Compaq SANWorks™

DRM Using Very Long Distance GBICs 7/2000

Application Note

About This Document

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

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

This Application Note contains the following sections:

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- Data Replication Manager
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- Power Budget
  - Single Mode Fiber Attenuation
- Examples of Fiber Link Budgets
- Configuration Restrictions and Recommendations
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- Laser Safety Compliance
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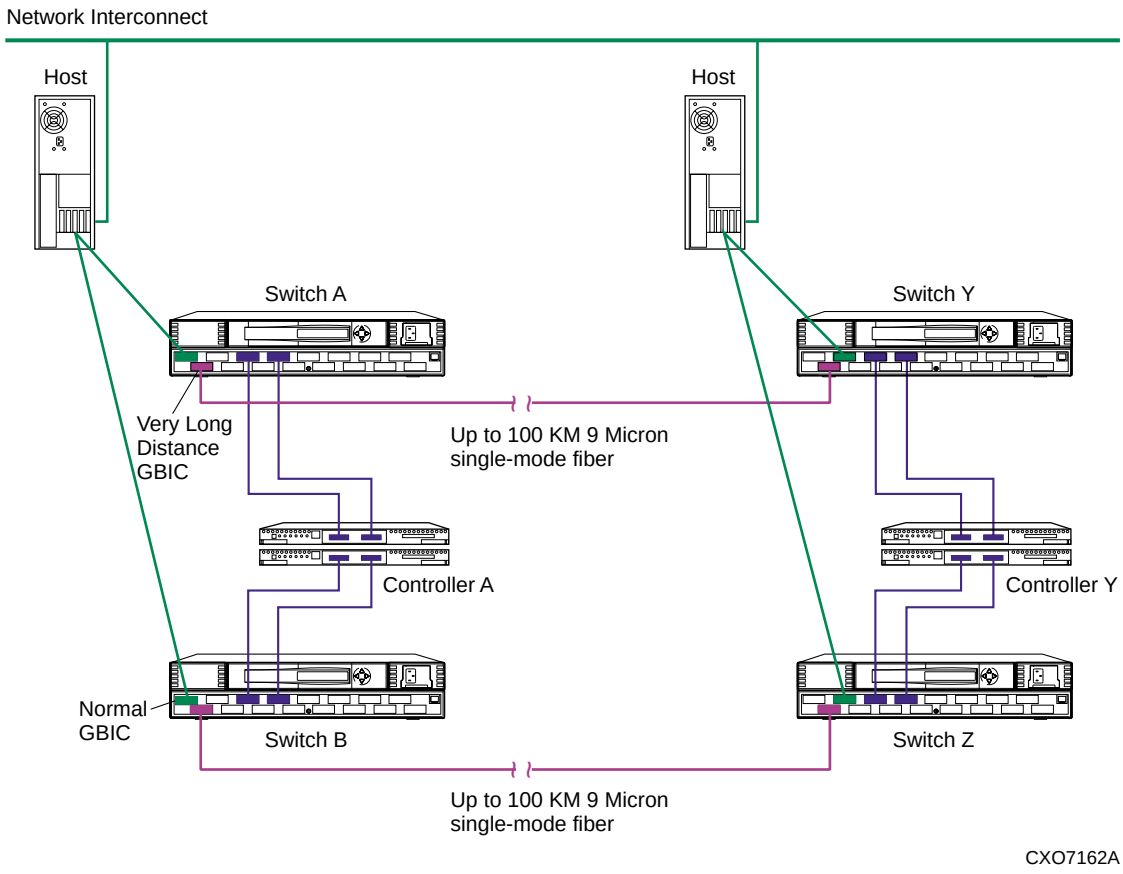
EK-DRMLD-AA. A01

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 km and 100 km, depending on dB loss in the link.

The diagram below shows a typical Data Replication Manager (DRM) configuration using the *Compaq SANworks Very Long Distance GBIC's* 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 there is a failure or catastrophe that disables processing at that site. In the event of an initiator failure, another site can continue processing data in the interim.

Data Replication Manager provides rapid data access recovery and continued data processing after the loss of one or more components. Data Replication Manager 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.

Data Replication Manager can replicate data up to 100 km (approximately 60 miles) via an extended storage area network over direct Fibre Channel links from 10 to 100 megabytes/second depending on distance.

Very Long Distance GBIC Product Features

- Supports Fibre Channel 1062.5 megabits per second
- Distances of 10 to 100 km over 9-micron single-mode fiber optic cable
- 1550 nm center optical wavelength
- Integrates a distributed feedback (DFB) Laser
- Supports Serial ID Functionality
- Low Power Consumption (1.1 watts typical)
- Duplex SC optical port
- Hot-pluggable

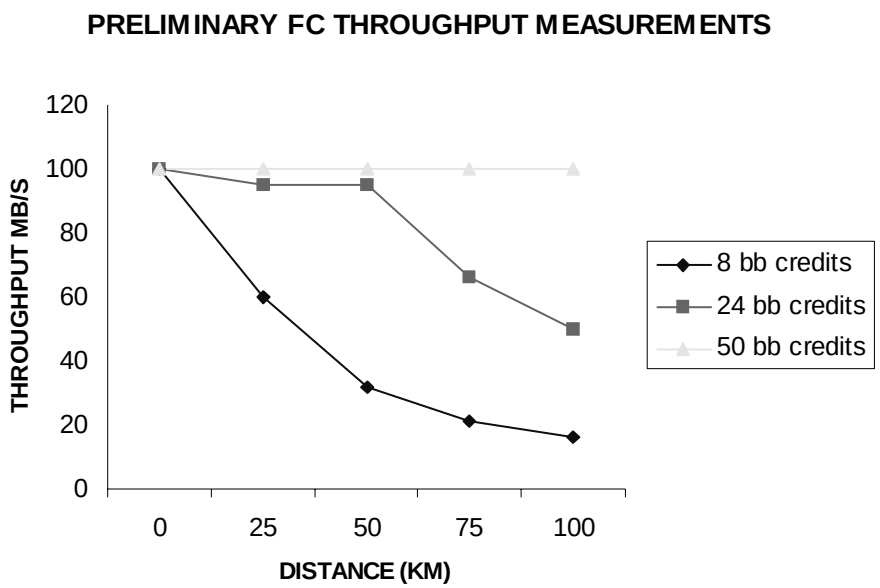
Performance Considerations

Buffer-to-Buffer Credits

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 credits. Currently, eight buffer-to-buffer credits are the maximum number assigned. Efforts are underway to increase the available buffer-to-buffer credits to improve throughput at long distance.

The chart below shows that with eight buffer-to-buffer credits, the throughput will diminish with increased distance.

FIGURE 2. Credit-based flow control

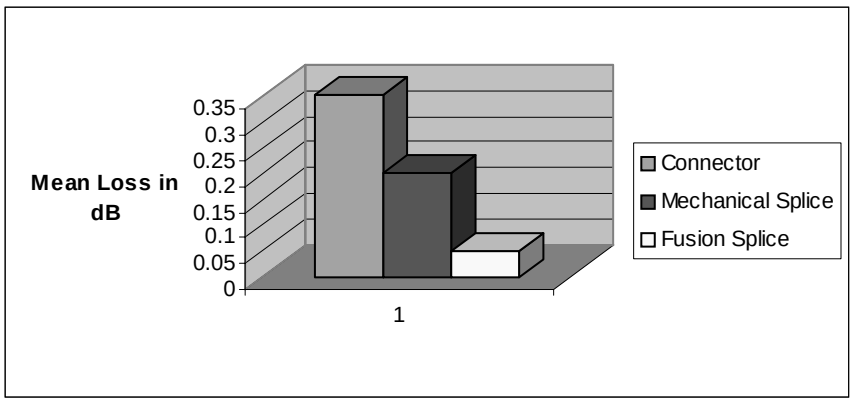


Power Budget

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 typically 27.5 dB with 23.0 dB as the worst case.

The following should be taken into consideration when calculating your link distances: power budget, connections, splices, and fiber attenuation. The chart below shows typical mean loss in dB for connectors, mechanical splices, and fusion splices.

FIGURE 3. Typical mean loss in dB



The single-mode fiber attenuation table below show typical losses for cables and patches.

Table 1 Single-Mode Fibre 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 link and the second example demonstrates a fiber link that would not work.

Link power used for calculations has a worst case value of 23.0 dB. Typical power is 27.5 dB. Calculations are done for one direction in a bi-directional link.

Example #1

The following is an example of a workable fiber link.

Company A wants to set up a 70 km link from their local data center to a remote site. Their link power budget is 23.0 dB.

Their link will have the following parameters:

- A high quality fiber with an attenuation rate of 0.21 dB per kilometer. This equals 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 which equals 0.7 dB of attenuation.
- Six connectors at 0.3 dB of loss per connector. 0.3 dB x 6 connectors equals 1.8 dB of attenuation.
- One mechanical splice at 0.15 dB of attenuation.
- One 0.5 km length of indoor cable at 0.23 dB of attenuation per kilometer. This equals 0.23 dB x 0.5 (one half of a kilometer) equals 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

Total Loss 17.465 dB

Total Link Power Budget minus Total Loss: 23.0 dB - 17.465 dB = 5.535 dB

The worst case margin of 5.535 dB indicates that this is a workable fiber link.

Example #2

The following is an example of a fiber link that would not work.

Company B wants to set up a 70 km link from their local data center to a remote site. Their link power budget is 23.0 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 kilometers equals 21 dB of attenuation.
- One fusion splice every 5 kilometers. 0.05 dB x 14 fusion splices, which equals 0.7 dB of attenuation.
- Twenty connectors at 0.3 dB of loss per connector. 0.3 dB x 20 connectors, equals 6.0 dB of attenuation.
- Five mechanical splices at 0.15 dB of attenuation per mechanical splice, equals 0.75 dB of loss.
- Two 0.5 km lengths of indoor cable at 0.23 dB of attenuation per kilometer. This equals 0.23 dB of attenuation loss.

Summing up the total loss:

21.0 dB fiber attenuation
0.7 dB fusion splices
6.0 dB connector attenuation
0.75 dB mechanical splice
0.23 dB indoor cable loss

Total Loss 28.68 dB

This total loss is greater than the 23.0 dB link power budget and the fiber link would not work.

For Company B to resolve this issue, they would reduce the number of connectors, change the mechanical splices to fusion splices, and invest in a higher quality fiber cable.

Table 2 Configuration Restrictions and Recommendations

Restrictions/Recommendations	Implication
Use low attenuation 9-micron fiber.	Best for long distances (preferably less than 0.3dB per km).
Minimize connectors.	Connectors account for 0.3dB 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 inches during installation and 2.0 inches long-term.	Exceeding the bend radius could result in fracture of the fiber.
During installation, avoid aggressive environments such as excessive temperature, vibration, etc.	Possible damage to the fiber cable.
Prevent risk of compression and stretch to the fiber during installation	Make sure fiber cable is not pinched or pulled.
Verify optical link losses.	Use measurement tools such as calibrated light sources, power meters and Optical Time Domain Reflectometer (OTDR).

Ordering *Compaq SANworks Very Long Distance GBICs*

Contact your local Compaq representative with the following kit number and description:

Kit Number: 169887-B21

Description: GBIC-LW MODULE KIT ALL

Laser Safety Compliance

The *Compaq SANworks Very Long Distance GBIC* is an international Class 1 laser product under IEC825 and the US Department of Health and Human Services (DHHS) Radiation Performance Standard. The Center for Devices and Radiological Health (CDRH) of the US Food and Drug Administration implemented regulations for laser products on August 2, 1976. Compliance is mandatory for products marketed in the United States. The information shown below indicates compliance with the CDRH regulations:

This product conforms to the applicable requirements of 21 CFR 1040.10.

This product is a Class 1 product, Laserklasse 1, and complies with Par. 3 of the "Equipment Safety Law" of June 24, 1968.

This product complies with Class 1 Laser Safety under the following conditions: power supply voltage less than 5.25 V and 8B/10B encoded input data (i.e. Average duty cycle = 50%).

For international compliance, this device complies with EN60825 as well as EN60950.

Additional Resources

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