Enterprise IT has gone through several major shifts over the past several decades. The 1960s and 70s saw the rise of the mainframe. The mainframe ceded control in the client/server era, which in turn gave way to Internet computing. Today, the industry finds itself in the midst of another major computing transition: the shift to virtual computing. For the purposes of this report, virtual computing is defined as a computing model where all IT resources are virtualized and then tied together with the network. Virtual computing is the most network-centric computing paradigm to date (Exhibit 1). Virtualization technology has already reshaped the face of computing and applications, and now, for organizations to optimize the benefits of virtualization, the network needs to evolve.

Section I: Introduction — The Rise of Virtual Computing
Each of these computing transitions has:

- Lowered the cost of computing. Computing continues to get cheaper. During the mainframe era, organizations would spend millions of dollars to give compute capabilities to only about 25% of the people in an organization. Now, computing is so cheap that IT managers are able to deploy compute resources anywhere they are needed. Virtualization has dropped the cost of computing even further, as physical devices are no longer required.

- Increased the value of the network. The network has gone from being the unequipped “highway system” of a company to being the most significant IT asset. The network is pervasive and the single resource that ties all corporate workers to the resources they need. Organizations that find a better way to leverage the network will gain a significant competitive advantage.

- Increased the relationship between network and computing. The era of virtual computing is predicated on virtual IT resources being located in resource pools and then allocated to the enterprise applications and services as business policies dictate. In this scenario, the network is the resource that can secure and orchestrated the movement of these virtual resources. The more virtual the resources in a data center become, the stronger the interdependency on the compute and network infrastructure.

Driving the shift to virtual computing are several IT megatrends:

- Enterprise mobility. Workers can be located anywhere today, and it’s critical that the IT infrastructure be able to deliver content and applications to users no matter where they are.

- Virtualization and cloud computing. Virtualization technology has evolved rapidly over the past five years. The maturity of virtualization allows IT to move corporate data and resources to a centralized data center or out to the cloud.

- Device evolution. Just a few years ago, the thought of the company workplace being filled with consumer devices was laughable. Today, that is the norm. The variety of consumer devices and operating systems in use makes traditional IT delivery impossible to scale. A new way of delivering IT resources is needed to meet the challenges of consumerization.

- Explosion of data. Data has been growing exponentially over the past decade. This trend will only accelerate, as users are able to create more media-rich content, edit it and store it themselves.
These trends combined have ushered in the virtual computing era. IT is in the midst of a major transition that is highly network-dependent. To take full advantage of virtual computing, the network needs to transform. It will become the backplane for the virtual compute environment and the resource that orchestrates and secures the movement of virtual resources.

Section II: The Role of the Network

The rise of virtual computing has put the corporate network in a position to be the most important IT resource in delivering a high-quality, consistent user experience. Legacy IT considers the network to be the outdated highway system of a company, with little strategic value. Today, though, nothing can be further from the truth. The network, in fact, is the ideal resource to build an IT strategy around, for the following reasons:

- **The network is the most scalable, cost-effective platform for application delivery.** Legacy computing architectures operate on the premise that the majority of the applications and content workers need is locally installed on users’ laptops or desktops. With the diversity of endpoints today, that computing model no longer scales. Now, the most cost-effective mechanism for delivering applications and content is the network.

- **The network has become the backplane of the virtual data center.** IT resources have historically been deployed in tight silos. With virtual computing, those IT resources are now located in pools that can be distributed to applications when needed. In this model, the network becomes the backplane of the virtual data center (Exhibit 2).

- **The network becomes the “orchestrator” of virtual resources.** As stated above, IT resources become fluid and dynamic. The network will need to play the role of orchestrator and policy enforcer to ensure that the right resources are being delivered to the applications that require them most.
Organizations that fully leverage the network as part of their virtual data center strategy find that the network becomes a significant point of strategic differentiation. The network enables CIOs to achieve greater IT agility, ensuring that the IT organization can meet whatever challenges the business brings forward.

**Section III: Network Requirements of the Virtual Data Center**

The network requirements of a virtual data center have created the need for change, and the underlying network infrastructure and architecture must evolve. Legacy network decision criteria often revolved around the market share of the vendor, as long as the network was “good enough.” With virtual computing, good enough is no longer good enough. To support the needs of a virtual data center, there can be no compromise on performance, reliability, scalability, features and cost-effectiveness.

For the long-term evolution and success of IT, a solid network foundation is required, with infrastructure that has been designed with the virtual data center in mind. Key attributes for the network are as follows:

- **Open solution.** As stated before, the network and compute platforms become more tightly coupled than ever before. An open solution allows for easier integration with compute solutions and workload provisioning.

- **Standards-based solutions.** In addition to being open, the solution needs to follow industry standards. This ensures the broadest interoperability, without the need to do custom integration with other IT partners.

- **End-to-end network.** Meeting the challenges of a virtual data center involves more than just a single switch. The network solution must extend to all parts of the data center and all the way out to the access edge to ensure an optimized user experience.

- **High-density 10 Gigabit Ethernet, upgradeable to 40 GigE.** The amount of data being moved in a data center and across a corporate network has increased exponentially over the past five years. This trend will only continue, as virtual machine mobility, video use and storage requirements increase. Not only does that make high-density 10 GigE a must today, but it also means that the network must be upgradeable to 40 GigE in the future.

- **Road map to converged storage/network.** In many data centers, two “data” networks exist: a Fibre Channel network for storage traffic and an Ethernet network for data networking. The long-term vision is to bring these two networks together into a single network, creating operational and cost efficiencies. While many organizations may not be ready to do this today, current network deployments must be able to reach that point in the future.

- **Support for virtual workloads and East-West traffic.** Data center traffic used to be driven by client to server interactions. This traffic was inherently North-South in nature, as traffic flows from the edge of the network, to the core and back to the edge. Virtualization drives traffic across the network in an East-West direction. Any network being deployed today must be able to efficiently deliver traffic in both a North-South and an East-West direction.
• Migratory strategy versus forklift upgrade. Shifting to a new architecture can be a risky process, particularly when the network needs a forklift upgrade. Any network solution being deployed today must instead allow the IT department a low-risk migration path.

• Operational simplicity. Running a network can involve a complex set of tasks. The network manager must often update software on numerous devices running different versions of an operating system or even completely different operating systems. Given the increasingly important role of the network, it’s critical that any network today be simple to run, operate, manage and optimize.

These are the primary requirements of a network capable of supporting virtual computing. Legacy decision points don’t work in this new era of IT. Network managers need to consider the impact of virtualization, consumerization and mobility and use decision criteria pertinent to today’s computing environment.

Section IV: What to Look for in a Solution Provider

The transition to virtual computing will be the most significant shift in networking since the rise of the Internet. This role of strategic enabler puts the network in a unique position, requiring organizations and their IT leaders to broaden their evaluation of network vendors past the incumbent vendor or market-share leader.

However, what to look for in a solution provider is not always obvious, especially with the ongoing compute transition under way. Enterprise network managers should choose a solution provider based on the following:

Product breadth: The network that supports the virtual enterprise extends past the data center out to the users’ edge. The solution provider must provide not only an end-to-end solution for the data center, but also network devices for the campus core, aggregation edge and network edge.

Architectural choice: Every data center is different, and the network needs to be thought of as a foundation for the virtual data center. It’s critical that the network vendor provide an open solu-
tion that makes it easy to integrate with all of the leading compute vendors, management tools and other parts of the IT ecosystem.

To meet whatever challenges the business faces, the network needs to support a number of different deployment models, including conventional core, spine and leaf, and distributed core. Additionally, the network should not limit compute choice. Instead, the network should give the IT department freedom and choice when it comes to the infrastructure that leverages the network.

**High performance and scalability:** Today’s data center requires a network where there is no compromise when it comes to performance. The network needs to have line-rate performance to every port. Additionally, high-density 1 GigE and 10 GigE are table stakes today, with a roadmap to 40 GigE. Lastly, network managers should look for data center and campus core switches with terabytes of switching capacity.

**Simplified management:** The most prevalent cause of downtime in enterprise networks today is human error. According to ZK Research, 37% of network downtime is the result of network managers making mistakes due to the overwhelming number of manual processes and changes needed to keep a network up and running. Keys to improving the manageability of the network are:

- A scripting interface to customize the feature set in the switch. This can lead to improved network uptime, an increase in the predictability of network performance and faster time to problem resolution.
- An API interface into the network software. This further increases the tight coupling between the network and compute infrastructure. Additionally, the API interface can be used to pass information to management tools and can make applications more network-aware, ultimately improving performance.
- A graphical interface. A strong graphical Web interface allows for error-free administration by enabling network managers to automate repetitive tasks instead of mandating human interaction. This significantly reduces the amount of downtime due to human error.
- An industry-standard command-line interface (CLI). Many network managers use scripts and automation tools that interact with the CLI to perform a specific task. Utilizing an industry-standard CLI is an important part of ensuring the broadest support from the engineering community, value-added resellers and third-party vendors that interact with the network.

**Section V: Dell Networking Meets the Challenges of the Virtual Computing Era**

Through its acquisition of Force10, Dell has assembled a portfolio of networking devices specifically designed to meet the needs of the virtual data center. To accommodate many different architectural designs, Dell offers a broad range of network products, including the following:

- The E series and Z series switches for conventional, 10 GigE core deployments and distributed core fabrics
- The C series for high-density aggregation
- The S series top-of-rack switches for server and storage connectivity
• The PowerConnect series for high-density wiring closet deployments

Dell has built its network portfolio on the following principles:

• Open, flexible system. Unlike the many network solution providers offering closed, locked-in systems, Dell takes an open approach. This strategy enables Dell to interoperate with many compute vendors. This allows Dell to have among the broadest of ecosystem partners that enables greater levels of automation while being optimized for virtualization. Additionally, Dell utilizes Cisco’s CLI to reduce the learning curve on managing the devices.

• Capable solutions. Dell boasts a broad set of Web 2.0 and high-performance customers that create extreme demands on their networks. The mission-critical performance that Dell enables in its demanding customer base will become increasingly important as virtual computing expands.

• Affordable solutions for all customer segments. While providing high levels of performance, Dell boasts a very affordable solution. Dell uses standards-based technology to enable a best-of-breed solution offering rapid scale-up and scale-out affordability.

In addition, Dell has a modular operating system (FTOS) that provides common software functionality across all of its products, making tasks that are typically very complex, such as scripting and programmatic management, simple.

These are among the main reasons why Dell’s network solution is ideally suited for the virtual computing era.

Section VI: Conclusions and Recommendations

As the era of virtual computing descends upon corporate IT departments, the network needs to shift from a closed, proprietary system to an open, dynamic platform.

For the network to realize its full potential, though, this shift must occur rapidly and without risk. With this in mind, ZK Research recommends the following for organizations looking to utilize the network as a point of strategic differentiation:

• Evaluate solutions on criteria unique to virtual computing. This requires considering the entire network, not just a single device. A few of the new questions that need to be raised to evaluate networks today are how well the network handles virtual traffic, what the port-to-port latency of virtual machine movement is and how consistent the user experience is.

• Do not compromise on the network, even if it means shifting away from the incumbent vendor. The incumbent vendor may be the path of least resistance but is often only the “good enough” choice. However, in the era of virtual computing, good enough is no longer good enough.

• Simplify the network and operations. Organizations should look to migrate away from network solutions that add complexity. Choose a solution that can be deployed easily and has a robust management interface but is still highly customizable.