized software on the Nexus 9000.)
- Support for third-party controllers on Cisco switches

Open Source Activities

Cisco has invested a significant amount of resources writing open source code and giving it to communities to drive innovation in networking. Its activities include:

- Platinum sponsor of OpenDaylight
- Major contributor to OpenStack

Partner Ecosystem

Cisco's APIC automates the insertion and provisioning of network services such as Secure Sockets Layer (SSL) offload, load balancing, web application firewalls (WAFs) and traditional firewalls. The network services are delivered from technology partners that interface with Cisco through the following methods:

- **Device packages:** Third parties can interface with APIC through a device package that can be used to insert and configure network service functions on a network service appliance.
- **Hypervisor integration:** One of the key benefits of Cisco ACI is that it is hypervisor independent. ACI is independent of the tenant traffic, so it can be tagged with IEEE 802.1q (VLAN), VXLAN or Network Virtualization using Generic Routing Encapsulation (NVGRE). Because of this, traffic forwarding is not limited to nor constrained within the encapsulation type or encapsulation overlay network.
- **DevNet:** Cisco has a robust developer network called DevNet. The program is designed to provide developers with the tools, resources and code required to build innovative, network-enabled solutions. Those who join DevNet will have access to the following:
  - APIs and SDKs
  - Fully tooled sandboxes
  - Customized notifications
  - Learning labs
  - Community forums
  - Cisco technical support

Section III: Benefits to Cisco Customers

This era of computing requires solution providers to be open, and Cisco has taken an aggressive approach toward openness. As a result of this, Cisco's customers can leverage its network as the foundation for an agile data center. Customers that choose Cisco and embrace openness will realize the following benefits:

- **Unparalleled interoperability:** Cisco's open strategy enables it to work with almost any other vendor, including its competitors. This is a huge benefit for customers, as it will make it easier for them to operate multi-vendor data centers.
- **Reduction in deployment times:** Historically, the lead time required to deploy new applications and services was very lengthy because each

vendor's infrastructure had to be configured independently. Cisco's ACI can orchestrate the configuration of the entire ecosystem, which means provisioning time can be reduced from months to just a few hours.

- **Network-enabled applications:** The open approach combined with DevNet opens the door for independent software vendors—both large and small—to build applications that can interface with the network to bring unique functionality to businesses.
- **Greater network agility:** Digital transformation is driving the need for better business agility, which, in turn, drives a requirement for IT to be agile. Cisco's open network brings a never-seen-before level of flexibility and agility to the network.
- **Better resource utilization:** In an agile data center, all of the data center resources become fluid "pools" of infrastructure that can be migrated from one application to another. This means unused resources can be directed toward an application or service that may require it, which increases utilization. Historically, data center infrastructure utilization was in the 20% to 30% range. A software-defined data center built on an open network can reach utilization rates greater than 75%.

Section IV: Conclusion and Recommendations

Digital transformation has changed almost every part of IT over the past five years. The shift to the cloud is driving the need for a highly agile and flexible data center that can only be enabled by an open network. Cisco is committed to making the transition to a software-defined environment as simple as possible by taking an open approach to networking. Any organization looking to harness the power of digital transformation should begin the journey to an agile data center immediately. To get started, ZK Research recommends the following:

- **Insist on open solutions.** When it comes to data center infrastructure, there are many choices available. IT decision makers should insist on solutions that are open and standards based. This will guarantee multi-vendor interoperability and make the deployment and ongoing management of the environment easier.
- **Leverage the network as the foundation for the data center.** The cloud is a network-centric compute model, which means the network will play a significant role in the success or failure of an organization's future IT initiatives. The network should be the platform that connects the applications to other data center resources.
- **Automate processes where possible.** One reason why the people-related costs to run a data center are so high is because so many repetitive tasks need to be done manually. Businesses should automate as many tasks as possible to offload that burden from IT departments.