White paper

Safeguarding Business Continuity on Critical SAP HANA Systems

Ongoing collaboration by Fujitsu, NetApp, and SAP has produced synergies among the companies' offerings that combine as groundbreaking infrastructure solutions for business-critical and mission-critical SAP HANA implementations. Businesses of all types and sizes stand to benefit with cost-effective, reliable, powerful mechanisms that drive insight and profitability.

Contents

Introduction

Having moved beyond the initial phase of simply making sense of massive data through efforts to build value from it, businesses now depend on big data analytics as a fundamental driver of profitability. Pricing, supply chains, and a multitude of other operational and strategic factors require real-time or near-real-time insights derived from emerging and/or stored data. SAP HANA is purpose-built for such analysis, with an in-memory engine that taps into data wherever it resides, instantaneously running the computations that fine-tune business operations for optimal efficiency and success.

As the value of these operations has become woven into the fabric of business, the systems that underlie them have become more critical to the business as a whole. In response to that progression, Fujitsu, NetApp, and SAP have collaborated to build resilient, efficient, powerful solutions to safeguard business continuity that depends on real-time analytics based on SAP HANA implementations.

This paper investigates the theory, technology, and architecture to enable business-critical and mission-critical SAP HANA infrastructure based on building blocks from Fujitsu, NetApp, and SAP. It consists of the following main sections:

- **A Growing Reliance on Critical Systems** examines some of the business transitions that are making critical SAP HANA implementations instrumental to more organizations.
- **Design Considerations for Business Continuity** correlates strategic aspects of technical and business operations in the context of high availability and disaster resilience.
- **Topologies for Resilient SAP HANA Implementations** relates various design approaches for SAP HANA business continuity to the fulfillment of business and technology goals.
- **Hardware, Software, and Services for SAP HANA Business Continuity** explores building blocks used in business-critical and mission-critical SAP HANA implementations.
- **Architecture for Backup and Recovery, High Availability, and Disaster Resilience** investigates deployment and architectural options for the development of critical SAP HANA infrastructure.
- **Fujitsu Integrated System PRIMEFLEX for SAP Landscapes: An All-Embracing Concept** describes how FlexFrame Orchestrator automates operations and incorporates SAP HANA into management and disaster-recovery processes.

1 A Growing Reliance on Critical Systems

The growing reliance on data-rich, demanding applications means that mission-critical and business-critical systems are proliferating and becoming larger, with greater requirements in terms of throughput, processing, and storage than ever before. At the same time, commercial-off-the-shelf (COTS) hardware has become more capable, with advanced reliability, availability, and serviceability (RAS) features that make it better suited to critical usages.

Business-critical systems are those such as business intelligence (BI) and analytics, where failure would result in substantial disruption and financial loss. Mission-critical systems, on the other hand, are functions, such as an e-commerce company's web presence, whose failure would result in the halting of the business as a whole. Note that a single type of system might be mission-critical at one company but business-critical at another.

Competitive efficiencies such as supply-chain optimization have helped drive the growing prevalence of business-critical systems in particular. Analytics based on real-time supply, demand, and other such factors have become instrumental to core operations, and an SAP Sales Scenario Guide identifies analytics as "business-critical and becoming more so every day."[1] Indeed, in a recent survey by Accenture and General Electric, 80 to 90 percent of respondents report that big data analytics are one of their companies' top three priorities.[2]

Adding to the proliferation of these business-critical systems, they are increasingly being driven by business units, rather than IT. In fact, Gartner has posited that 90 percent of all technology spending will be done outside of IT by 2020.[3] PricewaterhouseCoopers chief technologist Chris Curran recently said, "We're moving into a world where IT doesn't run IT anymore. IT is going to be consultative in a way that helps organizations make good decisions."[4]

In this context, business-critical systems are being established on the basis of corporate data stores to drive competitive value in areas such as the following:

- Real-time analysis and decision making
- Precise marketing
- Operational efficiency
- Innovative business models
- Customer experience enhancement

Driving value toward these goals, SAP is the decided leader in BI and analytics, with a 21.3 percent market share as of 2013, the latest year for which data is available from Gartner.[5] This figure is far above that of any competitor, all of whom had shares below 14 percent. One insight into how those data operations will be handled comes in SAP Supervisory Board Chair Hasso Plattner's 2013 letter to shareholders: "SAP HANA is the most successful product in SAP's history. This technology is the basis of all SAP applications in the future."[6]

Fujitsu and NetApp present a compelling vision for this "everything on SAP HANA" future, which is represented in Figure 1. Fujitsu and NetApp are SAP Global Partners, the highest level of such partnership granted by SAP. Solutions based on engineering from all three companies offer an excellent basis for customers to safeguard their critical systems based on SAP applications and databases.

2 Design Considerations for Business Continuity

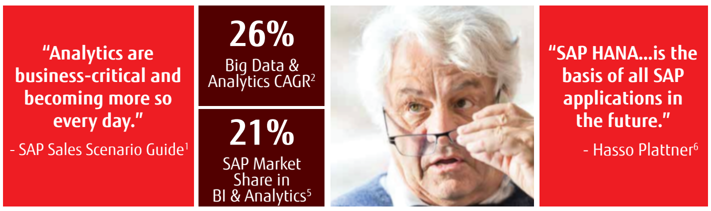

Figure 1. Business-critical analytics on SAP HANA.

Companies must plan for both routine problems and unforeseeable crises. The former could be as simple as a memory error or as significant as a server failure. The latter can include fires, natural disasters, or malicious intrusions. Protecting business continuity is crucial to the relationship between IT and the rest of the business. The process must begin with proper definition of the service-level agreement (SLA) that governs the response requirements for high availability and disaster recovery (disaster resilience) to avoid unacceptable consequences to the business.

Two of the foundational concepts that drive business-continuity planning are Recovery Point Objective (RPO) and Recovery Time Objective (RTO), which are depicted in Figure 2.

In the timeline, RPO defines the amount of data that is lost between the time of the failure event back to the latest recoverable data state.

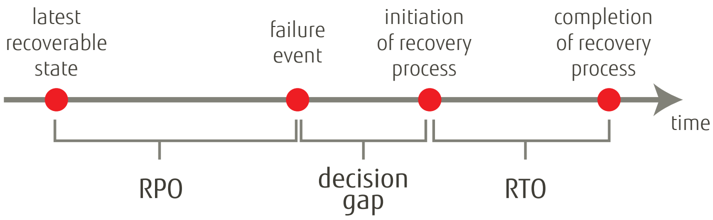

Figure 2. Business-continuity process timeline.

RTO is the period of time required after the recovery process is initiated to resume normal operation of all systems affected by the failure. Note that a decision gap is also shown, corresponding to the amount of time required to determine that the recovery process is needed and to initiate it.

This timeline also illuminates key differences between high availability and disaster recovery, two aspects of business-continuity planning. High availability refers to the automatic recovery of data and resumption of normal operations after an isolated failure at a single site. In this case, both RPO and the decision gap should be zero (or nearly so, and RTO should be fast (on the order of minutes). No data loss should occur.

Disaster recovery, on the other hand, involves manually initiated recovery from multiple concurrent failures, which could involve the catastrophic loss of an entire data center or even multiple sites. Disaster recovery typically occurs at a remote site from where the failure occurred and consists of an integrated set of processes that may involve data loss. RPO and RTO may extend into hours or even days, and the decision gap may be significant, as a decision by business management is mandatory to initiate the disaster recovery process.

Note that the decision gap is distinct from RTO in this case–the total recovery time from the failure event until the disaster recovery goal is equal to the decision gap plus RTO. This factor must be appropriately accounted for in the SLA. In addition, the completion of the recovery process is defined as reaching a set of predetermined goals according to the SLA, rather than necessarily restoring full normal operation. Other key performance indicators to be accounted for in the SLA include disaster-recovery bandwidth to be provided, as well as performance and response times associated with key business systems.

The optimum distance between the primary site and the recovery site is also vital to disaster recovery planning. The distance between the sites must be sufficient to prevent a single event such as a fire or natural disaster from affecting both. If the distance is too great, however, it may place limitations on the bandwidth available between the recovery site and the primary site, which could have a negative impact on the business. All these factors, of course, must also be considered in the context of cost.

In disaster-recovery planning specifically for SAP HANA systems, it is important to consider the impacts of real-time SLA requirements. In the case of application failover, sufficient bandwidth must be provided between the SAP HANA database and the application layer (for example, NetWeaver AppServer). The start-up time requirements for SAP HANA can also be significant: typical throughputs over 10 Gigabit Ethernet are on the order of 50–100 gigabytes per minute or 10–20 minutes loading time for a terabyte (TB) of memory.

Proper continuity planning is vital from a business perspective, in order to protect near-term profitability as well as longer-term public reputation. It can also play a significant role in regulatory compliance, where proper planning can be vital to satisfying audit requirements. The full scope of this process must adequately consider both the financial and liability costs of business interruptions and potential data loss, as well as less tangible impacts on user and customer experiences.

3 Topologies for Resilient SAP HANA Implementations

Standard architectural approaches have been established to support high availability and disaster recovery for SAP HANA implementations, including single-node and multiple-node methods. Content may be replicated to memory, disk, or central storage; in some cases, mechanisms may be based on redundant server hardware that is held on standby, to be brought online in the event of a failure. This range of flexible but standardized approaches offers businesses the choice among topologies based on best practices to meet specific needs.

3.1 High-Availability Topologies

Standard methods of configuring failover for high availability are illustrated in Figure 3. In the single-node case shown on the left side of the figure, the persistence layer and data are held in the primary SAP HANA server's memory. SAP HANA system replication is used to mirror the memory state from the primary SAP HANA server to the secondary one at the application level, providing redundancy in real time, so that if the primary server fails, the secondary one can take over.

If table preloading is turned off, the data replicated from the primary server can simply be written to disk on the secondary server, rather than being pre-loaded into memory. In that case, the data would need to be loaded from disk into memory as part of the process of bringing the secondary server online during failover. While that approach requires more time for the failover to be completed, it frees up memory on the secondary server, allowing the system to be used for other purposes (for example, development and test) when it is not actively filling in for the primary. A similar approach can be taken using storage replication, which is discussed in more detail later in this paper.

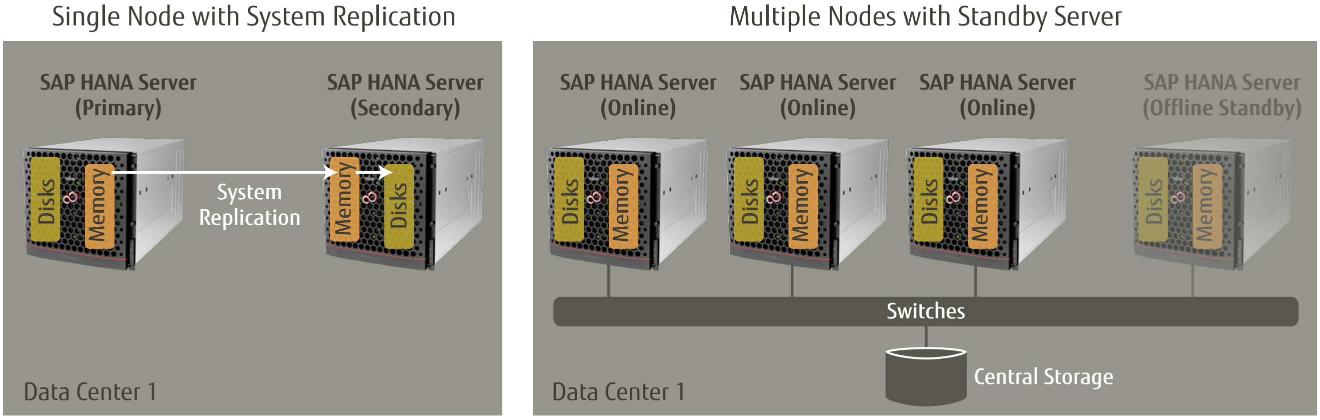

Figure 3. Application-level high-availability topologies.

The multi-node topology for high availability that is shown on the right side of Figure 3 supports scenarios where SAP HANA implementations are set up to span multiple physical servers. Here, all of the SAP HANA servers are connected to central storage through network switches, including an offline standby server that is held in reserve to cover for any of the main servers in the event of a failure. Note that this approach is only intended to address the failure of a single server. On its own, this topology does not provide redundancy to parts of the infrastructure other than the servers themselves, so that failure of a central part of the topology could result in an outage that covers the entire installation.

3.2 Disaster Recovery Topologies

Some representative topologies for multi-site disaster recovery are illustrated in Figure 4. The single-node case that is illustrated on the left side of the figure is similar to the single-node high-availability topology described above, except that rather than being co-located in the same data center, the primary and secondary servers are located at separate geographic locations. The same system replication mechanism is used over a wide-area link as was used over a local-area one in the co-located case.

Similar to the single-node high-availability approach described above, table preloading can be turned off, so that data is written to disk on the secondary server, rather than being preloaded into memory. The topology can be configured for synchronous operation (though with some distance limitations between the sites), which prevents data loss. Asynchronous operation can support longer distances, but there is some potential for data loss during failover from the primary server to the secondary one.

In the topology illustrated on the right side of Figure 4, the data required for a restart of the SAP HANA system (which may consist of a single node or multiple nodes) is stored to NetApp storage. The data is mirrored across the two sites through any of several storage-based replication mechanisms from NetApp, such as MetroCluster or SnapMirror. This replication can be configured to occur synchronously or asynchronously, according to the business needs of the customer, the distance between the sites, the throughput available between the sites, and so on.

SUSE Linux Enterprise Server for SAP Applications helps automate system replication and failover at the OS level, using resource agents that enable the high-availability and disaster-recovery topologies described in this section using SAP HANA clusters. The relevant mechanisms from both NetApp and SUSE are described in more detail later in this paper.

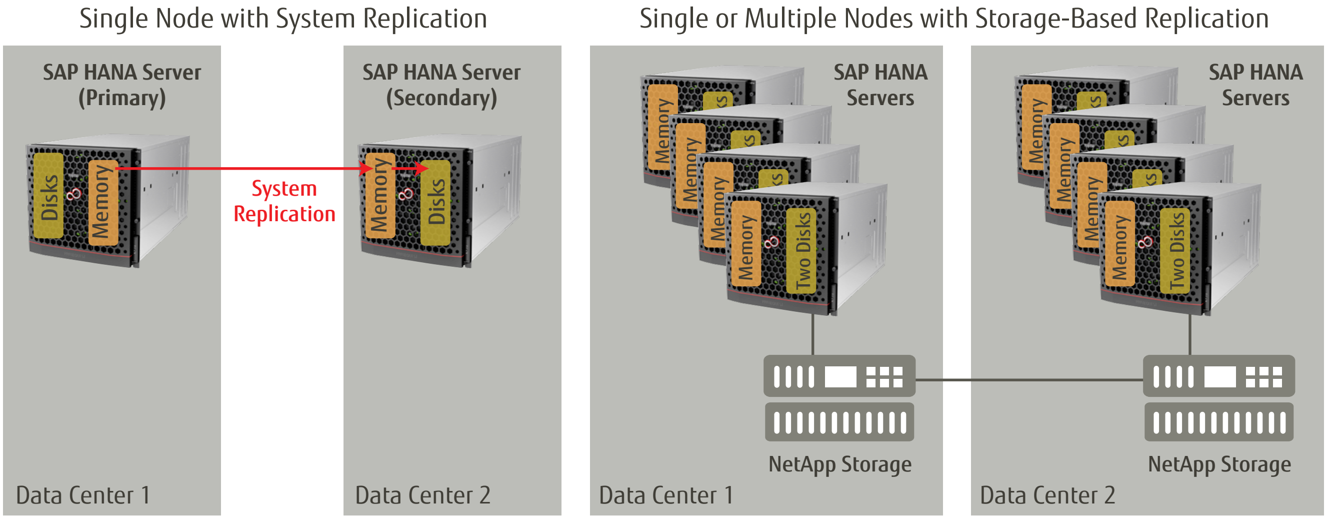

Figure 4. Application-level and storage-based disaster-recovery topologies.

4 Hardware, Software, and Services for SAP HANA Business Continuity

The ongoing collaborations among Fujitsu, NetApp, SAP, and SUSE have created an interconnected set of synergies that deliver business value by safeguarding business continuity in implementations such as those based on SAP HANA. Hardware and software features play separate but complementary roles in providing high availability and disaster resilience that protect the business in both ordinary and extraordinary operational circumstances.

4.1 Fujitsu Servers Tailored to Various Business Needs

As the foundation for business-critical and mission-critical infrastructure, Fujitsu Server PRIMERGY and PRIMEQUEST, shown in Figure 5, protect business continuity while helping ensure low cost and complexity in the data center. Built on a foundation of open standards and based on the Intel® Xeon® processor E7 v2 product family, these systems provide a range of options to meet the varying needs of critical applications across SAP HANA implementations.

Figure 5. Fujitsu Server PRIMERGY and PRIMEQUEST for business-critical and mission-critical implementations.

The Fujitsu Server PRIMERGY RX 4770 M1 is a quad-socket, 4U rack-mount system for business-critical implementations, supporting up to 6 TB of memory. This offering incorporates built-in redundancy and hot-pluggable components to help reduce the potential for unplanned outages. RAS features include Advanced ECC, memory scrubbing, and other resiliency capabilities that operate at the processor, firmware, and software levels to diagnose, contain, and recover from otherwise-fatal errors.

Another set of options for critical SAP HANA deployments, Fujitsu Server PRIMEQUEST systems offer a range of options, with multiple system boards and different levels of RAS features. The Fujitsu Server PRIMEQUEST 2800B supports up to four system boards with two processors each and a total of 12 TB RAM. Fail-safe operation for business-critical implementation is enhanced with capabilities such as memory mirroring, multiple system-interconnect routes, and redundant fans, PCI Express components, Ethernet ports, hard drives, and more.

Enhanced with features for further protection of business continuity, the Fujitsu Server PRIMEQUEST 2800E (with four two-way system boards) and 2400E (with two two-way boards) target mission-critical implementations, including those based on SAP HANA. These systems allow partitions to span multiple system boards, enabling service to continue even in the event of a full board failure. In addition, Dynamic Reconfiguration helps recover from failures on system boards or I/O units without system stoppage.

This range of server options from Fujitsu enables businesses to build interoperable, standards-based infrastructure that is tailored to the needs of specific solutions. Working together, these building blocks help provide fail-safe operation for business-critical and mission-critical SAP HANA implementations.

4.2 NetApp Storage for Cost-Effective Disaster Recovery

As described above, the data-management fabric provided by NetApp allows storage-based replication of SAP HANA data sets across either short or long distances. NetApp also provides technologies that enhance those capabilities by addressing the traditional challenges associated with cloning data.

Conventional copy utilities were not designed to handle the extremely large production data sets used in SAP HANA implementations. In fact, because of the high cost of moving and maintaining many copies of production data, companies often rely on static, stale copies of data, which can dramatically reduce the effectiveness of the disaster-recovery solution.

As an alternative to making resource-intensive full physical copies, NetApp Snapshot™ technology can reduce the time required to create a database backup from a matter of weeks or days to minutes, independent of the size of the data set. Moreover, the use of Snapshot backups has no impact on production systems, allowing them to be made even during periods of peak activity. Typical usage scenarios may create Snapshot backups several times per day, which can be carried efficiently, delivering business benefits that include the following:

- **More comprehensive backup operations** associated with more frequent recoverable data states that can be created and stored using a far lower amount of resources.
- **Enhanced performance**, because resources on production systems that would otherwise be consumed by large-scale data copies can be applied to more useful work.
- **Dramatically accelerated restore and recovery**, reducing downtime by eliminating time-intensive transport and load requirements associated with large data sets.

Using copies of production data created with FlexClone technology (essentially a writeable Snapshot), development and operations teams can test the disaster-recovery system on an ongoing basis, without involvement from the storage team. The lightweight nature of the data backups allows the test environment to be set up and broken down quickly, reducing the effort and time requirements for such testing. The frequent testing helps increase the confidence of the broader business in IT's ability to carry out effective disaster-recovery operations if needed.

The lightweight backup and recovery operations enabled by the Fujitsu and NetApp approach enables benefits that go far beyond efficiencies in the disaster-recovery environment itself. Rather than having the associated server hardware stand idle on a day-to-day basis, it can be used to support ongoing development, test, and QA operations. Organizations effectively obtain the infrastructure to support those activities free of charge when they implement disaster recovery for SAP HANA.

The NetApp Solution for SAP HANA tailored data center integration (TDI) provides a compelling range of certified options for disaster recovery solutions. The breadth of TDI certification gives IT organizations a wealth of choices among pre-validated, high-capacity, high-performance storage components, allowing tight integration of SAP HANA into existing data center environments.

4.3 Automation and Enhancements from SUSE Linux Enterprise Server

SUSE Linux Enterprise Server for SAP Applications, which is endorsed by SAP as the OS of choice for SAP HANA implementations, automates system replication and the initiation of disaster-recovery operations. Capabilities built into the OS enable failure detection and automated responses according to pre-established rules and business logic. It also simplifies the process of switching the environment back from disaster-recovery mode to normal operating status when the event underlying disaster-recovery initiation is resolved.

SUSE Linux HA Cluster is a standard cluster implementation that has been validated for use with SAP HANA implementations, with the addition of two resource agents that enable and automate SAP HANA system replication (SAPHanaSR). The first of these is SAPHanaTopology, which runs on every node in the cluster and analyzes the status of the environment on an ongoing basis. This topology agent monitors all system replication data flows, including the roles of individual nodes and the statuses and configurations of all individual transfers.

The other resource agent packaged with SAPHanaSR is SAPHana, which is configured as a master/slave resource that assumes responsibility for the SAP HANA database instances. (The master governs the database instances running in primary mode, while the slave takes charge of the database instances running in secondary mode.) This cluster agent responds to guidance from the topology agent, automatically restarting databases or taking other corrective action, according to configurations that are established using the SAPHanaSR Hawk Wizard that is provided for that purpose.

Fujitsu worked closely with SUSE during the development of SAPHanaSR, including validating it for use with SAP HANA systems based on Fujitsu hardware. As such, Fujitsu has substantial expertise with the technology, adding value to customer implementations, where SUSE SAPHanaSR offers the following benefits for SAP HANA environments:

- **Reduced complexity**, including a simplified, wizard-based configuration that enables disaster-recovery operations to be automated.
- **Lower risk**, enabled by a constant monitoring view of the SAP HANA topology as the basis for intelligent component and site selection for failover.
- **Greater reliability**, based on shorter takeover times and monitoring of system replication status to increase data consistency.

Ongoing SUSE development for additional topologies is underway, including in areas such as multi-node and chain topologies, as well as support for remote development and test functionality.

4.4 Consulting and Integration Services Drive SAP HANA into the Fabric of the Business

Implementations of large-scale environments such as SAP HANA are necessarily customer-specific, meaning that the ideal solution for any given customer is always a unique one. To that end, Fujitsu has developed extensive expertise, processes, and facilities to optimize solutions for specific customer needs. The Fujitsu Business Solutions Group brings together diverse expertise that spans business and technical considerations to create a comprehensive, multi-faceted approach that helps ensure project success. As part of each SAP HANA customer project, Fujitsu offers three solution phases: Design, build, and operate.

In the design and pre-implementation phase, Fujitsu experts meet with business and technical teams within the customer organization to identify opportunities and challenges to be addressed by the project. Based on the outcome of that fact-finding effort, specifications and designs for the implementation are created and refined, according to best practices established through extensive prior experience with similar efforts. Detailed planning for the migration to the new environment, including change management and contingency planning, is established to map the transition.

In the build and implementation phase, the entire solution is staged at one of the Fujitsu Staging Center facilities, where the solution is installed, configured, and extensively tested, according to the specifications developed during the design phase. After the solution has been successfully verified and tested, it is shipped in a preinstalled, preconfigured state to the customer site. Upon arrival, the SAP HANA systems are put into service by Fujitsu engineers, testing verifies correct integration with existing infrastructure, and final fine-tuning is carried out to ensure fully optimized operation.

In the operational phase, Fujitsu remains closely involved with "go live" support to ensure smooth operation in production. Customer-specific training materials and services are provided to administrators and end users within the customer organization to help maximize return on investment. Fujitsu also coordinates ongoing support and integration of new offerings, features, and capabilities from providers of solution building blocks, including NetApp, SAP, and SUSE.

5 Architecture for Backup and Recovery, High Availability, and Disaster Resilience

5.1 Storage and Tool-Based Methods for Backup and Recovery

As described previously, Snapshots is a storage-level technology that allows for the near-instantaneous creation of read-only images of production data, without additional overhead to the production systems. Snapshot images can be integrated with SAP HANA Studio to provide full, application-consistent backups that can be used for point-in-time recovery. Replication mechanisms allow replication at the storage level from one storage system to another, physically separate one, using either NetApp SnapVault or SnapMirror.

- **NetApp SnapVault** allows for the retention of a configurable number of multiple snapshots for use in backup; separate retention policies can be specified on primary and secondary storage, allowing longer retention policies on (typically less expensive) secondary storage than on primary storage, for example.
- **NetApp SnapMirror** creates an incremental snapshot on a regular schedule for use in disaster-recovery operations, which it uses to update the previous snapshot, which is mirrored from primary to secondary storage.

For both SnapVault and SnapMirror, only the changed data is replicated from primary to secondary storage, reducing load on the storage systems and the network link between primary and secondary storage. In all but the initial backup snapshot, SnapVault stores only the changed blocks at the destination, which significantly speeds up database backup and reduces backup volumes drastically when compared to more conventional, server-based backup methods, which currently only support full backups of the SAP HANA database. SnapMirror stores a complete, incrementally updated copy of the SAP HANA database.

Because backup operations are decoupled from the SAP HANA servers, impacts on production are avoided. Backups can also be copied from the secondary system to archival storage for long-term retention. Snap Creator manages snapshots at the application layer, ensures database consistency among snapshots, and manages retention of snapshots on both primary and secondary storage.

5.2 Two-Site Deployment Options for Disaster Recovery

Two-site disaster-recovery topologies can be deployed for SAP HANA in either asynchronous or synchronous mode. With asynchronous mirroring, as described earlier in this paper, storage-based replication of data from the production environment can be made to a remote recovery site using snapshot copies, as illustrated in Figure 6. In this topology, the hardware at the disaster-recovery site can be used both for disaster-recovery testing and to operate a general-purpose operational development and test environment, delivering value from the disaster-recovery hardware, rather than requiring it to stand idle during normal operating conditions.

When disaster recovery is initiated, the following actions are taken:

1. Development and test servers are shut down.
2. The mirroring relationship between the sites is broken.
3. Servers are pointed to the latest snapshot on the production mirror.
4. SAP HANA is started.

This failover process requires roughly 30 minutes to complete, not including SAP HANA start-up time.[7] Because the data replication is asynchronous, the data is only as fresh as the latest snapshot and some data loss is possible. In cases where the customer requirement is to have an assured RPO of zero (guaranteed zero data loss), synchronous mirroring of data can be used, as illustrated in Figure 7. This approach uses MetroCluster to mirror data synchronously across sites that are up to 200 kilometers apart.

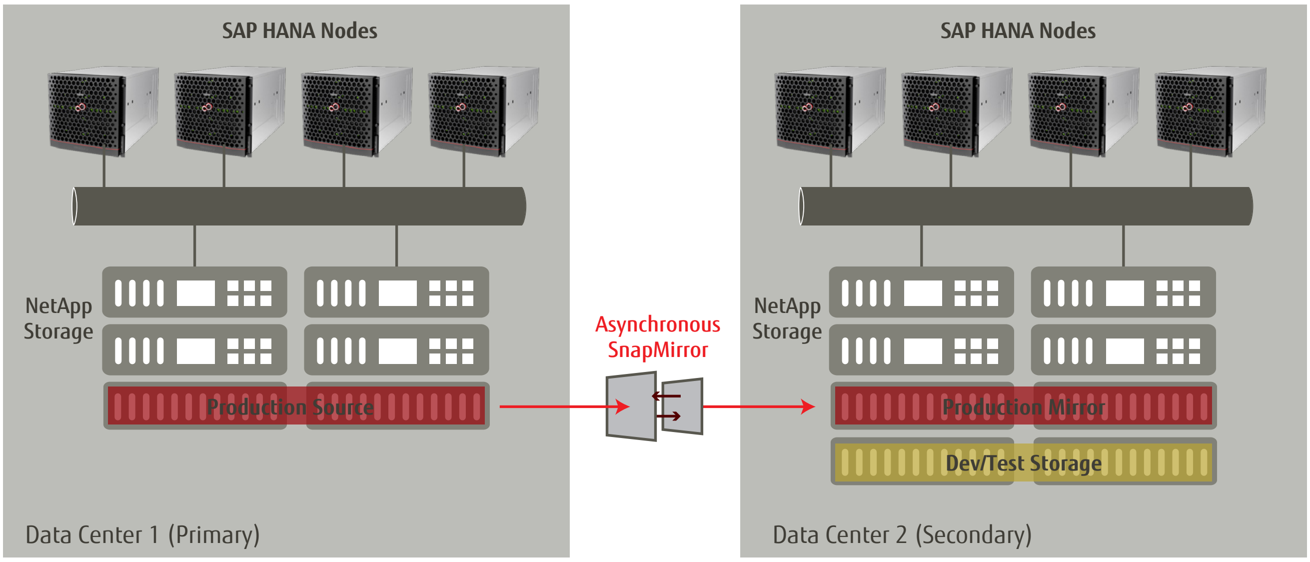

Figure 6. Disaster recovery for SAP HANA with asynchronous storage-based mirroring.

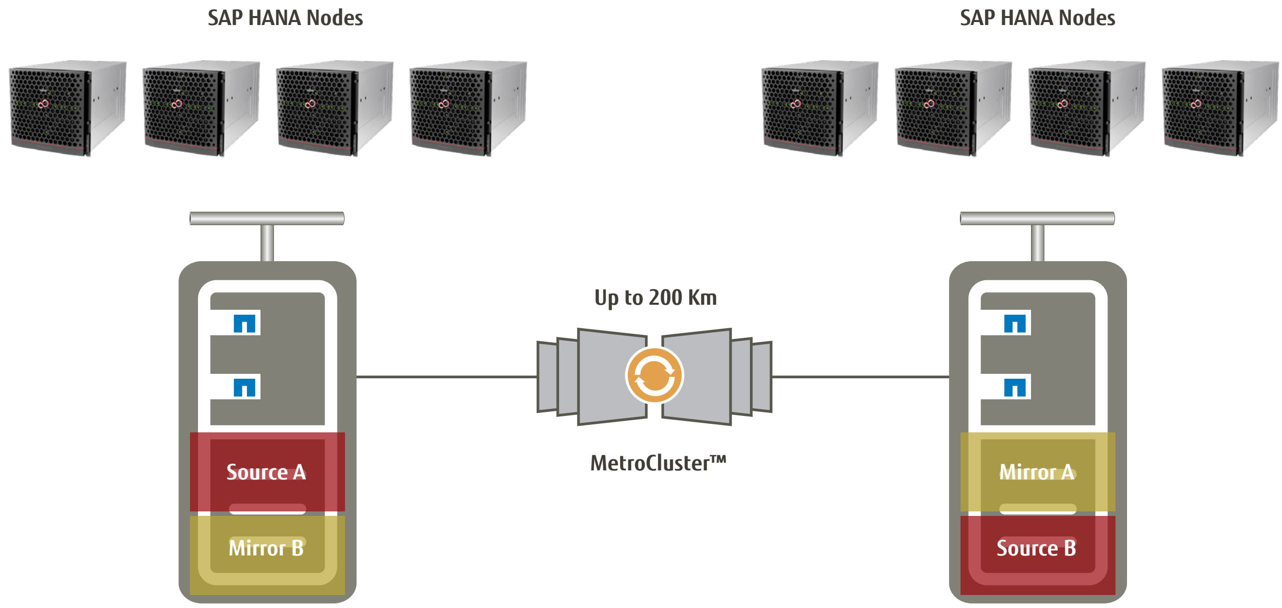

Figure 7. Disaster recovery for SAP HANA with asynchronous storage-based mirroring.

5.3 Summary of Primary SAP HANA Approaches to Business Continuity

The primary approaches to business continuity architecture described in this paper are summarized in Figure 8. As noted previously, synchronous approaches are generally better suited to high-availability usages than asynchronous ones are, with the chief differentiator in terms of KPI being an RPO of zero. Further, synchronous system-replication in memory (with table preloading turned on) is better suited to high-availability scenarios than the equivalent approach where data is written directly to disk instead of to memory (table preloading turned off).

Method	Usable for	Primary KPIs	
	HA DR	RPO	RTO
MultiNode Standby		0	5-45 minutes
System Replication (synchronous, in-memory)		0	5-15 minutes
System Replication (synchronous)		0	5-15 minutes
System Replication (asynchronous)		seconds	5-15 minutes
Storage Replication (synchronous)		0	10-60 minutes
Storage Replication (asynchronous)		seconds to hours	15-75 minutes
Backup / Recovery		2x backup interval*	many hours**

Figure 8. Summary of primary SAP HANA disaster recovery and high-availability concepts.

NOTES:

* RPO for backup and recovery can be reduced by retaining system logs at the disaster-recovery site.

** RTO of backup and recovery can be reduced to a couple of minutes using Snapshot backups.

For disaster-recovery scenarios, system replication approaches offer shorter typical RTO than storage replication. On the other hand, using asynchronous storage replication as the basis for disaster recovery architecture offers compelling business advantages. The ability to use the disaster recovery servers for disaster recovery testing as well as for operational development and test environments provides outstanding business value from the capital cost and operating expense associated with the disaster recovery hardware. Moreover, the ability to test the disaster recovery solution on an ongoing basis with little overhead helps build IT's credibility, better aligning it with the rest of the business.

6 Fujitsu Integrated System PRIMEFLEX for SAP Landscapes: An All-Embracing Concept

As discussed in this paper, approaches to ensuring resilience for business-critical and mission-critical SAP applications and databases range from advanced server, storage, and OS features to two-site disaster recovery topologies. However, measures to increase the availability of a platform may conflict with other operational goals, such as simplifying the infrastructure, reducing costs, and increasing agility. The challenge of meeting all these goals requires an over-arching mechanism to automate operations while integrating SAP HANA fully into management and disaster recovery processes.

The Fujitsu Integrated System PRIMEFLEX for SAP Landscapes provides that all-embracing solution. It leverages advancements based on the well-proven FlexFrame for SAP solution, which was created through a joint development initiative with NetApp and SAP that began more than 10 years ago. The Fujitsu FlexFrame Orchestrator software, a core component of PRIMEFLEX for SAP Landscapes, enables the quick setup of intelligent, efficient infrastructures for SAP applications and SAP HANA, including built-in high availability and simple implementation and management of mission-critical readiness. All of the software needed to run SAP HANA instances, including the server OS and all SAP software, is stored on NetApp storage devices that are typically clustered together using MetroCluster technology. The OS images include FlexFrame agents that are part of the FlexFrame Orchestrator software and enable management of the environment, spinning up and shutting down SAP HANA instances as needed on any suitable physical or virtual server.

By decoupling SAP HANA instances from the hardware they run on, this approach eliminates the need to size individual servers to accommodate maximum potential peak requirements. Instead, the need for headroom capacity is shared among all servers in the environment, increasing efficiency in the use of server assets and reducing hardware spend. The FlexFrame Orchestrator software identifies the optimal choice of server hardware for a given SAP HANA instance at start-up, dynamically sizing and load balancing the environment.

The underlying virtualization technology is an example of the paradigm SAP refers to as "adaptive computing." The virtualization layer is situated above the OS level, decoupling instances of SAP HANA and other SAP applications from the OS, allowing them to be dynamically reassigned among physical and virtual servers as needed. Thus, from a management standpoint, SAP HANA is treated as any other database, more fully integrating it into the environment as a whole. This application-level virtualization can be combined with other mechanisms such as hypervisor-based virtual machines to enhance flexibility in overall architecture and management.

A single environment can also span multiple sites that are 100 kilometers or more apart. Because normal day-to-day operations involve dynamically assigning applications to servers across the environment according to availability and capacity, disaster recovery is essentially transparent. In the event of the failure of one or more servers, or even an entire site, the FlexFrame Orchestrator software continues to have access to other resources, allowing production systems to continue operation without invocation of any special DR process. In sum, PRIMEFLEX for SAP Landscapes delivers benefits within SAP HANA environments that include the following:

- **Increased business productivity** enabled by rapid provisioning of new applications and services
- **Improved profit margins** due to cost effectiveness gained through accelerated development, test, and integration times and better physical resource utilization
- **Dramatic simplification** of resource management and business continuity planning and operations
- **Automated and integrated HA/DR** concepts for the entire SAP landscape, including SAP HANA and the innovative SAP S/4HANA software suite

As the management backbone of the SAP HANA environment, PRIMEFLEX for SAP Landscapes integrates latest-generation technologies from NetApp, SUSE, and SAP. This simplifies customer efforts to implement new capabilities, providing a source of automatic innovation for customers on an ongoing basis.

The pretested and preinstalled combination of servers, storage, network connectivity, and software rounded out by industrialized services helps ensure a seamless and secure high-quality implementation and operation and a quick path to business value.

Conclusion

Comprehensive SAP HANA solutions from Fujitsu, NetApp, and SAP can accelerate and improve mission-critical and business-critical solutions and processes. Comprehensive technology and expertise built through years of ongoing collaboration among these first-tier providers help customers improve their agility by transforming operations through innovation.

The recently completed Fujitsu KISS Report on SAP Projects[8] reveals that while the majority of companies see potential in further exploiting the value of SAP solutions, doing so can be a demanding task for managers. The comprehensive, individualized approach to solutions design that is led by Fujitsu includes both IT and business decision makers within customer organizations early in the process, rigorously identifying and addressing the challenges and opportunities associated with every implementation.

Every design and implementation builds on a history of more than four decades of collaboration between Fujitsu and SAP, as well as more than 10 years of work on PRIMEFLEX for SAP Landscapes by Fujitsu, NetApp, and SAP. The consulting and integration expertise built through those years of working together, and hundreds of SAP HANA implementations, uniquely positions customers to transform the SAP landscape in their organizations, tapping into data wherever it resides to build business value, while meeting the high-availability and disaster recovery needs of their business-critical and mission-critical systems. This on-ramp to continuing innovation from Fujitsu, NetApp, and SAP also helps customers grow the solution to meet changing needs, using the best that the industry has to offer.

For more information, visit

www.fujitsu.com/fts/products/computing/servers/mission-critical

and

www.fujitsu.com/fts/sap

[1] Source: https://websmp102.sap-ag.de/~sapidp/011000358700000434802013E/assets/SAP_Analytics_Sales_Scenario_Guide.pdf.
[2] Source: http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Industrial-Internet-Changing-Competitive-Landscape-Industries.pdf.
[3] Source: http://www.gartner.com/newsroom/id/2208015.
[4] Source: http://www.informationweek.com/strategic-cio/digital-business/how-cios-can-help-cmos-take-technology-leadership/d/d-id/1316233.
[5] Source: http://www.gartner.com/newsroom/id/2723717.
[6] Source: http://www.sap.com/bin/sapcom/en_us/downloadasset.2014-04-apr-01-01.sap-2013-annual-report-pdf.html.
[7] 30 minutes is an approximate figure, based on experience from multiple implementation projects.
[8] http://globalsp.ts.fujitsu.com/dmsp/Publications/public/Fujitsu%20KISS%20Whitepaper%20Draft%20V3_CLEAN.pdf.

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