Resilient, high-performance networking for virtual infrastructures

By Saleem Muhammad, Monte Barton, and Craig Phelps

Virtualization is changing expectations for enterprise networks. The virtual top-of-rack solution available in Dell™ PowerConnect™ B-MLXe routers can provide an infrastructure designed for high performance, resiliency, scalability, and simplicity.

Reducing complexity
Dell PowerConnect B-MLXe routers help to simplify networking in dense virtualized environments—freeing resources to drive business innovation.

- Increased operational efficiency with a single chassis and single point of management
- Optimized application performance with line-rate communication, minimum hops, and near-instant link or node failover
- Infrastructure flexibility with collapsed layers, massive scalability, and reduced cabling

Data centers continue to grow as business reliance on the network increases and organizations deploy a rising number of cloud-based applications. The traditional model of separately provisioning servers, storage, and networks is too rigid, and in many cases leads to underutilized, static resources. Organizations expect agile application deployment—in minutes, not months—to maintain their competitive edge as markets and competitors become global in scale. At the same time, data center resources such as rack space, power, and cooling are becoming increasingly scarce and costly. Server virtualization is being aggressively implemented to help meet these challenges, but it is also changing expectations for current networks.

Now, imagine a virtualized data center where workloads migrate anywhere within the data center without performance degradation, where all links from the servers to the network core are active to help maximize bandwidth utilization, and where the network is highly resilient and flexible enough to allow server connectivity to scale up or down in response to the demand. The virtual top-of-rack solution available in Dell PowerConnect B-MLXe series routers enables organizations to move toward these goals by helping to simplify virtualized data center networks and deliver agile IT.

Identifying key networking challenges
IT departments face a variety of challenges in complex data center infrastructures, including scalability in virtualized environments, application mobility, and network management complexity.

Scalability in virtualized environments
When scaling a virtualized server environment, the network presents several challenges and limitations, including the limitations of Spanning Tree Protocol (STP), the growing number of server connections, low utilization, link failure recovery, and management complexity. For example, enabling capabilities such as virtual machine (VM) mobility requires VMs to migrate within a single Layer 2 network. To create a highly available network with traditional Layer 2 Ethernet, paths through the network are designed as active or standby using STP. Although this approach provides an alternate path, only one path can be used to forward traffic in a steady state. As a result,
half of the top-of-rack ports remain idle until a failure occurs—an inefficient use of available bandwidth.

Another challenge with STP is network behavior when links fail. When failures occur, the spanning tree must be redefined. This process can take anywhere from a few seconds with Rapid STP (RSTP) to several minutes with STP—and this convergence can vary unpredictably even with small topology changes. The demands for nonstop traffic flow increase with server virtualization, and consequently network convergence times must shrink. In addition, when a spanning tree is re-converging, broadcast storms can occur and result in network slowdown. Other drawbacks include limited buffer memory to handle high workloads and bursty traffic, oversubscription ratios for server-to-server or server-to-network communications, and latency when traffic must traverse the aggregation layer (multiple hops).

Using traditional access-layer architectures in virtualized environments can also require many switches, making it difficult to perform software upgrades and increasing potential points of failure. When a node or link does fail, slow control-plane failover can result in lost traffic and application availability.

Application mobility

When an application is running in a VM rather than on a physical server, it is not tied to a specific physical host. In such environments, application mobility, or VM mobility, can take place between hosts when application demands change, when servers need to be maintained, or when a quick disaster recovery from a site failure is necessary. VMs can migrate within a cluster of physical servers that are in the same IP subnet and Ethernet virtual LAN (VLAN), which is required for the migration to be nondisruptive to client traffic. The solution for flexible VM mobility is a more scalable and available Layer 2 network with higher network bandwidth utilization than is typically available in traditional physical environments.

For a VM to migrate from one server to another, many server attributes must be the same on the origination and destination servers, and this requirement extends to the network as well—requiring VLAN, access control list, quality-of-service, and security profiles to be the same on both the source and destination access switch ports. If switch port configurations differ, either the migration preflight fails, or network access for the VM breaks or may cause a security hole. In addition, automated VM migration leaves network administrators with only limited visibility into the location of applications, making it challenging to track issues to a specific VM for troubleshooting.

Network management complexity

Multitiered architectures involve considerable complexity, and server virtualization and blade servers have only increased this complexity. The access layer is no longer managed through a single switch, but now includes multiple stages of switching extending from the software switch in the hypervisor to the top-of-rack or end-of-row access switch (see Figure 1). Each time IT staff deploy a new rack of servers to host VMs, they must also configure each switching layer, driving up cost and complexity. Contributing to management complexities are the separate tools used to manage the LAN, storage area network (SAN), blade server connectivity, network interface cards (NICs), and host bus adapters (HBAs).

Delivering a highly efficient network architecture

Dell’s turnkey virtual top-of-rack solution combines Dell PowerEdge™ servers and Dell PowerConnect B-MLXe series routers to deliver a highly efficient virtualized data center. It extends the reach of the...
PowerConnect B-MLXe routers to the top of the rack through passive patch panels—offering highly reliable server patch panel connectivity at line rate and helping administrators overcome network challenges through high performance, high availability, massive scalability, and simplicity. The resulting environment enables IT organizations to reduce the cost of growth and enhance their responsiveness to business needs.

PowerConnect B-MLXe routers provide line-rate performance that enables servers to fully utilize the available bandwidth on each link irrespective of the features configured on the routers. The routers are designed with very deep buffers per module, which helps ensure optimal congestion management to handle high workloads and bursty traffic. Additionally, these routers can significantly enhance network utilization by avoiding the performance reductions associated with STP: unlike STP, which disables some links to eliminate network loops, PowerConnect B-MLXe routers with Multi-Chassis Trunking (MCT) technology help ensure that all links are active from server to core. The resulting network offers increased capacity by utilizing all links for data transport without requiring special configuration changes to the server.

One of the key foundations of the virtual top-of-rack solution is its ability to collapse access and aggregation layers by allowing all interconnects to take place within the PowerConnect B-MLXe routers. This architecture helps increase network availability, benefiting from the very low failure rate and high mean time between failures offered by the modular PowerConnect B-MLXe routers. In the unlikely event of a link or node failure from server to core, data traffic can deterministically fail over almost instantly, helping ensure that applications remain available to users. Additionally, the modular PowerConnect B-MLXe routers allow IT staff to replace a failed module in the chassis without resetting the system, simply by disconnecting eight cables from the module, replacing the module, and reconnecting the cables to the new module. A collapsed architecture also helps increase application mobility, because the applications move within a single chassis as opposed to a number of separately managed top-of-rack switches.

The virtual top-of-rack solution also offers massive scalability to handle dense virtualized server deployments by supporting up to 768 Gigabit Ethernet (GbE) server connections per switch. It further allows the creation of an MCT cluster, which combines two PowerConnect B-MLXe routers and presents them as a single router to the servers, pushing the maximum number of server connections even higher. As VMs are created on the servers, the network sees multiple Media Access Control (MAC) addresses on each server port. With up to 1 million MAC entries supported per router, the network can forward data traffic without negative performance impact in dense VM deployments. These routers also offer a choice of interconnects, including GbE, 10 Gigabit Ethernet (10GbE), and 100 Gigabit Ethernet (100GbE) port speeds to help ensure that they can continue to meet future needs.

PowerConnect B-MLXe routers help to simplify IT through their ease of deployment, configuration, management, and operation. With up to 768 GbE ports on a single router, these routers deliver massive consolidation, helping reduce the number of network elements that must be deployed to support virtualized server environments. This approach helps simplify network configuration and maintenance by avoiding the need for a spanning tree from the servers to the core of the network. The main component that provides connectivity to servers is a passive top-of-rack patch panel. Because it does not have any electromechanical components, it does not require power, cooling, or out-of-band management network access at the server rack. Administrators can manage the complete solution using the Network Advisor tool, a single application for managing Fibre Channel and IP data center products and IP LAN products from HBAs and converged network adapters (CNAs) in the server to the core of the network.

**Simplifying IT through high-performance virtualization**

Virtualization has become a critical method for consolidating server sprawl, accelerating server deployment, improving compliance with service-level agreements, and reducing the cost and complexity of IT management. As part of an overall virtualization strategy, organizations can take advantage of the virtual top-of-rack solution available in Dell PowerConnect B-MLXe series routers to help them identify and remove unnecessary complexity from their infrastructure, thus freeing resources to focus on the core value of IT to drive business innovation. 

**Saleem Muhammad** is a product manager at Brocade Communications Systems, where he manages PowerConnect B-Series IP products for Dell.

**Monte Barton** is a business development executive with Brocade dedicated to Dell. He has over 20 years of storage industry experience and is responsible for the OEM product portfolio.

**Craig Phelps** is a product strategist in the Dell Networking Product Group. His 18 years in enterprise technology also includes work at TippingPoint/3Com, Surgient, Cisco Systems, and Mead Data Central.

**Learn more**

Dell PowerConnect B-MLXe routers:
dell.com/PowerConnect_B-MLXe