Mainframe Storage Compatibility and Innovation With Hitachi Virtual Storage Platform G1x00 and F1500

By Hitachi Data Systems
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## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>3</td>
</tr>
<tr>
<td>The Hitachi Two-Pillar Approach to Mainframe Storage</td>
<td>4</td>
</tr>
<tr>
<td>Compatibility</td>
<td>4</td>
</tr>
<tr>
<td>Innovation</td>
<td>5</td>
</tr>
<tr>
<td>Mainframe Storage Performance and Use</td>
<td>6</td>
</tr>
<tr>
<td>Enhanced Storage Features for Today's Mainframe Environments</td>
<td>9</td>
</tr>
<tr>
<td>Information Availability and Data Resilience</td>
<td>9</td>
</tr>
<tr>
<td>Recovery and Protection Offerings</td>
<td>10</td>
</tr>
<tr>
<td>In-System Replication</td>
<td>10</td>
</tr>
<tr>
<td>Remote Replication</td>
<td>12</td>
</tr>
<tr>
<td>Recovery and Consistency Innovations</td>
<td>14</td>
</tr>
<tr>
<td>3-Data-Center Replication</td>
<td>15</td>
</tr>
<tr>
<td>Automated Disaster Restart</td>
<td>17</td>
</tr>
<tr>
<td>Virtual Tape Library Support</td>
<td>19</td>
</tr>
<tr>
<td>Data Mobility and Migration</td>
<td>19</td>
</tr>
<tr>
<td>Hitachi Cross-OS File Exchange</td>
<td>19</td>
</tr>
<tr>
<td>FICON Data Migration</td>
<td>19</td>
</tr>
<tr>
<td>Integration With Databases and Applications</td>
<td>20</td>
</tr>
<tr>
<td>Mainframe Productivity</td>
<td>20</td>
</tr>
<tr>
<td>Mainframe Analytics Recorder (MAR)</td>
<td>20</td>
</tr>
<tr>
<td>Hitachi Technology Partners</td>
<td>20</td>
</tr>
<tr>
<td>INNOVATION Data Processing</td>
<td>20</td>
</tr>
<tr>
<td>Luminex</td>
<td>20</td>
</tr>
<tr>
<td>Secure Agent</td>
<td>21</td>
</tr>
<tr>
<td>Hitachi Mainframe Professionals, Capabilities and Services</td>
<td>21</td>
</tr>
<tr>
<td>Hitachi Data Systems Global Services Offerings</td>
<td>21</td>
</tr>
<tr>
<td>Summary</td>
<td>22</td>
</tr>
</tbody>
</table>
Mainframe Storage Compatibility and Innovation With Hitachi Virtual Storage Platform G1x00 and F1500

Executive Summary
With over 25 years of experience supporting IBM® mainframe environments, Hitachi Data Systems is a leading supplier of storage for these critical environments and is committed to supporting the mainframe. We provide innovative storage solutions designed to improve storage processing, performance and management in mainframe environments.

Hitachi Data Systems is a leading provider of mainframe storage. Hitachi and Hitachi Data Systems use a two-pillar approach in the design and development of IBM mainframe compatible storage systems. The first is compatibility, or, in other words, the focus on support and qualification of essential IBM mainframe storage features. The second is innovation, which includes the development and testing of unique Hitachi storage and storage management features to provide mainframe customers with additional capability and value.

IBM successfully completed qualification testing of Hitachi Virtual Storage Platform with IBM GDPS® using Hitachi support for PPRC, XRC and, in 2012, also qualified Hitachi Universal Replicator (HUR) to be used in combination with GDPS. This qualification was completed for Hitachi VSP G1000 in 2015. This qualification testing is one more way organizations can be confident in the Hitachi commitment to providing compatibility with essential mainframe storage features. And they gain full support of unique, innovative, Hitachi value-added replication solutions, including Hitachi TrueCopy, HUR and Hitachi ShadowImage Replication.

Hitachi Data Systems has a large installed base of Hitachi storage systems connected to IBM S/390® and zSeries® mainframes via IBM ESCON® and FICON® networks as well as mainframe-based Linux environments via Fibre Channel networks. Hitachi provides high-speed flash storage for mainframe environments. Hitachi Accelerated Flash (HAF) storage is an enterprise-class, solid-state storage option built from the ground up. It combines the unique Hitachi embedded flash controller and MLC flash memory to deliver superior performance over single-level cell (SLC) devices. It lowers bit costs over multilevel cell (MLC) flash-based solid-state disks (SSDs). Additionally, Hitachi is the first storage manufacturer to offer virtualized storage in the mainframe environment, including the ability to virtualize external multivendor storage.

With industry-leading Hitachi storage innovation, IBM mainframe compatibility, performance and data resilience, you can trust that your Hitachi storage system will meet the demands of your mainframe and open systems storage environments.
The Hitachi Two-Pillar Approach to Mainframe Storage

Hitachi and Hitachi Data Systems design and develop IBM mainframe compatible storage systems with a two-pillar approach: compatibility and innovation.

Compatibility

Hitachi and IBM share APIs to ensure compatibility between Hitachi storage and IBM mainframes. For over 25 years, Hitachi, Ltd., has provided mainframe technology to business and industry, including solutions for z/OS®, z/VM®, z/VSE, z/TPF and Linux for z. During this time, license agreements have provided Hitachi access to IBM APIs and interface specifications for mainframe storage platforms as well as IBM access to selected Hitachi APIs. Access to these APIs has enabled Hitachi storage systems to support IBM PPRC, XRC, FlashCopy®, FlashCopy Space Efficient, Remote Pair FlashCopy, Parallel Access Volumes (PAV), HyperPAV, Multiple Allegiance (MA), High Performance FICON (zHPF), TPC-R, and Basic HyperSwap®. The license agreements have also given IBM access to Hitachi APIs for NanoCopy disaster recovery manager technology from Hitachi Data Systems and Hitachi ShadowImage Replication. This licensing agreement also enables Hitachi and Hitachi Data Systems to develop and deliver storage management software for mainframe environments. Hitachi participates in the IBM Early Ship program for z/OS, which means that Hitachi has early access to z/OS versions for testing. This access enables Hitachi to ensure compatibility with new versions of z/OS when they become generally available.

Hitachi storage systems and features are tested and qualified with IBM mainframes, operating systems and critical features. This testing and qualification includes features such as support for GDPS/HyperSwap, FlashCopy and zHPF. Hitachi Virtual Storage Platform (VSP), Hitachi Universal Storage Platform V (USP V) and Hitachi Universal Storage Platform VM (USP VM), are qualified and supported on the IBM z196, Z9®, z10™, z114, zEC12 and zBC12 processors. They are also supported under the latest z/OS version, including day 1 support for z/OS 2.2. IBM successfully completed compatibility qualification testing of VSP with z/OS 1.13, 2.1 and GDPS. VSP G1000 completed compatibility qualification testing for FICON and zHPF (including Multi-Track and Bi-Directional Data Transfer) on a z13, z13s, zEC12, zBC12, z196, z114, z10 EC and z10 BC through supported directors and switches, as well as direct connection. IBM also successfully completed compatibility qualification testing of VSP G1000 with z/OS 2.1 and GDPS.

Hitachi has implemented technologies that are compatible with IBM’s Metro Mirror (PPRC), FlashCopy V2 and FlashCopy Space Efficient on Hitachi storage systems. We are the first storage vendor to go through this qualification. We also successfully completed the qualification tests for GDPS/HyperSwap, GDPS/XRC and a 3-data-center (3DC) multtarget replication configuration using VSP GDPS/HyperSwap support and Hitachi Universal Replicator with delta resync along with Hitachi Business Continuity Manager.

The license agreements ensure that as IBM announces and delivers new features and functions for mainframe environments, Hitachi Data Systems will be able to support these new features. In addition, Hitachi has its own testing facilities to ensure that Hitachi delivered products and features are compatible with the IBM solutions.

The Hitachi and IBM license agreement provides Hitachi access to the design specification for key technologies from IBM, which enables Hitachi to deliver support for these key technologies:

- Parallel Access Volumes (PAV).
- HyperPAV.
- Multiple Allegiance.
- MIDAW.
- Extended Address Volume (EAV).
Dynamic Volume Expansion (DVE).
Extended-Distance FICON.
IBM Metro Mirror (PPRC).
IBM z/OS Global Mirror (XRC).
FlashCopy V02.
FlashCopy Space Efficient (FlashCopy SE).
Remote Pair FlashCopy.
Geographically Dispersed Parallel Sysplex™ (GDPS) HyperSwap.
Basic HyperSwap® with either TPC-R or Copy Services Manager.
IBM zHyperWrite™ for DB2®.
High-Performance FICON (zHPF).
  zHPF multitrack.
  zHPF DB2.
  List Prefetch.
  zHPF Bi-directional channel program.
  zHPF List prefetch optimizer.
  zHPF BSAM/QSAM support.
  zHPF Format Write.
  zHPF and DB2 I/O.
z/OS Discovery and Auto Configuration (zDAC) support.
Latest zSeries processors including the z114, zEC12, zBC12, z13 and z13s.

Hitachi not only provides support for IBM compatible replication solutions such as Metro Mirror (PPRC), but also provides ongoing innovation, delivering alternative high-performance replication solutions.

Hitachi Data Systems and IBM have a long-term agreement to provide assistance to each other to quickly resolve any joint customer issues related to Hitachi storage and IBM mainframes and mainframe operating systems. The focus is on determining the source of the problem, with the root cause and solution being provided by the vendor whose product or products are identified as the source of the problem.

Innovation
Hitachi innovation, the 2nd pillar of the Hitachi Data Systems 2-pillar approach, delivers unique Hitachi storage and storage management features, providing mainframe customers with additional capability and value.

Hitachi enterprise storage platforms are used by most of the Fortune 100 organizations today. These represent some of the most critical mainframe environments in the world.

1 Hitachi support for z/OS Global Mirror (XRC) via Hitachi Compatible Replication for IBM® XRC® is only available on Hitachi VSP G1000 as a migration aid for organizations moving to Hitachi Universal Replicator.
Mainframe Storage Performance and Use

Hitachi Dynamic Provisioning

Hitachi Dynamic Provisioning (HDP) for Mainframe complements existing mainframe storage provisioning processes while improving performance and simplifying performance and capacity optimization. HDP for Mainframe automatically spreads the content of application data sets across a storage pool, containing a large number of physical disks, distributing I/O activity across available physical resources. This action eliminates the challenges of manually spreading an application’s data over many spindles in order to optimize performance and throughput. At the same time, it reduces storage management concerns.

Hitachi Dynamic Tiering

Hitachi Dynamic Tiering (HDT) for Mainframe is an extension of Dynamic Provisioning. HDT for Mainframe offers an additional level of automated, optimized storage management by managing data across a full range of storage tiers from high-performance storage to low-cost storage. Data is automatically moved between tiers according to simple policies. With HDT for Mainframe, there can be up to three storage tiers ranging from high-performance flash storage to low-cost storage, such as nearline SAS or virtualized external storage in the same storage pool. Dynamic Tiering requires no elaborate decision criteria or data classification exercises to move data between tiers of storage. From one to three tiers of storage, any storage media types available on the VSP or VSP G1000, including Hitachi Accelerated Flash storage, can be defined and used with a single virtual volume. Tier creation is automatic, based on configuration policies, including media type and speed, RAID level and sustained I/O level requirements. HDT is an automated methodology that attempts to move the most active back-end data to drives with higher performance, while migrating less active data to slower, less expensive drives. The most active data is determined through embedded performance monitoring and periodic analysis and is moved to the highest tier on a periodic basis. The system automatically optimizes the use of storage by keeping the higher tiers fully utilized.

Hitachi Dynamic Tiering for Mainframe complements existing mainframe storage provisioning processes, such as DFSMS. At the same time it offers the full benefits of Hitachi Dynamic Provisioning to improve performance and simplify performance and capacity optimization. Existing SMS storage groups and ACS routines can be aligned to differently tiered storage pools.

Today, organizations can also take advantage of Hitachi Accelerated Flash storage, which provides excellent Tier 1 storage for use with HDT for Mainframe. This software can also use virtualized external storage for lower tiers to store infrequently accessed data.

Hitachi is the first storage vendor to support virtualization of external storage behind an enterprise storage platform.
Hitachi innovation enables administrators to extend the life of older storage assets for less frequently accessed data that is most effectively maintained in lower-tier storage. HDT for Mainframe provides the ability for the system to automatically move blocks of data within data sets, to the most appropriate class of storage based on performance and access requirements.

Policy-Based Management With Hitachi Tiered Storage Manager for Mainframe

Hitachi Tiered Storage Manager (HTSM) for Mainframe is a z/OS software management product for Hitachi Dynamic Tiering for Mainframe that enables a user to control service levels based on performance and/or time to facilitate meeting mainframe service level agreements (SLAs). As an example, when using DB2, access to any part of a tablespace located on slower tiered disk can affect the performance of the entire application. HDT for Mainframe policies, managed through HTSM for Mainframe have the capability to hold selected data to a specified tier, regardless of the access patterns. The policies can also be defined to migrate selected data to a higher or lower tier on a predictable, even scheduled, basis.

HTSM for Mainframe enables HDT for Mainframe policies to be managed from the mainframe at the volume level or through DFSMS tools and constructs familiar to the mainframe administrator. HTSM for Mainframe uses ISPF or, optionally, REXX scripts to manage tiered storage. It provides a host-based solution. It uses familiar TSO/ISPF screens to view, manage and control and automation of tiering policies for application datasets aligned to an SMS storage group or to individual devices. At the same time, this offering provides capabilities for reporting and ongoing management and monitoring of HDT for Mainframe. This software runs on the mainframe, providing a familiar interface for mainframe storage administrators.
HITACHI DYNAMIC TIERING FOR MAINFRAME DELIVERS TOP PERFORMANCE FOR LARGE FINANCIAL INSTITUTION

A large financial institution installed the next-generation Hitachi enterprise-class storage controller and implemented HDT for Mainframe on the new controller with a mix of SSD, SAS and nearline-SAS drives. Staff determined that this would provide the performance required while saving operational costs.

With HDT for Mainframe, they achieved a 55% higher I/O rate and almost two times faster response time than they achieved with the previous-generation storage controller. These performance improvements were achieved using a tiered hierarchy of storage spread across a configuration of 3.3% SSD, 33.32% SAS and 63.38% nearline SAS (NL-SAS) drives. The drives were configured in two storage pools with each having a three-tier storage hierarchy with the SSD drives in Tier 1, SAS drives in Tier 2 and NL-SAS in Tier 3 using dynamic tiering. HDT for Mainframe was able to take advantage of the small number of high-performance SSD drives and the large-capacity, lower-performance NL-SAS (3TB) drives along with the Tier 2 SAS drives. It ensured that highly referenced data was maintained in Tier 1, delivering the improved performance. Over 50% of the I/O activity was on the SSD drives with less than 20% on the NL-SAS drives.

Back-End Physical Capacity Versus I/O Distribution

Performance improvements and operational savings include: electrical power (60% less), reduced heat output (60% less), and space requirements (almost 50% less). The savings were achieved with this next-generation storage controller. They have been able to support their corporate growth in their existing infrastructure while delivering better service to their users.

Mainframe Analytics Recorder

With the mainframe analytics recorder capability included in SVOS we deliver storage-system-specific detailed performance information integrated with other SMF/RMF reporters. This capability is key to providing system programmers with an integrated view of their mainframe storage performance. It enables time- and load-synchronized reporting, an essential capability that is very hard (and laborious) to achieve with a mix of different open-base array reporting and mainframe tools.

Mainframe analytics reporter shortens the time needed to analyze and optimize the system, and to solve time-critical performance problems. It can also help you to avoid them in the first place. And it enables third-party partners to better extend their analysis and management capabilities for Hitachi and virtualized storage.
Enhanced Storage Features for Today's Mainframe Environments

Information Availability and Data Resilience

Data is at the core of your data center, and any data center must provide for the movement, provisioning, access and protection of data, which is provided by storage systems. An important element of your information availability strategy is ensuring your data is resilient (see Figure 1).

Data resilience does not mean just disaster recovery: It means that in the case of a system or site failure your data and information can be available in an alternate storage system at the same or a different location. It means you have availability that allows your business to continue business operations in the event of a planned or unplanned outage. Solutions to provide data resilience include service level agreements and requirements for high availability, with specific recovery time objectives (RTO) and recovery point objectives (RPO).

Figure 1. Hitachi Data Systems Data Resilience Solutions

An increasing corporate understanding of the value of data and importance of the IT infrastructure has resulted in IT organizations being tasked to ensure the IT infrastructure will protect these critical assets across the corporation. This means that data must be protected and guaranteed to be consistent across complex applications that share data and require the best local and remote replication and restart available.

Industry-leading Hitachi replication and replication management solutions support both IBM GDPS HyperSwap and Basic HyperSwap. So, you can be confident of your ability to restart operations in case of a disaster or other outage.

Hitachi data resilience offerings are designed to improve the availability of business data. The data resilience offerings from Hitachi can be used to improve the availability of a business’ applications by:

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2 Check with your HDS Representative for currently supported configurations and specifications.
Enabling application testing against a full copy of data to simulate full production.

Supporting parallel processing for reports, queries and data warehouse applications.

Allowing consistency checks of databases or facilitating application-level data recovery.

Performing upgrades and maintenance to hardware and software nondisruptively.

Migrating or moving data easily and nondisruptively.

Providing consistency across data volumes and arrays for replicated data.

Improving the time for backup and restore of data.

Providing protection of data in both local and remote locations.

Surviving a major outage or disaster with the ability to continue or restart business operations.

Reducing your RPO.

Minimizing your RTO.

Recovery and Protection Offerings

The ability to protect and recover your data requires creation of and access to a totally separate copy of the data. Depending on the situation, the copies may be local and/or remote and provide the ability to select the copy based on location RTO or RPO.

These separate copies not only provide protection and data availability in the event of an outage or disaster but also enable testing against real data. They also enable the performance of support operations, such as backup to tape or consistency checking. By coupling this replication or copy capability with virtualization and static and dynamic tiering capabilities, you can best align cost and risk.

Hitachi provides best-of-breed proprietary solutions for replication and replication management, such as Hitachi TrueCopy synchronous, Hitachi Universal Replicator, Hitachi ShadowImage Replication and Hitachi Business Continuity Manager (BCM). Using BCM, all three of these solutions can be seamlessly integrated into enterprise mainframe environments. Hitachi works with IBM to ensure compatibility of Hitachi replication solutions with IBM key technologies. To this end, the solutions employ Hitachi unique replication software and Hitachi enterprise-class storage systems support for GDPS HyperSwap. Also, as a lower-cost high-availability solution for storage, we support Basic HyperSwap with IBM Tivoli Storage Productivity Center for Replication (TPC-R).

In-System Replication

- **Hitachi Compatible Mirroring for IBM® FlashCopy®** provides support compatible with IBM FlashCopy V02 and enables application-aware, near-instant copies to allow backups with minimal performance impact on the applications. Now based on high-performance Hitachi Thin Image copy after write snapshot technology, it also provides near-instant restore capability to improve service levels and application availability (see Figure 2).

- **Hitachi Compatible Software for IBM® FlashCopy® SE (FCSE)** provides an in-system solution for data protection that is IBM mainframe compatible. This solution combines snapshots, virtual data management and dynamic provisioning to create logical point-in-time (PiT) copies. When a FlashCopy SE source-target volume relationship is established, FCSE uses HDP storage pools to allocate storage capacity, which is only utilized when a change has occurred within the source volume. As changed data is copied to the target volume, storage resources are consumed on an as-needed basis, depending on the amount of data that is changed and copied. With FCSE, storage resource utilization is minimized, potentially lowering overall storage costs compared to full volume physical mirroring.
- **Hitachi ShadowImage Replication** software provides nondisruptive, host-independent data replication to create copies of any customer-accessible data within a single Hitachi storage system. These copies can provide immediate, nondisruptive access and sharing of information for decision support, test and development. They can also optimize tape backup operations. ShadowImage copies provide nearly instant recovery from logical data corruption (see Figure 2). ShadowImage can use HDP storage pools to allocate target storage capacity, which is only used when a data is copied from the source volume. Storage resources are consumed on an as-needed basis, depending on the amount of data that is copied.

- **Consistency groups** are a standard feature of Hitachi in-system replication offerings, which ensure consistency of cross volume data when replicating or making point-in-time copies.

- **Multiple tiers** provide the ability with ShadowImage to make first- and second-generation copies of volumes that are being copied by ShadowImage. This capability supports disk-based backup as well as additional copies for testing or backing up to tape. The copies can be on different storage tiers, either internal or externally virtualized storage.

- **The interface to Hitachi replication solutions** for enterprise storage platforms has remained consistent across the last three generations of devices. It provides investment protection and eliminates the need to build new scripts and procedures when implementing the newest generation of Hitachi enterprise storage systems.

![Figure 2. Local In-System Replication With Hitachi ShadowImage Replication and IBM FlashCopy](image-url)
Remote Replication

Hitachi replication solutions for mainframe environments support intermix environments, which can include all of the latest generations of Hitachi enterprise-class storage systems, including VSP G1x00 and F1500, VSP, USP V and USP VM. Using Hitachi data replication solutions for mainframe, companies can implement GDPS, GDPS/HyperSwap or Basic HyperSwap. This includes the ability to implement 3-data-center solutions with the ability to synchronize the data at the alternate sites using delta resync if the primary site should be unavailable. This can all be managed using innovative Hitachi Business Continuity Manager software.

Hitachi also provides support for extended consistency groups, providing consistency of data during replication across multiple storage systems to the storage systems at the remote location.

Hitachi TrueCopy synchronous remote replication software provides a continuous, nondisruptive, host-independent, zero-data-loss solution. This rapid-restart remote data replication solution addresses disaster recovery or data migration for distances within the same metropolitan area (see Figure 3). For mainframe environments, TrueCopy synchronous supports host-application-dependent write order consistency across multiple controllers.

Figure 3. Remote Synchronous Replication Using Hitachi TrueCopy (synchronous replication)

TrueCopy synchronous:

- Offers a zero-data-loss solution (RPO = 0).
- Ensures remote copy is always a mirror image of source volume while in duplex (pair) state.
- Supports consistency across multiple storage systems (up to 12x12).
- Works in conjunction with Hitachi Universal Replicator to provide advanced 3DC configurations.

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3 Check with your HDS representative for currently supported configurations and specifications.
Hitachi Universal Replicator delivers simplified asynchronous data replication for internal and external storage attached to Hitachi enterprise-class storage platforms (see Figure 4). This software delivers the enterprise-class performance associated with storage-system-based replication, while providing resilient business continuity without the need for redundant servers or replication appliances. HUR provides unique RPO control through the use of storage system journal-based replication and leverages asynchronous replication driven by the remote site to minimize impact on primary site production systems. HUR supports consistency groups across volumes and across up to 12 controllers on Hitachi enterprise storage systems.

**Figure 4. Remote Asynchronous Replication Using Hitachi Universal Replicator**

HUR provides administrators with an innovative remote replication solution. HUR offloads the majority of processing for asynchronous replication to the remote storage system using unique Hitachi pull technology. It also uses journaling to keep track of all updates at the primary site until the updates are applied on the remote storage system. The journaling approach provides resiliency for a shorter RPO while protecting production performance during network anomalies. Pull technology frees up processing power at the primary site for critical production activities and, as you grow, limits the need to upgrade your primary site storage infrastructure, avoiding costs.

**Universal Replicator:**
- Supports near-zero RPO while providing resiliency to minimize RPO elongation during unexpected network or workload anomalies.
- Creates no impact on application response time as a result of distance or latency.
- Supports journal-based replication.
- Manages replication with target controllers; frees source controller resources.
- Supports extended consistency groups across multiple storage systems and between two storage complexes (up to 12x12).
- Provides advanced 3DC configurations with extended consistency between the storage complexes in each data center (up to 12x12x12) when used with TrueCopy synchronous.
Recovery and Consistency Innovations

In today’s complex IT environments, it is not unusual for data access to cross many boundaries, including volumes, storage systems, databases, operating systems and applications. Many applications, such as customer service, order entry, inventory and Internet-based e-commerce, may all share the same databases and need to be consistent with each other down to the transaction level. If it is necessary to restart this collection of applications due to an outage, equipment failure or disaster, it is critical that all data is consistent to a single point in time across the enterprise. Hitachi has developed several solutions to address this critical need:

Consistency groups provide consistent copies of data on secondary and/or remote storage systems. With Hitachi Universal Replicator, mainframe and open systems volumes can be intermixed in consistency and extended consistency groups. When replicating volumes within a single storage system or between multiple storage systems, consistency groups ensure that the replicated data is consistent and synchronized to a single point in time across volumes in the storage system. In the situation where the replicated data exists across multiple storage systems [up to 12 storage controllers (12x12)], extended consistency groups ensure the data is consistent and synchronized to a single point in time across all volumes in all associated storage systems (see Figure 5). Mainframe environments use a mainframe time stamp associated with each record to ensure consistency.

Figure 5. Extended Consistency Groups for Mainframe

For mainframe environments these groups ensure consistency of volumes across storage system boundaries when replicating or making point-in-time copies. For 2DC environments, these extended consistency groups can include up to 12 storage systems in each location (12x12). For 3DC environments, they can include up to 12 storage systems in each location (12x12x12). Consistency groups and extended consistency groups use a mainframe time stamp to ensure consistency across volumes and storage controllers in the remote (HUR target) site.

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4 Check with your HDS representative for currently supported configurations and specifications.
3-Data-Center Replication

The 3DC replication solution uses both Hitachi TrueCopy synchronous replication and Hitachi Universal Replicator asynchronous replication. It provides a synchronous copy to a separate Hitachi storage system within metro distance using TrueCopy. It provides an asynchronous copy to a second Hitachi storage system that can be located at any distance from the primary site. When Hitachi ShadowImage Replication is used in combination with Universal Replicator and its ATTime Split feature, it provides for consistent ShadowImage (clone) copies without stopping or resynchronizing the HUR copy sessions and elongating disaster recovery RPO. There are two implementations of 3DC replication: cascaded replication and multitarget replication.

Cascaded replication provides synchronous replication from a production Hitachi enterprise-class storage system (such as VSP G1x00 and F1500, VSP or USP V) to a secondary storage system using TrueCopy synchronous replication software. It then asynchronously replicates the data from the secondary storage system to an out-of-region Hitachi enterprise storage system using Universal Replicator propagating the TrueCopy (no data loss) copy to the remote (HUR) site in the event of a production site outage or disaster (see Figure 6).

The 3DC cascade solution:

- Provides a synchronous mirror image of primary data and an asynchronous image at an out-of-region site.
- Enables fast recovery using the in-region data center.
- Provides out-of-region copy to allow recovery from a regional disaster.

Figure 6. 3DC Cascade Solution With Hitachi TrueCopy (synchronous) and Hitachi Universal Replicator
**Multitarget (Concurrent) Replication** synchronously replicates data from the production site using TrueCopy synchronous software to a local site (within metro distance). It asynchronously replicates to an out-of-region remote site using Universal Replicator for optimal data protection. With multitarget replication, protection can be resumed with no data loss between the two remaining sites (hot standby site and remote site) using delta resync (see Figure 7).

The multitarget replication solution:

- Provides campus or metro copy plus out-of-region copy.
- Enables fast recovery and excellent data currency for local site failures, combined with advanced protection from regional disasters.
- Resyncs, using delta resync, the out-of-region asynchronous copy with the metro synchronous copy in event of primary site outage.

*Figure 7. 3DC Multitarget Remote Replication With Hitachi TrueCopy Synchronous and Hitachi Universal Replicator*

**Delta resync** provides additional disaster recovery protection. With a multitarget 3DC configuration as described above, the production site mirrors data synchronously to a hot standby site using TrueCopy synchronous replication. It mirrors the data asynchronously to a third remote site using Universal Replicator. If the production site experiences a failure, the hot standby (local) site can take over and use the remote site for disaster recovery; it only has to copy differential data, the updated data that has not yet been propagated to the remote site. A full copy of the data is normally not required. With delta resync, only the changes not recognized between the hot standby and remote site, as received at the remote site when the outage occurred, are transferred from the hot standby site (new production site) to the remote site (new disaster recovery site). As a result, disaster recovery protection for the hot standby site resumes within minutes instead of hours.
ATTime-Split is a feature of Universal Replicator that eliminates the need to actually split the Universal Replicator pairs when creating a tertiary copy with ShadowImage. Rather, the ATTime-split operation is performed on the specified remote ShadowImage copy group. It creates a data-consistent snapshot at a specified time while sustaining the Universal Replicator copy group in a duplex state. ATTime-Split uses mainframe time stamps to initiate the consistent split at the requested time when creating the tertiary copy.

Automated Disaster Restart
Hitachi TrueCopy synchronous replication supports IBM GDPS HyperSwap, as well as Basic HyperSwap. IBM z/OS provides continuation and GDPS provides automated restart of host application using the secondary storage system, locally or at a remote site, in the event of a planned or unplanned outage (see Figure 8). This includes support for consistency across volumes and across multiple storage controllers. It also supports GDPS HyperSwap and Basic HyperSwap in 3DC configurations with Hitachi Universal Replication software’s delta resync feature. Hitachi Business Continuity Manager can facilitate the management of Hitachi mainframe attached storage in daily operations. BCM can also be used to automate the delta resync after a HyperSwap and configure and manage Hitachi storage during a failover situation. BCM is required for failback and when using delta resync.

Figure 8. 2DC Automated Restart
**Basic HyperSwap (with TPC-R or Copy Services Manager) and GDPS/HyperSwap** are both capable of using replicated copies of data created by Hitachi TrueCopy synchronous. They provide fast failover in the event of a local outage or disaster and require no additional features on the storage system. This support of GDPS/HyperSwap and Basic HyperSwap enables the transfer of application workloads from disks in one Hitachi storage controller to disks in a separate Hitachi storage controller: there is no disruption to operations. Hitachi has worked with IBM to have support for Hitachi storage systems included in Basic HyperSwap. Hitachi Virtual Storage Platform G1000 and VSP support TPC-R Metro Mirror failover and failback with Basic HyperSwap. BCM can be used with TPC-R (or Copy Services Manager), a standard IBM offering, to manage Basic HyperSwap when used with Hitachi storage (see Figure 9). BCM is also used to manage 3DC multitarget implementations using HUR and its delta resync with HyperSwap.

**Figure 9. Support for Both Basic HyperSwap and GDPS HyperSwap; HyperSwap Does Not Require GDPS but Is Fully Supported by IBM**

**Replication Management**

Hitachi Data Systems provides flexibility in storage management for mainframe environments with both host-based and storage system-based storage management solutions. Hitachi Business Continuity Manager provides a host-based solution that uses familiar TSO/ISPF screens to view and manage storage replication. With BCM the storage administrator can set up and manage Hitachi Universal Replicator, Hitachi ShadowImage Replication and Hitachi TrueCopy synchronous remote replication software operations.
Business Continuity Manager, a z/OS-based management software solution from Hitachi, automates complex disaster recovery and planned outage functions, dramatically reducing recovery times. BCM provides autodiscovery of enterprise-wide storage configuration and replication objects, thereby eliminating tedious, error-prone data entry that can cause outages, as well as centralized management of HUR, TrueCopy and ShadowImage software solutions, wherever they reside. BCM uses ISPF or, optionally, REXX scripts to manage these replication offerings. Inband BCM commands can be used to manage replication at the remote site from the primary site.

Virtual Tape Library Support

As disk technology has advanced, use of lower-cost nearline SAS disk storage for data backup and archive has become a popular alternative to tape. Both SecureAgent’s SDS and Luminex’s Channel Gateway provide virtual tape library solutions for all IBM zSeries and compatible mainframes. These solutions greatly reduce or eliminate a data center’s dependence on physical tape by transparently replacing high-cost tape subsystems, including automatic tape libraries (ATL) and virtual tape systems (VTS) with new, low-cost storage.

Hitachi Data Systems works with and provides solutions from both SecureAgent Software and Luminex for virtual tape library (VTL) solutions. SecureAgent’s Secure Data solution (SDS) is an "all-in-one" solution that supports open systems, IBM iSeries and all IBM z/Series operating systems, including z/TPF. Luminex’s Channel Gateway supports z/OS, z/VM, z/VSE and OS/390. Both solutions provide lower tape processing costs, improved end-user service levels, and professional services to assist enterprise mainframe customers with their tape migration.

Data Mobility and Migration

Hitachi Data Systems is committed to ensuring that your data is available at the right place and at the right time. Hitachi Data Systems provides solutions for moving and/or migrating your information without impacting the performance of your system. These solutions ensure continuous access, business continuity and data resilience. They enable you to make the most efficient use of your storage assets and optimize the deployment of your critical data without impacting your business operations. Hitachi Data Systems offers solutions for movement of data in mainframe environments for migration or just for data mobility.

Hitachi Cross-OS File Exchange

Hitachi Cross-OS File Exchange software delivers high-performance, high-reliability data sharing between heterogeneous host platforms. It moves vast amounts of data quickly from mainframe to UNIX (AIX, HP, and Solaris), Linux (RedHat and SUSE) and Microsoft® Windows® environments without tying up networking resources or intermediate tape media. File transfer speeds are amplified 5 to 10 times. It enables data stored on the Hitachi storage systems to be converted and transferred between mainframe and open systems platforms and between different open systems platforms.

FICON Data Migration

FICON Data Migration is a unique feature by which z/OS data can be copied from legacy storage systems (HDS, EMC and IBM) to Hitachi Virtual Storage Platform G1000 without using host software. In addition, no conversion of data is necessary. The legacy system is connected to the Hitachi enterprise storage platform using FICON connections. The data is then moved while the mainframe applications continue to execute. It is intended purely as a means of migration. No other vendor offers this unique capability.
Integration With Databases and Applications

Hitachi supports tight integration between storage-system-based software and utilities with application and database functions. This integration optimizes resources, minimizes complexity, and provides efficient and effective management of storage resources.

Hitachi and Hitachi Data Systems have strong partnerships with companies such as INNOVATION Data Processing, Rocket Software and other independent software vendors, to strengthen Hitachi storage management and effectiveness in mainframe environments.

Mainframe Productivity

Enterprise storage solutions from Hitachi Data Systems are designed to improve productivity of storage administrators. With virtualization provided by Hitachi Universal Volume Manager, external storage from Hitachi or other vendors can be easily virtualized behind Hitachi enterprise storage controllers, such as VSP G1x00 and F1500, VSP, USP V or USP VM.

With the introduction of Hitachi Dynamic Provisioning for Mainframe environments, storage administrators do not have to manually provision storage. Rather, the storage controller will be able to provision storage, as it is needed. Hitachi Dynamic Tiering for Mainframe environments enables the automatic movement of data between tiers. HDT for Mainframe moves highly accessed blocks of data to the highest tier storage and migrates less-frequently accessed data to the lowest tiers. This reduces the time storage administrators have to spend analyzing storage usage and managing the movement of data to optimize performance.

Hitachi Tiered Storage Manager for Mainframe offers online storage service level control using HDT for Mainframe policies. With HTSM for Mainframe control of HDT for Mainframe policies, storage service levels can be controlled to improve performance and avoid problems before they happen. HTSM for Mainframe works with SMS storage group constructs, giving users the capability of managing HDT for Mainframe environments from the z/OS point of view. HTSM for Mainframe also provides reporting and control for ongoing management and monitoring of HDT for Mainframe operations.

Mainframe Analytics Recorder (MAR)

This new Hitachi Storage Virtualization Operating System feature provides detailed, time-coherent performance information in standard SMF record format for use by mainframe analytics tools. Maximizing mainframe systems use requires detailed performance information; therefore, delivering this data in native SMF format eases the performance reporting of the “whole system” mainframe analysis.

Hitachi Technology Partners

INNOVATION Data Processing

INNOVATION Data Processing’s FDR (Fast Dump Restore) Suite offers business resiliency for z/OS customers with solutions that help to eliminate business downtime for Hitachi Data Systems customers. The suite applies IBM FlashCopy data replication technology to the basic storage management operations of backup, restore and disaster recovery.

Luminex

Luminex’s Channel Gateway virtual tape solutions deliver support for z/OS, z/VM, z/VSE and OS/390; all major tape applications and tape management systems; as well as 3490 and 3590 tape devices. Luminex offers a number of
options, including compression, Luminex Replication, replication monitoring, tape monitoring and allocation control systems, plus encryption key management.

Secure Agent

Secure Agent’s SDS solution delivers a fully integrated capability for IBM zSeries and commonly installed tape management systems, providing a mainframe virtual tape solution. The SDS solution addresses organizational requirements for improved tape efficiencies, regulatory compliance and governance. It also improves compression, encryption, automation, file authenticity, secure long-term preservation and retention of mainframe content.

Hitachi Mainframe Professionals, Capabilities and Services

Hitachi Data Systems Global Services Offerings

Hitachi Data Systems Global Services organization offers market-leading storage consultants, proven methodologies and a comprehensive portfolio of assets and consulting, planning and design, installation, transition, management, education and support services for your mainframe storage environment. Global Services consultants have an average of 10 to 15 years experience at helping organizations migrate to new storage platforms, whether from Hitachi storage or other vendor’s storage. They are also able to help design, implement and manage availability and data resilience architectures to meet service level requirements. Global Services can perform a range of consulting services tailored to meet your needs. The following are some of our standard offerings:

Storage Assessment Service

By assessing your mainframe storage infrastructure, our Storage Assessment Service helps you to get the maximum value from Hitachi storage systems. This service, which can be a one-time or recurring (weekly, monthly or quarterly) assessment, provides information and guidance needed to address changes in workload and capacity patterns. It enables your organization to keep the storage infrastructure and applications running at an optimal level. This offering provides Hitachi Data Systems expertise in understanding storage usage.

FICON Migration Capabilities

Hitachi Data Systems has a unique offering for migrating mainframe data to Hitachi enterprise storage platforms. This capability helps copy z/OS data from Hitachi legacy storage and other vendor’s storage systems, such as IBM and EMC, to Hitachi Virtual Storage Platform G1x00 and F1500 without using host software or converting data. This capability moves data while mainframe applications remain accessible, all with minimal disruption or significant impact to host performance.

Local and Remote Data Migration Frame-Based Services

Hitachi Data Systems offers custom local and remote data migration services to help you achieve a seamless migration to your new storage system. Our services experts employ Hitachi TrueCopy synchronous remote replication or Hitachi Universal Replication software to efficiently transfer your data to your newly acquired Hitachi storage system at your local or remote data center.

Hitachi Cross-OS File Exchange Automation Services

Hitachi Cross-OS File Exchange automation services provide migration capabilities and z/OS automation for Hitachi Cross-OS File Exchange. It extends the capability of Hitachi Cross-OS File Exchange by enabling z/OS batch jobs to specify the details of the data exchange and then invoke the File Conversion Utility (FCU) to initiate the exchange. Multiple Hitachi Cross-OS File Exchange processes operating in parallel are supported in order to maximize throughput and minimize the elapsed time to complete the required data transfers. This service can also assist in customer migration from EMC’s InfoMover to Cross-OS File Exchange without modifying the customer’s InfoMover commands.
Remote Copy Planning and Design Service

The Remote Copy Planning and Design Service helps with costly bandwidth decisions and distance data replication challenges. Using Hitachi Data Systems remote replication best practices, our team of consultants produces a detailed study of the current workload environment. The consultants make bandwidth recommendations necessary to support and improve your remote copy environment. In addition, we provide you with a high-level design for the remote replication solution and a detailed analysis of workload and performance characteristics to help support potentially expensive bandwidth decisions.

Summary

Hitachi and Hitachi Data Systems are committed to providing industry-leading enterprise-class storage for IBM mainframe computing environments. For over 25 years Hitachi has produced and delivered storage with leading-edge function and capabilities. Hitachi has a strong relationship with IBM to ensure their ability to support the latest features and functions of z/OS when they are delivered. Additionally, Hitachi has developed and continues to develop new technology and capabilities to enable customers to maximize the efficiency and utilization of their storage and the availability of their data.

Technologies such as Hitachi Dynamic Provisioning and Hitachi Dynamic Tiering along with virtualization of both internal and external storage enable customers to get the best application performance and automated management of their storage tiers. In addition, Hitachi business continuity solutions are qualified by IBM to work with the latest releases of z/OS and GDPS and provide organizations with solid, tested disaster recovery capabilities.

Hitachi and Hitachi Data Systems are leaders in providing leading-edge technology and storage solutions for both large and not so large enterprise customers with IBM mainframe infrastructures.