Network Attached Storage over Optical Ethernet
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Executive Summary

The fundamental challenge for businesses today is to extract maximum value from all information assets in an environment where the amount of new information is doubling each year (UC Berkeley study, 2000). In the 1980s, process re-engineering and desktop computing led to impressive productivity gains. In the 1990s, the emergence of local area networks (LANs) improved communication and information access across the enterprise and provided the ability to collaborate, spurring further productivity gains. In this decade, productivity will be further driven by the quality and reach of collaborative activities.

In an increasingly competitive and complex environment, businesses recognize that to stay ahead of their competition, they need to leverage information more effectively, both across the enterprise and with key business partners. More effective collaboration is crucial for long-term success.

Collaborative development recognizes that information becomes more valuable as the number of people who have access to it increases. Network Attached Storage (NAS) offers the best storage solution for providing access to a company’s information through high-performance file sharing and content delivery. However, the effectiveness of enterprise file sharing is only as good as the performance and bandwidth of the network that transports the files — even when using the best NAS solution.

In order to extend the collaborative benefit of NAS beyond the enterprise LAN, network limitations such as slow data rates, access bottlenecks, network management complexity, and high costs must be removed. In a traditional network, effectiveness is diminished once the LAN is required to interface with the MAN (metro area network) and the WAN (wide area network). Access to MAN/WAN is both expensive and bandwidth-constrained, inhibiting the feasibility of real-time file sharing over extended distance. As a result, enterprises have had to either forego the benefit of multi-site collaboration, or pay dearly for it.

But now there is a network solution that can help overcome these limitations — Optical Ethernet (OE.) OE is simple, fast, and reliable. Optical Ethernet enables MAN/WAN communications using the ubiquitous Ethernet packet format and Ethernet equipment. The technology can run over different optical circuits — un-modulated fiber, dense wavelength division multiplexing (DWDM), and Synchronous Optical Network (SONET). OE supports speeds ranging from 1 Mbps up to 10Gbps. OE delivers an order of magnitude more bandwidth at a fraction of today’s access and wide area costs, while providing the predictable performance required to link all of an organization’s many clients, servers, storage systems, and locations into one seamless, centrally managed information infrastructure.

The next wave of productivity gains will be driven by multi-site collaboration and multi-site infrastructure consolidation across metro, regional, and national distances, and will be enabled by combining NAS with an OE network.

Driving the Next Productivity Wave with a NAS over OE Solution

The amount of digitized information created in the United States is growing exponentially, estimated by some to be over 100 percent per year, and driven in large part by the proliferation of digitized rich media, the accelerating use of the Internet for new services, and the success of collaborative product commerce.
Collaboration Enhances Overall Business Performance

Enterprises recognize that data, as intellectual property, is one of a corporation’s most valuable assets. Data becomes even more valuable as a result of collaboration, which improves productivity and the bottom line. Examples include opportunities to generate additional revenue from being first to market with a new product or service, improve customer satisfaction and loyalty by providing customer information throughout the enterprise, or by the impact of a well-timed advertising campaign. Productivity gains driven by collaborative engineering and design, collaborative processes to support customer relationship management (CRM), and supply chain management (SCM) lead to cost savings and revenue enhancement that increase shareholder value. In all cases, effectively leveraging a corporation’s intellectual property, both within an enterprise and with partners, improves overall business performance.

In addition to protecting internal information assets, some corporations and service providers are building lines of business that rely on the IT infrastructure to deliver information to customers — services such as e-learning and content delivery, or vertical applications such as hosted financial services.

The acceleration in information creation drives the need for more bandwidth to transport data across the WAN to other enterprise, customer, or supplier locations. Growth for both storage and network bandwidth capacity is currently doubling every 12 months. As bandwidth needs increase, service options spanning DS1-3 to OC-192, and FICON to Fibre Channel are multiplying, creating new layers of complexity and accelerating the cost associated with WAN communication.

In order to address these challenges, corporations must eliminate the barriers to information access and flow throughout the enterprise, regardless of location, and create an information infrastructure that will support rapidly changing business demands.

Consolidation Lowers the Cost of Doing Business and Improves IT Productivity

The increasing demand for information storage and bandwidth is driving the growth of the IT budget. Today’s typical storage solutions are networked through bus-based SCSI interfaces directly to application servers. In a distributed infrastructure model (individual sites with their own infrastructure), as storage needs grow, hardware will continue to proliferate along with associated operational and management tasks of software installation and upgrades, system configuration, maintenance, troubleshooting, volume/file system reconfiguration, and backup and restore. Each corporate site must employ expert staff to perform these tasks, which is very expensive and can cost many times more than the initial acquisition costs. “Islands of information” create budget and expense growth that offer little opportunity for the efficiencies that can be created by economies of scale, and greatly complicate the ability to efficiently share information across the enterprise.

Sometimes, although individual sites within the enterprise have their own storage systems, the corporate IT organization is expected to execute the requisite management tasks. As a result, IT organizations are faced with an environment of multi-vendor equipment — some of which they may not be able to support — that makes it exceedingly difficult to manage, protect, and share information, and seriously undermines the enterprise’s capability to increase the value of their information assets.

To meet the challenges of maximizing efficiency and controlling the IT budget, corporations must simplify and automate storage management while simultaneously simplifying the network and enhancing its performance. Corporations around the world are meeting these goals by putting information at the center of the IT infrastructure. By implementing enterprise storage networks that are comprised of storage area networks (SAN) and network attached storage (NAS) across distance, corporations have the power to reduce cost through hardware consolidation and simplified management and administration. EMC and Nortel Networks have the expertise and product breadth to offer a complete solution that enables those efficiencies to be realized.
The Advantage of Optical Ethernet from Nortel Networks

To understand how Optical Ethernet can help solve the problem of real time information management, the issues that plague current solutions must be fully understood.

The inhibitor to mass deployment of new high-speed services, such as NAS, required by enterprises is within the metropolitan area. Typically, enterprises deploy leased lines (either T1 lines at 1.5 Mbps or sometimes T3 lines at 45 Mbps) for wide area connectivity. These slow-speed last-mile connections keep enterprise gigabit LANs and terabit-capable long-haul networks apart, preventing the implementation of new applications and the financial benefits they have the potential to deliver. Additionally, legacy technologies are complex and expensive to implement. In the United States, it can take from three to six months for a new service to be turned up. This lengthy delay in service delivery results in negative impact on productivity for enterprises.

To date, the primary method of solving this speed mismatch has been through the use of an overlay router network. Routers were designed with the traditional T1/T3 infrastructure in mind, to manage data rate and protocol mismatches. Operating in a store and forward manner, routers buffer and stream out data across the network, holding packets and distributing them over bandwidth-constrained points in the network. The traffic, which is now mostly Ethernet (representing 97 percent of total enterprise traffic) must be converted to PPP, Frame Relay, or ATM, and converted once again to TDM or SONET for transmission across a service provider’s backbone network, with the process reversing itself at the other end. A result of this speed and protocol transformation work is the introduction of additional latency and variable transit delay (i.e., jitter) at each hop in the network. The viability of realtime applications like remote mirroring, disaster recovery, distance learning, NAS-enabled collaboration, and content distribution is severely limited by this level of delay and potential data loss.

Optical Ethernet is Nortel Networks’ solution to the metro bottleneck and the latency and jitter issues introduced by traditional multi-protocol router-based WAN. Optical Ethernet combines the simplicity of today’s Ethernet with the power of fiber-optics to provide fast, simple, and reliable networks that are capable of supporting the bandwidth-intensive needs of leading enterprises.

- **Fast**: Optical Ethernet provides an order of magnitude greater bandwidth at lower costs, with speeds up to 10 Gbps. Just as important, it delivers lower latency, lower jitter and higher utilization rates than other WAN technologies. This means that it can be used to do new things, such as centralize NAS servers and applications, which will reduce costs and provide increased productivity. Optical Ethernet also offers faster provisioning through soft bandwidth control. If an OE service of 5 Mbps needs to be increased to 15 Mbps, the provisioning is easy and the upgrade can be implemented in a matter of minutes, not months.

- **Simple**: Optical Ethernet enables a much simpler network. With Ethernet in the LAN and WAN, there is no need to deal with speed or protocol transformations between Ethernet and WAN protocols like ATM or Frame Relay. Ethernet traffic remains Ethernet end-to-end. This removes a great deal of complexity in the edge equipment needed and eliminates the provisioning of WAN protocols. Optical Ethernet automatically finds other end nodes; there are no complex “virtual circuits” to configure and manage. No changes to enterprise addressing schemes are required, and there are no complex configurations to understand and manage, even with thousands of users. Common network management also enables ease of operation.

- **Reliable**: Optical Ethernet is reliable through inherent high availability features of optical systems such as failover of 50ms. It seamlessly connects LAN/MAN and WAN, eliminating the barriers and distinctions between them. Optical Ethernet leverages the dramatic cost reductions seen in both optical and Ethernet technologies to offer the lowest cost per bit per mile of any transport technology. It can deliver this lower network cost because Ethernet connections and network components replace individual access routers with a routing switch port. It is scalable with the reach of optics, making it suitable for metro network connections.

Optical Ethernet was designed to be reliable, fast, and simple for an enterprise or a carrier to implement, operate, upgrade, and maintain. Part of the reason for this requirement is the shortage of router expertise necessary to configure and support MAN access networks and the edges of the large WAN core router networks owned by
Network Attached Storage over Optical Ethernet

service providers. Enterprises and local governments, the early adopters of Optical Ethernet, have been able to implement networks themselves using leased fiber because of the ease and simplicity of implementation.

**Additional network improvements**

Solving network bandwidth and latency issues is only one step in the improvement of the network. Service providers that will provide Optical Ethernet services to enterprises also need carrier-grade reliability and performance. Outage-free service must be guaranteed for any type of traffic running over the network.

In addition, Optical Ethernet service can handle any type of traffic, including traditional best-effort data as well as high-priority realtime applications. Quality of Service (QoS) mechanisms can be enabled, if required, to ensure that mission-critical storage traffic receives preferential treatment over other network traffic.

All of this contributes to a profound impact on the enterprise network. Optical Ethernet enables enterprises to re-think their computing implementation models and move from highly distributed environments to more centralized models for applications like NAS, which dramatically reduces cost and increases productivity. Optical Ethernet enables enterprises to bring users to the (centralized) data, rather than bringing (distributed) data to the users. The result is that using an Optical Ethernet MAN will enable enterprises to cost-effectively support a wider range of networked applications, including NAS, based on a network with numerous advantages.

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**The Power of Network Attached Storage from EMC**

Information becomes more valuable as the number of people who access it increases. Network Attached Storage (NAS) increases the value of information by offering the best connectivity method for providing access to shared files via the IP network, to any authorized host. A NAS solution addresses the challenge of connecting a large volume of stored data to many servers and enables collaborative design, development, and production.

NAS separates storage processing from the general application processing requirements of the server to resolve the problem of having to constantly upgrade server hard drives to accommodate growing storage needs.

NAS file servers process only input/output (I/O) requests and support the popular file sharing protocols, taking advantage of the ubiquity of Ethernet and leveraging TCP/IP networking as the transport. In fact, NAS communicates across LINUX, UNIX and Windows-based systems simultaneously, using their native protocols, without incurring the extra overhead of emulation.

The protocol-independent functionality of NAS enables any user to access information, regardless of location, operating system or server vendor — using just one instance of storage. Whether the information is generated in UNIX or NT, it is stored in the same place. Authorized users can access the information simultaneously. Updates occur in real time, so document revision schemes and storage of duplicate versions are no longer required, allowing true collaboration.

EMC’s high-performance NAS solutions are comprised of one or more specialized file servers that are dedicated to, and optimized for, one task only: serving files to be shared among multiple servers employing different operating systems. EMC offers a full range of industry-leading enterprise storage solutions to meet these requirements. With its high-performance, high-availability, and scalability features, EMC’s NAS solutions deliver continuous and instant access across the organization to the data that is critical to business success.

The storage and server infrastructure consolidation that is enabled by an EMC solution offers IT organizations the opportunity to reduce the total cost to deliver information services to their business while providing improved manageability and service levels. This lowered total cost is accomplished by a reduction in:

- **Acquisition Costs:** By consolidating file services using NAS, organizations can eliminate the purchase of many servers and their associated disk arrays. Given the high growth rates of unstructured (file) data (100 percent per year, typically), even a modest-sized environment can grow large in a few years offering large potential cost savings by implementing a NAS approach.
EMC’s NAS over Nortel Networks OE Creates a New Paradigm

For enterprises that need to increase productivity through both more effective collaboration and infrastructure consolidation beyond the LAN, help is available now in the form of network attached storage over an Optical Ethernet network. This combination of technologies provides a breakthrough opportunity for businesses to maximize the value of their intellectual property, minimize costs, and realize an attractive return on investment.

In the illustration below, consolidating pools of information into centralized locations is desirable since it would enable cross-functional collaboration required between Research and Development, Manufacturing, and Product Marketing teams (intra and inter-enterprise) to bring enhancements and products to market faster. Effective collaboration helps deliver financial returns by leveraging information assets and work group resources to create sustainable productivity gains. Consolidation helps reduce costs by providing opportunities for significant capital and operational cost reductions and enhanced IT productivity. Networked storage across distance makes it all possible.
Historically, Extending NAS Consolidation Across Multiple Sites Has Not Been Easy.

In the traditional network, there are many barriers to achieving the goal of consolidating multi-site enterprise NAS into centralized automated storage centers:

- **High costs:** The bandwidth required to link users to NAS storage systems in a central data center over metro, regional, and long haul areas through traditional routed MAN/WAN technology solutions can be prohibitively expensive. Linking remote sites to centralized NAS storage devices can require a company to purchase an order of magnitude more bandwidth than currently needed. With conventional metro links, this can become a huge financial barrier. For example, a metro T3 (45Mbps) connection from a carrier can cost $5,000 per month for each point of access, representing a significant expense of $10,000 per month for a simple point-to-point connection, not to mention the additional distance-related charges.

- **Inflexibility:** Metro access bandwidth cannot be quickly scaled as storage needs rapidly expand. For example, provisioning an additional T1/T3 circuit typically takes 1-2 months (but could take up to 6 months) to obtain in major metro areas. This represents a major impediment to the successful deployment of networked storage because of the inability to rapidly increase bandwidth as application and storage demands escalate.

- **Complexity and High Latency:** Today’s metro and wide area high bandwidth network solutions are far too complex and introduce unacceptable transit delays and unpredictable response time performance. IP Routing and/or PPP/FR/ATM mandate a dramatic down-speeding across the WAN, and the costly protocol conversions from the enterprise LAN to the MAN/WAN introduce significant overhead processing, buffering and latency, resulting in unpredictable response times.

Optical Ethernet Overcomes Traditional Limitations to Enable the Next Productivity Wave

With OE, reliable, high-bandwidth access to MAN/WAN becomes possible, and multi-site networked storage can be consolidated, and appear to be on the LAN, even if physically located across a city, a region, or a country. With the speed of light as the primary latency factor, the consolidation of networked storage can proceed without limitations from the network. The NAS solution can be run effectively from centralized data centers, thereby removing additional overhead cost, simplifying operations, optimizing skilled resources, and maximizing the leverage of information assets. Enterprises can deploy the solution by leasing dark fiber, purchasing Optical Ethernet service from a carrier, or, in some cases, by outsourcing the entire solution to a service provider.

The earlier illustration of an enterprise with different functional areas in different locations would be improved as below.
EMC’s NAS solutions allow qualified users from any device, on any platform, from anywhere, to access the information they need with complete security. Storage consolidation helps IT organizations to decrease complexity, lower cost, reduce risk, and promote better utilization of information resources.

Nortel Networks’ Optical Ethernet solution provides a fast, simple and reliable network that offers high bandwidth and low latency in an easy-to-deploy package, enabling unparalleled collaboration through file sharing and content distribution, and infrastructure consolidation, over any distance.

This solution from Nortel Networks and EMC introduces an infrastructure that meets the needs of the extended enterprise now and in the future. It helps improve the top line, helps drive cost out of the business to improve the bottom line, and offers a higher quality of service to improve overall productivity.