A Network Fabric Is the Foundation for Data Center Evolution

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Introduction: Compute Evolution Drives Network Evolution

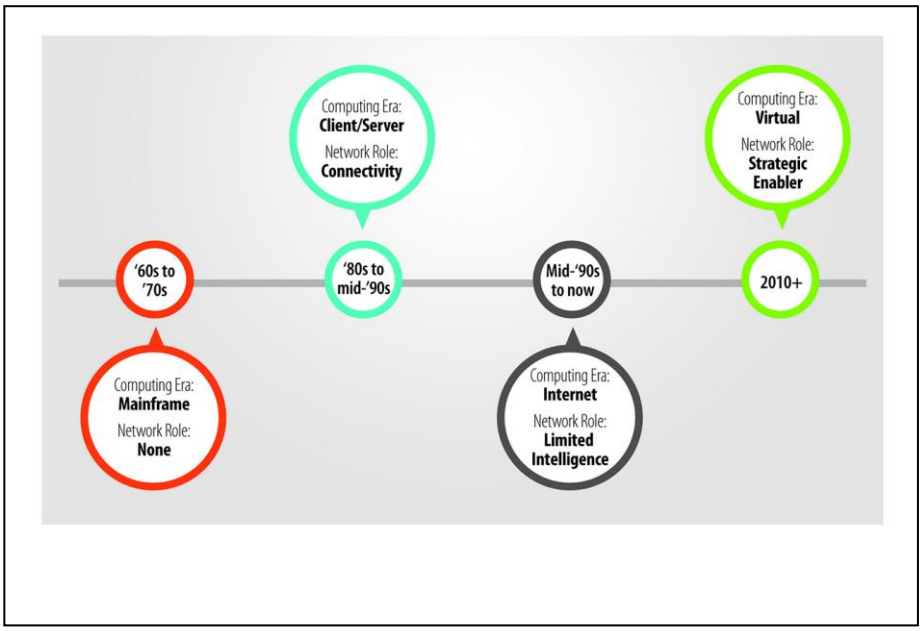
Data center architecture has gone through many major evolutionary shifts since the birth of computing (Exhibit 1). Each has been driven by the transformation of compute technologies. The industry moved from the mainframe era to client/server computing and then to Internet computing. Today we stand in the midst of another major data center shift: the shift to virtual computing.

Virtual computing is a key enabler for organizations transitioning to cloud computing. The shift to a virtual data center will be the single biggest transition in the history of computing and will impact IT in the following ways:

- **IT value will shift to the network.** Virtual and cloud computing are network-centric compute models. Over time, more IT resources will be virtualized, pooled and then allocated to applications and services as a network resource.
- **Agile IT will become a reality.** Business leaders today must be able to rapidly change or augment corporate strategy. To accomplish this, CIOs need a dynamic, agile IT infrastructure to support the business. The virtualization of IT resources creates a significantly higher level of IT agility than legacy compute models.
- **IT will adopt a services model.** As IT moves from virtual to cloud computing, it will evolve to more of a service model. This will enable organizations to allocate the proper resources to the applications and services that require them as per business policy. Consequently, businesses can significantly improve resource utilization and maximize investments in infrastructure such as servers and storage.
- **The network will evolve to a software-defined model.** Traditional networks are highly static and lack agility. As virtual computing becomes a reality, the network itself will become a more agile resource through the use of software-defined networking. Additionally, many network services, such as routing, will become virtual functions, giving customers the ability to deploy these services on the fly.

While the majority has evolved as virtualization technology has matured, the network has yet to change. The architecture used in data centers today is fundamentally the same as the architecture deployed 20 years ago. Today's networks are static and inflexible, and are designed to primarily support best effort traffic and client/server computing. If businesses are to achieve the level of IT agility required to migrate to virtual and cloud computing, the network must also evolve. The only way for businesses to successfully migrate to virtual computing is to migrate to a network fabric. The network fabric will be the foundation for further network evolution such as the migration to software-defined networking and network functions virtualization (NFV).

Exhibit 1: The Evolving Data Center



Source: ZK Research, 2014

Section II: Defining a Network Fabric

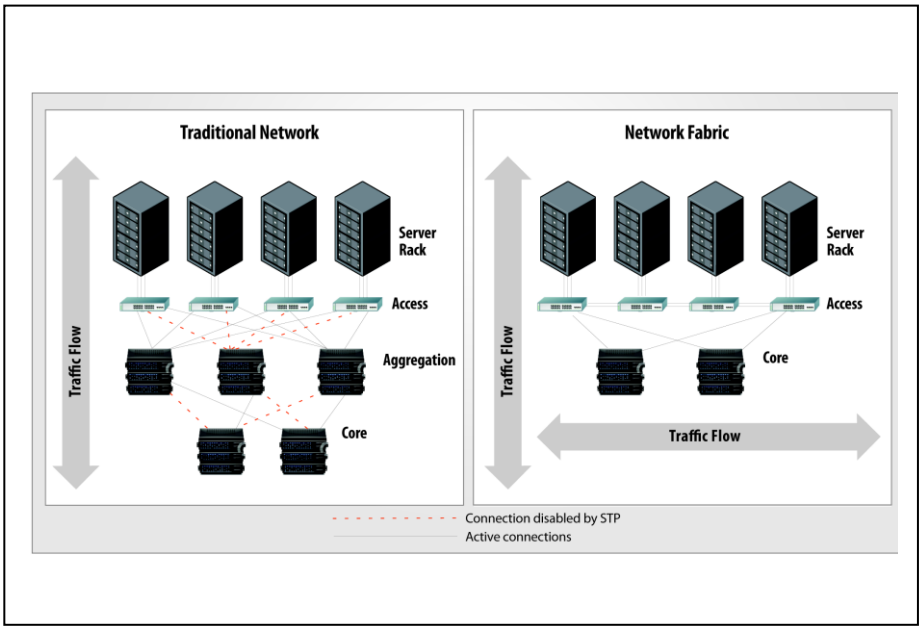
A network fabric can be thought of as a network in which every point is connected to every other point. A fabric is a network-centric system that connects storage and compute functions through high-bandwidth interconnects to function as a single, logical infrastructure unit. Fabrics will perform better and have higher availability and scalability than traditional networks, with better utilization. The network fabric can be thought of as the foundation for virtual and, in the future, cloud computing. A network fabric has the following characteristics:

- **Optimized for east-west traffic flows:** Legacy data centers are optimized for client/server traffic—that is, traffic that flows into a data center and back out in a north-south direction. A network fabric is designed for traffic that flows north-south and between servers, or in an east-west direction. East-west traffic is generated by applications such as clustering and virtual machine mobility, for example.
- **Flat network architecture:** Traditional networks are designed with three or more network tiers in mind. Each of these tiers adds extra hops for the network traffic and adds latency, which can significantly impact the performance of applications. A fabric is a flatter (Exhibit 2), two-tier network that simplifies the design and improves the flow of data.
- **Evolves away from Spanning Tree Protocol (STP):** Current networks utilize STP to prevent loops in which network traffic takes a circular path and fails to reach its destination. STP creates a loop-free network by forming a logical tree structure of switches in which only one link between devices can be active at one time. In cases where redundant links are used to connect two switches, one path is active and the other is left disabled until the active path fails. STP certainly works to prevent loops and provide redundancy, but the "active-passive" design uses bandwidth inefficiently. STP was a significant leap forward for networking in that it brought a level of reliability to Ethernet that had never been seen before. However, STP is now several decades old and cannot support the needs of a virtual data center. Network fabrics utilize protocols such as TRILL that provide the same level of redundancy but are designed with "active-active" links, improving overall network utilization.
- **Self-aggregating network:** A network fabric can prevent traffic loops without the use of STP. The interswitch link connections can automatically aggregate themselves, which more than doubles the bandwidth of the network. Keeping all connections active at all times helps avoid bottlenecks on the network.
- **Intelligent network that is better able to handle virtualization:** In a traditional network, the configuration of network services such as quality of service and VLAN assignment must be

done on a port-by-port basis. In a static network in which only physical compute resources are connected to the network, this type of design is sufficient for ongoing operations. However, in a virtual environment where it's possible to have multiple virtual machines connected to any single port and then put these in motion, the manual configuration of each port does not scale. A network fabric has distributed intelligence, which allows the network configuration parameters to be shared by every port in the fabric. When a virtual workload moves, no reconfiguration of the network is required.

- **Simplified design and architecture:** In a traditional network, each switch and switch port must be configured manually to assign policies for performance and security. Individual switch-by-switch and port-by-port management is adequate in static, small networks. But as the size of the network increases and more switches are added, manual configuration becomes unscalable. A network fabric looks like a single network, and all configuration information is shared across all devices. When a new switch is added to the fabric, it automatically receives all the required configuration information. This simplifies the network, reduces downtime due to configuration errors and lowers the overall total cost of running a network.

Exhibit 2: Traditional Network versus Network Fabric



Source: ZK Research, 2014

Section III: The Top Five Reasons to Migrate to a Fabric Architecture

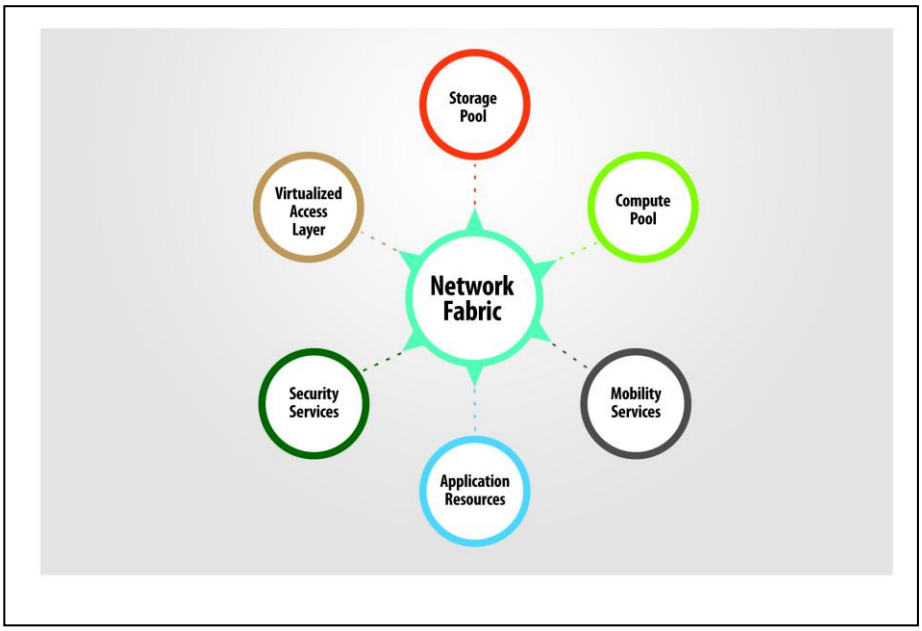
There are a number of reasons why organizations might want to deploy a network fabric. Fabrics are more efficient, more scalable, easier to manage and faster to deploy than legacy networks. However, the following are the top five reasons IT leaders should make deploying a network fabric a top priority:

1. **Platform for cloud computing:** ZK Research estimates that within five years, two-thirds of all workloads will reside in the cloud and will account for well over 50% of data center traffic. Cloud resources are highly agile IT assets that enable organizations to rapidly deploy new applications and services. A network fabric brings the necessary level of agility and flexibility to the network to be the foundation for cloud infrastructure.
2. **Higher uptime and better utilization of data center resources:** A virtual data center is composed of a number of physical resources that have been virtualized and reside in logical pools. In this case, the network fabric acts as a "backplane" for these virtual pools as it connects the pools to one another (Exhibit 3). This dramatically increases the utilization of IT resources compared to an architecture where the resources reside in discrete silos. ZK Research studies have shown that resource utilization in legacy data centers ranges from

20% to 30%. ZK Research predicts that by leveraging a network fabric, IT resource utilization can exceed 70%.

3. **Improved performance of demanding applications:** Businesses spend millions of dollars annually trying to improve the performance of demanding applications such as private clouds, enterprise video and virtualization. Much of the investment is related to rewriting applications and deploying other infrastructure such as application delivery controllers. A network fabric is a low-latency, fast network that eliminates any network issues that can hamper the performance of applications. The investment in a network fabric will easily be recovered because it can improve the performance of application dollars already spent.
4. **Faster time to deliver services through reduced provisioning time:** Legacy infrastructure often has long deployment times, meaning it can take weeks or even months to deploy a new service. The dynamic nature of a network fabric combined with centralized management can shorten the deployment time of a new service from weeks to days or even minutes in some cases.
5. **Foundation for the future of networking:** A fabric creates highly flexible, agile network resources for businesses. Organizations should look to extend the value proposition of a fabric by shifting to a software-defined network that provides centralized control and programmability. According to the 2014 ZK Research Network Purchase Intention Study, 62% of respondents would use a fabric to support the company's SDN strategy. Additionally, a fabric can be used to implement an NFV strategy to enable the rapid provisioning of network resources such as routing and security.

Exhibit 3: The Network Fabric Connects Virtual Resources



Source: ZK Research, 2014

In addition to the above benefits, a fabric can significantly reduce both hardware costs and operational expenses. Because all of the ports in a fabric are always active, network managers do not have to overbuild the network. This means fewer devices are required, which lowers the amount of physical hardware required. Additionally, fabrics bring a high level of automation to the network. More automation means simplified management for the operations team. The lower hardware and operational costs can cut the total cost of running a data center by as much as 30% in the first five years.

Section IV: Conclusion and Recommendations

The era of the virtual data center is here. A virtualized data center brings with it many benefits because it can lower the overall cost of computing while allowing workers access to important resources faster than ever before. Historically, much of virtualization's focus has been on re-architecting the server and application layers, and the network must go through a similar transformation. A network fabric is a key requirement for companies to meet the short- and long-term challenges involved in implementing a next-generation data center. To help with this transition, ZK Research recommends the following:

- **Consider the network a strategic asset.** Historically, the network has been considered plumbing and has not been assigned the same level of importance as compute or storage technology. The ultimate success of an organization's data center strategy will be based on the network's ability to facilitate the transition to a virtual data center. Companies that treat the network as a strategic differentiator will gain an advantage over the competition.
- **Measure possible solution providers on criteria unique to the needs of a virtual data center.** Network evaluation criteria should be based on metrics such as the end-to-end latency of virtual workload migration, the total number of active ports in a network, the ability to carry converged storage traffic, and the cost and complexity of scaling up the network. An easy decision is to stay with the incumbent vendor—but that may be the wrong choice as the data center continues to evolve.
- **Leverage the fabric for both SDNs and NFV.** The network fabric should be thought of as the first step toward building an agile, flexible network that aligns with the future of computing and application development. IT leaders should deploy SDNs and NFV in conjunction with their fabric strategy. Network fabrics, SDNs and NFV should be thought of as strategic technologies, not tactical ones, with the next phase consisting of automating many current data center tasks by using orchestration software. For example, organizations can automate the movement of virtual workloads. This places new traffic demands on the network as the majority of traffic becomes east-west rather than north-south, which calls for simpler, more efficient networks.