

DELL EMC + BIG SWITCH NETWORKS®: IDEAL SDN FABRIC FOR VMWARE SDDC

Big Cloud Fabric™, from Big Switch Networks®, enables network automation and visibility for VMware vSphere, NSX, and vSAN on Dell EMC Open Networking Switches

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Executive Summary

Achieve network operational velocity at the speed of virtualization for software-defined data centers. Experience next-generation data center networking by leveraging integration of Big Switch Networks® SDN-based Big Cloud Fabric™ with VMware SDDC:

1. Physical network **intelligence** via 'one logical switch' operational model, deep fabric-wide visibility and easy-to-configure service chaining
2. Physical network **agility** via network automation, zero-touch fabric, controller-coordinated upgrading, and rapid VM-to-VM troubleshooting
3. Deployment **flexibility** via Dell EMC open network hardware and scale-as-you-grow options, for all application workloads (physical, VM, and container).

Accelerate the realization of a software defined data center by leveraging Big Cloud Fabric (BCF) integration with vSphere, NSX, vSAN, VIO and vRealize Log Insight to provide network automation and visibility. Provide network admins visibility into the virtualization environment via BCF Controller, and leverage vSphere web client plugin to provide fabric visibility to the VM admin.

The Challenge: Network is SDDC's Weakest Link

Enterprise data centers are challenged today to support cloud-native applications, drive business velocity and work within flat budgets. They are rapidly adopting software-defined data center (SDDC) technologies to drive agility and cost efficiencies in the data center, by leveraging best-in-class VMware virtualization technologies for their application workloads.

The network layer often is the least agile part of data center infrastructure to design, configure and operate, especially when compared to compute infrastructure. Most data center networks are built using old network architecture, a box-by-box operational paradigm that inhibits the pace of IT operations to meet the demand of modern applications and software-defined data centers. Network overlays consisting of virtual switches have emerged to provide agility but still lack the visibility required to effectively troubleshoot issues. Unfortunately, legacy box-by-box networking approaches fail to provide visibility and are also complex to operate, as they are stuck in the pre-virtualization era.

SDDC Demands Networking at the Speed of Virtualization

Software-defined data center systems may include one or more of compute, an overlay network and hyper-converged storage layers. It is critical that a physical network is able to also interact with all three components. Additionally, SDDC systems deploy visibility and troubleshooting tools for the VM admin. Hence, the physical network also needs to extend its own visibility into the SDDC tools for consistent operations and troubleshooting across both virtualization and network domains.

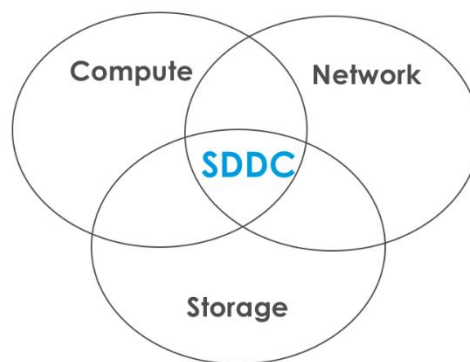


Figure 1: SDDC may include compute, hyper-converged storage infrastructure, and network overlay

In a SDDC, Physical Network needs to interact with Hypervisor, Virtual Network and HCI Storage layers.

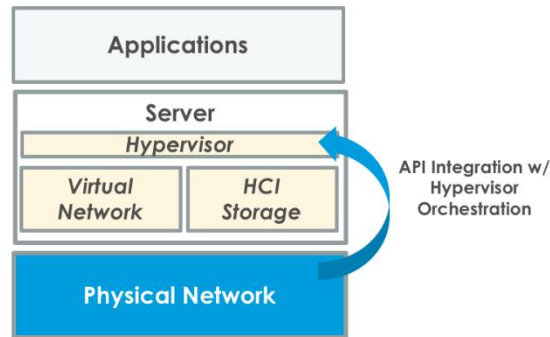


Figure 2: In SDDC, the physical network is required to interact with hypervisor, virtual network and HCI storage

With virtualization going mainstream, networks are required to provide visibility into virtual machines, east-west traffic across VMs, and deliver network service connectivity easily. Networks are expected to not adversely impact software-defined data center agility by mandating manual box-by-box network configuration and upgrades. Emerging cloud-native applications require rapid application and services deployment. This demands network operations to be more automated instead of relying on manual CLI and limited GUI workflows. Automation across physical and virtual networks therefore becomes a critical aspect of the SDDC-automated infrastructure. In addition, gaining visibility across physical and virtual networks is becoming paramount for network and VMware administrators, as troubleshooting is challenging with traditional networks. Given the flat line infrastructure budget trends in most organizations, an innovative networking approach is needed compared to the legacy network stuck in a box-by-box operational paradigm using expensive proprietary hardware.

Next-generation data center networks, powered by SDN software on open networking hardware, offer a promising solution to the above challenges and demands posed by software defined data centers.

Solution: Next-generation Switching Fabric

Big Cloud Fabric (BCF) is a next-generation switching fabric that provides agility, operational simplicity, and open networking (white-box/brite-box) switch economics. With built-in integration for VMware, Big Cloud Fabric is an ideal physical network for virtual environments, network virtualization, and hyper-converged infrastructure (HCI). It is the industry's first SDN-based fabric, leveraging open networking switch hardware, that provides intelligent, agile and flexible networking for VMware software-defined data center (SDDC), including vSphere, NSX and vSAN environments.

BSN-Dell Solution for VMware environments: vSphere, NSX and vSAN

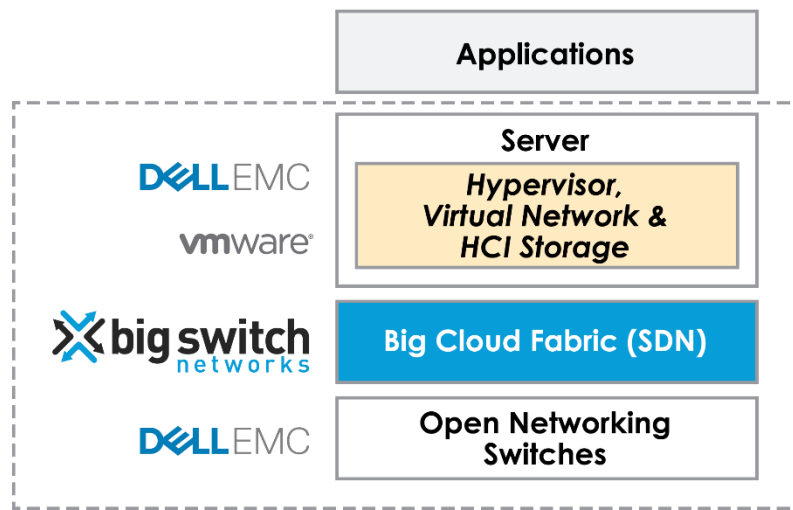


Figure 3: Conceptual view of the Big Switch Networks (BSN) and Dell EMC solution for VMware environment

Big Cloud Fabric Controller provides a single pane of glass for fabric configuration, and it integrates with vCenter for physical network automation. As new VMs are created in vCenter, they are automatically learnt in the fabric, and network policies are auto-migrated upon VMs migrating via vMotion. The BCF Controller also acts as a single pane of glass to provide VM-level as well as vMotion visibility across the entire physical fabric. This visibility coupled with advanced analytics offers fabric-wide troubleshooting, enabling tremendous operational simplicity compared to legacy box-by-box approaches. The physical fabric automation, visibility and troubleshooting benefits have been extended to VMware NSX-based network virtualization environments to make BCF the ideal SDN underlay for VMware NSX. Net Admins gain full visibility of virtualization environments versus it being a gap today, thus helping rapid resolution of issues. BCF solution for VMware environments extend across its multiple products:

	Integration	Visibility	Troubleshooting
vSphere	✓ Fabric Automation	✓ VM, Host Visibility	✓ VM-to-VM
NSX	✓ HW VTEP Tech Preview @ Vmworld	✓ Overlay Visibility	✓ VTEP-to-VTEP
vSAN	✓ vSAN Transport Network Automation	✓ VMkernel (node) Visibility	✓ Node-to-Node
vSphere Web Client (for VM admin)	✓ vCenter GUI Plug-in	✓ Fabric Visibility	✓ VM-to-VM
vRealize Log Insight (for VM admin)	✓ Content Pack	✓ Fabric Visibility	✓ Log Correlation

Figure 4: Big Cloud Fabric (BCF) is the ideal network fabric for VMware SDDC, providing network automation, integration, visibility and troubleshooting.

Solution Components

VMware vSphere and vCenter

VMware vCenter Server provides a centralized and extensible platform for managing vSphere based virtual infrastructure. It manages VMware vSphere environments, giving IT administrators simple and automated control over the virtual environment. It ensures security and availability, and reduces the complexity of managing virtual infrastructure. A single administrator can manage hundreds of physical hosts and thousands of VMs, more than doubling typical productivity when managing traditional (non-virtualized) physical server infrastructure. The open plugin architecture of vCenter Server enables third party integration, enabling new capabilities such as automation through integration of physical and virtual management tools, capacity management and business continuity. BCF leverages this plugin to provide automation and visibility for VMware environments.

Big Cloud Fabric (BCF)

BCF embraces hyperscale design principles to enable rapid innovation, operational simplicity with TCO reduction. More information on the need for Big Cloud Fabric (BCF) may be found [here](#), and its architecture, [here](#).

Dell EMC Open Network Hardware Switches

Dell EMC networking portfolio includes products for small business to large datacenters. This solution refers to open network switches from Dell EMC that deliver high performance data center fabrics, when coupled with Big Cloud Fabric product from Big Switch Network. The BCF solution mentioned in this document supports 1G, 10G, 25G, and 40G connectivity to Dell EMC open network switches (leaf role), and 10G, 40G and 100G for Dell EMC open network switches (spine role).

Big Cloud Fabric supports the following open networking switches from Dell EMC:

- S4048-ON: 48x10G + 6x40G
- S4048T-ON: 48x10GbT + 6x40G
- S6010-ON: 32x40G
- S6100-ON: 64x40G
- Z9100: 32x100G

Big Cloud Fabric software can also be purchased from Dell EMC; hence, users can select Dell EMC as their single supplier of open networking hardware and SDN software.

Solution Benefits

The key solution benefits, driven by the BCF component, are listed in the table below:

SDDC Requirements for Physical Network	Big Cloud Fabric Capabilities for SDDC
Provisioning at speed of VM	Automatically provisioned when VMs assigned to port groups
Dynamically re-provision for VM mobility events (e.g: vMotion)	Automatically re-provisioned during VM mobility event
Hitless change management for network links, switches, servers, upgrades	Zero-touch fabric operations for upgrades and auto provisioning of leaf and spine elements
Scalable dynamic API interactions with SDDC systems	BCF controller – single points of control/management and API integration
SDDC visibility & troubleshooting for network admin	1. BCF controller visibility for Host, VM, vMotion, logical switch, VNI etc. 2. Provide VM-to-VM troubleshooting across leaf-spine fabric
SDDC visibility to physical network & troubleshooting for VM admin	1. Complete fabric visibility and VM-to-VM troubleshooting across leaf-spine fabric via vCenter BCF Plug-in. 2. BCF log correlation in vRealize Log Insight via BCF Content pack

Figure 5: How BCF satisfies the various physical network requirements demanded by SDDC.

The benefits of this solution approach may also be understood from the needs of VM and Network administrators during troubleshooting. The below tables capture the visibility that this solution provides and how it differentiates from legacy networks.

Areas of interest for Network Administrator towards VM visibility & troubleshooting	With Big Cloud Fabric	With legacy (box-by-box) networks
ESXi host attachment location on network fabric	Automated	Manual box-by-box configuration
VM on/off status, viewed by the fabric	Visible via BCF Controller GUI	None/Limited
Map of VM to ESXi host to physical switch ports		
View services enabled on ESXi vmkernel adapter for granular visibility.		
Indicate where network errors and warnings come from – virtual or physical layer.		

Table 1: How BCF helps network administrators with VM visibility and troubleshooting on the fabric.

Areas of interest for VM Administrator towards network visibility & troubleshooting	With Big Cloud Fabric	With legacy (box-by-box) networks
ESXi host physical connectivity to leaf switches	Automated	Manual box-by-box configuration
VM-VM / vmkernel physical path view	Visible via vCenter Web Client Plugin	None/Limited
VM status on the network		
Map VM/host connectivity to fabric		
Indicate where network errors and warnings come from – virtualization layer or physical network		

Table 2: How BCF helps VM administrators with physical network fabric visibility and troubleshooting for VMs.

Solution Details: Network Automation, Visibility, and Troubleshooting

vSphere Environments

The BCF/vSphere solution streamlines application deployment workflows by automating the physical network configuration for VMware virtual workloads. The BCF controller acts a single point of integration with vCenter through a vCenter extension developed using vCenter APIs. It gets notified of events from vCenter, upon which it performs the corresponding fabric operations, completely eliminating the need for any manual configuration of the physical network. The solution offers the following capabilities, which tremendously simplify network operations in VMware environments.

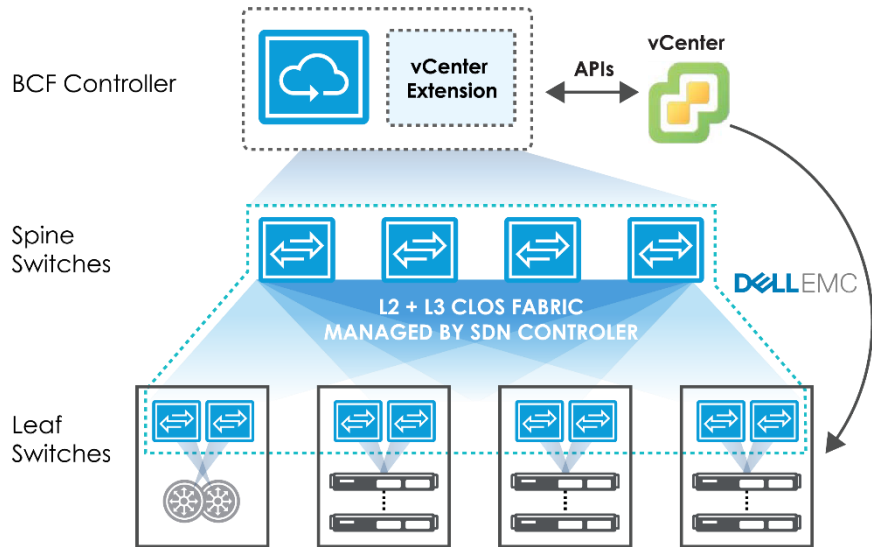
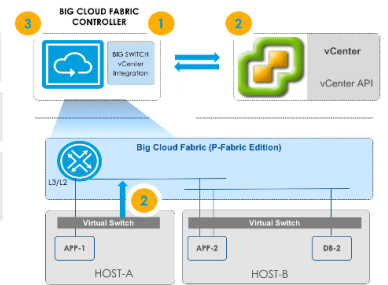


Figure 6: BCF Integration with VMware vSphere and open networking hardware switches from Dell EMC.

Automatic Host Detection and Link Aggregation

Once LLDP/CDP is configured in vCenter, BCF automatically discovers ESXi hosts connected to the leaf switches. BCF controller then automatically creates link aggregation groups (LAGs) with the leaf switches making this a zero-touch operation. The operational savings due to this automation are significant when there are hundreds of servers connected to the fabric.

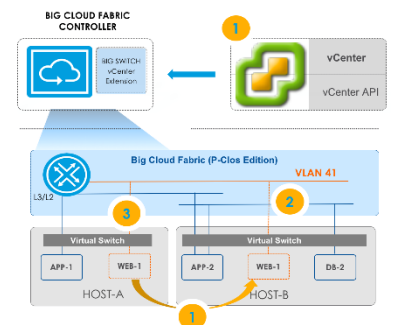
- 1 BCF Registers with vCenter
- 2 Enable CDP/LLDP on virtual switch
- 3 BCF gets vCenter notification and forms LAG/MLAG using CDP/LLDP on leaf switch



Automatic L2 Network Creation & VM Provisioning

As part of the application deployment process, vCenter creates, modifies or deletes VMware virtual switch port-groups. BCF controller gets notified of these events and automatically creates, modifies or deletes the corresponding BCF Layer-2 network segments. If the added VM is the first one on the host for the vCenter port-group, the corresponding VLAN is provisioned on the respective host LAG. To achieve this, the BCF controller enables segment membership for the designated LAG connected to the corresponding host and programs the forwarding tables. A newly created VM in vCenter is dynamically learnt by BCF as an endpoint.

- 1 Initiate vMotion on the vCenter
- 2 BCF learns VM's new location and updates the forwarding table
- 3 BCF prunes VLAN on Host-A (since there are no other VM's in that VLAN)

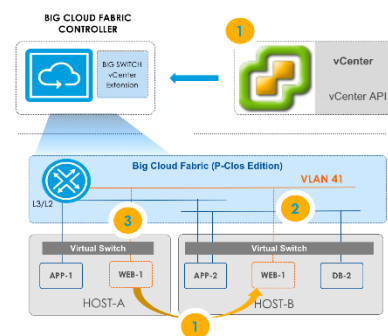


Network Policy Migration for vMotion

After an application is deployed and VMs are up and running, vMotion is a powerful capability to seamlessly move VMs from one host to another. When vMotion is initiated in vCenter, BCF controller gets notified of the new location of the VM information and migrates the network policies dynamically and updates the forwarding tables with the new information.

If the VM is the first one in that VMware port-group on the new host, BCF will automatically provision the VLAN on the new host's LAG port. Similarly, if the VM is the last one on the VMware port-group on the old host, BCF will prune the segment membership from the old host after vMotion is complete.

- 1 Initiate vMotion on the vCenter
- 2 BCF learns VM's new location and updates the forwarding table
- 3 BCF prunes VLAN on Host-A (since there are no other VM's in that VLAN)



Simplified Visibility and Troubleshooting

The key challenge with networking in virtual environments is the lack of visibility on the end-to-end connectivity between VM endpoints across both the virtual and physical networks. The BCF/vSphere solution offers significant benefits to data center administrators by providing advanced end-to-end visibility and enhanced troubleshooting capabilities, all exposed through a single pane of glass, the BCF controller.

Visibility at Virtual Machine level

BCF controller presents all VM-related information that it learns from vCenter. The display includes all hosts, their vmNICs, and the physical fabric interfaces to which the hosts are connected. It also includes VM endpoint information, including the name, logical segment, IP, MAC, and LAG. All this information helps admins get a quick understanding of the virtual environment configuration



Filter	Power State	Active in BCF	Segment	Tenant	VLAN	Host DNS Name	Physical Connection	Endpoint Type	IP Addresses
power_state==powered-on host_dns_name==arkady-esxi-2.tme.bigswitch.com									
	powered-on	Yes	Inband-mgmt	Infra	20	arkady-esxi-2.tme.bigswitch.com	vmnic5 - R2L2 / ethernet3 [arkady-esxi-2.tme.bigswitch.com-DVS-VP001-VSPHERE]	vmkernel	10.10.2.12
	powered-on	Yes	bcf-vcanten-1-31	bcf-vcanten-1	31	arkady-esxi-2.tme.bigswitch.com	vmnic4 - R2L1 / ethernet3 [arkady-esxi-2.tme.bigswitch.com-DVS-VP001-VSPHERE]	virtual-machine	31.1.1.154, fe80::250:56ff:feb9:7b1a
	powered-on	Yes	bcf-vcanten-1-21	bcf-vcanten-1	21	arkady-esxi-2.tme.bigswitch.com	vmnic5 - R2L2 / ethernet3 [arkady-esxi-2.tme.bigswitch.com-DVS-VP001-VSPHERE]	vmkernel	21.1.1.12
	powered-on	Yes	bcf-vcanten-1-21	bcf-vcanten-1	21	arkady-esxi-2.tme.bigswitch.com	vmnic4 - R2L1 / ethernet3 [arkady-esxi-2.tme.bigswitch.com-DVS-VP001-VSPHERE]	virtual-machine	21.1.1.12

Figure 7: BCF provides in-depth information on VM, host, interface and endpoint connectivity & status on the physical fabric.

VM-to-VM Troubleshooting

VM-to-VM traffic visibility across the virtual and physical network can be simulated using BCF's test path feature which displays on the controller both the physical and logical path taken by the traffic from one VM to another. This level of visibility to traffic, which cannot be achieved with box-by-box networking, helps rapidly determine if an application issue is network-related versus compute-related without going through tedious trouble ticket processes.

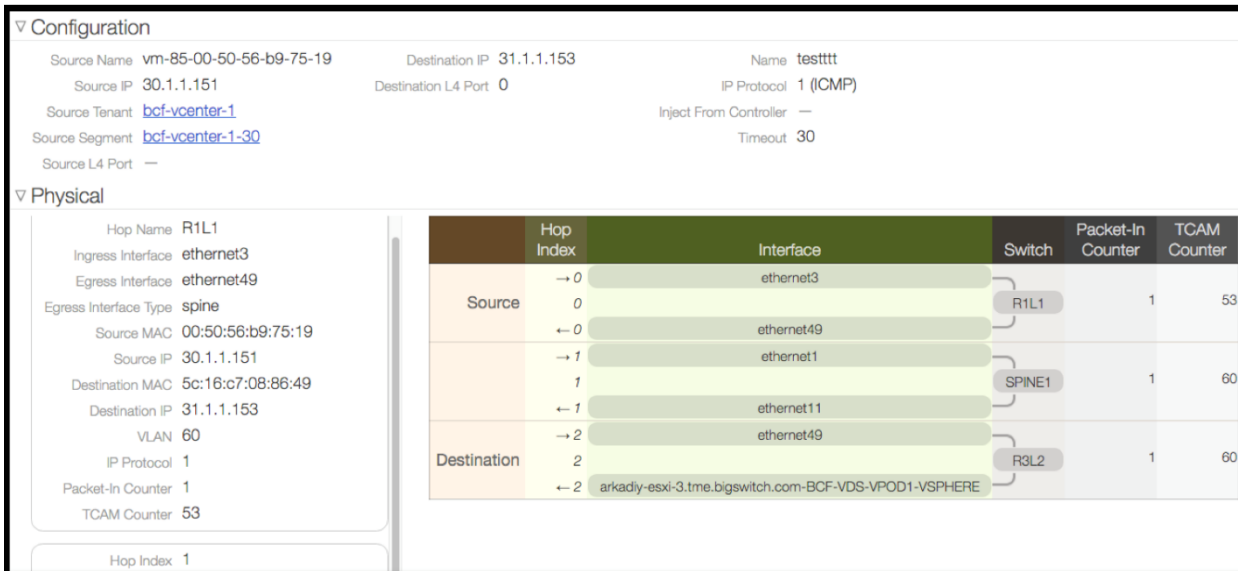


Figure 8: BCF provides hop-by-hop physical path information to aid VM-VM troubleshooting, across virtual and physical networks.

Fabric Analytics for VMware Networking

BCF provides advanced fabric analytics for VMware networking with a graphical representation of all VM-related information (name, creation time, pNIC info, port-groups), and time-series of events related to VMs. This is a tremendous asset for troubleshooting as the administrator can get to details of specific events for one or more VMs or can zoom into a timeslot to obtain all events that may have occurred during the period.

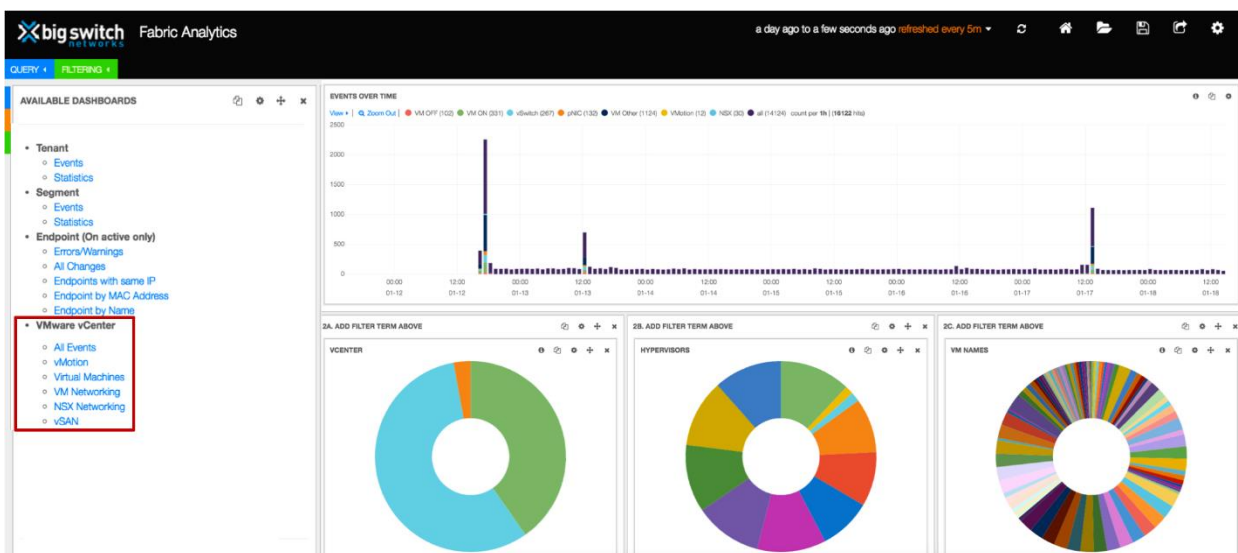


Figure 9: BCF delivers network analytics to filter and track physical fabric events across VMs, vMotions, NSX and vSAN nodes.

VMware NSX

When deploying NSX-v (NSX for vSphere) based overlay for network virtualization and/or micro-segmentation, network teams are often concerned about box-by-box physical networks being opaque to overlays. Architecturally, NSX, being an SDN overlay (operating as one logical v-switch), is best served by an SDN underlay (operating as one logical p-switch) like Big Cloud Fabric.

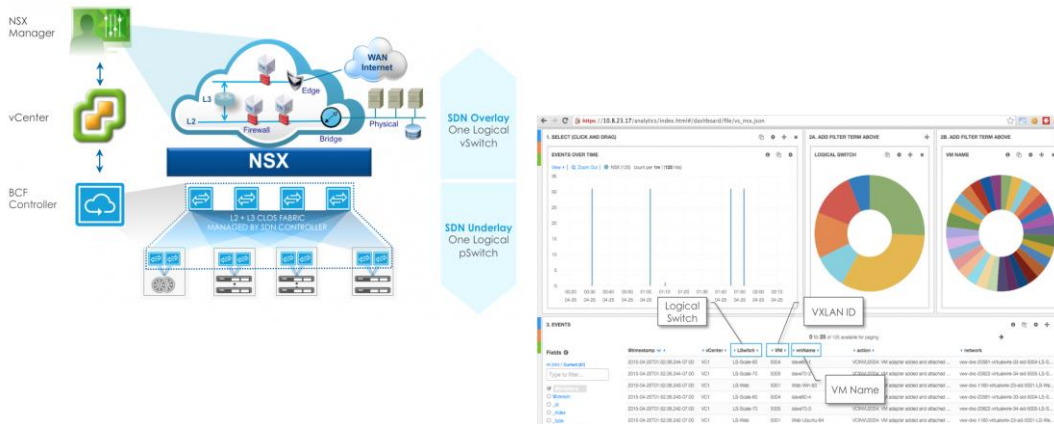


Figure 10: BCF Underlay Automation and Analytics for VMware NSX

Physical Fabric Automation for VMware NSX

When BCF is deployed with vCenter and VMware NSX for network virtualization, all the advanced automation benefits from the BCF integration with vCenter are available to the network administrator. When NSX creates a virtual switch port-group with an assigned transport VLAN for the VTEPs (VXLAN Tunnel Endpoints) on each of the ESXi hosts, BCF automates the provisioning of the corresponding logical segment for the transport VLAN to enable VTEP communication. It also auto-learns all the VTEP endpoints and the VMs behind the VTEPs.

Physical Underlay Visibility and Troubleshooting for VMware NSX

Providing NSX overlay visibility to BCF underlay creates a consistent and combined view of both environments that can be a great asset for network administrators. BCF controller provides NSX cluster/VTEP visibility, and the use of BCF's Fabric Analytics, for NSX-v overlay visibility. Correlations across VMname, VXLAN ID (or VNI), and Logical Switch are also provided to simplify debugging of VM connectivity issues. Big Cloud Fabric's automation capabilities result in auto host detection, LAG formation, auto transport network creation for NSX, VM learning, and auto-discovery of VTEPs. Integration of BCF with NSX hardware VTEP enables bare metal applications to interact with VMs on overlay network. A demo of the BCF's hardware VTEP capability can be found here. BCF's VTEP-to-VTEP fabric trace capability makes troubleshooting the physical underlay fabric a simple operation — one of many examples of how BCF, as an SDN-based physical fabric, is the best underlay for the SDN-based NSX overlay.

VMware vSAN

Software-defined data center (SDDC) operators can get unique automation and visibility for Virtual SANs — thanks to BCF's integration with VMware vSphere. In addition, one-click fabric multicast enables a virtual SAN cluster to be deployed in minutes.

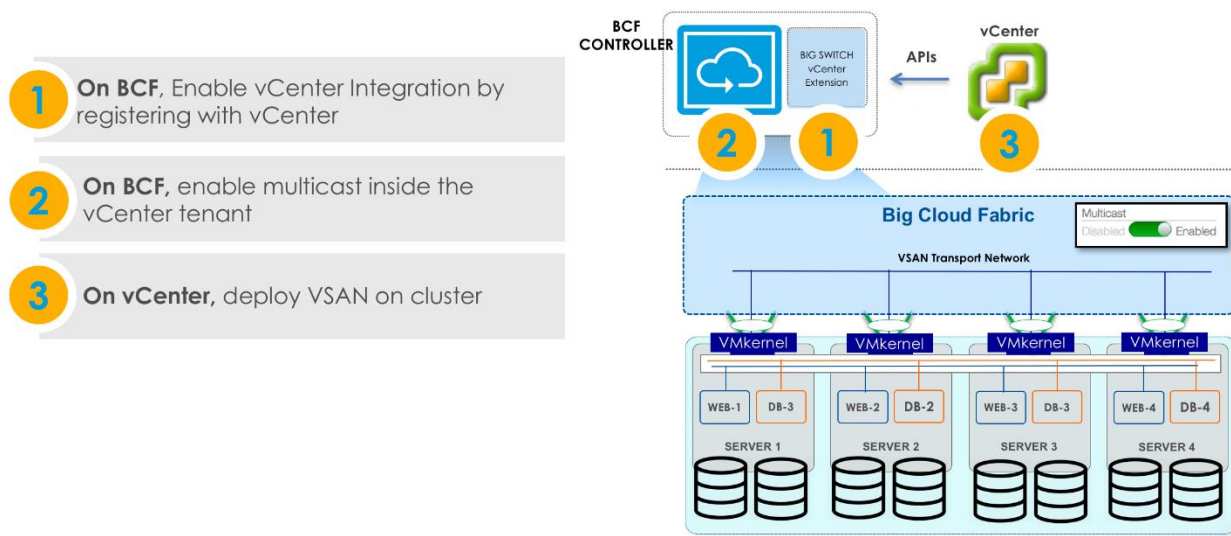


Figure 11: BCF delivers single-click multicast configuration for faster vSAN deployment.

Virtualization admins can leverage the familiar vCenter GUI to view BCF information, using the BCF GUI plugin. This consistent telemetry is very handy for rapidly identify issues across network and virtualization domains. Examples include (a) finding connectivity information of a Virtual SAN ESXi host to BCF leaf switch, and (b) troubleshooting connectivity issues between two vSphere VMs across different Virtual SAN hosts, across the network fabric, in a few clicks — without hunting box to box.

Additional Functions

Single Big Cloud Fabric with Multiple vCenters (BCF vPODs)

BCF enables support for overlapping IP addresses and VLANs across vCenters. When cloud service offerings are built with VMware vSphere, multiple vCenters are deployed for the multiple tenants leveraging the cloud service. BCF can integrate with multiple vCenter instances to support multiple tenants. Each vCenter configuration is only synchronized with its respective tenant. This allows the administrator to achieve secure segmentation for physical networks with logical tenants mapping to distinctly separate administrative domains for each vCenter.

Running multiple vCenter instances on a unified SDN fabric enables seamless provisioning and management of the physical network as well as VM-level visibility and analytics that significantly enhance end-to-end troubleshooting. The benefits of multi-vCenter integration leveraged by a managed cloud service provider, U2 Cloud, are detailed here. The multi-vCenter solution is also beneficial for independent software vendor's (ISV's) quality assurance (QA) teams, as they can share a common physical network across multiple test teams.

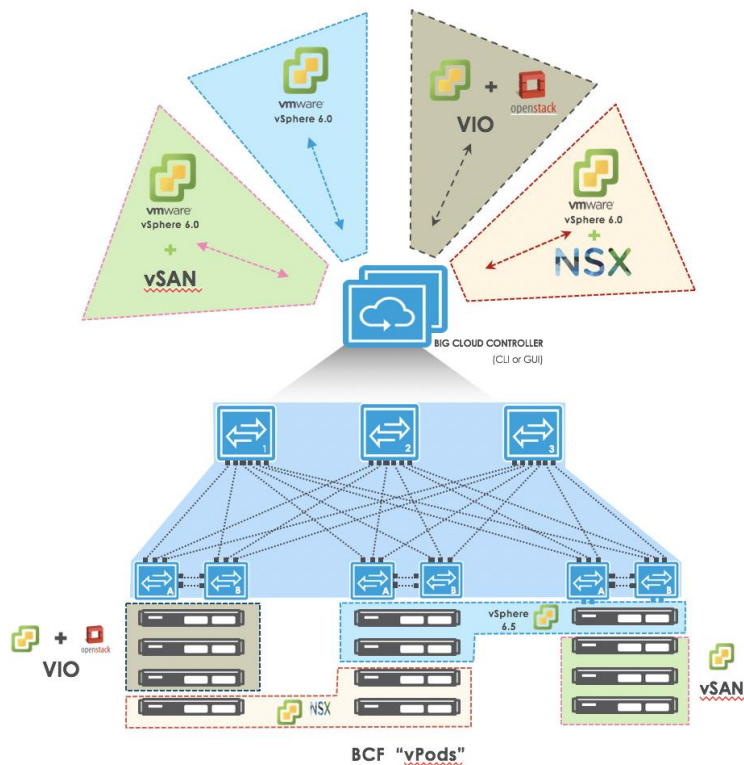


Figure 12: Big Cloud Fabric's SDN fabric with tenant-native approach.

Big Cloud Fabric's vCenter Web Client Plugin

BCF enhances its integration with vCenter with a GUI plugin for vCenter. This provides network visibility for virtualization admins, including host-to-leaf connectivity. It also aids in VM-to-VM troubleshooting on the leaf-spine fabric. Examples of tasks that can be performed by VM admins within the plugin's GUI include:

- Visualize Layer 2 segment mapping to vSphere port groups
- Add logical segment interface to configure a layer 3 gateway for inter port-group traffic.
- Look up fabric endpoints, corresponding to specific virtual machines.
- Understand fabric topology by visualizing virtual switch port-groups' connectivity to the physical fabric.
- Troubleshoot VM-to-VM connectivity by initiating a test path to visualize a hop-by-hop path between VMs across BCF's leaf-spine fabric.

The diagrams below illustrate some of these capabilities.

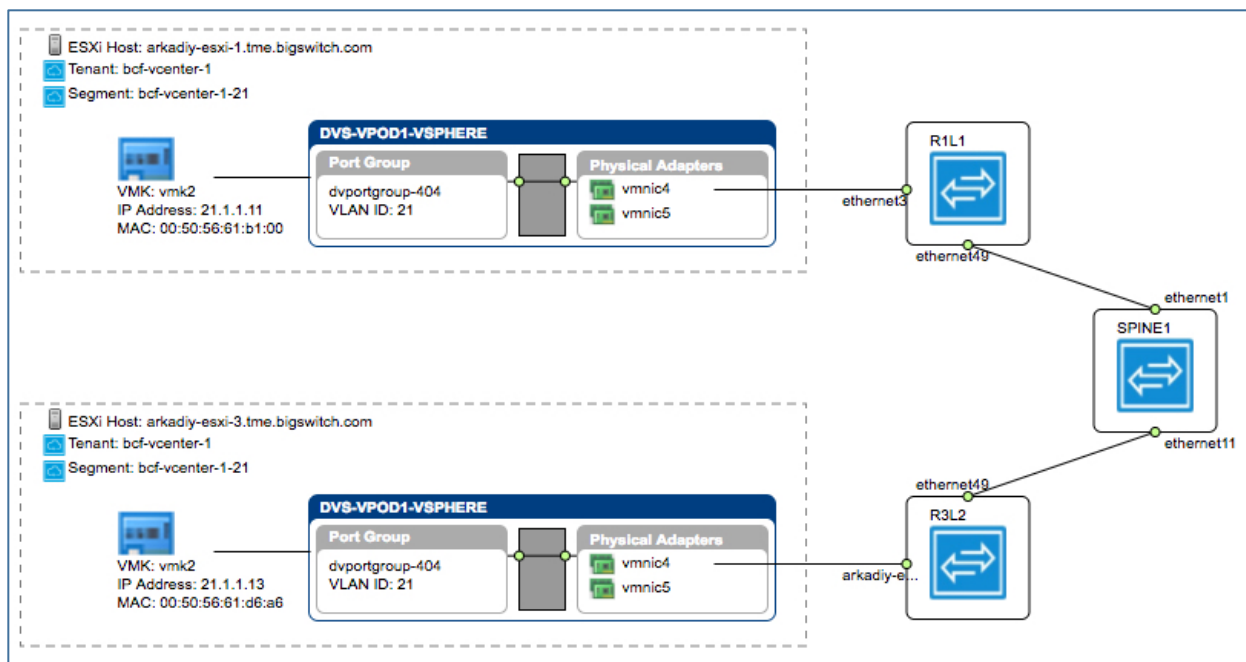


Figure 13: BCF's vCenter Web Client plugin visualizes end-to-end mapping of the path between VMs — across specific ESX hosts, Tenants, Segments, IP, Port Groups, Physical adapters, leaf and spine switches.

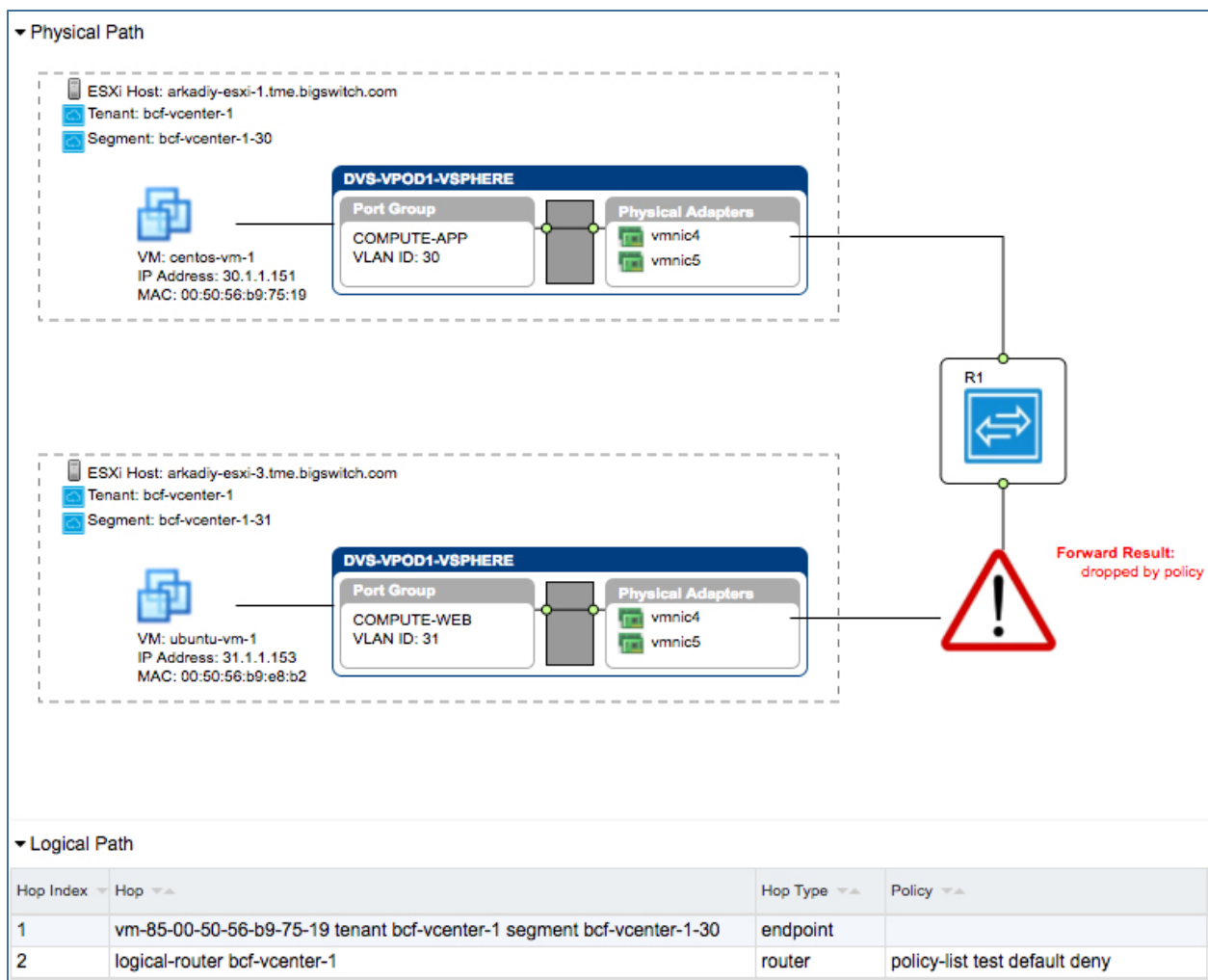


Figure 14: BCF's vCenter Web Client plugin makes troubleshooting easy versus jumping from box to box with legacy physical networks. Here, it visualizes the physical hop-to-hop path first and highlights dropped packets by the specified policy.

BCF Content Pack for vRealize Log Insight

VMware vRealize Log Insight delivers automated log management through log analytics, aggregation and search. Using pre-defined dashboards, widgets, and alerts supplied by vendors, a virtualization admin could analyze terabytes of logs, perform smart parsing to discover structure in unstructured data, and enable interactive, real-time search and analytics through a GUI-based, easy to use interface. BCF content pack provides a graphical representation of BCF network events that occur in the fabric. Several pre-defined dashboards show tenant & network segment log views and granular end-point events information. The content pack also covers the configuration changes made to the BCF Controller via REST API calls, and errors/warnings across multiple vPods. Customized queries may be defined on the fabric using pre-defined extracted fields. Lastly, the option to notify vRealize Ops suite could stand to significantly reduce the mean-time-to-respond metrics during troubleshooting applications. An illustrative diagram is shown below.

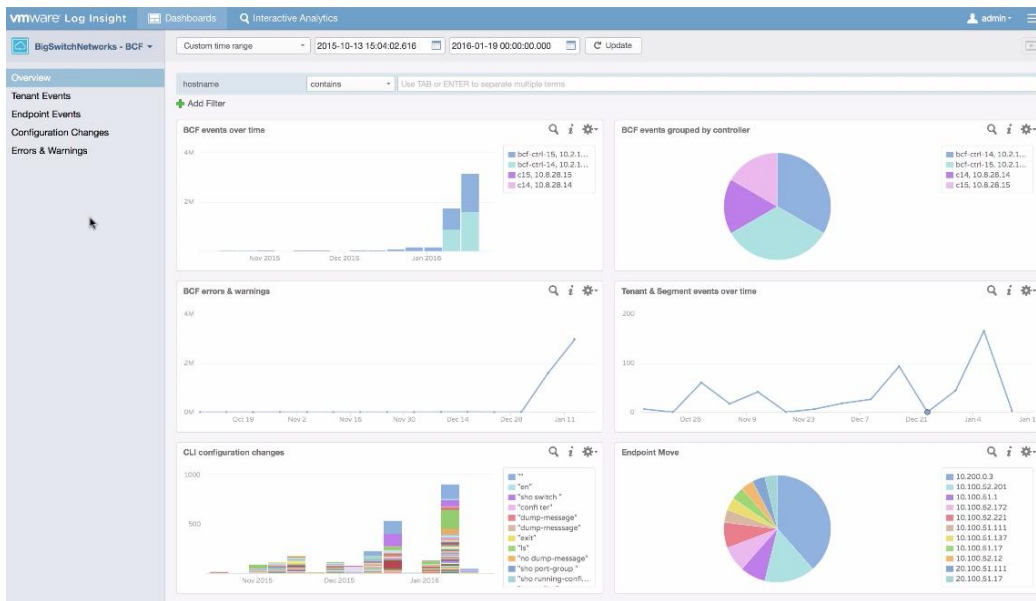


Figure 15: BCF's Content Pack for vRealize Log Insight delivers a graphical representation of BCF network events

BCF support for VMware Integrated OpenStack (VIO)

For environments with VMware Integrated OpenStack (VIO), Big Cloud Fabric enables enterprises to deploy production-grade OpenStack private clouds on VMware vSphere and NSX-v environments with BCF physical underlay. With OpenStack storage offerings increasingly evaluated within private cloud projects, BCF could be an ideal networking solution for consideration.

Conclusion

Enterprise data centers are increasingly software defined. Operational velocity is a critical attribute to realize SDDC benefits. Legacy physical networks, with their box-by-box operational paradigm inhibit agility. Big Cloud Fabric, from Big Switch Networks, is a next generation data center switching fabric that packs intelligence, agility and deployment flexibility. Inspired by hyperscale network design and built for enterprise, BCF is powered by a Clos-based fabric architecture that provides physical network automation, visibility, and troubleshooting for VMware environments.

Combined with Dell EMC high-performing (up to 100G) open networking switches, BCF delivers an SDN solution that enables data centers to drive innovation in VMware SDDC environments. BCF provides network automation for multiple VMware products that include vSphere, NSX, vSAN, VIO, and VIC while delivering new visibility and troubleshooting capabilities for both VM and network admins via vCenter Web client plugin and vRealize Log Insight.

Resources

- [Drivers and benefits of next-generation data center switching](#)
- [Overview of Big Cloud Fabric](#)
- Big Cloud Fabric Community Edition can be downloaded [here](#)
- To try BCF online, sign up for our free [Big Switch Labs](#)
- In-depth Blogs, demos and webinars for specific topics covered in this document may be found [here](#).

About Big Switch

Big Switch Networks is the *Next-Generation Data Center Networking Company*. They disrupt the status quo of networking by designing intelligent, automated and flexible networks for our customers around the world. They do so by leveraging the principles of software-defined networking (SDN), coupled with a choice of industry-standard hardware. Big Switch Networks has two solutions: Big Monitoring Fabric, a Next-Generation Network Packet Broker, which enables pervasive security and monitoring of data center and cloud traffic for inline or out-of-band deployments and Big Cloud Fabric, the industry's first Next-Generation switching fabric that allows for choice of switching hardware for OpenStack, VMware, Container and Big Data use cases. Big Switch Networks is headquartered in Santa Clara, CA, with offices located in Tokyo, Sydney, London and Istanbul.

About Dell EMC

[Dell EMC](#), a part of [Dell Technologies](#), enables organizations to modernize, automate and transform their [data center](#) using industry-leading [converged infrastructure](#), servers, [storage](#) and data protection technologies. This provides a trusted foundation for businesses to transform IT, through the creation of a [hybrid cloud](#), and transform their business through the creation of cloud-native applications and [big data](#) solutions. Dell EMC services customers across 180 countries – including 98 percent of the Fortune 500 – with the industry's most comprehensive and innovative portfolio from edge to core to cloud.



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