CIENA CLOUD NETWORKING: DATA CENTER WITHOUT WALLS

First in a four-part series of white papers

The expanded use of virtualization in enterprise data centers is redefining the economics of IT delivery. It is enabling the consolidation of physical resources and more automated instantiation of virtual resources to support application needs. Virtualization leads directly to IT-as-a-Service, which empowers enterprise IT consumers to create and modify IT resources and operating applications efficiently, at any time, according to their needs. The private cloud—where enterprise data center resource virtualization enables IT-as-a-Service—supports, in principle, any and all enterprise IT applications, irrespective of application design, computing or I/O intensity, or mission-criticality.

The notion of IT-as-a-Service opens up the prospect of IT delivery by service providers. Public cloud services are still at the early stages of what is widely expected to be a very significant revenue expansion over the next decade, creating a major new market opportunity for service providers. Still, many public cloud services today comprise either simple applications (Software-as-a-Service [SaaS]) or basic infrastructure services (computing or storage) that are little evolved from legacy hosting practices. They often do not share virtualized data center assets among customers for resource efficiency, and connection typically is Internet-based. Such services lend themselves well to applications that can leverage everyday IT resources and that do not require intensive communications between the hosted infrastructure and users, or between hosted and enterprise-resident infrastructure components. From an enterprise perspective, this limitation tends to restrict public cloud utility to selected applications such as Web hosting, information archiving, and development and testing. The broader range of operational IT applications remains out of reach of the public cloud.

The next phase of cloud development must bridge the public and private cloud paradigms. This connection is necessary to extend improvements in enterprise IT economics and for public cloud providers to capture more of the enterprise IT budget. The public cloud must become capable of supporting operational and mission-critical applications on virtualized infrastructure mirroring and connected to the enterprise private cloud. The next-generation cloud requires a new architecture: the Data Center Without Walls.

Private clouds are based on the success of virtualization. While virtualization and data center consolidation go hand in hand, many consolidated enterprise IT architectures continue to employ multiple data centers. This practice is driven primarily by information resiliency requirements, addressed through multi-site storage replication. An evolution from storage backup to distributed storage technologies is now adding

SERIES OVERVIEW

This paper is the first in a series describing Ciena's vision for the future of cloud networking, and the solutions that turn that vision into reality for both IT providers and IT users.

1. **Data Center Without Walls** - the combination of geographically distributed data centers able to function as an efficient shared resource pool to address any magnitude of workload demand from anywhere across that geography with assured service performance.
2. **Cloud Backbone Network** - an integral component of the Data Center Without Walls, leveraging high-capacity Ethernet service-oriented architectures between data centers to provide cost-effective scale and assured traffic performance.
3. **Performance-on-Demand** - true software-driven networking for the cloud, with automated resource orchestration and provisioning that yields reduced network capacity requirements, predictable service performance, and simpler operations.
4. **V-WAN Hypervisor -** Ciena's network virtualization and automation solution that delivers Performance-on-Demand by automating the allocation of shared network resources among data centers on behalf of cloud operations.

enhanced computing service availability and performance to the equation by supporting the migration, placement, and distribution of computing virtual machines across multiple sites. This same capability directly enables resource efficiency gains as computing machines can be situated in any data center, enabling the pool of virtualized assets to expand beyond the walls of any single data center. The physical walls of individual data centers effectively are broken down to create a virtual data center encompassing multiple physical ones—a Data Center Without Walls.

Cloud service providers also will tend toward operating multi-data center architectures. As with private clouds, this tendency will be driven initially by a requirement to support high levels of information availability, requiring storage replication between provider data centers. Furthermore, since public clouds will support customers at many different locations, provider architectures are more useful when their data centers are situated in multiple regions, better assuring consistently high application performance through user-to-data center proximity. With active-active storage distribution, fluid workload mobility becomes possible among the set of provider data centers, within distance limits defined by the latency tolerances of processes and applications. Such mobility directly delivers enhanced computing service availability. By allowing for a significant degree of effective asset pooling among data centers, workload mobility allows up to 35 percent reduction in total data center resource needs. As such a reduction saves data center capital and operating costs—like real estate, power, cooling, maintenance and administration overhead—it yields a significant total service operating cost advantage for the provider.

Finally, the seamless connection of private and public clouds, required broadly to support operational enterprise IT in the cloud, takes the Data Center Without Walls across the enterprise-provider data center boundary. Referred to by the industry as the hybrid cloud, this connection enables the enterprise data center infrastructure effectively to be extended on demand into the provider cloud, such that the provider data center resources supporting any particular application may be "dialed" from zero to 100 percent of the total. In particular, this allows for enterprise-owned data center infrastructure to be right-sized to support long-term average or minimum workloads, with periodic excursions above these levels supported through on-demand addition of resources from the provider cloud, improving overall IT delivery economics.

The evolution of the cloud toward expanded enterprise IT utility is thus seen to drive the creation of a true Data Center Without Walls, comprising multiple provider and enterprise customer data centers, among which "north-south" (user-to-machine) and particularly "east-west" (machine-to-machine, storage-to-storage, machine-to-storage) traffic is generated and flows. Therefore, a cloud backbone network interconnecting data centers is an integral component of the Data Center Without Walls.

East-west traffic may scale to large volumes and, in general, is sensitive to network latency and connection quality. Maintaining cloud service performance at consistently high levels requires that east-west inter-data center traffic be carried on network services that both minimize latency and reduce random or bursty frame losses to very low levels. In some cases, such as block storage traffic, the frame losses must be strictly zero. These performance requirements have implications for both the nature and the operational implementation of cloud backbone networks. Ethernet service architectures

Key Takeaways

- **Challenge** - Today, the utility of public cloud computing remains largely restricted to hosted applications or simple infrastructure services. Next-generation cloud requires a new architecture, able to support a much broader range of operational and mission-critical applications through greater assured service performance and resiliency.
- **Ciena Solution** - The evolution of cloud toward expanded enterprise IT utility drives the creation of a virtualized architecture Ciena calls a "Data Center Without Walls". This is the combination of geographically distributed data centers able to function as one large pool to address any magnitude of workload demand from anywhere across that geography—providing money-saving efficiency and supporting assured service performance.
- **Benefits** - The Data Center Without Walls allows for effective asset pooling among provider data centers, delivering up to 35% reduction in total data center resource requirements over isolated provider data center architectures, while enhancing service resiliency and performance capabilities. It also creates a true hybrid cloud service architecture, delivering improvements in enterprise IT economics and enabling public cloud providers to capture more of the enterprise IT budget.

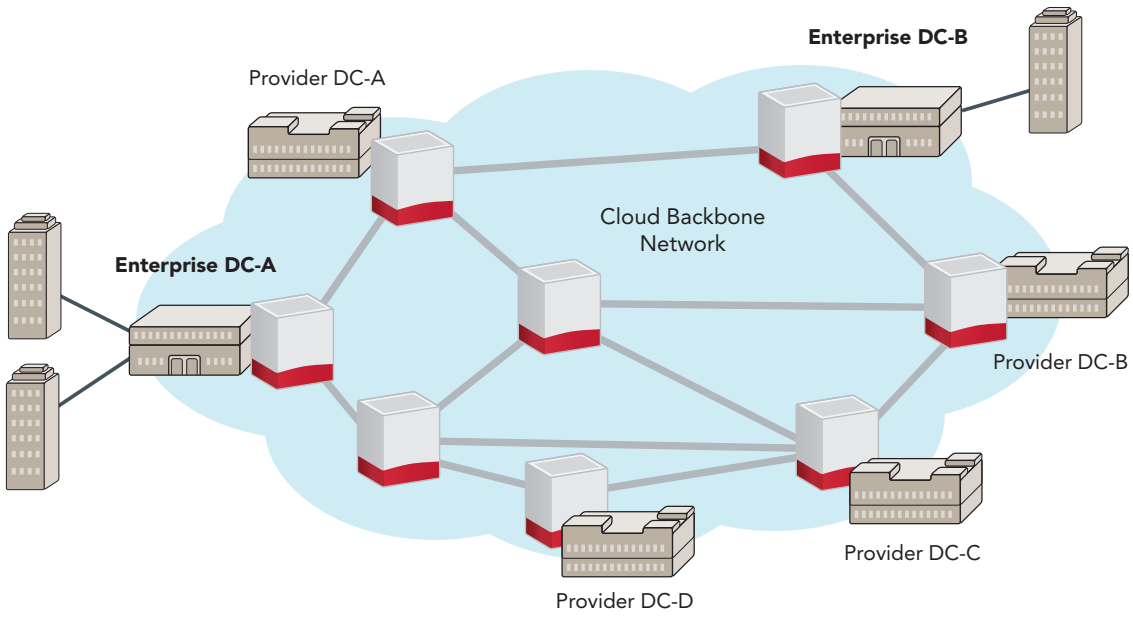

Figure 1. Cloud backbone network interconnecting data centers in a Data Center Without Walls

are ideally suited to the operational requirements of the cloud backbone, and, in particular, Ethernet-over-OTN implementations provide for strictly minimized connection latencies and zero on-the-wire frame losses. Carrier Ethernet or Ethernet-over-MPLS implementations also can deliver consistently low connection latencies and consistently high connection qualities, provided appropriate operational design and implementation practices are followed. In both cases, network equipment costs and overall network designs support cost-effective network scaling.

Ciena's networking toolkit offers the optimum cost-at-scale and assured service performance for the Data Center Without Walls backbone. It is also the ideal network architecture paradigm to support the Performance-on-Demand operational capabilities that will become increasingly important as on-demand, enterprise-class customer applications scale in volume in the cloud, and as policy-driven, automated service and resource optimization practices proliferate. Ciena leads the industry in the creation of the network operations software needed to support powerful Performance-on-Demand capabilities in the emerging carrier-scale cloud, in close alignment with the industry trend toward software-defined networking. Performance-on-Demand is a key pillar of Ciena's network solution for the Data Center Without Walls.

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