I D C T E C H N O L O G Y S P O T L I G H T

The Next Phase of Datacenter Network Resource Management and Automation

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Executives want to undertake an "operational" transformation of IT to boost the effective use of IT assets and make it easier for organizations to react quickly to major positive or negative changes in the business environment. One of the key strategies that IT teams are pursuing to reduce capital costs while boosting asset utilization is the transition to highly virtualized datacenters. Increasingly, organizations are looking to move to the next phase of virtualization, which allows for the dynamic migration of workloads throughout the datacenter. From a networking perspective, the paths that virtualization is taking will require a leap forward in innovation on the datacenter network that involves as its foundation a migration to an Ethernet fabric network. Essential to this new datacenter architecture is a scalable dynamic datacenter fabric that enables the flexibility and efficiency of connectivity of virtualized workloads over 10 Gigabit Ethernet, with emphasis on dynamic resource allocation and automation.

This Technology Spotlight discusses the need for a virtual-aware dynamic fabric and the role that Mellanox Technologies plays in the virtualized datacenter.

The Aligned Datacenter Architecture

As organizations move to create a dynamic datacenter enabled by virtualization, they are moving to architectures where server, storage, and network assets are in tighter alignment with converged infrastructures. Faced with a future where organizations need to deploy and effectively use hundreds, thousands, and even tens of thousands of server (and/or desktop) application instances in a virtual environment, IT teams increasingly require tighter alignment of IT resources. Server, storage, and network infrastructure resources are treated as pools to be assigned as needed to business services. The goal is to create a pool of network entities that can be allocated and deallocated by the push of a button; this model requires a new type of abstraction and resource manager. The performance and density requirements of the new virtualized datacenter will dictate a migration from 1 Gigabit Ethernet to very high-scale 10 Gigabit Ethernet switches. 10 Gigabit Ethernet is the foundation of this new datacenter network.

In addition to density, the evolution in application architectures has increased the demand for 10 Gigabit Ethernet. Traffic patterns in the datacenter are changing because there is growing reliance on the servers, either physical or virtual, to act as a single fabric instead of silos of resources. The datacenter increasingly has traffic flowing between multiple servers and data stores before flowing out to the end user. The bandwidth requirements are higher for each physical server because there is more communication between servers for every application, adding to the need for 10 Gigabit Ethernet.

A migration to virtualized IT means that the network must converge onto Ethernet with a unified network fabric. A unified fabric provides the ability to set up, move, and change both physical servers and virtual servers faster in order to more easily respond to changing business needs, and it is designed to provide greater scalability for the entire datacenter. The movement of virtual machines adds further stress to the network. When on-demand facilities are spinning up virtual machines to meet time-of-day or time-of-month computing requirements, the virtual machine images require dedicated bandwidth. Performance, scale, and intelligence are required specific to each virtual machine to meet the availability and resiliency requirements of the highly virtualized datacenter.

The ease with which virtual servers can migrate within the datacenter for load balancing, maintenance, and energy efficiency is a cornerstone benefit of server virtualization. Currently, less than 10% of organizations have progressed to a fully virtualized on-demand datacenter where virtual workloads continuously and automatically migrate across the datacenter. Today, the network is one of the barriers to moving along this IT maturity model. IDC believes that in order to continue on the path to a fully virtualized datacenter, IT organizations need to make sure that all the components in the datacenter are able to connect seamlessly. The challenge arising from this process is how to keep connectivity and networking policies abreast of these changes of physical location and do so without manual intervention. IT managers need to sustain network policies, service-level agreements (SLAs), and security policies in the face of virtual machine migrations. Additionally, IT managers must plan for the reality that each workload in a typical enterprise-class datacenter has unique network demands, and many workloads have very stringent requirements such as lossless packet delivery, deterministic latency, and high bandwidth. These network policies must be maintained throughout workload migration.

The path to managing and troubleshooting a virtual IT infrastructure brings an additional challenge. Server virtualization has created a problem for network administrators because virtual machines tend to be managed through server management platforms and tools. This creates a blind spot for network administration teams, making it difficult to effectively troubleshoot and manage virtual machine network performance. This lack of visibility makes it difficult for network administrators to understand traffic patterns and create policies around virtual machines. Examples of problems requiring visibility include migration storms and migration over large domains that cross several switches. Also, server virtualization software uses virtual switches that reside on the server to switch traffic between virtual machines on the server, which demands visibility from the network switch.

The network needs to become an equal partner in the datacenter migration to a virtualized IT infrastructure. It is clear that for organizations to further exploit the benefits of virtualization and create a true pool of compute and storage resources, virtual machine policies and service levels need to be managed in conjunction with the network administrator. Lack of visibility creates havoc for network administrators when a problem occurs at the virtual machine level and halts an organization's ability to maintain mission-critical service levels.

For network administrators to effectively and efficiently manage network resources in a dynamic datacenter, the following network resource management capabilities are needed to support workloads in a virtual datacenter:

- **Abstraction of complexity.** The fabric must in and of itself become virtualized. Switching between virtual machines and across the datacenter must be visible and seamless to the fabric. The fabric must have the ability to be managed, monitored, and configured as a single entity.

- **Visibility into the virtual machine.** The new datacenter fabric must support each virtual machine in the same way it can support each physical server today. The hypervisor must be visible for policy configuration and management, virtual port provisioning, virtual port monitoring, and troubleshooting. Additionally, virtual and physical assets need to be treated equally.

- **Process migration joined by connectivity and SLA migration.** For organizations to move to the next phase of virtualization maturity, virtual machine mobility in the datacenter must be managed in conjunction with policies and service-level agreements. Connectivity and network configuration properties must migrate together with the workload. The notion of combining network policy migration with workload migration is essential to a successful datacenter deployment, in effect coupling server migration with network policy migration.
- **Integration.** Fabric management needs to integrate with the scheduler, the framework, and heterogeneous switching platforms.
- **Automation.** The complexity of traffic patterns and the magnitude of virtual machines mean the network fabric needs to work with datacenter automation platforms, and the network provisioning needs to be automated. Virtual networking is not possible without a degree of automation because no one knows when a machine migrates. A manual process of virtual machine migration without automation is risky to the business as well as time consuming and expensive.
- **Monitoring.** An application should be monitored so that it is correlated into the virtual workload.

Benefits

Adopting a new unified network fabric encompassing the requirements of systems and storage requires organizations to address the management issues that can arise. Implementing management capabilities into a network fabric can enable organizations to realize the agility and scale benefits of a virtualized IT datacenter. A unified fabric is not only beneficial but also mandatory if customers are going to achieve both the economic benefits and the performance benefits of next-generation datacenters. Specifically, a unified network fabric can accomplish the following benefits:

- Enables the infrastructure to scale to meet the performance requirements of hundreds and even thousands of virtual machines
- Offers flexibility to dynamically provision and reprovision workloads to meet changing business requirements
- Contributes to operational efficiency by using network automation and supporting datacenter automation to optimize datacenter staff time
- Ensures that policies are applied consistently to meet service-level requirements
- Provides the framework for the network to deliver resources in alliance with the demands of applications and servers

Product Profile

Mellanox Technologies is a supplier of high-performance, end-to-end connectivity solutions for datacenter servers and storage systems with headquarters in Sunnyvale, California, and Yokneam, Israel. The company's Unified Fabric Manager (UFM) software is a platform for managing scale-out Ethernet and InfiniBand computing environments.

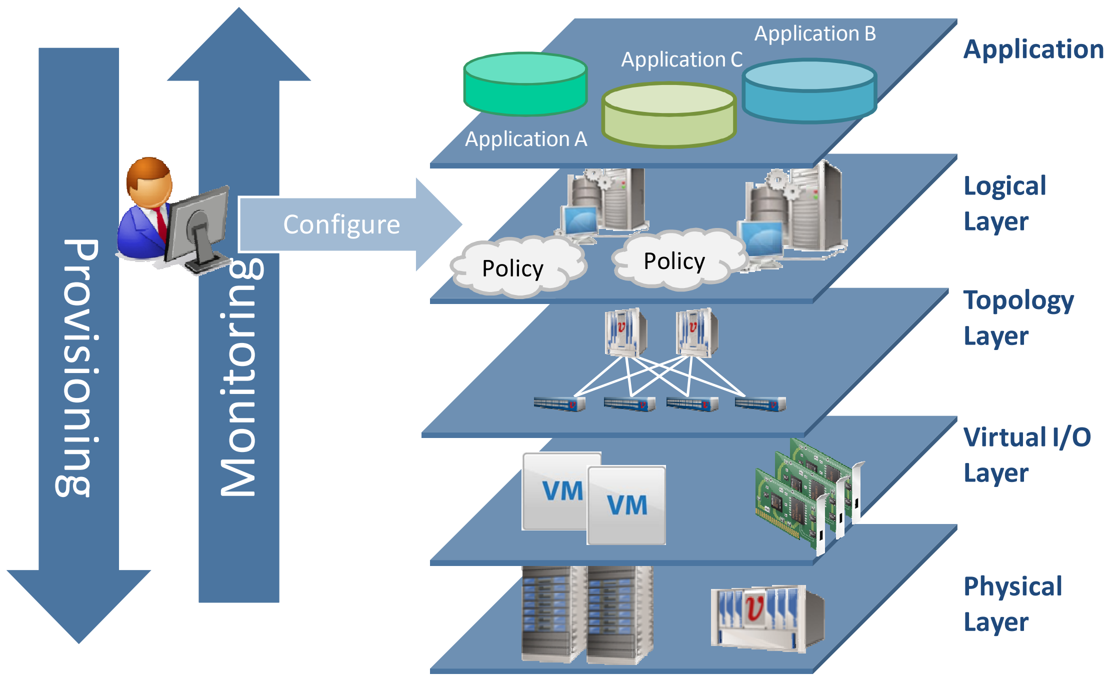
According to Mellanox, UFM enables datacenter operators to efficiently provision, monitor, and operate the modern datacenter fabric. In addition, UFM is designed to improve application performance and ensure that the fabric is up and running consistently.

Fabric Management Abstraction Layers

UFM eliminates the complexity of datacenter administration by introducing innovative fabric management abstraction layers. It uses an application-centric model to correlate the physical fabric elements with the virtual application workloads. UFM enables customers to have provisioning and monitoring on each individual layer of the datacenter network. The layers start with the application and include the logical layer, topology layer, virtual I/O layer, and physical layer (see Figure 1). This product architecture also enables UFM to add additional third-party devices at the physical layer to assist in controlling legacy networking gear in conjunction with Mellanox technology.

Figure 1

UFM Layers Datacenter Model



Source: Mellanox Technologies, 2011

Fabric and Policy Templates

UFM's fabric model allows users to manage fabrics with policy templates that automatically relate to virtual applications or services. For instance, the logical layer groups physical and virtual compute resources that serve a common application workload. With UFM, network administrators no longer need to configure each individual device and port in the fabric. Instead, they can just match network policy to a logical compute group. From that point on, UFM automates the process, enabling a zero-touch infrastructure while maintaining a rigid and controlled networking policy.

Fabric Monitoring and Provisioning

UFM's management infrastructure also enables fabric monitoring and performance optimization on the application-logical level rather than just at the individual port or device level. In addition, one of the challenges of network management today is segregating and partitioning the network in light of VLANs and bandwidth guarantees. UFM can assign a workload to a VLAN and isolate it from other workloads.

In a dynamic public or private cloud infrastructure, it is critical to understand where congestion occurs. Customers need to know if fabrics have collided. It is also important to automate the provisioning process by linking to the workload scheduler. UFM has been integrated with leading schedulers such as Platform LSF and Moab Adaptive Computing Suite to allow automatic provisioning per the scheduler workload submission without any human intervention.

Hypervisor Connected

With its open APIs, UFM interfaces with hypervisors such as VMware ESXi and enables discovery and network policy provisioning and monitoring at the granularity of each virtual machine. This integration enables UFM to become aware of workload migration events and adjust the configuration accordingly. UFM has achieved the VMware Ready certification.

In the next-generation datacenter, there will be a constant need to provision and reprovision if necessary. In terms of networking, monitoring, and provisioning, UFM can model a workload and bridge the gap between an application and a physical port. Like any provisioning and monitoring system, UFM provides visibility into the switches and allows administrators to click to configure. Administrators are able to define policies in containers or pods of computes; as a result, all the associated workloads — including all the virtual machines that serve that application — are automatically defined by the policy. As virtual machines move, the policies, workloads, and applications are monitored by UFM, and everything is linked to provisioning over time. In addition, UFM can understand from a network perspective if there are bottlenecks in correlation to an application and can see all of the ports that serve the application to determine the cause of the bottleneck.

According to Mellanox, its UFM software includes the following benefits:

- Improved visibility into fabric performance and potential bottlenecks with its monitoring engine
- Improved performance due to application-centric optimizations by correlating to an application through its event mechanism
- Quicker troubleshooting time due to advanced event management
- Efficient management of dynamic and multitenant environments
- Reduced risk and increased compliance of fabric configuration changes
- Real-time results because provisioning and monitoring systems are visible immediately

Challenges

Migrating to the next phase of server virtualization where virtual machines are provisioned and reprovisioned based on fluid business requirements has hit a roadblock due to the limitations of the current network architectures. Mellanox's largest challenge will be to continue to create market awareness among potential customers of the benefits of UFM in creating a dynamic datacenter. In addition, because UFM provides the foundation to work with datacenter and systems orchestration products, the company needs to extend awareness of these capabilities as they relate to customers' existing higher-level automation and datacenter management platforms. While Mellanox has a loyal base of enterprise IT customers that use its InfiniBand and 10 Gigabit Ethernet adapters and platforms, the company can expand its UFM customer base by targeting cloud and telecom service providers. These segments are aggressively deploying new scale-out datacenters, and therefore, Mellanox should create additional awareness around UFM's benefit in multitenant and highly automated datacenters.

Conclusion

Organizations continue to deploy various virtualization technologies to create a dynamic datacenter that can quickly adapt and respond to business needs. As virtualization takes hold in the areas of systems and storage, the network itself becomes increasingly important. A unified network fabric, in which storage, system, and network resources are in alignment and pooled to create business services, is an essential component of a dynamic virtualized IT datacenter.

However, as the network, systems, and storage become increasingly interdependent, network resource management is a critical building block for datacenters. For many IT organizations, a network fabric that provides visibility into all of the components within a datacenter is necessary to effectively manage the datacenter. If Mellanox can address the challenges outlined in this paper, IDC believes the company can succeed in the important market for flexible network fabric technologies.

A B O U T T H I S P U B L I C A T I O N

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