Compaq SANworks™

Application Note
Data Replication Manager Using Very Long Distance GBICs

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About This Document

This application note provides an overview of the Very Long Distance GBIC (Gigabit Interface Converter) that is available for the Data Replication Manager (DRM). DRM is a storage-based data replication and workload migration solution that copies data online and in real time to remote locations through an extended Storage Area Network (SAN). The Compaq SANworks Very Long Distance GBIC has not been qualified for configurations other than the Data Replication Manager.

For complete details on the DRM, refer to the *Compaq SANworks Data Replication Manager HSG80 ACS Version 8.5P Operations Guide* for your operating system.

This application note contains the following sections:

- Overview
- Data Replication Manager
- Performance Considerations
- Power Budget
- Examples of Fiber Link Budgets
- Ordering Compaq SANworks Very Long Distance GBICs
- Laser Safety Compliance
- Website

Overview

The Compaq SANworks Very Long Distance GBIC is a serial-electrical-to-serial-optical transceiver module, which operates at 1062.5 megabits per second. It provides optical link lengths for ANSI X3T11.2 Fibre Channel applications between 10 and 100 kilometers, depending on dB loss in the link.

Figure 1 shows a typical DRM configuration using the Compaq SANworks Very Long Distance GBIC 9-micron single-mode fiber with SC connectors.

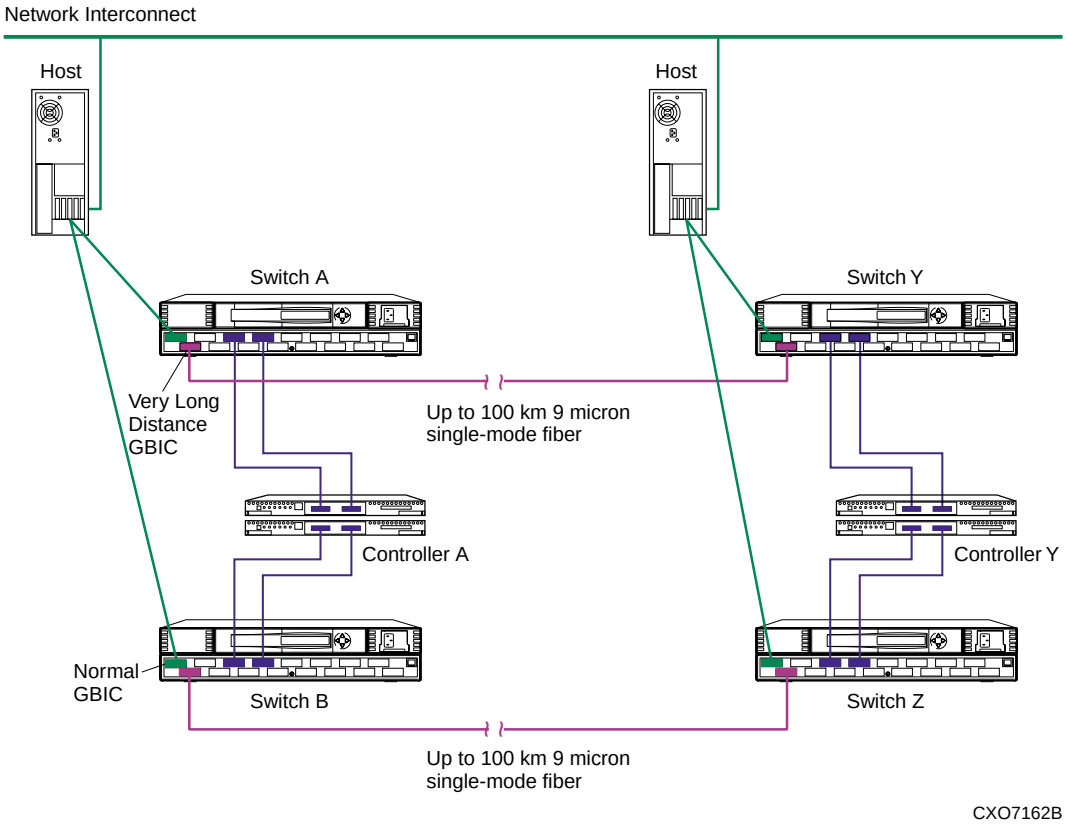

Figure 1. Data Replication Manager using Very Long Distance GBICs

Data Replication Manager

During normal data processing, data is simultaneously written to initiator (local) and target (remote) sites. While copies of data reside at both sites, host data access occurs through the initiator site, unless a failure or a catastrophic event disables processing at that site. In the event of an initiator failure, the target site can continue processing data in the interim.

The DRM provides rapid data access recovery and continued data processing after the loss of one or more components. The DRM uses the peer-to-peer remote copy function of the HSG80 controller to achieve data replication. HSG80 controller pairs at the initiator site are connected to their partner HSG80 controller pairs at the target site.

The DRM can replicate data at distances up to 100 kilometers (approximately 60 miles) through an extended Storage Area Network over direct Fibre Channel links that operate at 10 to 100 megabytes per second, depending on distance.

Very Long Distance GBIC Product Features

The following features are supported:

- Fibre Channel at 1062.5 megabits per second
- Distances of 10 to 100 kilometers over 9-micron, single-mode fiber-optic cable
- 1550-nm center optical wavelength
- Integration of a distributed feedback (DFB) laser
- Serial ID functionality
- Low power consumption (800 mW typical)
- Duplex SC optical port
- Hot-pluggability

Performance Considerations

Fibre Channel has a credit-based flow control. The Compaq SANworks Very Long Distance GBIC extends the distance between the Fibre Channel switch E_ports. The credit given on the E_port is eight buffer-to-buffer (bb) credits. Currently, eight buffer-to-buffer credits are the maximum number assigned. Efforts are underway to improve throughput at long distance.

Figure 2 shows that with eight buffer-to-buffer credits, the throughput diminishes with increased distance.

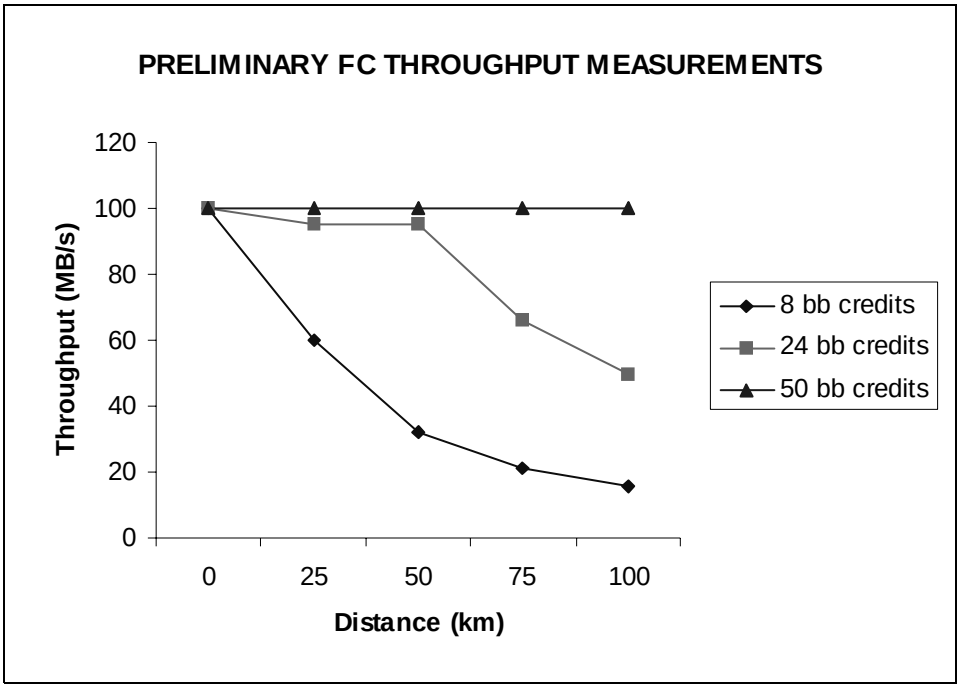

Figure 2. Credit-based flow control

Power Budget

The link power budget is the power available to transmit light over the link. The power budget of the Compaq SANworks Very Long Distance GBIC is 21.5 dB, minimum.

The following should be considered when calculating link distances:

- Power budget
- Connections
- Splices
- Fiber attenuation

Figure 3 shows typical mean loss in dB for connectors, mechanical splices, and fusion splices.

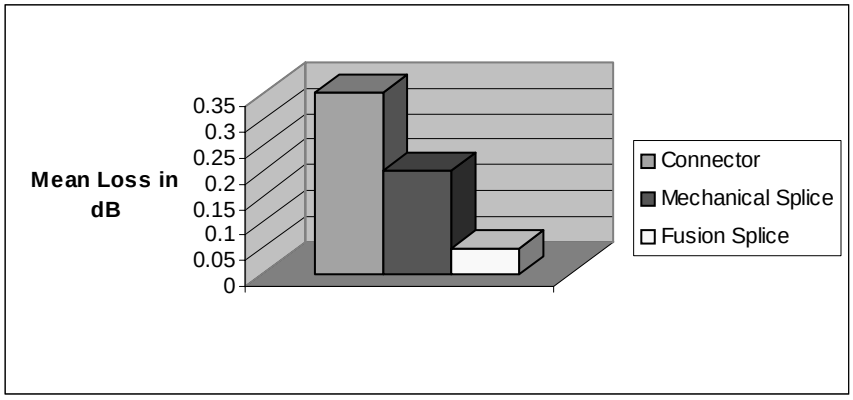

Figure 3. Typical attenuation (mean loss) in dB

The single-mode fiber attenuation in Table 1 shows typical losses for cables and patches.

Table 1 Single-Mode Fiber Attenuation

Description	Attenuation
Patch cords	0.20 - 0.22 (dB per km)
Indoor cables	0.23 - 0.27 (dB per km)
Outdoor cables	0.22 - 0.26 (dB per km)
Main trunk (duct)	0.21 - 0.25 (dB per km)
Aged fiber (estimate)	0.30 (dB per km)
Connector	0.30 dB
Mechanical splice	0.15 dB
Fusion splice	0.05 dB

Examples of Fiber Link Budgets

The following two examples demonstrate how to calculate the link power budget for the Compaq SANworks Very Long Distance GBICs. The first example demonstrates a workable fiber line; the second describes a fiber link that will not work.

Link power used for calculations has a minimum value of 21.5 dB. Calculations are performed for one direction in a bidirectional link.

Example 1

Company A wants to set up a 70 kilometer link from their local data center to a remote site. Their link power budget is 21.5 dB.

Their link will have the following parameters:

- A high-quality fiber with an attenuation of 0.21 dB per kilometer. This is equal to 0.21 dB x 70 km, or 14.7 dB of attenuation or signal loss.
- One fusion splice every 5 kilometers: 0.05 dB x 14 fusion splices is equal to 0.7 dB of attenuation.
- Six connectors at 0.3 dB of loss per connector: 0.3 dB x 6 connectors is equal to 1.8 dB of attenuation.
- One mechanical splice at 0.15 dB of attenuation.
- One 0.5 kilometer length of indoor cable at 0.23 dB of attenuation per kilometer. This is equal to 0.23 dB x 0.5 (half a kilometer), which is 0.115 dB of loss.

Summing up the total loss:

14.7 dB fiber attenuation

0.7 dB fusion splices

1.8 dB connector attenuation

0.15 dB mechanical splice

0.115 dB indoor cable loss

17.465 dB Total Loss

Total Link Power Budget minus Total Loss: 21.5 dB - 17.465 dB = 4.035 dB.

The margin of 4.035 dB indicates that this is a workable fiber link.

Example 2

Company B wants to set up a 70 kilometer link from their local data center to a remote site. Their link power budget is 21.5 dB.

Their link will have the following parameters:

- Average quality fiber with a 0.3 dB per kilometer attenuation rate: 0.3 dB x 70 km is equal to 21 dB of attenuation.

- One fusion splice every 5 kilometers: 0.05 dB x 14 fusion splices is equal to 0.7 dB of attenuation.
- Twenty connectors at 0.3 dB of loss per connector: 0.3 dB x 20 connectors is equal to 6.0 dB of attenuation.
- Five mechanical splices at 0.15 dB of attenuation per mechanical splice is equal to 0.75 dB of loss.
- Two 0.5 kilometer lengths of indoor cable at 0.23 dB of attenuation per kilometer. This is equal to 0.23 dB of attenuation loss.

Summing up the total loss;

21.0 dB of fiber attenuation

0.7 dB fusion splices

6.0 dB connector attenuation

0.75 dB mechanical splice

0.23 dB indoor cable loss

28.68 dB Total Loss

This total loss is greater than the 21.5 dB link power budget; the fiber link will not work.

For Company B to resolve this issue, it must reduce the number of connectors, change the mechanical splices to fusion splices, and invest in a higher quality fiber cable. Table 2 shows the implications of configuration elements.

Table 2 Configuration Restrictions and Recommendations

Restrictions and Recommendations	Implication
Use low-attenuation 9-micron fiber.	Best for long distances (preferably less than 0.3 dB per km).
Minimize connectors.	Connectors account for 0.3 dB, or greater, of signal loss.
Use fusion splices.	Minimizes attenuation.
For fibers, from any point of the optical link, minimum bending radius is 3.1 inch during installation and 2.0 inch long-term.	Exceeding the bend radius can result in fracture of the fiber.
During installation, avoid extreme environments, such as excessive temperature and vibration.	Avoids possible damage to the fiber cable.
During installation, ensure that the fiber cable is not pinched or pulled.	Prevents compression and stretch to the fiber cable.
Use measurement tools such as calibrated light sources, power meters, and an optical time domain reflectometer (OTDR).	Verifies optical link losses.

Ordering Compaq SANworks Very Long Distance GBICs

Contact your local Compaq representative to order the following kit:

- Kit number: 230800-B21
- Description: GBIC-VLD Connector Kit ALL

Laser Safety Compliance

The Compaq SANworks Very Long Distance GBIC is an international Class 1 laser product under IEC825. The GBIC-VLD Module contains a laser device. All Compaq systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission EN60825-1:1994+A11 and EN608252:1994. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous laser radiation. The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976.

Compliance is mandatory for products marketed in the United States. This device is classified as a Class 1 laser product as defined by 21 CFR 1040.10.

The following label or equivalent is located on the surface of the unit:

This product is a Class 1 Laser Product.

This label indicates that the product is classified as a Class 1 laser product; Laserklasse 1.

Website

Check the Compaq website for more information on the complete line of Fibre Channel storage products, product certification, technical information, updates, and documentation. This information can be accessed through our web page at:

http://www.compaq.com/products/storageworks