

BROCADE HOST BUS ADAPTER TECHNOLOGY LEADERSHIP



DATA CENTER

Leveraging Brocade Host Bus Adapters with Microsoft SQL Server

HIGHLIGHTS

Microsoft SQL Server 2008 R2 is a relational model database server and the leader in the data warehousing, enterprise, and Web application space. It runs on the Microsoft Windows family of server operating systems.

Brocade Fibre Channel (FC) Host Bus Adapters (HBAs) are uniquely designed to work with SQL Server. They offer:

- The best performance at lower power and cost for both sequential and random I/O
- The ability to prioritize and isolate traffic and minimize the effects of congestion in Storage Area Networks
- The lowest latency for host-to-storage connectivity
- Reduced server downtime with hot-swappable optics and tightly coupled OS driver and firmware
- Unified SAN and HBA management and monitoring

As customers require access to their data not only in the enterprise space but also from cloud services and mobile devices, new demands are being placed on database performance. This paper examines the server I/O requirements to support Microsoft SQL Server deployments effectively.

DATA STORAGE AND DISK I/O ACCESS PATTERNS

The three main components of data storage in a SQL Server installation are:

- The *database*, which is a collection of tables
- *Transaction logs*, which maintain transaction consistency
- The temporary work space, *tempdb*

A page is the basic unit of I/O for SQL Server operations. Database pages are buffered in server memory and written to disk only when free resources are available to minimize disk I/O. In comparison, transaction logs are written to disk immediately and require the highest levels of performance from the storage. In order to optimize SQL Server, disk I/O performance is critical.

Storage space allocated to a database is divided into sequentially numbered pages, each 8 KB in size. Disk I/O can be a multiple of 8, 64, 128, 256 or 1,024 KB for sequential I/O; for random I/O, usually only 8 KB. Pages are buffered in server memory to minimize disk I/O. Data is read and written from the buffer and is only written to disk by the Lazy Writer thread when the Buffer Manager decides it is optimal to do so or when it has not been referenced for some time.

All operations performed on the database are also written to transaction logs, which are written to disk immediately in order to maintain transaction consistency. Transactions are not marked completed until log files have been updated on disk, whereas the updated database pages may still be in the buffer. As long as the log files are committed on disk, transactions can be recovered.

The I/O profiles of the database, transaction logs, and tempdb can be quite different and need to be managed differently for optimal performance. Applications that use SQL Server also display different I/O patterns, but can usually be categorized into two types: *Online Transaction Processing (OLTP)* or *Decision Support Systems (DSS)*.

Typical I/O profiles are shown in this table.

Application	R/W	Access Type	Block Size
OLTP log files	Write	Sequential	Up to 60 KB
OLTP DB			
- Lazy Write	Write	Random	8 – 256 KB
- Index Seek	Read	Random	8 KB
OLTP Tempdb	Read/Write	Sequential	8 – 256 KB
DSS DB	Read	Sequential	8 – 512 KB
DSS Tempdb	Read/Write	Sequential	8 – 256 KB

BEST PRACTICE CONFIGURATION

I/O Response Times and Storage. The log files I/O response time should be between 1ms – 5ms and placed on a RAID 1+0 disk. The database and tempdb I/O response times should be between 5ms – 20ms and can be placed on a RAID 5 disk. Additionally, best practice is for the database and tempdb not to be in the same RAID group.

Server Adapters. In order to effectively load balance I/O and ensure necessary performance for the database, deploy at least two Host Bus Adapters (HBAs) in the server. This will also ensure path redundancy or high availability, should one path to the storage fail or become congested. Common factors affecting performance are:

- Suboptimal drivers or firmware used on HBAs or the storage array
- Improper queue depth settings on HBAs
- Incorrectly configured multipath software and/or Fibre Channel switches

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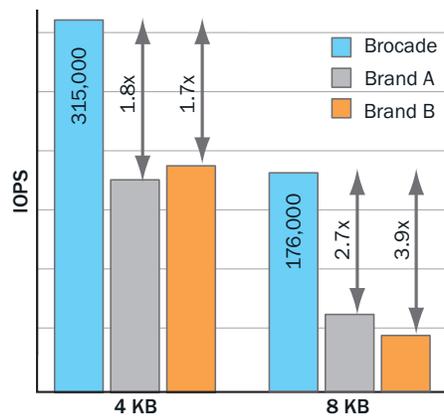
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BROCADE ADVANTAGES

I/O Performance. I/O performance is a complex measure of IOPS, throughput, and latency. Brocade HBAs offer up to 2.5 times the number of IOPS at a typical 8 KB SQL Server block size according to Medusa Labs and over double the bandwidth at 1,568 Megabytes per second (Mbps) according to OpenBench labs.

Brocade HBAs offer up to 500K IOPS per port, demonstrating best-in-class performance. Numbers are published in the IBM white paper titled, “Enabling 8Gbps Fibre Channel End-to-End Performance” (ftp://ftp.software.ibm.com/common/ssi/sa/wh/n/xsw03048usen/XSW03048USEN.PDF). Based on testing in a real-world environment, the numbers demonstrated world-beating throughput at 4 and 8 KB transfer sizes, as shown in the graph below.



There are differences in the way sequential I/O performance is measured and the way random I/O performance is measured. For sequential I/O performance, throughput is measured in megabytes per second; whereas random I/O performance is measured as the number of IOPS. In all cases, latency is the key factor.

Tolly states that Brocade HBAs have the lowest latency, “In these tests, Brocade consistently delivered the lowest latency across the entire range” (Tolly Report Document # 209102, April 2008)

Ensuring Service Levels. Typically, customers configure multiple smaller OLTP databases that support different business units, such as order entry, human resources, and accounting. These different databases have vastly different I/O patterns and also Service Level Agreements (SLAs), though all share the same storage, SAN, and possibly server resources via use of server virtualization technology. Only Brocade HBAs can isolate and prioritize individual database and transaction log I/O streams, maintaining Quality of Service priorities from server to storage by using Brocade’s Server Application Optimization (SAO) and Adaptive Networking (AN).

Highest Levels of Availability. Features such as hot-swappable optics allow most HBA hardware problems to be corrected without taking the server offline or adversely impacting the SAN or storage configurations. Brocade provides a single driver and firmware package tightly coupled to eliminate version incompatibility issues and allow user-friendly installation with the host OS. These features minimize IT operational risk and lead to the highest levels of availability and stability.

True Unified Management. Brocade HBAs leverage the same hardware platforms as Brocade FC switches and directors to enable end-to-end monitoring and reporting capabilities unique to Brocade. This unified solution provides local and remote management through a native element manager, Brocade Host Connectivity Manager (HCM), and a CLI, which enables users to configure and monitor HBAs. In addition, Brocade DCFM® provides a unified view from the fabric into the host and target across Brocade fabrics. Server and SAN management from a single “pane of glass” enables unparalleled ease of use and control.

To find out more about Brocade HBAs and third-party performance reports, visit www.brocade.com/hba.

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