



Hewlett Packard
Enterprise

HPE Reference Architecture for Enterprise Application Continuity Solution for SAP/SAP HANA

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Executive summary

It's 2:35am in the morning and you are awakened by a severe thunderstorm that has knocked out power to your neighborhood. A quick glance at your smart phone and you see an update from your data center management system indicating a power outage at your primary data center. This is followed by another message indicating your mission critical SAP HANA® systems have successfully migrated to your secondary Disaster Recovery (DR) site. Just to reassure yourself, you open a browser on your phone and check your personal profile page. As your information comes up, you wince at the sight of your five-year-old photo showing off your badly out-of-date haircut. Your thoughts of needing to change that photo are interrupted by a text from your Operations Center. It reads, "Complete power outage at DC1. No observed outages of mission critical services..." It worked!"

In today's world economy, outages of business-critical applications can be extremely costly. Many best-run companies have experienced negative financial impacts due to system outages and the inability to recover quickly. Protecting mission-critical SAP® applications is becoming increasingly challenging. Larger data volumes, persisting databases in memory, and geographically dispersed data centers make protecting business-critical applications and their data one of the most complex jobs in the IT industry. According to SAP, one of the critical success pillars for enterprise-grade SAP deployments is continuous availability of applications. Application complexity, accelerated data growth, and the ever increasing business demands to always have access to business data can stress even the best IT organization. Hewlett Packard Enterprise understands how important your business needs are and how demanding today's business requirements are when architecting and designing enterprise business applications. That is why we at Hewlett Packard Enterprise focus on business solutions – to help you sleep at night!

This HPE Enterprise Application Continuity (EAC) Solution Reference Architecture (RA) for SAP HANA has been created for IT architects, systems engineers, operations engineers, supporting sales engineers and system integrators who are involved in planning, implementing, and configuring an SAP HANA installation. It covers all the necessary hardware, software, installation, and configurations for production, High Available (HA) and Disaster Recovery (DR) environments. This Reference Architecture (RA) has been built and tested, using HPE equipment certified for SAP HANA for Tailored Datacenter Integration (TDI). The architecture, design principles, and best practices supporting this Reference Architecture come from our teams of research and development engineers, pre-sales SAP support engineers, HPE Pointnext service teams, and Hewlett Packard Enterprise's combined 27 years of co-innovation with SAP.

This Reference Architecture is based solely on creating a multi-geographical, production data center model running SAP/SAP HANA applications. It has been designed and configured for maximum uptime with safeguards to address single and multiple single points of failure. Mission critical applications and databases are distributed across HPE award winning servers, storage, and networking infrastructures. SAP applications are protected using HPE Serviceguard for Linux® and HPE storage offerings including: HPE Recovery Manager Central for SAP HANA, HPE StoreOnce systems, and HPE 3PAR StoreServ replication and remote copy services.

This Reference Architecture provides not only the design and architecture for a production HA/DR SAP/SAP HANA environment, it also provides the configuration and operational elements to verify, test, and modify your environment. It identifies required IT services necessary to ensure correct production configuration and simplified management. All of these best practices have been organized in one place to help your IT organization be successful in meeting your business demands.

When you implement this HPE Reference Architecture for EAC Solution for SAP/SAP HANA, we recommend you engage with HPE Pointnext to provide automation of HPE Recovery Manager Central (RMC) for SAP HANA under Serviceguard, which will also give you access to support, advisory, operational, and professional services to help you customize all your SAP applications. You can also subscribe to the HPE Datacenter Care program to have Hewlett Packard Enterprise provide you with a more personalized and custom approach to managing your data center.

Target audience: This document has been created for IT systems architects, systems engineers, and operations engineers participating in the installation and configuration of an SAP HANA TDI solution.

Document purpose: The purpose of this document is to describe the design, configuration, and operations of the HPE Reference Architecture for Enterprise Application Continuity (EAC) Solution for SAP/SAP HANA, highlighting recognizable benefits to technical audiences.

Introduction

Designing and implementing a highly available and disaster tolerant architecture for SAP HANA can be a challenging undertaking. Ensuring your SAP applications and SAP HANA databases are performing at their best can take significant effort. Verifying failover strategies and replacement practices work as expected without disrupting business-critical services is an often neglected practice; however, those operational and maintenance activities are essential if you want to have the confidence your solution is ready for production.

This HPE Reference Architecture for Enterprise Application Continuity Solution for SAP/SAP HANA outlines the equipment, infrastructure, and software necessary to create a multi-geographical data center to support production SAP applications using SAP HANA. Included in this Reference Architecture (RA) are the design, reasoning, configurations, validations, and best practices for building your SAP HANA Tailored Datacenter Integration (TDI) SAP applications.

We recognize that each customer environment is unique and has variables that must be taken into consideration when using this RA to design a specific customer environment. These variables can impact performance and add complexities, which can require differences in configurations and operational steps. All of these corner cases are not accounted for in this RA. There are also many use cases around different parts of an application continuity solution for SAP/SAP HANA, which add to the complexities of the solution. For example, customers often ask about the following use cases when discussing backup and restore:

- Restore parent disk – restoring from a backup to the same server node to a new volume. This is the most common use case after a volume failure.
- System Refresh – restoring from a backup to a new set of equipment. This is a common use case when replacing equipment after a server failure or server upgrade.
- Disaster Recovery – restoring from a backup to a new site and new set of equipment. This is a worst case scenario, which covers a failure of a complete site and the failure of a DR site's data integrity.

Each customer's environment can introduce many unique use cases for each of the major areas of this EAC solution Reference Architecture. This document doesn't attempt to cover all use cases. When necessary we have identified in the respective sections the limits of testing and validation performed for specifically known use cases. For example, in the backup and recovery section of this RA we identify: "This HPE EAC SAP HANA solution RA currently addresses the "Restore parent disk" use case."¹

The following sections outline all the details and specifications needed to support SAP/SAP HANA TDI in a fully production environment.

- Solution overview
- Design features
- Solution components
- Capacity and sizing
- Configuration
- Installation and configuration

Each of these sections identifies the components of the solution and outlines the specific details for those components for that particular section.

In most enterprise IT environments, the responsibility and expertise for all the components for this architecture are typically found on multiple teams. To assist with the implementation and configuration, this RA includes an overview of the solution to provide all teams with a basic understanding of the systems that make up the SAP/SAP HANA solution. Following this overview is a summary of all the components that make up the solution.

¹ Documentation of configuration and operations of this use case and the other two use cases are planned for subsequent versions of this RA. Check the [HPE Information Library](#) for updates.

Solution overview

In traditional IT sales patterns, business solutions were talked about; however, point products were sold. This would leave customers and system integrators trying to figure out how to connect all this “stuff” together and what configurations to use. Not all products play by the same rules and not all configurations work the first time. Hewlett Packard Enterprise understands how critical SAP business applications are to their customers. The Enterprise Application Continuity Solutions Team has designed, implemented, and tested this HPE Reference Architecture for Enterprise Application Continuity Solution for SAP/SAP HANA. The HPE EAC Solution for SAP HANA focuses on the full stack of applications, services, infrastructure, and recovery services for a Highly Available (HA), disaster recovery (DR), production business environment. Our solution covers the systems and infrastructures for a multisite data center based on a primary site and a remote active/standby site fully supported and certifiable under the SAP HANA TDI model. Using HPE industry leading servers, storage, networking, services, and clustering software, this Reference Architecture design models a multi-geographical data-center solution, including application load balancing and failover protection, storage replication and snapshots, and recovery solutions to create a complete Enterprise Application Continuity plan.

Figure 1 provides a high-level view of the major elements associated with the HPE Reference Architecture EAC Solution for SAP HANA. An overview of the components referenced in this document are found in [Solution components](#). A complete listing of the components and part numbers are found in [Appendix A: Bill of materials](#).

Design features and considerations are described in [Design features](#), which highlights the reasoning behind design decisions and architecture choices. Following this section are configuration and operational specifics used to create this Reference Architecture.

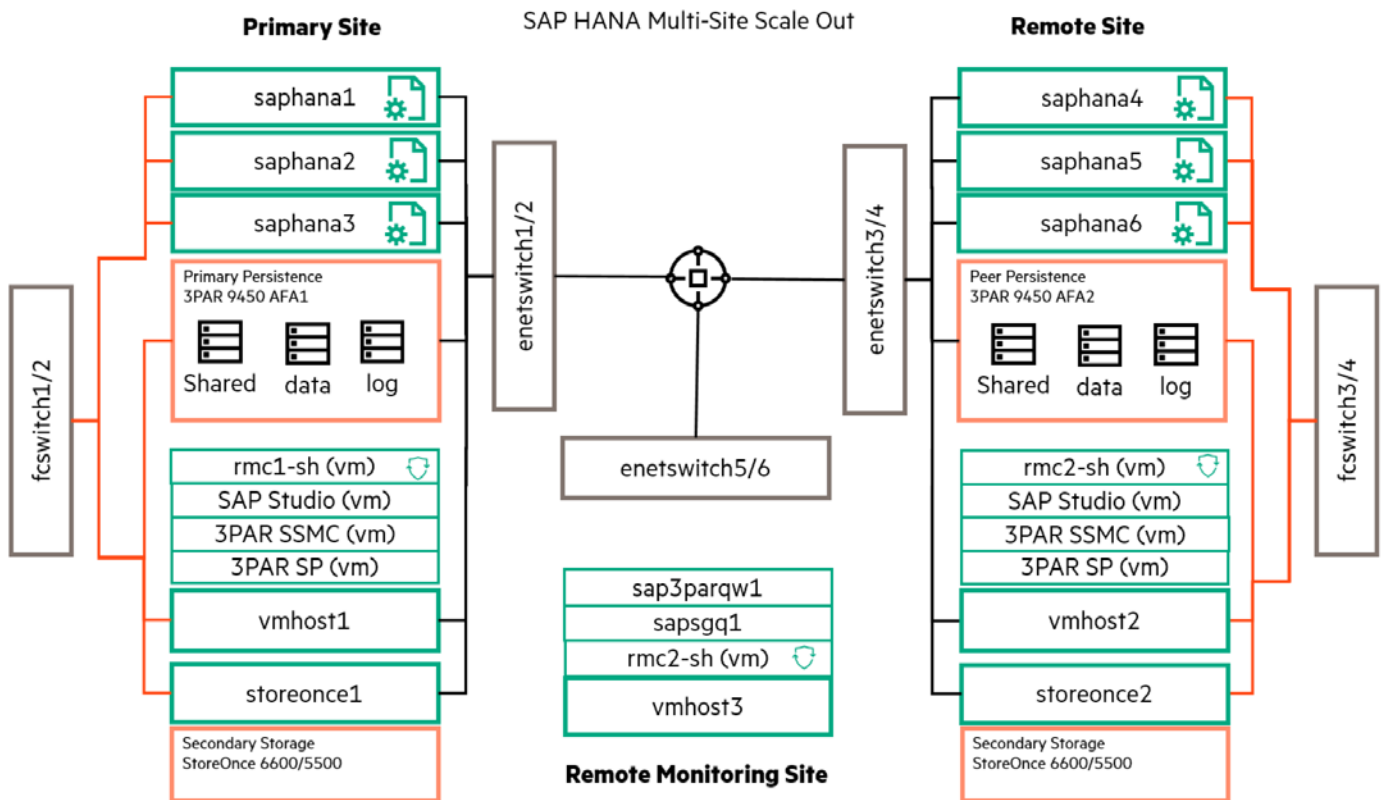


Figure 1. SAP HANA solution architectural diagram showing support systems and SAP HANA database and application servers for an Active/Passive site design

Figure 2 shows the physical rack layout for a single site for this SAP HANA solution. The HPE 3PAR 9450 All-Flash-Array (AFA) is the primary storage used along with HPE ProLiant DL580 servers for the SAP HANA server cluster.

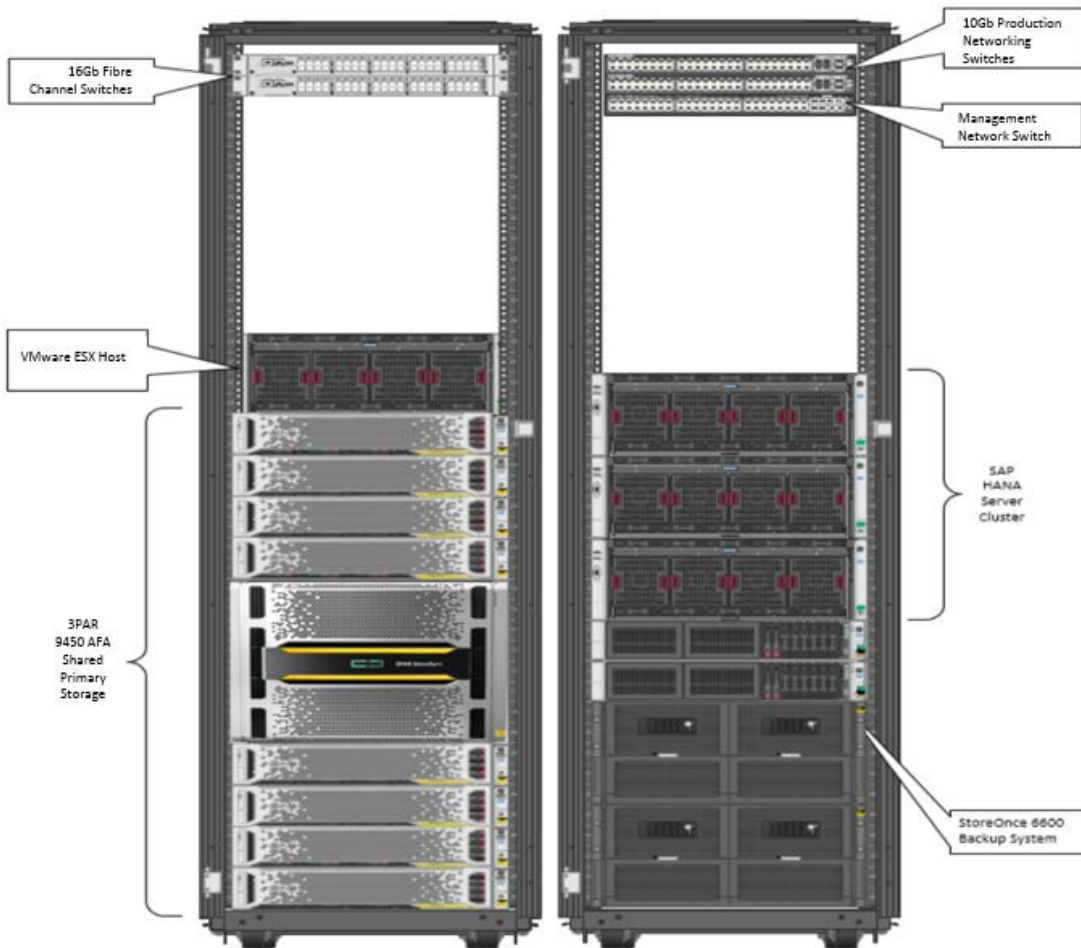


Figure 2. SAP HANA solution Architectural rack layout for a single site. The second site should have an identical configuration.

Design features

When creating a solution design for a mission-critical, SAP HANA-based application, there must be a strong understanding and balancing of many architectural considerations. This Reference Architecture has been designed based on the extensive experience of HPE pre-sales engineers, support teams, and HPE customers. The architecture focuses on six 9's High Availability, site disaster recovery, and the rigorous performance demands of SAP HANA production systems. Design considerations have also been made based on operational management of the solution, including validation and testing processes associated with replacement and recovery methods for single-and multiple-points of failure common to a production IT environment. This includes the potential for localized data center failures. This is why the primary and remote data center designs have been included as part of this Reference Architecture.

Primary Site

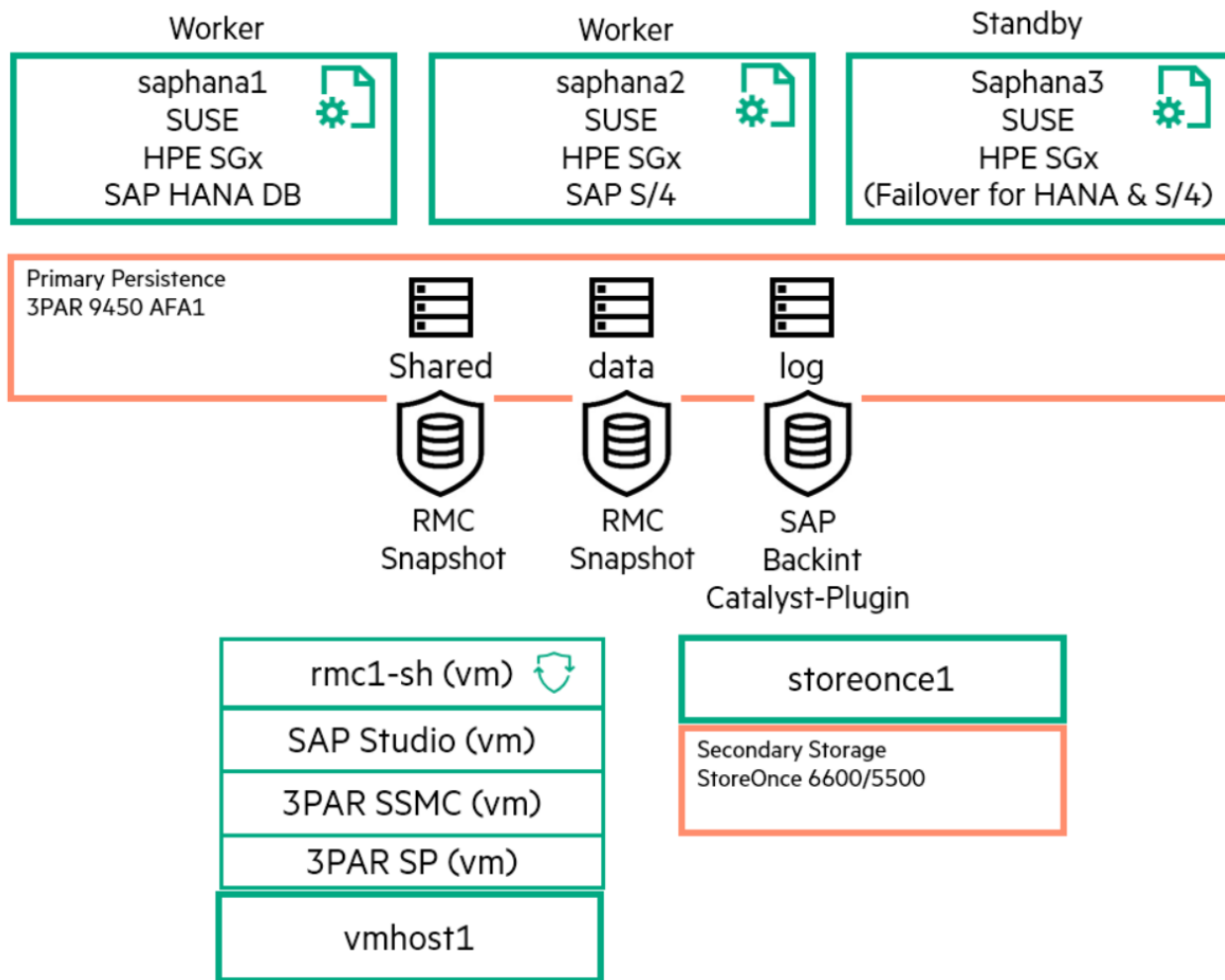


Figure 3. SAP HANA solution architectural Primary Site block diagram

When creating complex solution designs, simplification becomes a key to success. For this reason, this Reference Architecture recommends using the same equipment at both locations and keeping configurations the same, as much as possible. Although this design recommendation has budgetary impacts, the benefits of simplified management and replacement inventory during a time of crisis can quickly outweigh those extra expenses.

Secondary Site

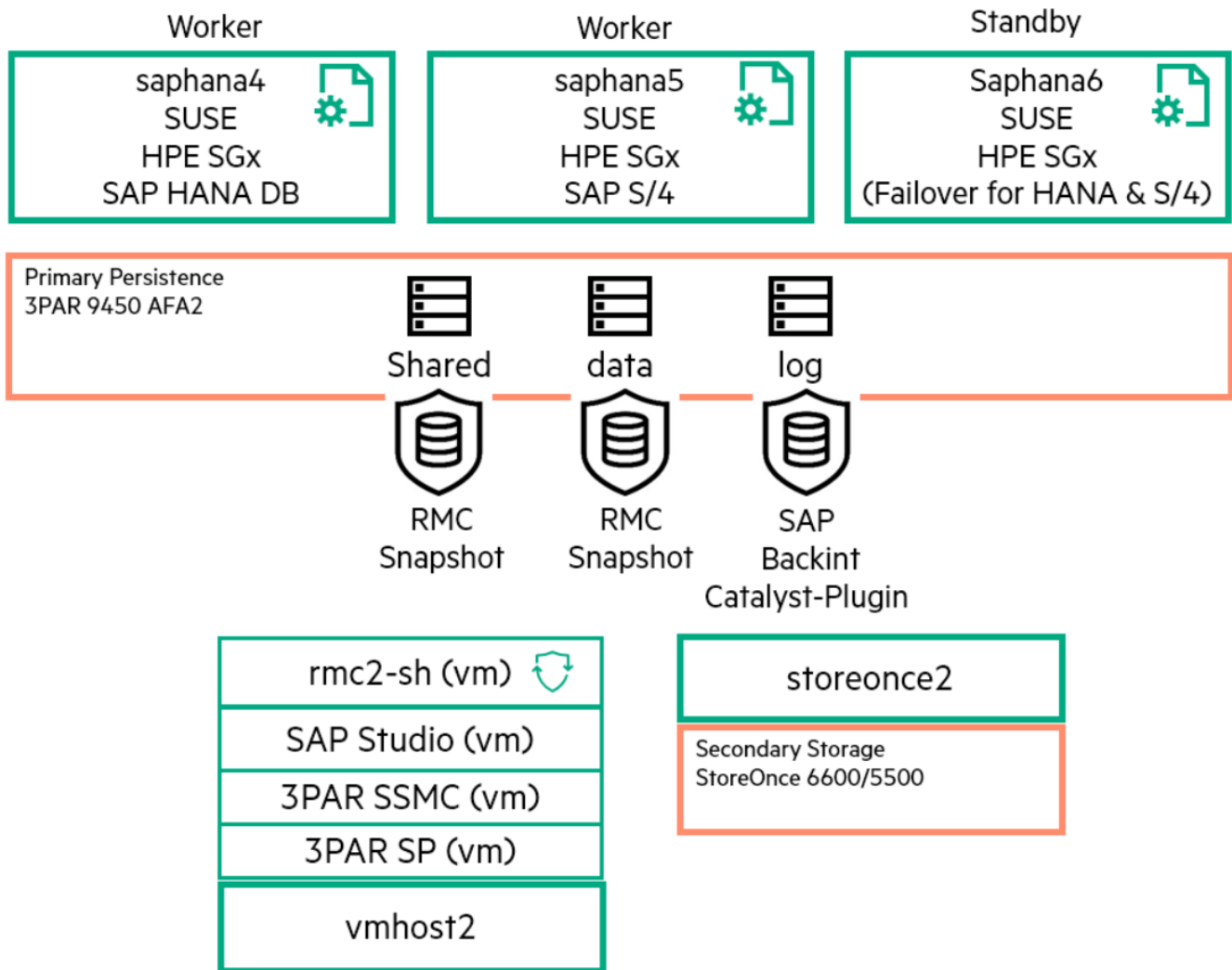


Figure 4. SAP HANA solution Secondary Site block diagram

This design focuses on a very small subset of SAP applications; yet, the design has taken into consideration scaling up and scaling out systems to meet the demands of a thriving business that is expanding its SAP application use.

Two key metrics of application continuity, Recovery Time Objectives (RTO) and Recovery Point Objectives (RPO), are found embedded in every aspect of this solution design. This is why you will see HPE 3PAR StoreServ All Flash arrays, HPE Serviceguard for Linux (SGx), and HPE StoreOnce as key parts of the solution.

Although a mission-critical status for a solution can warrant having isolated equipment for the solution, Hewlett Packard Enterprise recognizes the significant expense of IT systems needed to meet SAP mission critical solutions. As an IT systems provider, Hewlett Packard Enterprise

knows how important cash flow is to a business; therefore, the design team has made architectural and design decisions that align with that objective. An example of one of these design decisions is to use the HPE 3PAR StoreServ All Flash array for multi-purposes rather than including multiple storage arrays, each isolated for a single purpose.

This design includes recommendations based on common services required to support this solution; however, the details associated with configuration and maintenance of these services are not included in this Reference Architecture. Because these are common services to the Enterprise IT environment, they are expected to already exist in your environment.

One of the key elements to this solution design is the connectivity infrastructure and service to connect the multiple data center locations. There are a variety of providers and offerings that can provide this service at varying costs and service level agreements (SLA); however, this document doesn't provide a vendor or technology of choice.

Finally, this RA has been designed to support an end-to-end application solution for SAP using SAP HANA in a Tailored Datacenter Integration model. This design has also been created to align with standards set forth by the HPE Datacenter Care Service organization in the event you want to contract with our team of operational experts to assist you with your mission-critical business applications.

Solution components

This section outlines the components used to create this HPE Reference Architecture EAC Solution for SAP HANA. The following tables outline which components are found in each of the two data centers as well as the necessary services for the third remote monitoring site. A solution of this magnitude also requires common services found in the enterprise environment, which are included for completeness.

Table 1. Data center components

Primary Data Center Site

SAP Business Applications	SAP HANA S/4
SAP HANA	SAP HANA 2.0 SP 1
SUSE	SUSE Linux Enterprise Server for SAP Applications
Servers	HPE ProLiant DL580
Networking	HPE FlexFabric 5900CP Routing Switch Aruba 3810 Series FastEthernet Switch
Storage Persistence	HPE 3PAR StoreServ 9450 All Flash
Storage Fabric	HPE SN6000B Fibre Channel Switch
Clustering	HPE Serviceguard LX (SGx)
Data Protection	HPE StoreOnce 6600 HPE Recovery Manager Central (RMC) HPE Recovery Manager Central Solution for SAP HANA on 3PAR service (consulting from HPE Pointnext)
Supporting Services	DNS, NTP, DHCP

Remote Data Center Site

Servers	HPE ProLiant DL580
Networking	HPE FlexFabric 5900CP Routing Switch Aruba 3810 Series FastEthernet Switch
Storage Persistence	HPE 3PAR StoreServ 9450 All Flash
Storage Fabric	HPE SN6000B
Clustering	HPE Serviceguard LX (SGx)
Data Protection	HPE StoreOnce 6600 HPE Recovery Manager Central (RMC) HPE Recovery Manager Central Solution for SAP HANA on 3PAR service (consulting from HPE Pointnext)
Supporting Services	DNS, NTP, DHCP

Common Enterprise Services

DNS	DNS
NTP	NTP

Hardware

When considering server hardware for an SAP HANA database environment, you look at servers quite differently from the traditional database server. SAP HANA maintains the complete data model in memory. All read and write requests are served from memory. The persistence of the database to storage is only for the purpose of loading the database when shutting down and bringing the database back up. This in-memory database model changes some of the assumptions traditional database system design has been based on.

Servers

HPE ProLiant DL server series is a data center standard because of its best-in-class performance and expandability. The HPE ProLiant DL580 server was selected for the server clusters in this Reference Architecture to support SAP HANA based on the following features:

- Memory capacity of 6 TB of RAM
- 4U server with 4 CPUs
- Expansion capacity to support multiple Fibre Channel and Ethernet cards
- HPE Integrated Lights-Out (iLO) remote management

The 4U HPE ProLiant DL580 server is an excellent selection for many SAP HANA implementations because it can support both the scale-up and scale-out SAP design models. With a top-end memory of 6 TB, the HPE ProLiant DL580 can easily scale to a 2 TB SAP HANA database. If your SAP HANA database needs exceed the 3 TB threshold, the HPE Integrity MC990 X or HPE Integrity Superdome X should be considered the better server option for your SAP cluster of servers. These servers have been certified for 4 TB databases using the 64 GB RAM option. Regardless of your database growth trajectory, Hewlett Packard Enterprise has a class of server to meet your SAP HANA database needs up to 192 TB.



Figure 5. HPE ProLiant DL580

The HPE ProLiant DL580 servers in this Reference Architecture have been selected and sized to provide the virtualization of management and backup services needed to support this SAP HANA solution. Although multiple HPE ProLiant DL380 servers could have been used for these VMware® ESX hosts, HPE ProLiant DL580 servers are more commonly found as ESX hosts in the field. With their higher density of CPU cores and greater memory, HPE ProLiant DL580 servers make a better choice to integrate into existing ESX clusters.

Networking

The networking for this solution uses two different switches to follow many of the best practices observed and designed in the HPE ConvergedSystem 500 and HPE ConvergedSystem 900 SAP HANA appliances. Network segregation of traffic for application servers, system management, replication, backup, and clustering heartbeat networks have all been taken into consideration. The use of multiple HPE FlexFabric 5900CP routing switches as top-of-rack switches connecting to core data center routing switches provides our solution with the ability to support network segregation within each rack of the solution. Using multiple ISL trunk ports and OSPF for IP routing between core and edge switches makes this solution fast, robust, and able to integrate into any production enterprise networking environment.



Figure 6. HPE FlexFabric 5900CP-48XG-4QSFP+ switch

In conjunction with the HPE FlexFabric 5900CP series switches designed into the Reference Architecture networking configuration is the inclusion of a lower-cost Aruba switch to support management and server iLOs remote management features. These Aruba 3810 series switches are fully managed at a price point appropriate for management requirements of your infrastructure resources. This separate Ethernet fabric for management purposes also provides a benefit of controlled security access and traffic isolation from production networks.



Figure 7. Aruba 3810 Ethernet switch

Storage

The SAP HANA in-memory database technology changes the role of the traditional storage array systems. Previously, arrays served a primary role often becoming the bottleneck for database access; however, the role of storage arrays is now becoming a secondary role. Persisting data in an SAP HANA environment is now used to load the database into memory when the database is shut down and restarted. Trying to preserve the SAP HANA database creates two challenges: (1) Keeping up with save points as data is saved in the memory database and (2) reading data from the array as fast as possible when starting the SAP HANA server. This is where the HPE 3PAR StoreServ 9450 All Flash array has met and exceeded the certification criteria set by SAP.

This Reference Architecture includes the HPE 3PAR StoreServ 9450 All Flash array at both the primary and secondary locations to provide the storage persistence for both the data and log volumes of the SAP HANA environment. Since the HPE 9450 is also very good at providing storage for multiuse configurations, the design also includes using the HPE 9450 for providing the storage needs for the virtualized server environment.



Figure 8. HPE 3PAR StoreServ 9450 All Flash array

Another part of the storage requirements for the HPE EAC for SAP HANA solution is backing up and restoring SAP HANA data and log volumes in the event of a catastrophic data loss. To preserve a point-in-time snapshot of the database requires a backup of both the data and log volumes. To back up the SAP HANA database, Hewlett Packard Enterprise recommends creating snapshot backups of the data volume using HPE Recovery Manager Central REST API scripting to an HPE StoreOnce 6600 and using the HPE StoreOnce Catalyst Plugin for SAP HANA to back up the log volume. The HPE StoreOnce systems supports deduplication and superfast snapshot copies of HPE 3PAR 9450 volumes.



Figure 9. HPE StoreOnce 5500 and 6500 backup arrays

Storage fabric

The SAP HANA in-memory database technology has created some new challenges for persisting database data. Keeping up with cache writes and transaction log entries requires the speed of an All Flash array (AFA). Running a set of mission-critical applications that are pushing millions of transactions per hour requires a predictable and fast storage infrastructure. To keep up with such workloads and to ensure privacy of data without impacting other Ethernet networks, Fibre Channel storage fabrics are still the medium of choice for enterprise storage solutions.

This Reference Architecture recommends Fibre Channel connectivity between SAP servers and HPE 3PAR StoreServ storage arrays using redundant HPE SN6000B 16 Gb Fibre Channel switches. Configuring these switches with dynamic peer-to-peer zoning, ISL Trunking, and extended switch routing provides insurance your storage persistence, backup, and recovery needs will keep up with your SAP environment.



Figure 10. HPE SN6000B Fibre Channel switch

Although core Fibre Channel Director switches aren't included in this SAP HANA solution Reference Architecture, most production enterprise IT environments implement core FC routing switches to simplify fabric management and to create highly available, shared storage arrays with their distributed server hosts. HPE has an excellent line of director-class switches that can be added to this Reference Architecture to expand the FC fabric to handle multiple-edge switches and core-shared arrays. This includes the HPE StoreFabric SN8000B 16 Gb SAN director switch.

Remote connectivity and infrastructure

A key part of this Reference Architecture is the connectivity between the primary and secondary location. Hewlett Packard Enterprise does not make a formal recommendation in this design for what type of remote connectivity you should use for your installation; however, we do recommend you check with your local service provider and telco vendor for options that are available to you that support 10 Gbps Ethernet and 16 Gb Fibre Channel speeds. Some of these options could include; Metropolitan WANs, Internet VPNs, and dark fibre. Every option requires specialized infrastructure equipment and service contracts. Keep in mind the most significant properties you will need to consider for this solution are: latency, throughput, and availability.

Software

The HPE EAC for SAP HANA solution involves many interactive services, each presenting unique challenges and requiring different resources. This section outlines the underlying software requirements to create the platform for SAP HANA applications to work effectively in a continuous delivery environment.

SUSE Linux Enterprise Server for SAP Applications

SUSE Linux Enterprise Server for SAP Applications was the only operating system supported by SAP when SAP HANA was first released. It is still the preferred OS among HPE's SAP HANA customers. This Reference Architecture builds upon the SUSE Enterprise foundation using the SUSE Linux Enterprise Server for SAP Applications bundle. The SUSE installer is customized to provide an SAP specialized installation wizard, in-memory security hardening, and automated SAP HANA scale-out and scale-up installations.

Each HPE ProLiant DL580 in this Reference Architecture is configured with the SUSE Linux Enterprise Server for SAP Applications bundles to create highly available clusters to support the SAP HANA database and core SAP applications. More information can be found at suse.com/products/sles-for-sap

SAP S/4 HANA

VMware ESX 6.5

The HPE EAC for SAP HANA solution includes multiple management tools for different aspects of the infrastructure and backup environment. The majority of these services have been deployed as virtual machines for simplicity of installation and easy of management. To support these virtual machines, this Reference Architecture includes an installation of VMware ESX 6.5 at both the primary and remote data center locations.

Table 2. Solution tools

Virtual machine tools	Purpose	Description
HPE 3PAR StoreServ Service Console	HPE 3PAR Array administration	The HPE 3PAR Service Console provides a simplified interface to perform common administration and configurations of your HPE 3PAR StoreServ array. Using this simple UI interface, you can view log files and perform online firmware and patch updates.
HPE 3PAR StoreServ Management Console (SSMC)	HPE 3PAR Array management	HPE 3PAR StoreServ Management Console is a centralized management tool for all file and block-based operations for your HPE 3PAR StoreServ storage. It is a web-based UI to improve visibility of your storage environment.
HPE Recovery Manager Central (RMC) 4.0	Backup and restore	HPE Recovery Manager Central (RMC) is the data-protection solution for flash environments. By integrating with HPE 3PAR StoreServ, HPE RMC copies snapshots directly to the HPE StoreOnce systems. HPE RMC provides seamless, application-managed snapshots and data movement to secondary HPE StoreOnce systems, independent of backup server software. Only unique blocks are sent to the HPE StoreOnce reducing network traffic. Adding the HPE Recovery Manager Central Solution for SAP HANA on 3PAR service (consulting from HPE Pointnext) provides the automation of backup and restore to the SAP HANA environment.
SAP Design Studio	SAP HANA management	The SAP Design Studio is an Eclipse-based tool that provides a way of creating data visualizations, dashboards, and BI based apps to help you use your SAP HANA data. It directly connects to your SAP BW and SAP HANA data allowing you to validate your SAP HANA environment.
VMware vCenter	VMware management	Although we have not included VMware vCenter as part of this solution, most enterprise virtualized environments have implemented this virtual application to manage all of their virtual hosts and resources.

HPE Serviceguard for Linux

For over two decades, HPE Serviceguard has been protecting mission-critical systems from unplanned downtime. With the latest release of HPE Serviceguard for Linux (SGLX), Hewlett Packard Enterprise has brought those years of experience to the SAP and SAP HANA environments. As a critical part of this Reference Architecture, HPE Serviceguard for Linux is configured on all our SAP HANA hosts to monitor the operating system, networking, and applications to ensure an end-to-end continuity plan.

Using HPE Serviceguard with SAP System Replication provides a significant improvement over using SAP System Replication by itself. In an HPE Serviceguard HANA-clustered configuration, when there is a catastrophic failure of the primary (production) system, HPE Serviceguard performs an automatic, unattended failover to a secondary system. Based on the type of failure, HPE Serviceguard takes appropriate recovery actions as part of a failover operation. Since HPE Serviceguard integrates with SAP System Replication, the failover just needs to promote the already running secondary instance to the primary role. This significantly reduces downtime since there is no need to restart the SAP HANA database at the secondary system.

Additionally HPE Serviceguard also fails over the IP address used to access the SAP HANA database to the secondary system and the clients can now continue to access the database just by reconnecting. When a primary system recovers after a failure, HPE Serviceguard starts it in a secondary role so that HA and DT are restored and the database is protected continuously without any manual intervention.

The A.12.00.20 release of HPE Serviceguard software introduced a new feature called Site Aware Disaster Tolerant Architecture (SADTA), which extends HPE Serviceguard's Disaster Tolerance (DT) capabilities to include scale-out SAP HANA systems. HPE Serviceguard software makes use of "sites" to manage failover of application processes, spanning across multiple systems from one site to another. SADTA enables coordination between scale-out SAP HANA nodes running on separate servers at a given site, so that the site failover is invoked only when a sufficient number of servers have failed to cause a database outage and in proper sequence. SADTA also allows the failover of SAP HANA partition instances within a site to provide various active-standby configuration options, available to increase the protection from failures at site level.

Licensing specifications

Storage fabric

To configure ISL Trunking between the edge Fibre Channel switches and a core director class switch, Hewlett Packard Enterprise highly recommends purchasing the Power-Pak licenses for your HPE SN6000B switches.

Storage arrays

To use HPE 3PAR Peer Persistence software between the primary and remote HPE 3PAR arrays, a multiple-arrays license suite is necessary to allow the arrays to be set up in a uniform configuration, allowing all hosts in the SAP Cluster to access the volumes on both arrays.

Backup recovery

The HPE 3PAR StoreServ 9450 includes all-inclusive licensing that covers the licenses needed for Recovery Manager Central (RMC).

HPE Serviceguard

The HPE Serviceguard requirements for this Reference Architecture are based on a per-CPU licensing model. The initial configuration of six HPE DL580 servers includes four multi-core CPUs per server.

Capacity and sizing

This Reference Architecture has been created to support scalability and expandability. Various elements of this design require consideration when looking at capacity and sizing. This section covers considerations for sizing SAP HANA hosts, storage persistence, and backup storage requirements.

SAP HANA hosts

There are three principle elements for sizing for SAP HANA—host memory, CPU performance, and storage persistence.

SAP has various methods for capacity planning and right-sizing of SAP HANA databases. These can easily be found by searching the SAP site. The SAP HANA Storage Requirements document is updated frequently with general formulas and insights as database sizes continue to increase. The following table highlights the most current SAP rules for storage sizing.

Table 3. SAP storage-sizing rules

SAP Storage Preference Requirements

Data Volume	1 X RAM	
Log Volume	RAM < 512 GB	½ x RAM
	RAM > 512 GB	512 GB
Installation	RAM < 512 GB	1 x RAM
	RAM > 512 GB	1 TB

HPE EAC solution engineers and certification engineers working with SAP HANA generally use the following rules when sizing systems and storage requirements.

Table 4. HPE sizing recommendations

Server Memory Size	Rule	512 GB	1 TB	3 TB	6 TB
Database size	60% of RAM	300 GB	600 GB	1.8 TB	3.6 TB
CPUs	1 CPU / 512 GB	2	2	4	8
Data Volume	1.2 x RAM	600 GB	1.2 TB	3.6 TB	7.2 TB
Log Volume	0.75 x RAM	384 GB	750 GB	2.3 TB	4.5 TB

Workload description

This HPE EAC Solution for SAP/SAP HANA Reference Architecture has used many performance workloads to validate different areas of the solution. For example, the solutions backup throughput performance results have been published in multiple documents, including [HPE Reference Architecture 2.0 for SAP HANA backup and recovery using the StoreOnce Catalyst Plug-in for SAP HANA 1.0.1](#) and [HPE Reference Architecture 1.0 for SAP HANA Data Protection using REST API scripted Recovery Manager Central](#). Workloads for these tests have been generated through industry-trusted database creation tools. In conjunction with these types of workloads, this solution used SAP SHINE demo database tools and workloads to create the 1 TB database used.

Analysis and recommendations

This Reference Architecture starts out with a sound foundation of HPE ProLiant DL580 servers and HPE 3PAR StoreServ All Flash arrays. This is a great combination; however, many SAP HANA application solutions require larger in-memory databases than the 3 TB max recommendation for the HPE ProLiant DL580 servers. Hewlett Packard Enterprise has a complete range of SAP HANA TDI certified servers including the HPE ProLiant DL580, HPE Integrity MC990 X, and the HPE Integrity Superdome X. These options can be found in the QuickSpecs for [HPE Solutions for SAP HANA Tailored Data Center Integration \(TDI\)](#). Combining these servers with the SAP HANA TDI certified HPE 3PAR StoreServ All Flash arrays and you have a winning proposition for any business critical SAP HANA environment.

Adding HPE Serviceguard LX and HPE Recovery Manager Central to your SAP/SAP HANA environment provides you with reassurance that your servers are protected from hardware and site failures; and also that your data is preserved and can be restored quickly from snapshots and modification log files.

Configuration

Overview

The principles used for this Reference Architecture have been based on the design for a Highly Available, production environment where protocols and systems are selected, designed, and configured to support optimal performance with a Disaster Recovery model. Speed, scale, and resiliency are at the forefront of the design with end-to-end availability being the key principle of continuity. This is why you will see the following in the design and configuration: redundant path connectivity for servers and supporting infrastructures, a fibre channel base storage fabric to support the fastest and most reliable storage communication medium to the All Flash arrays, and isolated management and backup networks.

Enterprise common services

This Reference Architecture recommends the use of Domain Name Services (DNS), Network Time Synchronization (NTP), and LDAP/DS/AD for naming, timing, and authentication authorization. The configuration of these services is not outlined in this RA but is expected to be in place at the time of installation.

SAP server nodes

Each SAP server node in this Reference Architecture is configured with the same hardware, CPUs, memory, and operating systems. To be an SAP supported HANA production environment all nodes in the cluster must be configured identically. The following table outlines the base configuration for each of the server nodes.

Table 5. SAP HANA server nodes base configuration

SAP HANA server node

HPE DL580	Gen9
Memory	1 TB
CPU	4 x 18 Cores
Boot Disks	2 (800 GB SSD – Mirrored)
Networking	2 (Dual 10 Gb Ethernet) 1 (Quad 1 Gb Ethernet)
Storage Fabric	2 (Dual 16 Gb Fibre Channel)
Management	1 Gb Ethernet iLO
Power	2 (1200W)

VMware servers

This Reference Architecture includes one VMware ESX host at the primary and secondary locations. These servers provide the support for management applications. To simplify management and be consistent, each server at both sites are configured identically and follow the same pattern of networking and storage fabric connectivity as the SAP HANA server nodes. The storage arrays are shared between sites and use the best practices outlined in this white paper: [HPE 3PAR StoreServ Storage and VMware vSphere 6.5 best practices](#). The following table outlines the base configuration for each of the server nodes.

Table 6. VMware server nodes base configuration

SAP HANA server node

HPE DL580	Gen9
Memory	3 TB
CPU	4 x 18 Cores
Boot Disks	2 (800 GB SSD – Mirrored)
Networking	2 (Dual 10 Gb Ethernet) 1 (Quad 1 Gb Ethernet)
Storage Fabric	2 (Dual 16 Gb Fibre Channel)
Management	1 Gb Ethernet iLO
Power	4 (1500W)

Networking

The networking for this Reference Architecture is designed around traffic isolation and networks targeted to support SAP HANA, HPE Serviceguard LX, and operational management requirements.

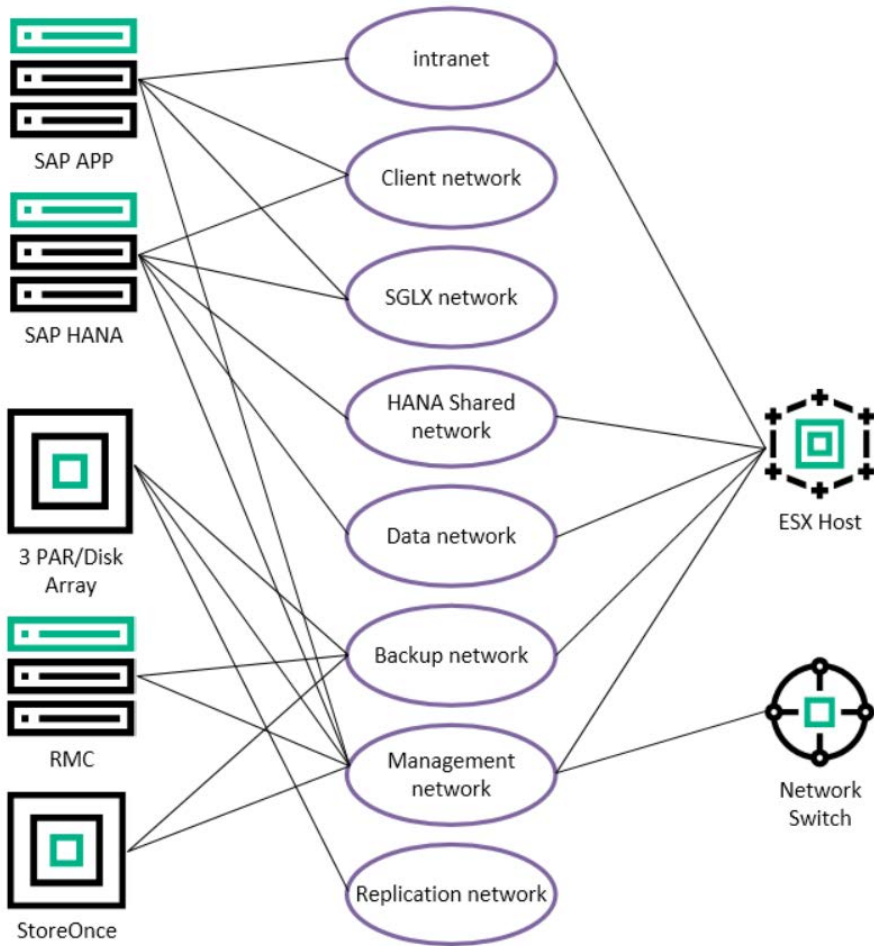


Figure 11. Networking segments for the SAP HANA solution Reference Architecture

The following table outlines the networks and general addressing used for this solution.

Table 7. Network and general addressing - EAC SAP HANA networking recommendations

Network name	Purpose	VLAN	IP Network
Client network	The network used by SAP HANA clients to connect to and make queries through SQL or SAP application interfaces to access the SAP HANA analytics and database.		
Data network	The data network is for data traffic from other data input devices. This is typically a connection to an ERP-ECC system or other external databases, which are configured to interact with SAP HANA services.		
Management network	This network supports connections to management interfaces for the infrastructure and server equipment. This includes the management ports on switches, arrays, server iLOs, and any managed device in the environment. This also includes a management interface on the SAP HANA servers.		
SGLX network	This is the HPE Serviceguard network used to initiate site replication and configured as a secondary heartbeat network.		
Heartbeat network	This is a dedicated heartbeat network for HPE Serviceguard and other services in the solution.		
HANA shared network	This is a private network used for sharing information between SAP HANA internals. This network is most commonly used for NFS traffic between SAP HANA nodes		
Intranet network	This is the private intranet that exposes the SAP application services to users.		
Replication network	This is a private data network for HPE 3PAR array data replication between storage arrays.		
Backup network	This is a dedicated private network used for backing up SAP HANA log data and shared configuration volumes using the Catalyst Plugin for SAP HANA.		

Storage fabric

The storage fabric is based on dual 16 Gb Fibre Channel switches with each server configured with two paths to each switch. Switches are connected with four ISL Trunking ports, either directly or to a director switch. The HPE 3PAR StoreServ 9450 is configured with a distribution of two ports from each of the four controllers to each switch. As a best practice, the FC switches are configured with their own domain IDs and defined as a single fabric to simplify management. Servers are configured with Multipath IO to balance FC traffic. Dynamic Peer Port Zoning is used to create secure peer-to-peer zones.

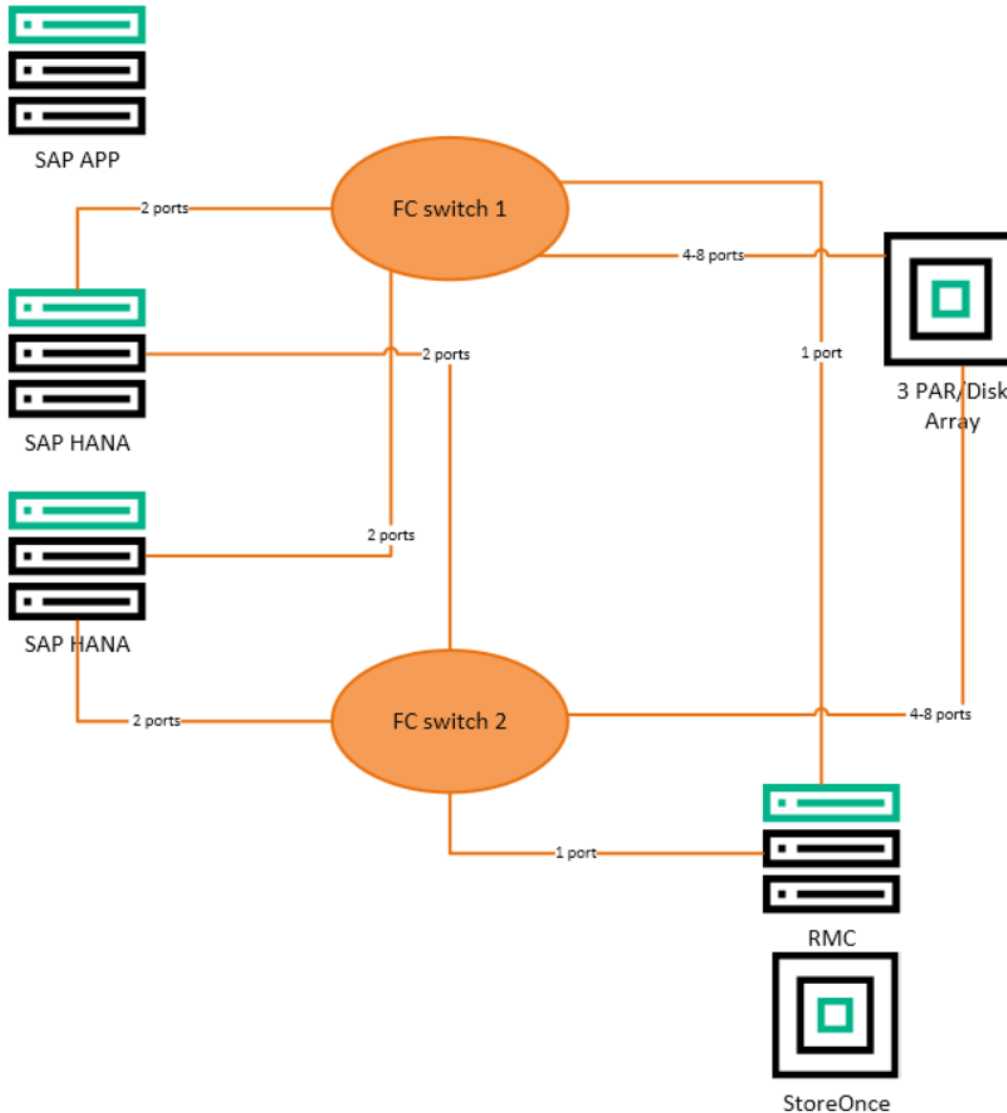


Figure 12. SAP HANA solution architectural storage fabric

Storage arrays

HPE 3PAR Peer Persistence software enables HPE 3PAR StoreServ systems located in different data centers to act as peers to each other. This capability allows you to configure a high-availability solution where storage access failover and failback remains completely transparent to the hosts and applications running on those hosts.

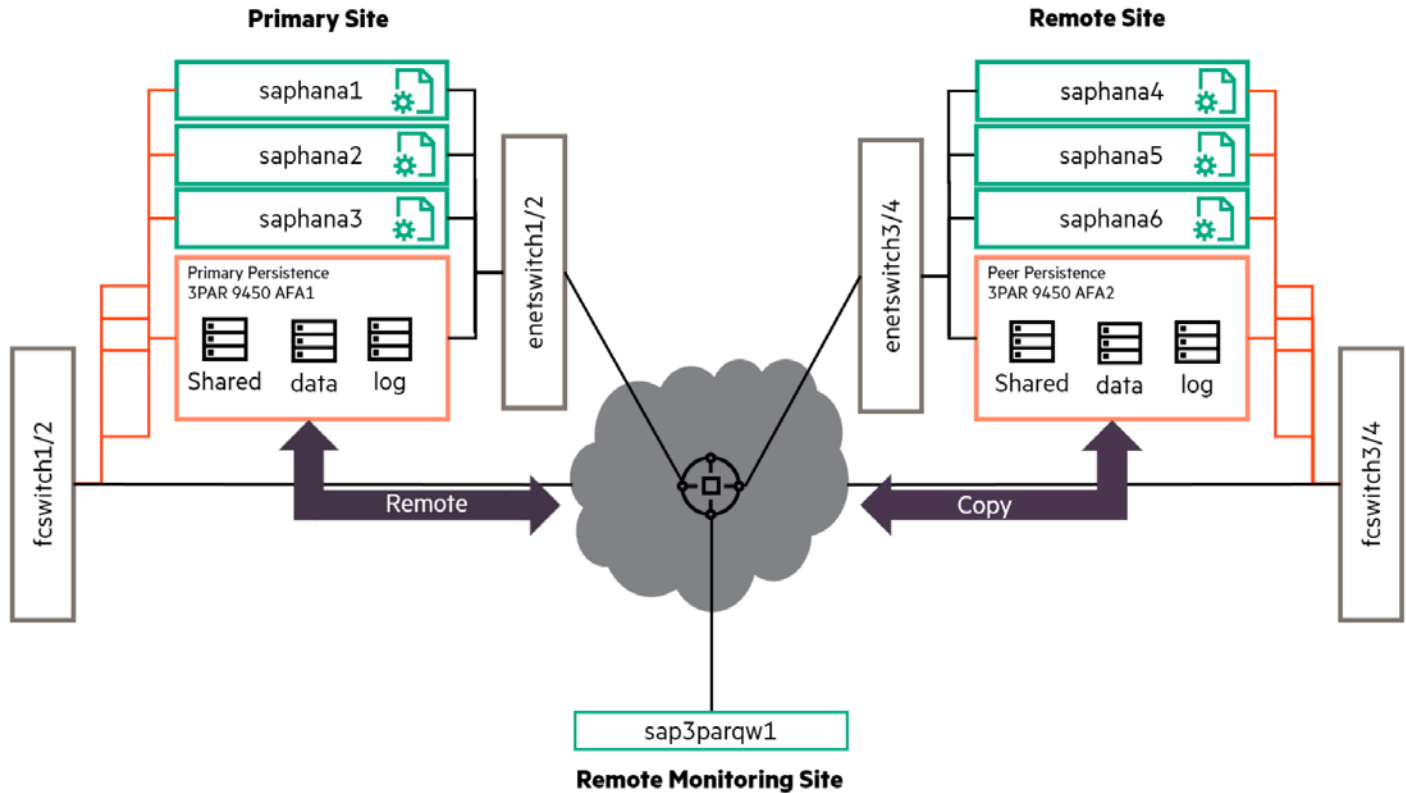


Figure 13. SAP HANA solution architectural SAN remote copy model

HPE 3PAR Peer Persistence software allows hosts to remain online even when the host switches storage access from its original site to the storage array in the remote site. Peer Persistence is based on HPE 3PAR Remote Copy and makes use of host multipath and Asymmetric Logical Unit Access (ALUA) capabilities to deliver transparent failover. To make the transparent failover automatic, Peer Persistence relies on a Quorum Witness at a third site.

HPE Serviceguard

HPE Serviceguard is a clustering software, which provides High Availability (HA) and Disaster Recovery (DR) capabilities for applications deployed in distributed environments. HPE Serviceguard provides enterprise HA and DR support to HP-UX and Linux operating systems. The HPE Serviceguard product has customizations for SAP HANA to provide automated mechanisms to detect failures and initiate recovery procedures to ensure continuous availability of SAP application services. Additionally, it employs precise control measures to protect the integrity of application data during the execution of remedial procedures in multi-node cluster configurations. Other HA and DR architectures based exclusively on SAP System Replication rely on system administrators to make the determination when a failure has occurred and manually initiate the failover. This dependence on human intervention can result in significant delays and can result in data loss and even worse—corruption of data. Enterprise class HA and DR with HPE Serviceguard in conjunction with SAP System Replication provides a significant improvement over using SAP System Replication by itself. When protected with HPE Serviceguard HANA-clustered configuration, if there is a catastrophic failure of the primary (production) system, HPE Serviceguard performs an automatic, unattended failover to a secondary system. Based on the type of failure, HPE Serviceguard takes appropriate recovery actions as part of a failover operation. Since HPE Serviceguard integrates with SAP System Replication, the failover just needs to promote the already running secondary instance to a primary role. This significantly reduces downtime since there is no need to restart the SAP HANA database at the secondary system. Additionally HPE Serviceguard fails over the IP addresses used to access the SAP HANA database and services.

When a primary system is restored after a failure, HPE Serviceguard starts it in a secondary role to restore the HA and DR environment to a fully protected state without any manual intervention.

Protection from database corruption: There are several opportunities for data corruption in an HA and DR cluster. The HPE Serviceguard cluster has an advanced data-access control mechanism that protects the data integrity for the SAP HANA environment, preventing split-brain scenarios. This condition occurs when both primary and secondary nodes are running as a primary instances at the same time. This results in data corruption. HPE Serviceguard uses a quorum server to monitor network communication between the primary and secondary system to prevent this scenario.

The A.12.00.20 release of HPE Serviceguard software introduced a new feature called Site Aware Disaster Tolerant Architecture (SADTA), which extends the DT capabilities to include scale-out SAP HANA systems. HPE Serviceguard software makes use of “sites” to manage failover of application processes spanning across multiple systems from one site to other. SADTA enables coordination between scale-out SAP HANA nodes running on separate servers at a given site, such that the site failover is invoked only when a sufficient number of servers have failed to cause a database outage and in proper sequence.

SADTA also allows the failover of HANA partition instances within a site to provide various active-standby configuration options available to increase the protection from failures at site level.

Increased uptime in case of site failures with unique Smart Quorum feature: The 12.00.30 release of HPE Serviceguard software introduced the Smart Quorum feature, which increases the availability of critical workloads. This can be deployed only in clusters configured with site-aware failover capability. The Smart Quorum provides proper coexistence with SAP’s built-in HANA auto-host failover mechanism and allows the combination of SAP High Availability with HPE Serviceguard Disaster Recovery technologies. For more information on how to configure this feature, refer to [Managing HPE Serviceguard for Linux A.12.00.51](#) and [Managing HPE Serviceguard Extension for SAP for Linux Version B.06.00.80](#).

Backup services

Another part of the storage requirements for the HPE EAC for SAP HANA solution is backing up and restoring SAP HANA data and log volumes in the event of a catastrophic data loss. The SAP HANA database has a unique challenge when considering backup and restore. Because the database is maintained in memory, the process for persisting the data is handled in two stages. Every database transaction committed in memory is persisted to the log volume. These transactions are then pushed to the data volume. To preserve a point-in-time snapshot of the database requires a backup of both the data and log volumes. To back up the SAP HANA database, this Reference Architecture recommends creating snapshot backups of the data volume using HPE Recovery Manager Central’s REST API scripting to an HPE StoreOnce 6600. Then using the Catalyst plugin for SAP HANA with SAP Backinit to back up the log volume. In the event of a total data failure, restoring the SAP HANA database consists of restoring the snapshot taken by HPE RMC, followed by a startup of the SAP HANA database. Then restoring the log volume using the SAP Backinit utilities. Using HPE RMC and the HPE StoreOnce secondary storage arrays provides the fastest backup and restores in the industry. The HPE StoreOnce backup series are specialized storage arrays that support deduplication and superfast snapshot copies from the HPE 3PAR 9450.

The HPE Recovery Manager Central Solution for SAP HANA on HPE 3PAR service (consulting from HPE Pointnext) offers a REST API script to automate the protection of both TDI and the HPE ConvergedSystems. HPE recommends that you leverage this service for both the SAP HANA snapshots and the Catalyst Copy actions on HPE 3PAR StoreServ. HPE also recommends the inclusion of the express protect backup to HPE StoreOnce. By including these customized scripts, you simplify the HPE Serviceguard integration into the data protection process.

When discussing backup and restore for this solution, customers most commonly ask about the following three use cases:

- Restore parent disk – restoring from a backup to the same server node to a new volume. This is the most common use case after a volume failure.
- System Refresh – restoring from a backup to a new set of equipment. This is a common use case when replacing equipment after a server failure or server upgrade.
- Disaster Recovery – restoring from a backup to a new site and new set of equipment. This is a worst case scenario, which covers a failure of the complete site and the failure of a DR site’s data integrity.

This HPE EAC for SAP HANA solution RA currently addresses the “Restore parent disk” use case.

Installation and configuration

Installation and configuration overview

The installation of this EAC solution requires planning and staging of equipment and software before the SAP HANA installation can take place. The following table outlines the order of activities necessary to set up and configure this solution.

Table 8. Setup and configuration activities - EAC SAP HANA Installation Activities

Action	Description of activities	Assigned To	Completed
Verify Common Service	Verify DNS, NTP, and authentication services, such as DS or AD, are available and accessible.		
Configure Network Switches	Set up and configure the networking infrastructure. Identify and assign IP addressing to VLANs, Routers, and management ports.		
Configure iLO ports	Assign IP addresses to server iLO ports.		
Configure Storage Fabric	Configure Management Ports. Configure Storage Fabric and Interconnect links. Configure Dynamic Domains.		
Configure Basic Storage Arrays	Configure Management ports.		
Configure VMware ESX Server	Configure and set up ESX server. Set up Management Server VM.		
Configure Storage Manage Systems	Configure HPE 3PAR Service Processor VM on ESX server. Configure HPE 3PAR Storage Service Management Console on Management Server.		
Configure SAP Storage	Set up Service Processor and install and configure HPE 3PAR array. Configure SAP Volumes.		
Install SUSE for SAP	Install SUSE Linux Enterprise Server (SLES) for SAP Applications. Configure SAP LUNs.		
Configure SAP Servers	Install customized SAP server software.		
Configure Serviceguard LX for SAP HANA	Install and configure HPE Serviceguard cluster for SAP servers.		
Configure StoreOnce	Set up and configure the HPE StoreOnce service.		
Configure Recovery Manager Central	Install and set up HPE Recovery Manager Central.		
Configure 3PAR Remote Copy	Configure HPE Remote Copy and failover configuration on the 3PAR 9450 arrays.		
Pointnext RMC Solution for SAP HANA	Configure the Serviceguard clusters to handle the RMC automation and catalyst copy operations.		

Summary

Designing and implementing a highly available and disaster tolerant architecture for SAP HANA can be a challenging undertaking. Ensuring your SAP applications and SAP HANA databases are performing at their best can take significant effort. Having confidence that your failover strategies and replacement practices work as expected without disrupting business-critical services is essential to the success of an IT organization.

Following this Reference Architecture's recommended configurations and best practices helps ensure your SAP HANA TDI (Tailored Datacenter Integration) SAP applications are meeting your company's availability and recoverability objectives.

Using HPE award-winning servers, storage, networking infrastructures, and support services will keep your mission critical applications and databases functioning at their best, while protecting them against the worst.

Appendix A: Bill of materials

This section contains the Bill of Materials (BOM) broken down into two sections – general equipment for a single site and a detail materials break down for a single site including products and options. The BOM for production systems includes the equipment and software needed for both the primary and secondary data centers. See Tables 9 and 10.

The following BOMs contain electronic license to use (E-LTU) parts. Electronic software license delivery is now available in most countries. Hewlett Packard Enterprise recommends purchasing electronic products over physical products (when available) for faster delivery and for the convenience of not tracking and managing confidential paper licenses. For more information, please contact your reseller or an HPE representative.

Note

Part numbers are listed at time of publication and subject to change. The Bill of Materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your HPE reseller or HPE sales representative for more details. hpe.com/us/en/services/consulting.html

Table 9. Bill of materials for the EAC Solution SAP/SAP HANA Primary and Secondary data centers

Qty	Description
Recommended options for Primary Site	
SAP/SAP HANA Servers	
3	HPE ProLiant DL580 Gen9 / 1TB
3	SUSE Linux Enterprise Server for SAP Applications
3	HPE Serviceguard LX
Virtualization hosts	
1	HPE ProLiant DL580 Gen9 / 3TB
1	VMware ESX Server
Storage	
1	HPE 3PAR StoreServ 9450 AFA
1	HPE StoreOnce 6600
1	HPE Recovery Manager Central for SAP HANA
Storage Fabric	
2	HPE SN6000B Fibre Channel Switch
Network	
2	HPE FlexFabric 5900CP Switch
1	Aruba 3810 Ethernet Switch
Racking	
2	HPE 42U 1075mm i-Series Shock Racks

Qty	Description
Recommended options for Secondary Site	
SAP/SAP HANA Servers	
3	HPE ProLiant DL580 Gen9 / 1TB
3	SUSE Linux Enterprise Server for SAP Applications
3	HPE Serviceguard LX
Virtualization hosts	
1	HPE ProLiant DL580 Gen9 / 3TB
1	VMware ESX Server
Storage	
1	HPE 3PAR StoreServ 9450 AFA
1	HPE StoreOnce 6600
Storage Fabric	
2	HPE SN6000B Fibre Channel Switch
Network	
2	HPE FlexFabric 5900CP Switch
1	Aruba 3810 Ethernet Switch
Racking	
2	HPE 42U 1075mm i-Series Shock Racks
Alternate solution components for Scale-up/Scale-Out	
SAP/SAP HANA Scale-out Servers	
	HPE ProLiant DL580 Gen9
	HPE Integrity MC990 X
SAP/SAP HANA Scale-up Servers	
	HPE ProLiant DL380 Gen9 Up to 1.5TB
	HPE ProLiant DL580 Gen9 Up to 3TB
	HPE Integrity MC990 X Up to 20TB
	HPE Superdome X Up to 192TB

Table 10. Bill of materials breakdown for primary or secondary site

Qty	Part Number	Description
2		Rack
1	BW908A	HPE 42U 600x1200mm Enterprise Shock Rack
1	J2R02A	HPE R/T3000 G4 HV NA/JP UPS
1	H5M57A	HPE Basic 3.6kVA/60320/C13/WW PDU
1	BW932A	HPE 600mm Rack Stabilizer Kit
1	BW930A	HPE Air Flow Optimization Kit
1	BW909A	HPE 42U 1200mm Side Panel Kit
1	120672-B21	HPE Rack Ballast Kit
3		SAP/SAP HANA Servers
1	793161-B21	HPE DL580 Gen9 CTO Svr
1	816665-L21	HPE DL580 Gen9 E7-8867v4 FIO 1P Kit
3	816665-B21	HPE DL580 Gen9 E7-8867v4 1P Kit
16	805358-B21	HPE 64GB 4Rx4 PC4-2400T-L Kit
4	788360-B21	HPE DL580 Gen9 12 DIMMs Mem Cartridge
2	779172-B21	HPE 800GB SAS WI SFF SC SSD
1	727060-B21	HPE FlexFabric 10Gb 2P 556FLR-SFP+ Adptr
1	811546-B21	HPE Ethernet 1Gb 4-port 366T Adapter
2	665249-B21	HPE Ethernet 10Gb 2P 560SFP+ Adptr
2	Q0L14A	HPE SN1200E 16Gb 2p FC HBA
4	656364-B21	HPE 1200W CS Plat PL HtPlg Pwr Spplly Kit
1	BD505A	HPE iLO Adv incl 3yr TSU 1-Svr Lic
4	BB095ACE	HPE SGLX Advanced x86 1y24x7 PSL E-LTU
1	M6K30A	SLES SAP 1-2Skt/1-2 VM 3yr 24x7 Flx LTU
1		Virtualization hosts
1	793161-B21	HPE DL580 Gen9 CTO Svr
1	816665-L21	HPE DL580 Gen9 E7-8867v4 FIO 1P Kit
3	816665-B21	HPE DL580 Gen9 E7-8867v4 1P Kit
4	788360-B21	HPE DL580 Gen9 12 DIMMs Mem Cartridge
48	805358-B21	HPE 64GB 4Rx4 PC4-2400T-L Kit
2	779172-B21	HPE 800GB SAS WI SFF SC SSD
1	684208-B21	HPE Ethernet 1GbE 4P 331FLR FIO Adptr
1	758836-B21	HPE 2GB FIO Flash Backed Write Cache
2	652503-B21	HPE Ethernet 10Gb 2P 530SFP+ Adptr
2	Q0L14A	HPE SN1200E 16Gb 2p FC HBA
4	684532-B21	HPE 1500W Ht Plg Pwr Supply Kit
1	P8B31A	HPE OV w/o iLO 3yr 24x7 FIO Phys 1 LTU
1	BD505A	HPE iLO Adv incl 3yr TSU 1-Svr Lic
1	F6M48A	VMw vSph EssPlus Kit 6P 1yr SW
1	H5M57A	HPE Basic 3.6kVA/60320/C13/WW PDU

Qty	Part Number	Description
1		Storage
1	Q0E92A	HPE 3PAR 9450 2N+SW Storage Base
2	Q7F41A	HPE 3PAR 9450+SW Storage Node
6	Q0E97A	HPE 3PAR 9000 4pt 16Gb FC HBA
1	P9M30A	HPE 3PAR Direct Connect Cabling Option
1	Q1H95A	HPE 3PAR 1U Rack Accessories Kit
1	Q0F86A	HPE 3PAR StoreServ RPS Service Processor
1	Q0E95A	HPE 3PAR 9000 2U SFF Drive Enclosure
4	Q0F41A	HPE 3PAR 9000 3.84TB+SW SFF SSD
16	716197-B21	HPE Ext 2.0m MiniSAS HD to MiniSAS HD Cbl
7	Q0E95A	HPE 3PAR 9000 2U SFF Drive Enclosure
32	Q0F41A	HPE 3PAR 9000 3.84TB+SW SFF SSD
1		Storage Backup
1	BB919D	HPE StoreOnce 6600 120TB System
4	BB929A	HPE StoreOnce 16Gb Fibre Channel Card
4	BB952A	HPE StoreOnce 16Gb FibreChannel Card LTU
1	BB918D	HPE StoreOnce 6600 120TB 1st Couplet
1	BB942D	HPE StoreOnce 6600 88TB Cap Upg Kit
2	BB929A	HPE StoreOnce 16Gb Fibre Channel Card
1		Storage Fabric
2	QR481B	HPE SN6000B 16Gb 48/48 Pwr Pk+ FC Swch
96	QK724A	HPE B-series 16Gb SFP+SW XCVR
2	313454-B21	HPE B-series 32-64 Fab Watch Switch LTU
2	313458-B21	HPE B-series 32-64 Extd Fab Switch LTU
2	J4V61AAE	HPE B-ser Mid/High ISL Trunking E-LTU
2	T5528A	HPE B-series 24-40p Integr Routing LTU
2	TC353B	HPE B-ser SAN Ntwk Adv Pro Plus SW LTU
1	TC472A	HPE Intelligent Inft Analyzer SW v2 LTU
1		Network
2	JG838A	HPE 5900CP 48XG 4QSFP+ Switch
96	JG081C	HPE X240 10G SFP+ SFP+ 5m DAC Cable
8	JG328A	HPE X240 40G QSFP+ QSFP+ 5m DAC Cable
2	JC680A	HPE 58x0AF 650W AC Power Supply
4	JC682A	HPE 58x0AF Bck(pwr) Frt(prt) Fan Tray
1	TC472AAE	HPE Intelligent Inft Anlyzer SW v2 E-LTU
1	JL076A	Aruba 3810M 40G 8SR PoE+ 1-slot Swch

Appendix B: Tested configuration

This Reference Architecture was tested by the HPE EAC Solution Team using the following block design. Our testing environment varied only slightly from the recommended Reference Architecture in the following three ways:

1. The remote site used an HPE 3PAR StoreServ 8450 All Flash array instead of an HPE 3PAR StoreServ 9450.
2. The remote site used an HPE MSA 2040 instead of an HPE StoreOnce 6600.
3. A Core Fibre Channel switch to simulate a dark fibre connection between sites.

All other software configurations and settings are as outline in this Reference Architecture.

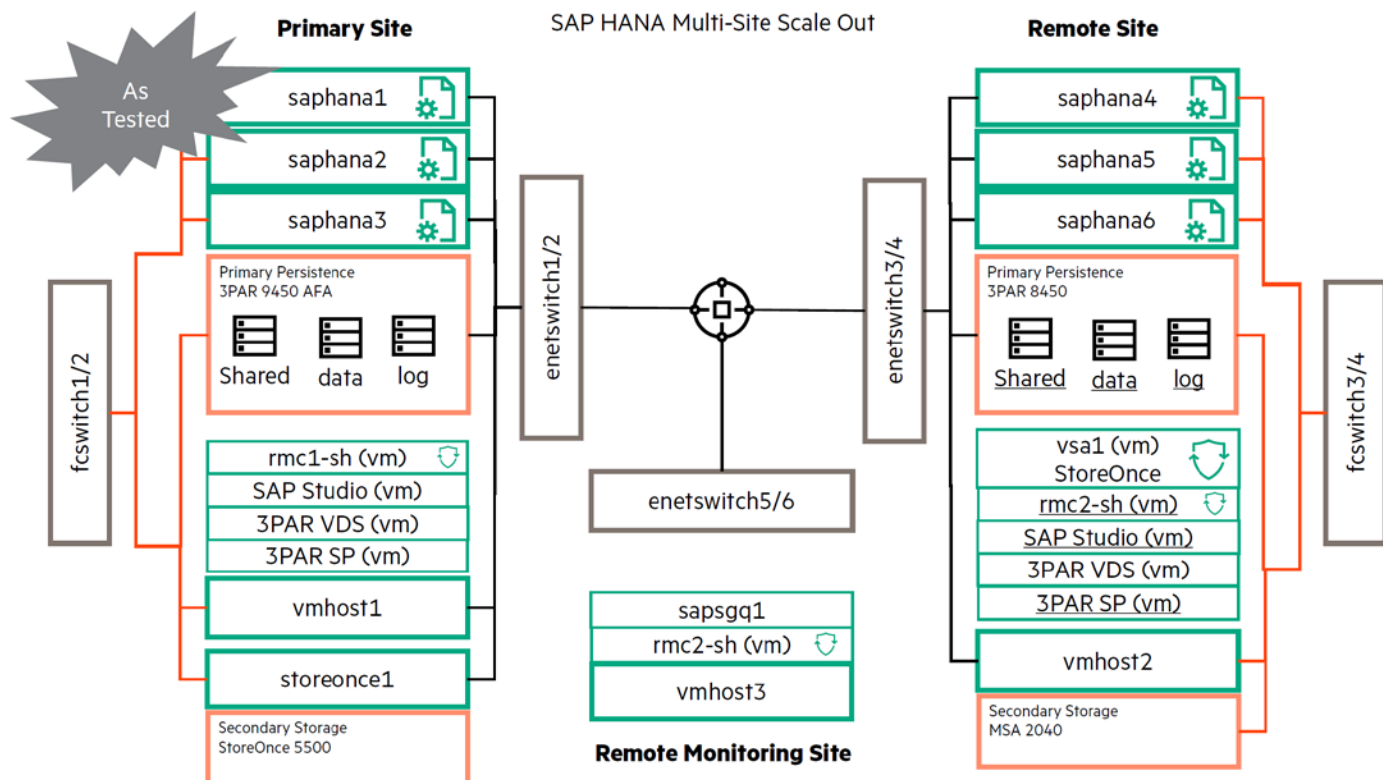


Figure 14. SAP HANA multisite scale out

Appendix C: HPE value-added services and support

In order to help you jump-start your SAP HANA solution development, Hewlett Packard Enterprise offers a range of SAP services, which are outlined in this appendix.

Factory Express Services

Factory-integration services are available for customers seeking a streamlined deployment experience. With the purchase of Factory Express services, your HPE EAC SAP HANA Solution will arrive racked and cabled, with software installed and configured for the easiest deployment possible, per an agreed-upon custom statement of work. Contact HPE Technical Services for more information and for assistance with a quote.

Technical Services Consulting – Reference Architecture Implementation Service for SAP/SAP HANA

With HPE Reference Architecture for Enterprise Application Continuity Solution for SAP/SAP HANA, Hewlett Packard Enterprise can install, configure, deploy, and verify your SAP/SAP HANA solution. Experienced consultants implement all the details of the HPE EAC Reference Architecture including: naming, hardware, networking, software, administration, backup, disaster recovery, and operating procedures. Where

options exist, or where the best choice is not clear, Hewlett Packard Enterprise works with you to configure the environment to meet your goals and needs. HPE also conducts an acceptance test using the SAP/SAP HANA validation tools to ensure your solution meets SAP's strict production requirements.

HPE Pointnext Technical Services Consulting – SAP/ SAP HANA Services

HPE Pointnext for SAP/SAP HANA Services can help you bring your IT infrastructure into its best production state by helping you get a handle on increasing volumes of data—from e-mails, social media, and website downloads—and convert this data into beneficial information. These services encompass strategy, design, implementation, protection, and compliance. Delivery of these best practices follow three steps:

1. **Architecture strategy:** HPE defines the functionalities and capabilities required to align your IT with your SAP/SAP HANA big data initiatives. Through transformation workshops and roadmap services, you will learn to capture, consolidate, manage and protect business-aligned information, including structured, semi-structured, and unstructured data.
2. **System infrastructure:** HPE designs and implements a high-performance, integrated platform to support strategic architectures for SAP and SAP HANA. Choose from design and implementation services, Reference Architecture implementations, and integration services. Your flexible, scalable infrastructure will support a variety of consolidations, including legacy SAP to SAP HANA solutions based on HPE's twenty-plus years of partnering with SAP.
3. **Data protection:** Ensure the availability, security, and compliance of your SAP/SAP HANA systems. HPE can help you safeguard your data and achieve regulatory compliance and lifecycle protection across your SAP/SAP HANA landscape, while including disaster recovery and enhancing your approach to backup and business continuity.

For additional information, visit hpe.com/services

HPE support options

HPE offers a variety of support levels to meet your needs. More information is provided below.

HPE Support Plus 24

HPE can provide integrated on-site hardware/software support services, available 24x7x365, including access to HPE technical resources, four-hour response on-site hardware support and software updates.

HPE Proactive Care

HPE Proactive Care provides all of the benefits of proactive monitoring and reporting, along with rapid reactive support through HPE's expert reactive support specialists. You can customize your reactive support level by selecting either six-hour call-to-repair or 24x7 with four-hour on-site response.

HPE Proactive Care helps prevent problems, resolve problems faster, and improve productivity. Through analysis, reports, and update recommendations, you are able to identify and address IT problems before they can cause performance issues or outages.

HPE Proactive Care with the HPE Personalized Support Option

Adding the Personalized Support Option for HPE Proactive Care is highly recommended. This option builds on the benefits of HPE Proactive Care Service, providing you an assigned Account Support Manager who knows your environment and can deliver support planning, regular reviews, and technical and operational advice specific to your environment.

HPE Proactive Select

To address your ongoing/changing needs, HPE recommends adding Proactive Select credits to provide tailored support options from a wide menu of services that can help you optimize the capacity, performance, and management of your environment. These credits may also be used for assistance in implementing solution updates. As your needs change over time, you have the flexibility to choose the services best suited to address your current challenges.

HPE Datacenter Care

HPE Datacenter Care provides a more personalized, customized approach for large, complex environments, providing a single solution for reactive, proactive, and multivendor support needs. You may also choose the Defective Media Retention (DMR) option.

Other offerings

HPE highly recommends HPE Education Services (customer training and education) and additional Technical Services, as well as in-depth installation or implementation services as needed. HPE Analytics & Data Management services provide a range of Business Intelligence (BI) modernization services, and include advisory and platform services to implement and manage Hadoop solutions.

More information

For additional information, visit:

- HPE Education Services: hpe.com/education
- HPE Pointnext Services: hpe.com/services

Resources and additional links

HPE Reference Architectures

hpe.com/info/ra

HPE Servers

hpe.com/servers

HPE Storage

hpe.com/storage

HPE Networking

hpe.com/networking

HPE Technology Consulting Services

hpe.com/us/en/services/consulting.html

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