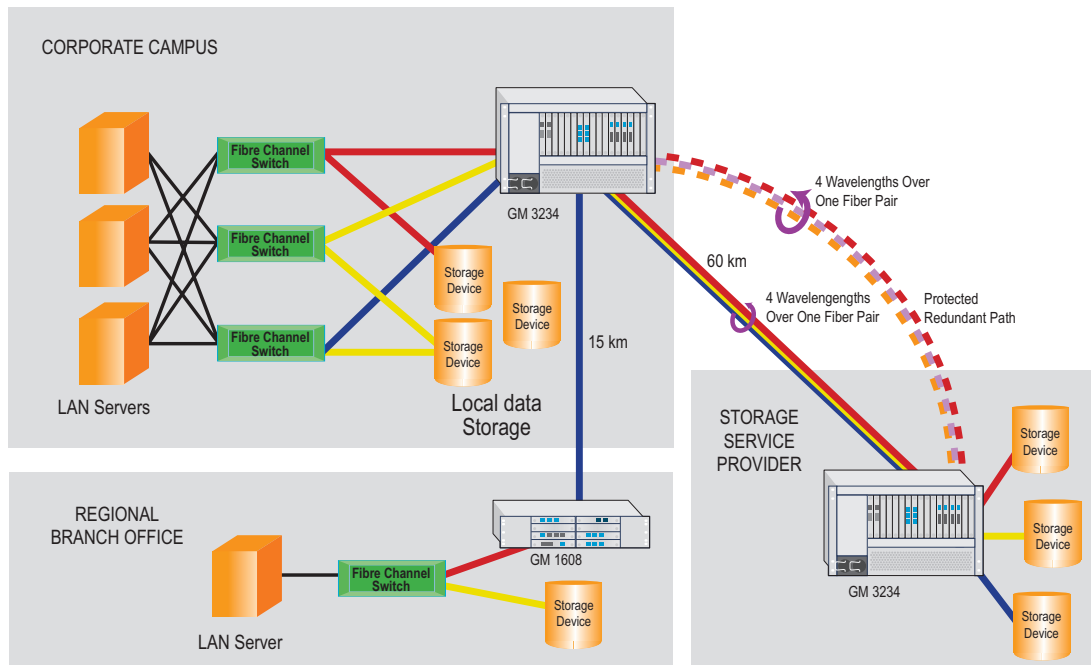


Storage Area Networks Application Note



✓ Key benefits of a SAN include the ability to:

- provide fast data storage and retrieval for multiple access points
- maintain data archives for disaster recovery
- create a safe physical distance for data warehousing

As the amount of data on enterprise networks proliferates, data warehousing and storage is becoming an increasingly important element of companies' information technology (IT) strategy. Traditionally, direct-attached storage was viewed as the systematic and reliable approach to the data storage and backup requirements of the enterprise. This approach brought along with it complex system management issues, high costs of ownership and lack of scalability - limitations that IT managers were forced to live with.

Given the complex demands of today's networking environments, the SCSI-based systems that have dominated storage networking for many years are becoming subject to serious limitations. High-speed Storage Area Networks (SANs) based on Fibre Channel protocol have emerged as a solution to the problem of interconnecting servers and storage at Gigabit speeds. By combining LAN architectural models with the design



concepts of server performance and mass storage, SANs eliminate the band-width bottlenecks and scalability limitations of SCSI-based architectures. By utilizing network servers, SANs allow a variety of storage devices (such as tape libraries and disk arrays) to be shared by all users. Storage Area Networks promise significant performance and administrative benefits over traditional LAN-based storage.

The key benefits of a SAN include the ability to provide fast data storage and retrieval for multiple access points, and the ability

to maintain data archives for disaster recovery. In many instances, the remote data storage site can be located some distance away from the end user, in order to take advantage of less expensive facilities or to create a safe physical distance for data warehousing. Successful implementation of these storage applications requires a high-bandwidth link between the storage server and the data storage devices, avoiding slow access and long data backup times, and extending the Fibre Channel link beyond the 10 km distances imposed by the protocol.

Case Study

A Fortune 100 company has three large buildings in a campus environment at one of its locations and a branch office 15 km away. The company wants to consolidate its data backup needs at a storage service provider 60 km away. Fibre Channel's normal reach is limited to 10 km, reducing the company's storage options and the security of its data in case of a catastrophic event.

Zhone's GigaMux™ provides the ideal solution for the requirements of remote storage facilities, supporting fast data transfer at native speed over the most widely used SAN protocols (see

Table 1 below). In addition, the GigaMux can extend the reach of these protocols over one thousand kilometers to maximize flexibility in choosing a data center location. By using a fiber link to transfer data across a Metropolitan Area Network (MAN), backup data traffic is accommodated, and the enterprise is assured of sufficient bandwidth to access data when needed. The GigaMux carries traffic using 1550nm region ITU wavelengths so that traffic can be overlaid onto existing network traffic (e.g., SONET ring), conserving fiber resources.

PROTOCOL	DATA RATES	APPLICATIONS
ESCON	17.5 Mbytes/s (200 Mbps)	Mainframe-to-peripheral connectivity applications, developed by IBM
Fibre Channel	100, 200 Mbytes/s (1.06, 2.12 Gbps) 4, 10 Gbps under consideration	Server-to-storage, server-to-server applications. Switching/routing features, service categories
FICON	100 Mbytes/s (1.0 Gbps)	Evolution of ESCON (by IBM), improved bit-rate, distance, etc. Fibre Channel interworking also
SCSI	160, 320, 640 Mbytes/s	Computer device interconnection standard, evolve to gigabit speeds, RAID interfacing
Infiniband	2.5 Gbps (2.0 Gbps data)	Defines processor nodes interconnection, switching capabilities, several service categories
Gigabit Ethernet	1.0, 10 Gbps available, 40 Gbps likely in the future	Native packet transport protocol, legacy SAN protocol tunneling

GigaMux technology also provides the scalability required to upgrade network capacity and interconnect SANs as network storage demands increase over time. The GigaMux can provide up to 64 Wave Division Multiplexed (WDM) channels over a single strand of fiber. In our example, four wavelengths would be multiplexed together; each wavelength corresponding to a

1.06 Gbps data connection from each SAN switch to the remote SSP site. Only two dark fibers (transmit/receive) are required to support the application - 1/4 of the amount of non-WDM solutions. As more capacity is needed, the Fortune 100 Company can simply add additional wavelengths. No further investment in the fiber cable plant is required.

Zhone GigaMux Native Transportation of SAN Protocols

Zhone's GigaMux suite of products enables service carriers to offer new classes of service—such as Storage Area Networking — in a transparent and native fashion, without the inefficiencies and expenses of protocol conversions. The GigaMux is a modular optical access platform consisting of a GM 3234 concentrator for service provider head ends, central offices (COs) or Points of Presence (POPs); a GM 3217 multi-port access multiplexer for

buildings serving multiple tenants or services; and a GM 1608 interface device for individual customer premises. The GigaMux functions as a network of optical modems, providing an “extension cord” that allows connectivity between business premises and carrier infrastructures at full LAN (or SAN) wire-speed. These products share common line cards and management capabilities to minimize both capital and operating expenses.

Other Benefits of the GigaMux

Scalability and Flexibility

Zhone's Optical Channel Module (OCM) is a single interface card that supports services for a number of standard protocols, including Gigabit Ethernet, Fibre Channel and ATM at OC-3/12/48 rates. Zhone also provides an interface card to integrate wire-speed Ethernet/Fast Ethernet service with multiple T1/E1 channels, enabling service providers to offer bundled voice and data services over an optical infrastructure.

NEBS Compliant

Zhone's GigaMux comply with GR-63-CORE Level 1 and Level 3. By meeting these stringent Telcordia standards, carriers and users are assured that Zhone equipment will provide safe and reliable carrier class operation under a wide range of environmental conditions.

Path Protection

Zhone's Optical Protection technology allows for the reliability and redundancy needed to ensure continuous operation. In the event of signal degradation, signal loss, or cable failure, the protection module automatically switches services to an alternate path within 25 milliseconds; well within the SONET/SDH standard of 50 milliseconds.

RUS Listed

Zhone's GigaMux products have been listed with the USDA's Rural Utility Service allowing rural telephone and utility companies to purchase and deploy Zhone's products with funds obtained through low-interest RUS loans.

Simple, Remote Service Provisioning and Management

Zhone's optical solution simplifies the tasks of network management, provisioning and performance monitoring by providing a set of tools specifically tailored to meet these needs.

In-Wavelength Management (IWM) eliminates the need for a management overlay network. With IWM technology, "in-wavelength" management signaling flows through all network elements, eliminating a separate physical management link and reducing costs and complexity.

ColorValve provides remote optical bandwidth provisioning. The carrier or the end-user can upgrade bandwidth temporarily or permanently, using Web-browser based point-and-click reconfiguration software. This feature can result in considerable cost reduction by eliminating expensive truck rolls and

physical site upgrades. **ColorValve** gives service providers an unmatched capability to respond quickly to customers changing requirements.

ColorSIM™ (Signal Integrity Monitoring) is a wrapperless and non-intrusive signal link integrity monitoring technique, that allows a carrier to monitor and deliver Service Level Agreement quality information. ColorSIM provides a cost-effective alternative to Digital Wrapper or SONET techniques.

These features are accessible via a browser-based GUI (**WavBrowser™**) or through a command-line interface (**WavCommand™**). Industry-standard SNMP MIBs allow standard network management and element management systems to query all network elements and to receive alarm information.

SAN Vendor Certification

Zhone has undergone rigorous formal testing and certification with the following key vendors.



▪ Fibre Channel switch leader



▪ Storage device leader



▪ Storage devices and integration



▪ Storage devices and integration leader



▪ Fibre Channel Director leader
▪ Recently acquired by CNT

Zhone's Enterprise Customers

Below is a representative list of enterprise customers who currently use Zhone's SAN solution.



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About Zhone Technologies, Inc. (Zhone)

Zhone Technologies, Inc. (NASDAQ: ZHNE) is the first company dedicated solely to delivering the full spectrum of next-generation local loop access equipment. Zhone's multi service products allow carriers to concurrently deliver voice, new premium data and video services over copper or fiber access lines. Zhone provides carriers with an elegant migration from legacy circuit-based technology to packet-based networks while substantially reducing operating costs. With deployments at over 250 carriers including among some of the world's largest networks, Zhone has enabled carriers to reinvent their businesses.

For more information about Zhone and its products, please visit the Zhone Web site at www.zhone.com or e-mail info@zhone.com

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