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## WHITE PAPER

# Oracle Virtual Networking Delivering Fabric Virtualization and Software Defined Networks

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## IDC OPINION

Today's server virtualization and cloud initiatives are about increasing the agility of the IT infrastructure and reducing the time needed to provision and configure that infrastructure. While hypervisors enabled a virtual server to be provisioned almost instantaneously, provisioning the elements surrounding the virtual machine (VM), such as storage and networking, took longer and thus made the newly created VM nearly useless until the rest of the elements were attached. Fabric virtualization is a technology that can be used to more quickly provision and reconfigure I/O by virtualizing the elements for datacenter I/O. A physical server needs to be wired only once, and then software can provision and configure any type of connectivity (LAN, SAN, etc.) dynamically and on the fly. This type of abstraction brings many of the same consolidation and agility benefits that the industry saw with hypervisors to I/O and networking. "Software defining" various elements of the datacenter is a trend sweeping the industry as companies seek to become more agile with IT.

## IN THIS WHITE PAPER

This IDC White Paper takes a close look at fabric virtualization technology and profiles the Oracle Virtual Networking line of products.

## SITUATION OVERVIEW

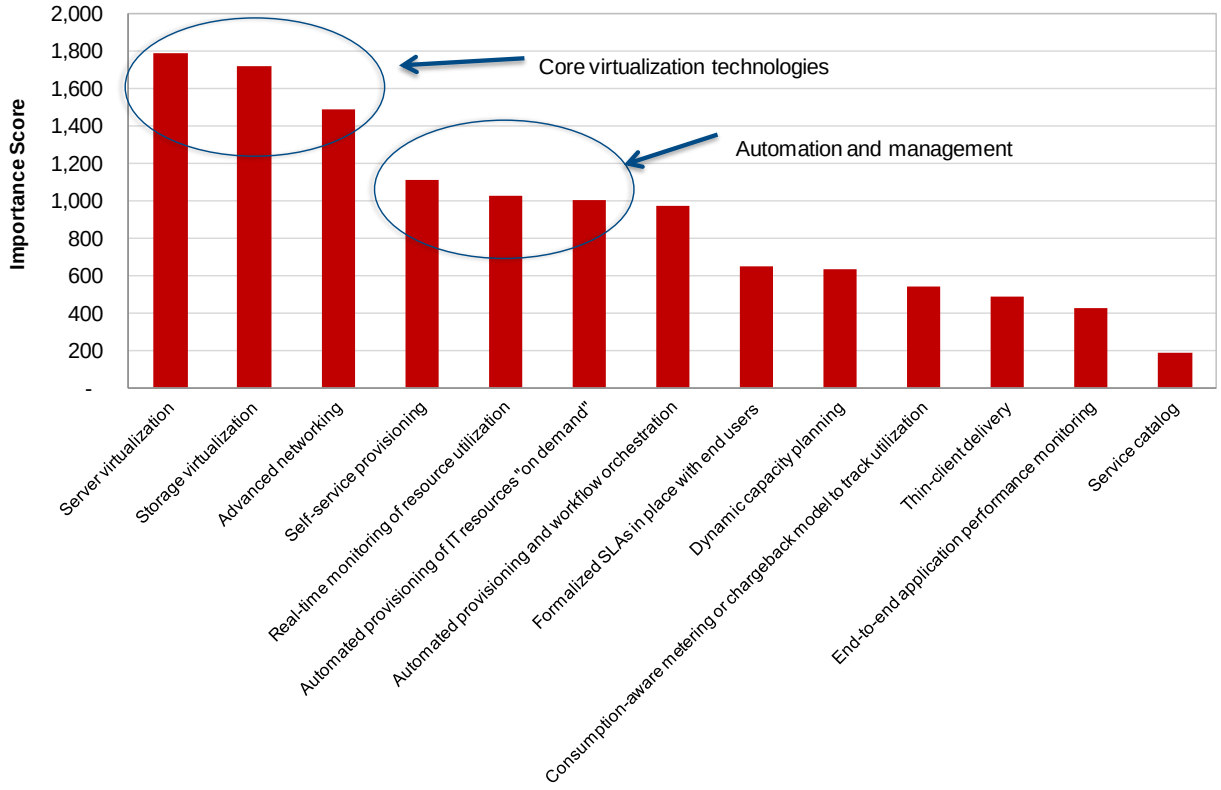
Virtualized servers are the default in today's datacenters, outshipping physical servers since 2009. According to IDC's server virtualization forecast, this year 73% of all new workloads deployed will be virtualized. By 2016, 78% of all new workloads deployed will be virtualized. While virtualization has been hugely successful by any measure, customers are still deploying bare metal workloads for a variety of reasons. For example, some workloads are CPU intensive or have high I/O rates that make them poor candidates for virtualization. While customers are virtualizing as much as they can over time, a mix of virtualized and bare metal workloads will have to be managed for quite some time.

Today, successful virtualization deployments require a holistic, end-to-end approach. Server virtualization is no longer just a server tool. It is the foundation for the entire datacenter and thus strongly influences nearly every aspect of the datacenter, such as storage, networking, and systems management. Virtualization's evolutionary impact on the datacenter is progressing naturally into private cloud. Data from IDC's 2012 *Cloud System Software Survey* (see Figure 1) shows that not just server

virtualization but also storage virtualization and networking virtualization are viewed as the core infrastructure for cloud. Just as server virtualization abstracted the software from the server hardware, virtualization across the datacenter essentially enables full datacenter agility for cloud. Agility is the key driver for private cloud. To achieve this goal of agility, the cloud must operate on demand, which means using software to define a workload, application, or VM. Hence, this model of an agile, cloud-enabled datacenter can be thought of as a "software defined" datacenter. In this approach, the entire object — including compute resources, storage, networking, security, and service level — is defined, implemented, and configured through software, which avoids the delays associated with making physical changes.

**FIGURE 1**

Essential Technologies for Private Cloud




n = 801

Source: IDC's *Cloud System Software Survey*, 2012

Some types of private cloud deployments can take advantage of cheaper hardware to maximize efficiency and lower costs. However, most customers are primarily looking to private clouds for the ability to effectively respond to rapidly changing business needs by developing new applications or provisioning new workloads with greater speed. While server virtualization is the foundation for private cloud, deployment architectures

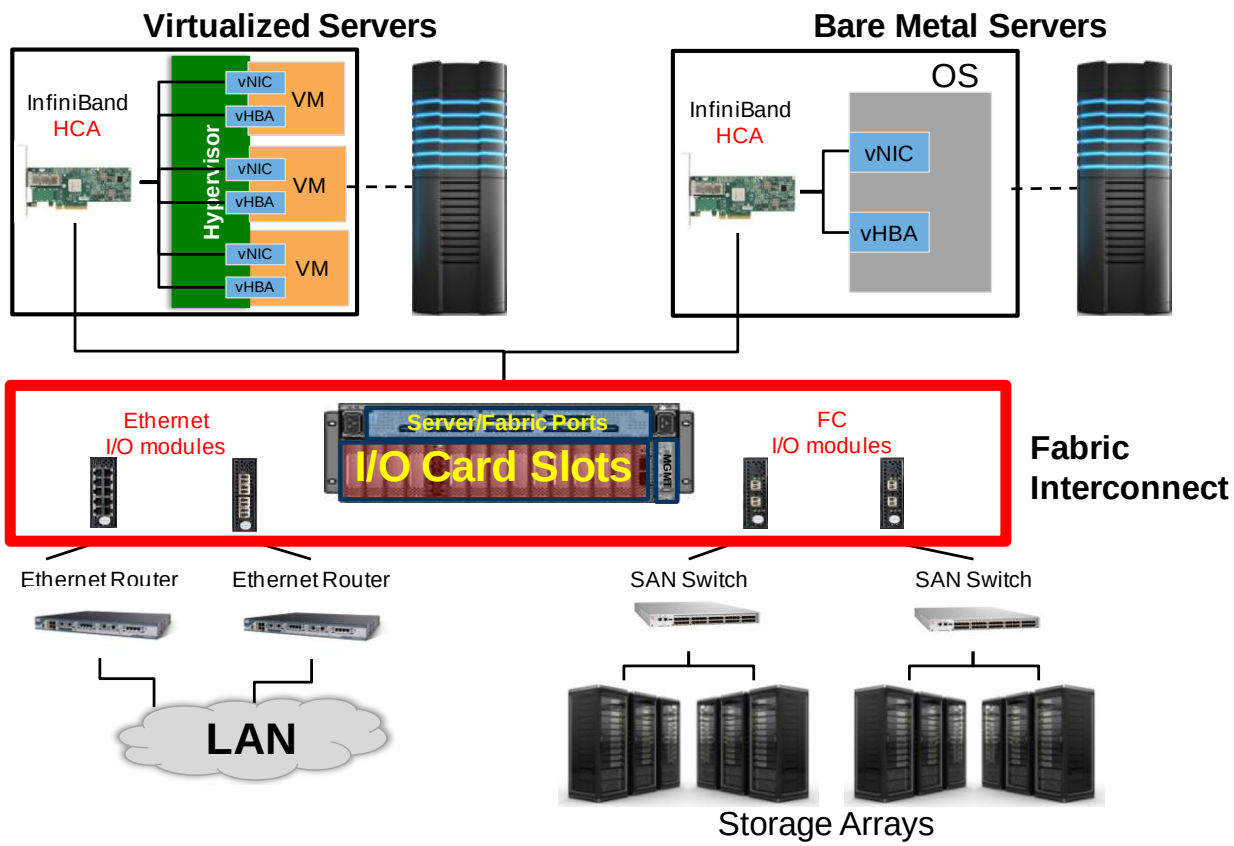
vary greatly. A private cloud can simply be an evolution of a server virtualization architecture with high compatibility for existing workloads, or it can be deployed in a more unique "greenfield" fashion with a native cloud design, tailored specifically toward new cloud-optimized applications.

## FABRIC VIRTUALIZATION

Fabric virtualization is a relatively new technology that significantly rearchitects datacenter I/O by using a centralized device, often called an I/O director/gateway or a fabric interconnect. The fabric interconnect contains the physical I/O adapters, such as Ethernet or Fibre Channel, for multiple servers. The physical servers themselves connect to the fabric interconnect through an intermediate high-speed network and present virtual adapters to the attached VMs or bare metal operating system (see Figure 2). Management software is used to provision, monitor, and adjust the I/O dynamically.

**FIGURE 2**

Fabric Virtualization Architecture




Source: IDC, 2013

Virtualizing I/O has many benefits — similar to the benefits associated with server virtualization — that span both capex and opex:

- **Physical I/O consolidation and simplification.**
  - **Fewer overall physical ports to manage.** Consolidation and sharing of physical adapters increase utilization.
  - **Less cabling.** Besides requiring less physical cable, consolidation allows customers to wire up the I/O director only once while serving multiple servers.
  - **Power savings.** Consolidation of ports/NICs reduces the electrical power needed. While not as dramatic as the savings from consolidating physical servers, the savings from consolidating ports/NICs can still be significant when added up over multiple racks. Additional power savings can be gained if the intermediate fabric is more power efficient.
- **Dynamic I/O management.** Separating the logical I/O architecture from the physical I/O architecture allows management software to dynamically connect and provision I/O for faster deployment of servers. I/O can also be reconfigured on the fly, which is useful in today's virtualized and cloud world where VMs can be live migrated and or dynamically reconfigured at a moment's notice. Dynamic I/O management can also make failover scenarios easier to handle because the I/O can be dynamically rerouted with software.
- **Ability to migrate between I/O technologies and add new I/O technologies with less disruption.** The physical networks and storage are abstracted from the attached servers, which allows more flexibility in adopting networking or storage technologies. The underlying networking or storage technologies can be upgraded or new technologies can be implemented while remaining relatively transparent to attached servers and VMs.
- **Increased performance.** The high-speed local fabric is generally faster than traditional Ethernet or SAN networking, boosting overall bandwidth available to the server or VMs and increasing the networking speed between nodes on the local fabric. These capabilities are ideal for new trends such as scaling cloud deployments, big data workloads, and converged infrastructure. For example, a live VM migration is a common event in today's virtualized infrastructure, and the migration can be done much faster over the local high-speed fabric than on standard Ethernet.
- **Network isolation.** VLANs have traditionally been used by enterprises for network isolation, but VLANs don't scale well for clouds. Fabric virtualization offers another useful tool for network isolation because it can create private networks on its managed fabric. Secure multitenancy is a major requirement for cloud, even in private deployments within a single enterprise.

- **Ability to adapt to a dynamic, on-demand cloud model.**
  - Provision, migrate, reconfigure on demand, in software, without waiting for physical changes to be implemented
  - Enable automation and policy-based management of networks and storage
  - QoS capabilities that enable SLA management of cloud services

## ORACLE PROFILE

The Oracle Virtual Networking product line, which is based on technology that Oracle acquired in its purchase of Xsigo Systems last year, consists of a hardware fabric interconnect as well as several supporting software components.

Oracle Fabric Interconnect is the physical hardware device that virtualizes the I/O and fabric. It connects servers to Ethernet networks and storage (FC, iSCSI, NAS) through high-speed, low-latency InfiniBand that runs at 40Gbps per line, with 80Gbps for dual redundant lines. Dynamic virtual NICs and HBAs allow the connected servers to dynamically add or move connectivity, such as with a newly provisioned VM or a live migrated VM. Oracle Fabric Interconnect also includes QoS controls to manage SLAs. It supports a wide variety of hypervisors and operating systems, including Oracle Linux, Red Hat Linux, Oracle Solaris, VMware ESXi, Microsoft Hyper-V and Windows Server, Oracle VM, and Red Hat KVM. A configuration with eight Oracle Fabric Interconnects can support up to 1,000 connected physical servers. According to Oracle data, fabric virtualization can help organizations realize the following benefits:

- Reduce LAN and SAN capital expenditures by 50%
- Reduce infrastructure complexity by 70%
- Accelerate virtual machine live migration time by 19x
- Provision new services and reconfigure resources in minutes instead of days
- Improve application performance by 4x

Oracle Fabric Manager is the software component that manages the I/O connectivity and the local InfiniBand fabric. It manages the provisioning and configuration of the I/O for all connected servers. The inclusion of a VMware plug-in allows configuration of VMware networking through the Fabric Manager UI. Oracle Fabric Manager also features a RESTful API for integration, custom development, and automation.

Oracle Fabric Monitor is a plug-in for Oracle Fabric Manager that monitors and aggregates performance data. Since the Oracle Virtual Networking system encompasses many physical and virtual networking components, including NICs (real and virtual), ports, switches, etc., it can easily collect and analyze data to assist network administrators.

Oracle SDN (Software Defined Networking) is a driver that allows the creation of Layer 2 Ethernet networks overlaid on the local InfiniBand fabric. Today, many think of SDN in terms of technologies such as OpenFlow that work at the network core level, but SDN is a much broader initiative that spans all levels of the network. Oracle SDN provides SDN functionality for east-west traffic that occurs between servers connected to the Fabric Interconnect and is transparent to applications. East-west traffic is a significant portion of datacenter traffic and a majority of the traffic in many deployments. Running at speeds of 40Gbps per link, Oracle SDN supports the creation of up to 16,000 private Layer 2 Ethernet networks.

Oracle envisions an open datacenter fabric that spans all environments and provides the automated, policy-based management of I/O that is critical for today's dynamic datacenters and clouds. Oracle's road map includes:

- Continuing support for the entire datacenter — virtualized and bare metal servers, x86 and SPARC, multiple hypervisors, multiple operating systems, both Oracle and non-Oracle environments
- Integration and synergy with engineered systems that are already using InfiniBand
- Convergence of the fabric management into Ops Center and then eventually into Oracle Enterprise Manager
- Exposure of I/O capabilities to applications to allow them to change or configure the fabric based on needs

## CHALLENGES/OPPORTUNITIES

### Challenges

- **InfiniBand adoption.** Although InfiniBand is an established technology, it isn't as widespread as other networking technologies and thus will be new to many customers. InfiniBand offers greater performance and consumes less power than other networking technologies, but cost and lack of familiarity may be obstacles. However, several vendors in the market are using InfiniBand for solutions, finding use cases for the technology. The Oracle Virtual Networking solution is architected in a way that shields most of the details of InfiniBand from the user, making it less intimidating to customers.
- **Rearchitecting I/O.** Rearchitecting anything in IT is disruptive in a design sense, and implementation involves significant pain or effort on the part of customers. Network and storage I/O is a critical component for servers. If the connectivity goes down, the servers are essentially useless. Further, consolidating I/O makes the fabric interconnect extremely mission critical because it affects multiple servers. Putting critical infrastructure in the hands of a new technology and architecture will require that Oracle demonstrate the benefits and reliability of the technology. Implementing new technology also requires companies to balance the risks and rewards. The long-term benefits of dynamic network connectivity and reconfiguration have high synergy with current industry initiatives around more agile computing and cloud.

- **Non-Oracle support.** Oracle has stated that its vision is of an open fabric that will span Oracle and non-Oracle environments. No matter what Oracle does, some customers will be wary of vendors playing nice with other vendors, having been caught in the middle in the past. In addition, Oracle Virtual Networking will have to integrate with the rest of the network, which isn't designed and controlled by Oracle, creating potential competitive conflicts. Fabric virtualization and SDN are disruptive technologies and threaten some of the established ecosystem.

### Opportunities

- **Cloud.** The explosion of cloud technologies, both public and private, is driving key infrastructure changes. Virtualization is spreading well beyond servers, and automation remains a key focus in the market. The ability to virtualize and automate I/O fits in well with these trends, and IT organizations deploying cloud will likely find interest in I/O virtualization solutions.

- **SDN.** Software defined networking is transforming the network industry. While initially driven by OpenFlow and technologies applied to the network core, SDN has spread to the rest of the network. Networking technologies in hypervisors and operating systems are transforming these layers of the stack, and similar new frameworks are being established in cloud system software platforms such as OpenStack. In the end, I/O virtualization and virtual networking technologies such as Oracle Virtual Networking will have many synergies with emerging SDN initiatives.

## CONCLUSION

Fabric virtualization is a technology that can be one piece of the larger puzzle of the software defined datacenter. Whether VMs are provisioned in a traditional manner largely under administrative control or fully automated through Web portals in a private cloud, virtualization must be viewed through the lens of the entire stack and across all the resources in the datacenter, not just compute resources. The Oracle Virtual Networking line of products offers an implementation of fabric virtualization that is worthy of consideration for any enterprise looking to address its I/O and connectivity issues.