Copper River
Information Technology

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White Paper

The Network *Is* the Data Center

In the era of "software-defined everything," don't underestimate the importance of a fast, flexible, intelligent data center network.

Introduction

It's been 30 years since Sun Microsystems rolled out its notorious tagline, "The Network Is the Computer." When the slogan first appeared many data center professionals simply scratched their heads. Others wore T-shirts saying "The network is the network. The computer is the computer. Sorry for the confusion. – Sun Microsystems." In the years that followed, however, the foresight of that statement became apparent as the Internet became the primary delivery mechanism for everything from compute power to communications to data protection services.

Yet today, strangely enough, when it comes to the strategic importance and business value of the data center network, there is still a disconnect. Even with momentum building behind the software-driven data center (SDDC) and software-driven services, applications and networks are often ships in the night. In many cases they are designed, built, deployed, and managed separately, as discrete entities. And there is still considerable inertia when it comes to modernizing the capabilities of the data center network.

The result is a lack of flexibility. All too often the data center network cannot easily scale to accommodate growth, cannot handle new types of traffic and workloads, cannot take advantage of cloud automation and orchestration opportunities, cannot move large volumes of data… the list goes on.

This lack of agility can put service providers at a huge competitive disadvantage, especially for hosting or co-location service providers (SPs) that supply Internet Exchange & Peering, IP transit, metro-Ethernet, and other bandwidth-intensive offerings as cloud-based or managed services.

This paper takes a closer look at the importance of overcoming the inertia and moving to an agile, high-performance, next generation data center (NGDC) network, along with the three key areas that need to be addressed: The data center interconnect (DCI), cloud connectivity, and building cloud-aware networks.

NGDC Network Now: The Benefits of Making Your Move

The next-generation data center has been the subject of magazine articles, conference break-out sessions, and PowerPoint presentations for years. For competitive Service Providers, particularly hosting/colo SPs, two key questions remain: What's the business value, and what's required?

By making the move to a modern, agile data center network—one that provides optimized cloud orchestration and bi-sectional bandwidth combined with WAN network integration—enterprises and SPs can achieve multiple benefits, including the ability to:

- **Deploy applications in near-real-time**: The ability to stand up new services instantly by having a fully orchestrated network (using software-defined networking).
- **Try more new ideas faster**: This will accelerate development timeframes for new services and enhance your company's reputation for innovation.
- **Survive disasters with less expense**: NGDC networks enable you to implement a mobile, recoverable, disaster recovery solution with a flexible and adaptive underlying network—which in turn enables you to limit the operational costs of having to spin up network infrastructure or capacity in the event of a disaster.

- **Model changes in real time**: A modern data center network allows you to do virtual slicing of the infrastructure into clean development and live systems, so you can see what works and what doesn't work faster—and get to an optimized infrastructure sooner.
- **Offer more high-bandwidth applications and services**: If your network can meet the demand for 40 and 100-gigabit connectivity between data centers and deliver high-performance access to data-intensive services, you have more options for new product development and competitive differentiation.
- **Mashup services across larger metro areas**: NGDC networks can enable you to connect data centers and resources more efficiently, so applications can interact over larger distances and clouds can communicate via optimized transport networks.
- **Reduce CapEx**: Avoid overbuilding of network resources and overcompensating on the application layer.
- **Extract more value from commoditized network services**: With overlay networks and open networking operating systems the dream of using white-box commoditized switching is now achievable. This allows you to focus precious capital on purpose-built hardware in the places where it has true value in the network such as high speed routers and firewalls, and smaller investments in commodity equipment where the functionality is more straightforward.
- **Harvest the benefits of NFV**: Network Functions Virtualization (NFV) enables the consolidation of network services onto industry-standard servers, on-prem or off-site—and the NGDC is ready-made for NFV. Service providers can use NFV to reduce the numbers of devices, cut equipment and power costs, speed time to market by minimizing the number of devices that the operator needs to certify and train for, and scale up services faster. With multi-tenancy capabilities enabled through software, network operators can provide tailored services and connectivity for multiple customers and applications on the same hardware with secure separation of administrative domains. And since hardware development isn't required, vendors can more rapidly develop virtualized appliances and give service providers a wider choice of service options in a shorter development cycle.

> "Requirements for data center networking equipment have evolved rapidly during the past four years after a period of architectural stability that lasted at least 15 years."
> – *Gartner*[1]

DCI Networking Considerations

Data center interconnect (DCI) has emerged as a major area of focus for the NGDC. From a business perspective, the key reason is that an intelligent, modern DCI can enable any service to be delivered anywhere, any time, and can be shared with everyone. It enables the flexible and dynamic provisioning of Layer-2 services, Layer-3 services, optical services, lambda services and more—while providing capacity on demand and reducing the complexity of optical/IP networks through a fully converged core. From a technical perspective, there are many additional advantages:

- **DCI is instrumental for data center consolidation and distribution**: The DCI implementation directly impacts scalability, availability, compliance, and multi-tenancy, which impacts a service provider's ability to consolidate and re-allocate data center resources.

1. Gartner: *Magic Quadrant For Data Center Network Infrastructure*, February 2013.

- **DCI allows SPs to offer integrated Layer-2 solutions**: MPLS Layer-2 VPNs allow service providers to offer services to enterprise customers by interconnecting their data centers for them. Ethernet VPNs (EVPNs) can complement these services. The service provider can set up the data center interconnects for the enterprise's account and put them into a Layer 2 domain for VM mobility using EVPNs, or put them into an L3 domain using L3VPN. This outsourced service provides the enterprise with a complete, managed VPN solution that replaces VPLS and co-exists with rfc4364 Layer-3 VPN service offerings at no added cost, technology, or operational risk.

- **DCI can deliver geo-clustering and disaster recovery**: Organizations are growing increasingly reliant on the wide area network (WAN) that connects data centers, yet while the WAN is key to data backup plans for maintaining business continuity, many WAN links aren't up to the task. Standards-based DCI technology can help your DR or backup plans operate more efficiently, so you can keep operating in the face of a disaster. With an efficient underlying DCI, you can implement services such as data replication between geographically distributed locations more efficiently and at a fraction of the cost. Application and storage traffic can flow between data centers so that you can maximize application availability and provide data redundancy in the case of an outage. In addition, Virtual Private LAN Service (VPLS) or the newer EVPN protocol enables multiple sites to be connected in a single bridged domain over the network, and by virtualizing the network path with VPLS, you can collapse the number of physical links between data centers and replace them with virtual circuits, thereby reducing WAN operating expenses. These capabilities are supported on open platforms such as Juniper's MX Series routers that connect data centers.

- **DCI provides L2 stretch and VM mobility**: In additional to facilitating disaster recovery and storage replication services, a next-generation, highly optimized DCI allows you to effectively map VM resources to WAN services at scale.

There are myriad technologies that serve as building blocks or play a role in creating the optimal DCI—from MPLS-TP overlays to GMPLS—but the key is that the fabric must tame the massive complexity that defines today's data centers. The transition from physical to virtual resources, the proliferation of virtual machines and network ports, the exponential growth in network interactions, and the constant roll-out of more applications and more interconnected devices have all increased network requirements. That is why an effective strategy to simplify the IT environment must begin with simplification of the network architecture.

Delivering Services at the Data Center Edge

A second key consideration for modernizing the data center network is how to bring resources and services at the network edge inside the data center. How do you stitch together islands of network resources to enable private or public service consumption? How do you seamlessly extend L2 domains across the metro areas, at scale, with maximum flexibility? As you roll out new applications, how will you connect them to the virtual network infrastructure?

More importantly, how can you create a system that doesn't care about the disparate L2 or service components, but that can connect these resources under a newly formed customer domain and extend them to wherever they need to go?

The gateway should be able to connect from an SDN environment using a tunnel protocol, convert to native L2 or L3, and then connect to a hypervisor using a vSwitch, to a bare metal server that might be hosting a database, to a non-x86 compute platform, or to IP storage.

In addition, resources must be connected from branch office users, data centers, customers, and supply chains. The gateway must be able to connect to resources in an SDN environment in one location using a protocol such as virtual private LAN service (VPLS) or MPLS Ethernet VPN (EVPN), or a Layer 3 VPN protocol. It then needs to connect over the WAN

to a remote location, and then convert back to an SDN-compatible Overlay tunnel type, or connect via traditional Layer 2 or Layer 3 services to a bare metal server or a hypervisor. Finally, the gateway should also be able to connect from an east-west DC SDN environment and then via Layer 3 stitching to an integrated routing and bridging (IRB) interface and then to the Internet.

Juniper has developed a set of Universal SDN Gateway capabilities that run on the MX Series routers to connect all devices and resources in the data center and across the WAN. These gateway functions build upon the rich Layer 2 and Layer 3 VPN capabilities already in the MX Series routers, including standards-based protocols for Data Center Interconnect (DCI) such as EVPN, VPLS, and MPLS. The MX Series Universal SDN Gateway provides four key gateway services (see Figure 1 below):

- **Layer 2 SDN Gateway**: Provides SDN-to-non-SDN translation services for connections over Layer 2 on the same IP subnet, using bridging to maintain the same addressing. This enables SDN controllers to communicate over Layer 2 to non-SDN VMs, bare metal servers, and L4-L7 network services.
- **Layer 3 SDN Gateway**: Provides SDN-to-non-SDN translation services for resources on different IP subnets, which enables the VM in the overlay environment to communicate over Layer 3 to legacy environments, to the Internet or other L3 destinations, to VMs in non-SDN environments, to bare metal servers, and to L4-L7 services.
- **SDN-to-WAN Gateway**: Provides SDN-to-WAN translation for devices that are on the same or different IP subnets.

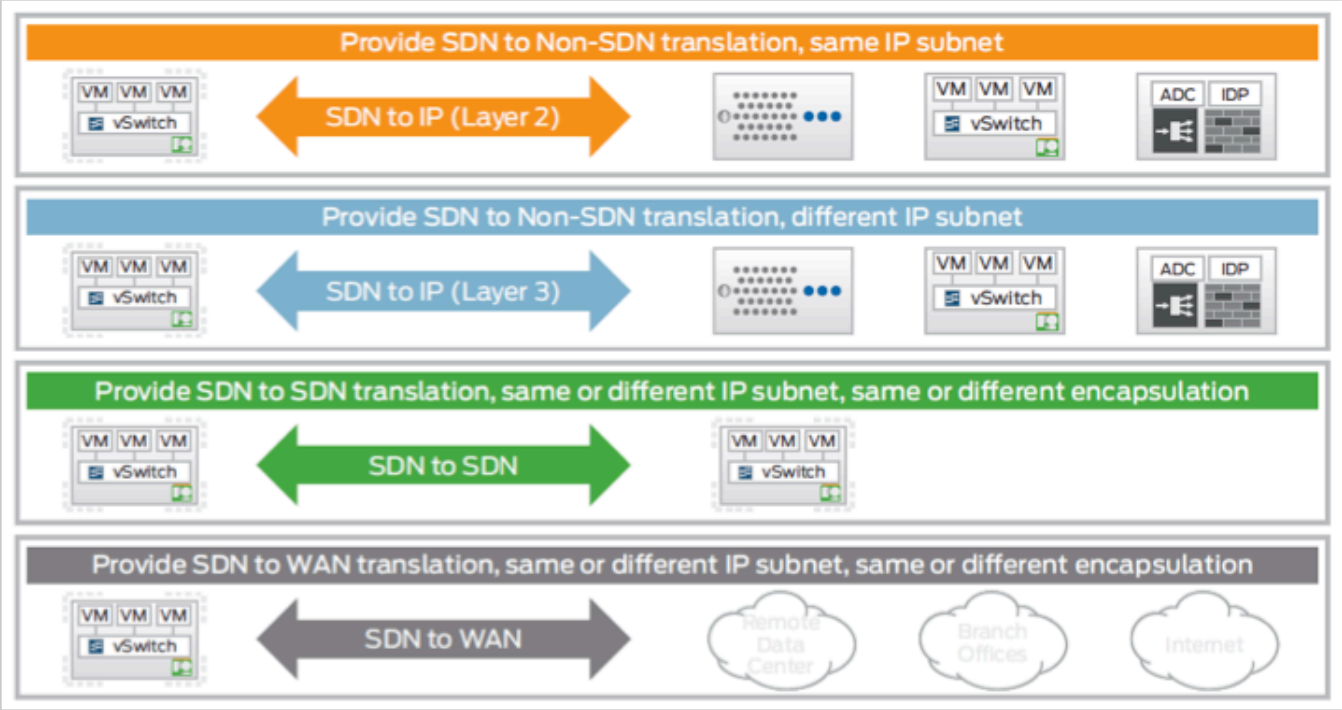

Figure 1. Four universal SDN gateway functions that should be addressed.

- **SDN-to-SDN Gateway**: Translates between SDN controller types on the same or different IP subnets, which might be local or remote, with the same or different tunnel encapsulations.

Building Cloud-Aware Networks

IT service providers spend hundreds of billions of dollars per year connecting data center systems, devices, networks, applications, and data to the cloud. To maximize this investment, it is critical to implement cloud-aware networks that adhere to open standards. This will reduce the cost and complexity of having a network that needs to scale with and map to software resources it doesn't integrate with.

> The service provider data center is no longer a centralized entity. With virtualized managed services extended and physically located in to the Central Office (CO) or even to a Customer Premise (CP), service providers seek to distribute the next generation distributed data center (and network) over multiple geographic locations, with extraordinary demands for elastic performance, scale and flexibility for multi-tenancy configuration and management. Though SDN offers some flexibility in this regard, performance at scale is ultimately achieved by hardware based switches and routers—elegantly controlled by tightly integrated SDN solutions such as Juniper's Northstar SDN Controller or the Contrail NFV platform.

Juniper's Contrail, an open-source, proactive overlay SDN solution, works with existing network devices and helps address the networking challenges for self-service, automated, and vertically integrated cloud architectures. Contrail also helps improve scalability and CapEx inefficiencies through an overlay virtual network. All of the networking features such as switching, routing, security, and load balancing are moved from the physical hardware infrastructure to software running in the hypervisor kernel that is managed from a central orchestration system. This allows the system to scale while keeping the costs of the physical switching infrastructure under control, as the switching hardware has no state of the virtual machines or tenant/application and is only involved in routing traffic from one server to another.

The Contrail system also solves the agility problem, as it provides all of the automation for provisioning of the virtualized network, networking services, and integration with cloud orchestration systems such as OpenStack and CloudStack using REST APIs.

Service providers can use Contrail virtual networks to harness the power of the cloud for new SaaS offerings and virtualized managed services. Specific benefits for hosting SPs include:

- Interoperability with OSS/BSS
- Ability to remove dependencies on physical appliances that add cost to cloud models
- Automation and orchestration of network services
- Manage service VMs, provide load balancing and service chaining without API integration

This type of SDN solution can also increase SP agility by making it easier to migrate applications and IT resources to more flexible private or hybrid cloud environments.

Another solution that can facilitate the move to next-generation data center networks is Juniper's MetaFabric architecture. It simplifies the environment by consolidating and combining switching, routing, and security platforms, leveraging programmable systems, network orchestration, SDN, and open APIs that enable integration with the technology ecosystem.

By achieving this level of integration, MetaFabric accelerates the deployment and delivery of applications within and across multiple data centers—while providing location-independent coordination and management of devices across multiple sites, maximizing data center resource utilization. Used in conjunction with Juniper MX-Series Universal Edge Routers, it provides the simplicity, flexibility and performance that can enable the DCI to fully deliver on the possibilities of next-generation data center networks.

Conclusion

Of course the data center is more than the network. The aim of this paper is to make a simple point: To consumers of IT services and to the business itself, nothing is more important than the agility, performance, scalability, and availability of the data center network. Thus from a strategic perspective, nothing is more important than ensuring that the data center network fully delivers on these requirements.

Copper River Information Technology is firmly committed to helping enterprise and SP customers simplify their data center networks without compromising on requirements. Whether you are planning a full-scale data center transition or executing a routine technology refresh, Copper River can ensure that your data center networking initiatives deliver the strategic advantages of the NGDC—today.

For More Information

For information about Copper River IT and its core competencies and service offerings, please visit www.copperriverit.com.

For additional details about Juniper solutions and capabilities for data center networks, please schedule an appointment with your local Juniper account representative or visit www.juniper.net.

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