Power Systems

SAP HANA on IBM Power Systems and IBM System Storage

Planning Guide

IBM Deutschland Research & Development GmbH
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Note

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1.4 (Feb/25/2015)	New get_size report, absolute min. configs added, SAP Note update: core/memory ratio.
1.5b (Mar/31/2015)	Ramp-Up Entry Version: Backup solution update, added chapter “Core to Memory Background information” and reduced chapter “Core Count Background information”, added chapter “Referenced documents”, VIOS planning considerations added, update on all links, Support/SAP Scope clarification for GPFS.

Preface

SAP HANA on POWER is a new solution allowing customers to run HANA-based analytics and business applications on an agile IBM Power based infrastructure. Existing IT assets - servers, storage, as well as skills and operations - can easily be (re-)used, instead of enforcing additional investment into dedicated SAP HANA only appliances.

About This Document

This document is intended for architects and specialists planning an SAP HANA® on POWER® deployment. It describes the design considerations for hardware, networking, and software components of the SAP HANA on POWER solution stack.

This guide does not replace existing SAP HANA documentation and sizing guides: It serves as a supplement to the existing SAP HANA documentation and SAP Sizing to provide specific guidance on how to meet SAP HANA sizing and operational requirements when running SAP HANA on top of IBM Power Systems™, IBM System Storage®, IBM PowerVM®, and Linux Operating System. It describes the requirements for LAN and external SAN topologies.

IBM processes and contacts are introduced which help to obtain a valid configuration based on SAP sizing for SAP HANA.

SAP Note 2055470 highlights all intermediate changes and provides an overview of the minimum requirements.

IBM employees can access the ISICC SAP HANA on Power Systems community for up-to-date materials complementary to this guide.

The most recent document version can always be downloaded from IBM TechDocs:
http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102502

Feel free to provide feedback and change requests for this document via email to isicc@de.ibm.com.

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Introduction

SAP HANA comprises several functional modules whose core is the SAP in-memory database. These are deployed on top of a hardware and software stack, which should be planned according to this Planning Guide.

Initially, SAP supported only the appliance delivery method for HANA in which certified hardware partners deliver a HANA appliance. HANA TDI opened the appliance deployment model to provide customers with more flexibility and choices for the storage infrastructure.

With SAP HANA, version for IBM Power Servers architecture SAP opened their model once more towards an enterprise hardware deployment model. Customers can choose their preferred IBM Power Server model along with the best fitting infrastructure and storage components from a large menu of suitable hardware. By enabling customers to leverage existing hardware and operation processes in their data centers, the SAP HANA on POWER deployment model can significantly lower the costs and allow for easier integration of SAP HANA into customers data center.

The SAP HANA on POWER implementation meets the requirements of the installed Power Systems base for a high degree of configurations and administration flexibility. SAP HANA systems can be deployed exploiting PowerVM capabilities. This can lower the entry barrier for SAP HANA significantly, since test systems can be easily installed on a partition using available capacity or Capacity Upgrade on Demand resources. This eliminates the need to purchase dedicated HANA hardware.

From a technology perspective, IBM Power Systems are very well suited to provide excellent SAP HANA database performance and reliability. SAP HANA on POWER exploits excellent memory bandwidth, SIMD parallelization, and Simultaneous Multi-Threading (SMT).

Before starting, please download or check

- SAP Note 2130682
- SAP Note 2055470
- SAP Note 2133369
- SAP Note 1943937
- SAP HANA – Storage Requirements
- Introduction to High Availability for SAP HANA

SAP HANA on POWER Solution Overview

Figure 1 shows the high-level solution stack[1]. On the infrastructure level existing hardware resources can be used, assuming they provide sufficient capacity and fulfill the specified SAP performance KPIs as described later in this document.

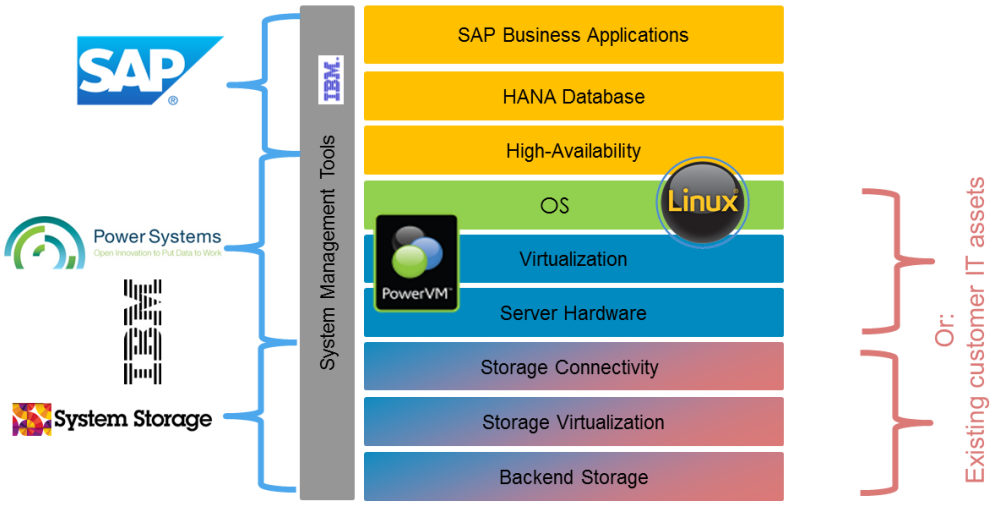

Figure 1. SAP HANA on POWER Solution Stack

For SAP HANA in general, the required memory and compute capacity can be provided by either a scale-out (multi-host) or scale-up (single-host) architecture. The supported servers and deployment options (solution scope) are listed in the SAP central note for SAP HANA on POWER (SAP Note 2055470 and SAP Note 2133369).

The storage layer is designed to accommodate the different I/O characteristics of SAP HANA persistent log and persistent data volumes during runtime, but also to allow for acceptable start-up times of a business critical HANA DB. Storage subsystems can be attached either natively or via a storage virtualization layer like IBM Spectrum Virtualize[4]. Database instances can attach to a SAN environment either via virtual fibre channel adapters with a dual-VIO server setup(Virtual I/O Server - a feature of PowerVM), or via dedicated fibre channel (FC) adapters.

On operating system level SAP HANA on POWER is exclusively supported with Linux distributions, as Figure 1 indicates.

SAP product support and processes for the SAP HANA, SAP NetWeaver Business Warehouse (BW), and SAP Business Suite layers will be consistent with the Intel-based platforms. The SAP Product Availability Matrix (PAM) and related SAP Notes are the official sources to reflect this.

Figure 2 shows that IBM and many 3rd-party application server platforms can connect to a HANA on POWER database instance. For a confirmed list please contact SAP.

[1] IBM offers system management tools focusing on the SAP landscape aspect what also includes the SAP business application layer.

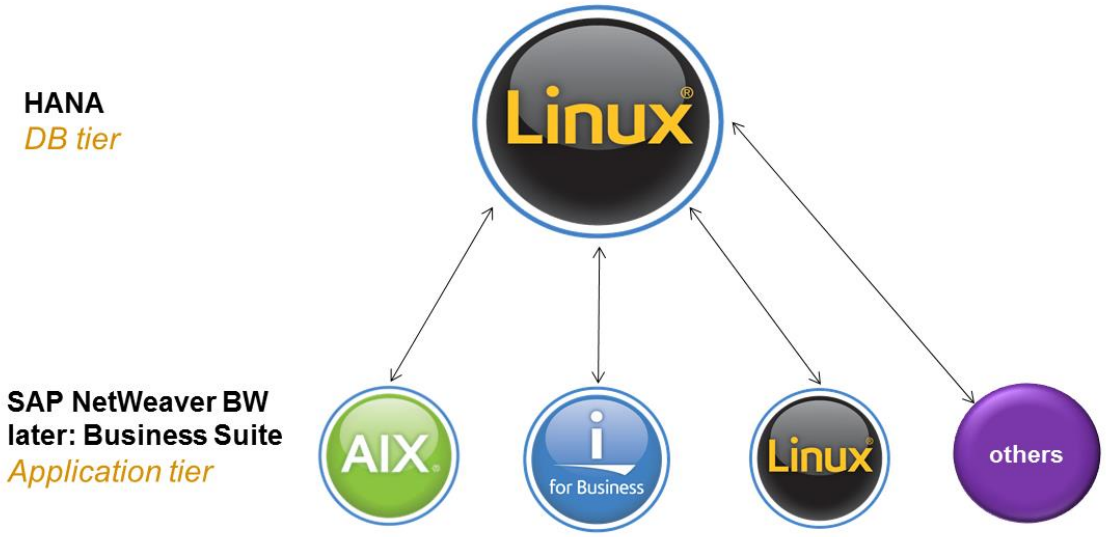

Figure 2. Supported Application Server Environments

Hardware Planning

The following sections describe the SAP HANA on POWER hardware selection and validation process based on an SAP sizing along the workflow outlined in Figure 3. SAP HANA on IBM Power Servers Planning Process:

Figure 3. SAP HANA on IBM Power Servers Planning Process

The orange part represents the initial sizing process as described in chapter “SAP Sizing for SAP HANA on POWER. It delivers some background information of the SAP HANA sizing methodologies and tools. Further, it helps to identify the appropriate planning resources by SAP and IBM.

The blue parts refer to the IBM specific SAP HANA on POWER hardware design and layout steps which are described in three chapters:

- Mapping SAP Sizing Output to IBM Power Systems Configurations
- Mapping SAP I/O KPIs to a Storage Design
- SAP HANA Node Connectivity (I/O Adapter Definition)

They will explain the background and provide the related IBM and SAP materials to select and configure the hardware. It is important to consider these three planning items as a whole in the context of the existing SAP landscape.

The green part represents the Operating System (OS) and software setup described in chapter "Software and Operating System".

Finally, the red box explains the verification of the deployed hardware and software stack. It is a mandatory task to ensure production readiness and overall functionality of each individual customer installation. This requirement is not specific to HANA on POWER deployments. Details and how to ensure datacenter readiness using the SAP HWCCT (Hardware Configuration Check Tool) datacenter readiness tool is documented in the chapter "Verification".

Support channels, IBM service offering details and contacts are summarized in a dedicated section "Support and Services" of this guide.

SAP Sizing for SAP HANA on POWER

Power Systems are not sold as an SAP HANA appliance. HANA resource requirements can be mapped into any valid POWER processor-based system, as long as it provides the resources defined by the following design considerations.

SAP HANA sizing for SAP HANA on POWER is based on methodologies and tools provided by SAP SE. Their output will specify vendor and platform independent SAP HANA system requirements.

System sizing for SAP HANA and its configuration is dominated by physical memory demand. CPU capacity of a selected Power System will in most cases be enforced by the number and size of memory per socket.

SAP HANA on POWER system configurations should not only focus on the SAP HANA Database instance itself, but also take into account resources for SAP application servers and other SAP systems maintained by the customer. Aggregating instance capacities and intelligently consolidating those with PowerVM will establish more effectiveness for IBM Power Systems. Always consider end-to-end solutions throughout the design process also comprising of none functional requirements for SAP HANA Database resiliency and operational aspects like backup/restore.

Two basic SAP HANA sizing methods can be performed:

Inductive Method
Customer fills the SAP HANA relevant section of the IBM SAP Sizing Questionnaire for Suite and BW with quantity structure of business KPIs. IBM TechLine transfers this input to SAP HANA Quicksizer, which calculates system requirements in accordance with SAP rules.

Deductive Method
Existing SAP Business Warehouse users intending to migrate to SAP HANA can run a SAP provided report within their existing BW system. The initial "get_size" report provided by SAP in SAP Note 1637145 has been replaced by a revised tool supplied in SAP Note 1736976 *"Sizing-Program for BW on HANA"*. Although result will not differ much, SAP SE recommends using the latter. SAP SE strongly recommends using this method as it provides more accurate and detailed sizing input.

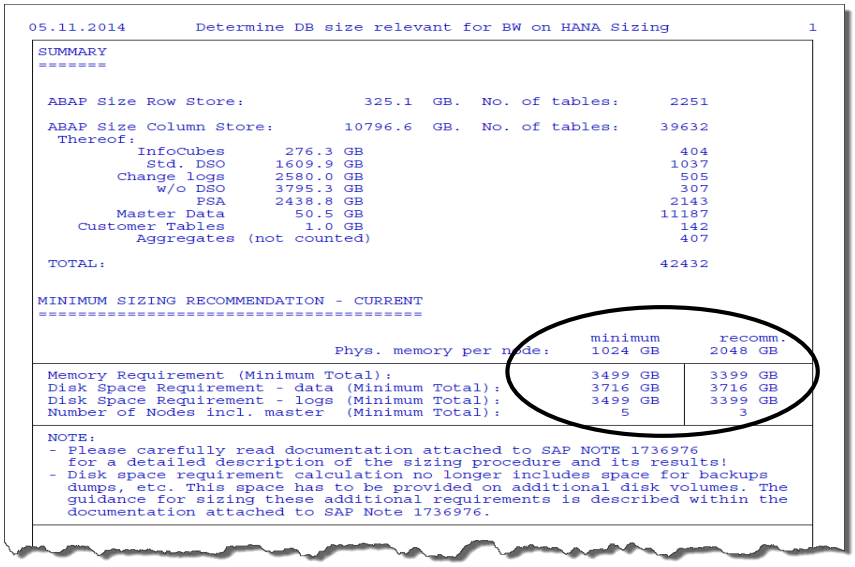

Figure 4 Sample get_size report output

Memory Capacity background information

Disclaimer:
The following paragraphs provide basic guidelines to allow for an initial opportunity and capacity assessment. It does in no way replace a qualified sizing process, but may be used to get an initial idea of HANA capacity requirements, aligned with current SAP best practice findings. See Sizing Approaches for SAP HANA – Lessons Learned *et al.*.

- SAP HANA compresses OLAP raw data, i.e. SAP BW data, in average roughly to a fraction of 1:4 per new SAP HANA Quicksizer.
  - Raw data means business data volume without existing indexes and BW aggregates
- For production BW systems the allocated storage volume for OLAP systems is about 2x of database raw data size
  - Includes incremental space for indexes, redundant data representations, free space etc.
- SAP HANA requires additional working memory footprint for internal processing which is approximately of the same size as the compressed business data.
- In total, physical memory requirements for a HANA DB are

  2*(raw data/4) =½ * raw data size.

  In other words: a HANA system effectively (incl. working overhead) compresses raw OLAP data by a factor of 2.

Figure 5 roughly shows the dependency of required SAP HANA partition memory size relative to the initial size of the business data (before the migration to HANA). Starting from the y-axis with the available partition memory size, one can also approximate the maximum feasible SAP BW database which may fit into this capacity. This approximation can in no way replace the SAP HANA Quicksizer process!

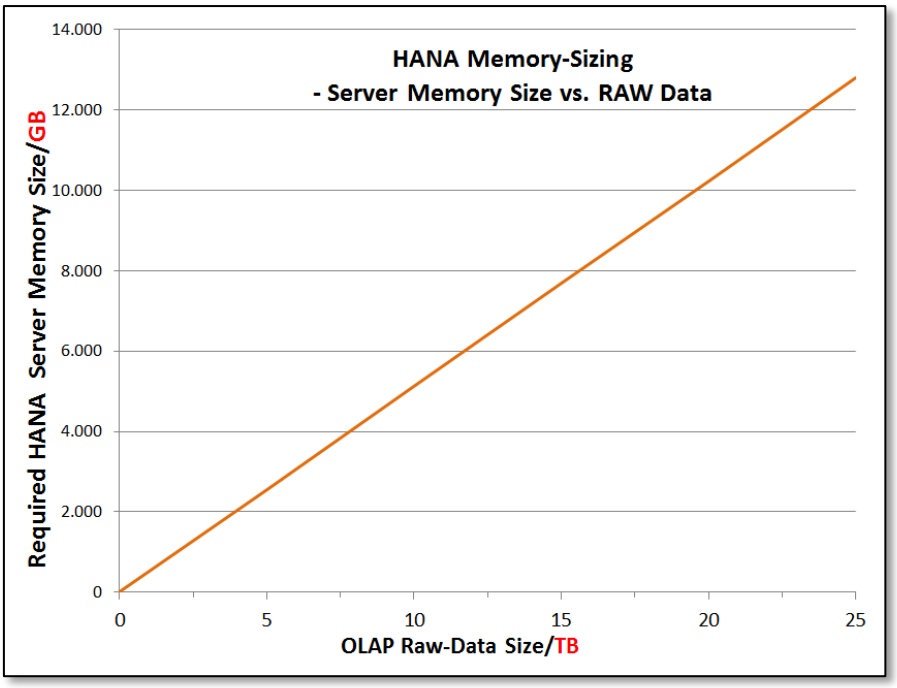

Figure 5. SAP HANA memory requirement vs. database RAW data

The ISICC SAPS Capacity Tables for Power Systems contain a "Maximum Memory" column, to identify maximum possible system memory in GB, dependent on number of sockets. The entries there correspond to the y-axis values in Figure 5

Core Count Background information

SAP HANA CPU requirements are also specified by the SAP sizing process. In late 2014 SAP SE has released a new "Quicksizer for HANA" flavor to support this. The classical Quicksizer (QS) version still is valid for sizing SAP Business Suite and other components.

Today, the HANA QS specifies SAPS values for Suite on HANA scenarios; however, it does not for NetWeaver Business Warehouse. The results are server memory and disk space. In order to calculate processor counts please contact the IBM TechLine and read SAP Note 2055470.

In case SAPS are provided in the SAP HANA Quicksizer these must be cross-checked with the ISICC SAPS Capacity Tables for Power Systems to comply with the SAPS requirements specified during the sizing step. For HANA make sure to use the Linux on Power sizing tables.

Core to Memory Background information

The core to memory ratio is defined in SAP Note 2133369. This is the mandatory mechanism from SAP to get started on the server sizing. There will be deployments which will not fit into that approach.

Today only a limited set of measuring points are listed in the SAP notes. The existing values cannot be extrapolated to larger systems. SAP has established an alternative process supporting also larger memory per core ratios (SAP Note: 2133369).

Disk Quantification Background information

The SAP HANA Server Installation Guide, the SAP HANA Storage Requirements Guide, along with the result of the SAP HANA Quicksizer gives a good understanding of the required volume requirements of storage. For each SAP HANA node (data and log) - considering SLA requirements - the minimum disk volume requirements can be calculated by following formula:

(3 + <Number of additional planned online backups>)*<RAM> + 60 GB

Quick Reference: Get SAP HANA Sizing from SAP

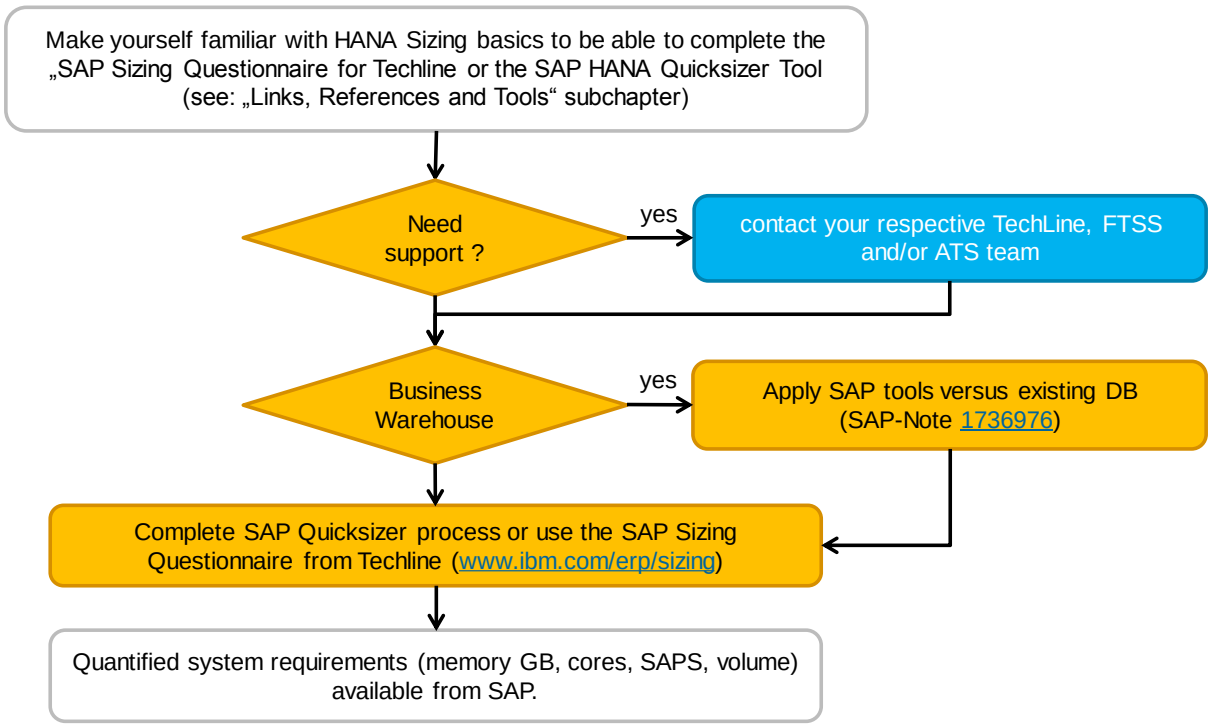

Figure 6. Quick Reference: "Get SAP HANA Sizing from SAP"

Links, References and Tools

Sizing Approaches for SAP HANA – Lessons Learned
How to size SAP BW on SAP HANA
Sizing for SAP Business Suite powered by SAP HANA
IT Planning Documents (SAP Wiki)
SAP Sizing Questionnaire for Suite and BW
Quick Sizer Tool
Read more about SAP HANA sizing on SAP Community Network (Registered S-Users only)

Central SAP Notes about SAP HANA sizing:

- Central BW Sizing SAP Notes: SAP Note 1637145 and SAP Note 1736976
- Central SAP Suite Sizing SAP Notes: SAP Note 1793345 and SAP Note 1872170
- Central SAP HANA Sidecar Solution SAP Note: SAP Note 1514966
- SAP Note 1599888 - SAP HANA: Operational Concept

Planning Sheets: SAP Sizing

Table 1. SAP Sizing Summary

No	SAP Planning Sheet	SAP Sizing Result	Notes
1	Memory for the SAP HANA DB		See SAP HANA Quicksizer output
2	SAPs/Cores for SAP HANA DATABASE		See SAP HANA Quicksizer and Planning Guide
3	SAP HANA disk space for data		See SAP HANA Quicksizer output
4	SAP HANA disk space for log		See SAP HANA Quicksizer output
5	SAP HANA disk space for share		See SAP HANA Quicksizer output
6	Minimum Storage KPIs		See SAP Note 1943937[2]
7	Number of HANA nodes		e.g. "get_size" report[3]

Table 1 builds the basis for the other tables. Values inserted here build the absolute minimum requirement and will in most cases not be sufficient for the final solution.

Note that additional requirements for Virtual I/O Servers (VIOS), application servers, or other applications will increase the overall requirements of server resources.

Mapping SAP Sizing Output to IBM Power Systems Configurations

The server decision has to be made to fit the memory, CPU and I/O adapter requirements including the planning of additional workload running on the same server. For scale-up (single SAP HANA node) all must fit into the same POWER processor-based server. To optimize TCO according to SLA criteria, you may differentiate between mission critical production and less critical non-production SAP HANA database servers.

Note:
SAP HANA server planning comprises of three parts:

The size of the SAP HANA **partition**
= SAP HANA Sizing + SLA requirements
Adapter/storage planning as outlined in the next chapters
= SAP TDI/Ethernet sizing + VIOS + SLA requirements
The size of the IBM Power **Server running multiple partitions** next to HANA
= workload consolidation + VIOS

Planning Considerations for Power Systems Memory Capacity

For scale-up single node SAP HANA configurations all required physical memory needs to fit into a single POWER processor-based systems.

PowerVM AME (Advanced Memory Expansion) is NOT supported for SAP HANA database partitions. This is independent of future AME support by Linux distributions.

[2] SAP specifies latency and MB/s. To transfer MB/s to IOPS: MB/s * 1024 = IOPS
[3] For scale-up setups the number of SAP HANA nodes can be multiplied with the resources to plan for a single partition setup.

Planning Considerations for Power Systems CPU Capacity

SAP Note 2133369 provides a rule of thumb for core/memory ratios. This ratio is linked to a workload pattern and the underlying memory footprint. It has to be ensured that the context of the ratio (workload and memory) is mapped to the actual deployment. If the planned system size does not fit in the given ratios please read chapter “Core to Memory Background information”.

No matter which Power Server is chosen, it has to fulfill all requirements (including e.g. adapter slots for I/O) specified within these sections. Refer to the *Power Systems Facts and Features* on Sales Support Information *(SSI)* or similar documents for detailed IBM Power Systems specifications. For example, POWER8 Facts and Features.

Linux only server models are available and can be an alternative at a compelling price. The same applies to Integrated Facility for Linux (IFL) specialty processors which are dedicated to run with Linux operating systems only. Since the basic IFL building block of 32GB/4cores is not a perfect fit for in-memory databases, additional IFL-memory feature codes have been released. For the E-class models these allow tailoring IFL memory to host a SAP HANA DB.

Virtualization / LPARs

In order to minimize Hypervisor dispatching latency and sustain best memory affinity, only dedicated or dedicated donating LPARs are supported for SAP HANA productions partitions.

Allocated memory per SAP HANA partition must be a dedicated resource - Active Memory Sharing (AMS) is not supported with an HANA database. For details and updates please see SAP Note 2055470.

Planning Considerations for Power Systems I/O Adapter Capacity

Please see chapter “SAP HANA Node Connectivity (I/O Adapter Definition)” to ensure the server provides sufficient adapter slots.

Quick Reference: Find valid IBM Power Systems options

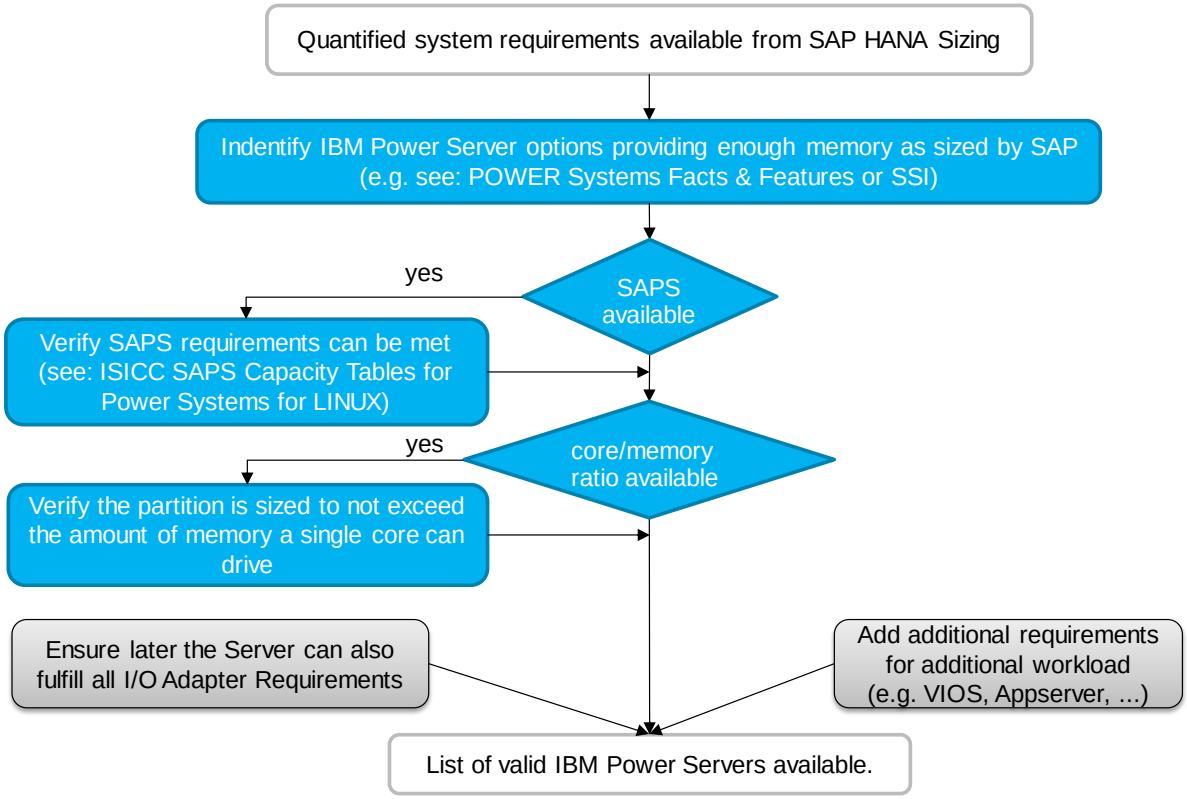

Figure 7. Quick Reference: Mapping SAP Sizing Output to IBM Power Systems

All POWER8 processor-based systems can be used to implement production or non-production systems. POWER7+ processor-based systems are restricted to non-production systems only.

Minimum requirements for SAP HANA on IBM Power servers running in a logical partition or in full system partition mode

Production systems
4 cores, 128 GB memory, POWER8 processor-based systems

Non-production systems
2 cores, 64 GB memory, POWER7+ or POWER8 processor-based systems

Links, References and Tools

ISICC SAPS Capacity Tables for Power Systems (IBM only):

> Use the table to identify systems and number of cores. The SAPS tables are maintained as an IBM Notes database and only accessible for IBM employees. BPs should contact IBM TechLine for support. This is identical to sizing systems for other SAP workloads.

Refer to the IBM *Power Systems Facts and Features* for detailed system specifications (IBM only):

- POWER8 Facts and Features
- POWER7+ Facts and Features

Sales Support Information *(IBM only)*

Planning Sheets: HANA Partition and IBM Power Server

Table 2. SAP HANA Partition Resource Planning Sheet

No	Partition Planning Sheet	Value	Notes
1	Number of dedicated/~ donating SAP HANA LPARs		Table 1.7
2	Memory		Table 1.1
3	CPU/SMT		IBM TechLine mapping based on SAP sizing (Processor specific)
4	# Ethernet paths		Defines minimum for Table 8
5	# active FC paths		Defines minimum for Table 9
6	Partition IPs/hostnames		

Table 3. SAP HANA Server Planning Sheet

No	Server Planning Sheet	Value	Notes
1	Power Server Model(s)		See SAP Note 2055470
2	Number of Servers		for high availability min 2 Servers
3	Overall Server Memory		SAP HANA Memory ++
4	Overall Server CPU		SAP HANA CPU ++
5	Number of Ethernet I/O Adapter/Ports		Consider SR-IOV capable ports for VIOS deployments, see Table 8, depends on VIOS planning
6	Number of FC I/O Adapter/Ports		Consider NPIV capable Ports, see Table 9, depends on VIOS planning
7	VIOS planning desired (yes/no)		See Table 7. VIOS Server Resource Planning Sheet
8	Additional workloads planned?		Provide location of documentation

If a new server is deployed, remember that processors and memory are required for Virtual I/O server partitions (VIOS). Power Hypervisor (PHYP) also uses memory – at a max of 8% of total server memory. Do not under estimate VIOS sizing as it can hurt SAP HANA performance.

Mapping SAP I/O KPIs to a Storage Design

SAP HANA database performance depends on processing everything in memory. Hence the ongoing load and store operations are reduced to initial loads at first access of data and writes to log files and save-points. SAP I/O characteristics definition of the file system and the underlying storage has four objectives:

- Start-up time:
  Starting an SAP HANA Database from the stored content on disk requires read performance on SAP HANA start time or initial data access time.
- Database Persistency:
  To provide persistency, data and log content is written regularly to disk. This requires low latency especially for log volumes.

- Backup:
  SAP HANA snapshots freezes the data file system for a period of time. This can be seconds, when using FlashCopy storage snapshots, or up to minutes doing a file system copy in the OS. The faster the write to the backup, the sooner the SAP HANA database can resume writing save-points again. SAP HANA database operations will continue. Find more information about backups in chapter “Backup”.
- Data Protection:
  A storage subsystem can provide functionality to duplicate data to a second location. This can be a storage mirror, IBM Spectrum Virtualize[4] stretched cluster, Hyperswap or similar storage methods to duplicate data to a second system.
- SAP approved storage subsystems:
  The chosen storage subsystem must be either an SAP HANA TDI (Tailored Datacenter Integration) approved system or an IBM SAN storage subsystem fulfilling the TDI KPIs provided by SAP. Ensure appropriate multipath drivers do exist in the targeted Linux operating system and used Power technology (e.g. NPIV).

Planning Considerations for a valid Storage Type

Although every storage subsystem fulfilling the SAP KPI requirements is eligible to run SAP HANA on POWER, we recommend focusing on TDI certified systems.

1. Storage systems having passed the test are published on the SAP Certified Enterprise Storage Hardware for SAP HANA web-site.
2. Customers deploying an SAP HANA landscape on POWER need to verify that their individual infrastructure fulfills the minimum performance criteria of SAP. Their intended SAP HANA environment comprising server, network and storage needs to be tested with the SAP HANA Hardware Configuration Check Tool “HWCCT”.
3. Besides fulfilling the SAP minimum I/O requirements the setup must allow to load the full data into memory accordingly to the customer RTO requirements for initial startup and SAP HANA Host Auto-Failover feature (available for scale-up and scale-out).

Planning Considerations for SAP HANA Disk Volume and I/O Sizing

The SAP HANA Quicksizer can be used for SAP HANA on POWER sizing. Use following SAP documents as a starting point: SAP HANA – Storage Requirements and SAP HANA Server Installation Guide.

> ***Note:*** *Be aware that the mapping of the SAP sizing output and the following planning steps identify a larger disk space requirement than the sizing provided by the SAP HANA Quicksizer and the SAP HANA – Storage Requirements paper, based on the desired backup, advanced performance and resiliency capabilities. However, the baseline requirements are identical to the TDI Storage Requirements given by SAP.*

The SAP HANA storage capacity requirements consist of several elements with different characteristics:

- SAP HANA install directory and /usr/sap
- SAP HANA share
- SAP HANA data and log files
- Number of online SAP HANA backups

Figure 8 shows the magnitude of required disk space in relation to SAP HANA instance memory. Because the highly dynamic log files benefit from SSDs or Flash technology, they are depicted by a separate curve (green). Other file categories often reside on HDDs. The graph makes it obvious that the number of online backups kept on disk significantly impacts the amount of disk space required.

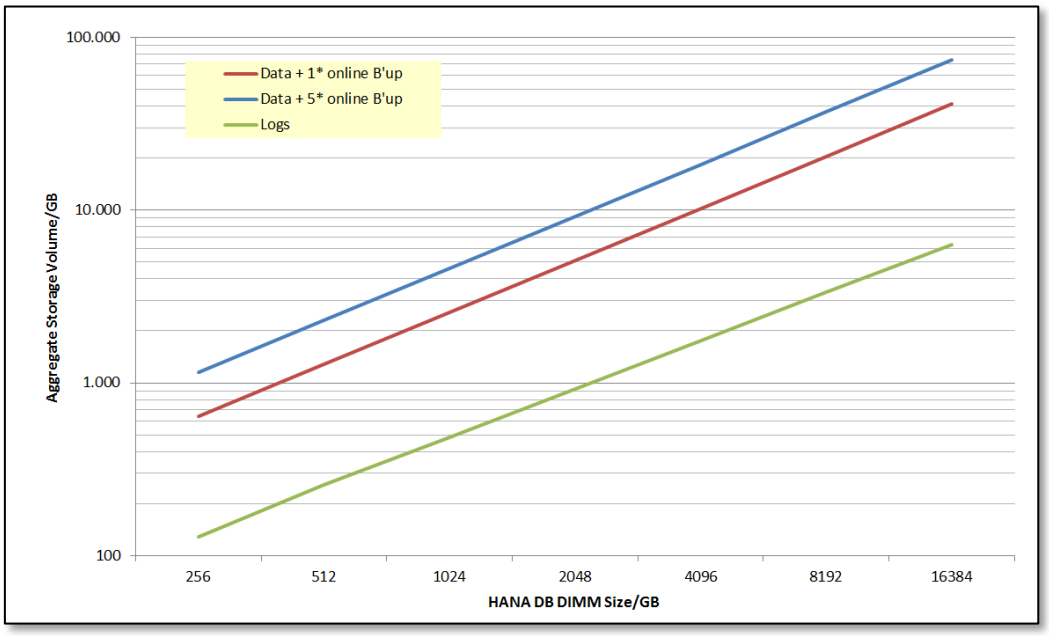

Figure 8. Storage Capacity Requirements for Data and Logs

IBM developed the SAPmagic - Storage Sizing Tool for SAP landscapes, which can be used to verify or outline options complementing the SAP HANA Quicksizer across IBM storage technologies. It includes a special method for optimizing SAP HANA file placement and I/O bandwidth leveraging a balanced blend of HDDs and SSDs/Flash.

See the IBM System Storage Architecture and Configuration Guide for SAP HANA TDI on TechDocs for a detailed description of SAPmagic methods.

Note:
The disk space requirements will be significantly higher than what SAP HANA Quicksizer suggests. This is because the SAP HANA Quicksizer only specifies the volume of the SAP HANA persistence layer and does not care about SLA aspects.

SAPmagic comes with no guarantee. Some aspects for a POWER based deployment are not covered as it is created for TDI deployments. But it is a good start point and can be well used for verification.

Additional Sizing Considerations for Backup, DR and HA

An SAP HANA database landscape also requires space and functionality for:

- SAP HANA file system backups and snapshots
- Disaster recovery data protection
- High availability data protection
- SAP HANA backups consist of an individual strategy for SAP HANA data, log, and configuration files. The SAP HANA Administration Guide provides all required information to determine the space and setup requirements and the different options for creating the backup. Some of the SAP Solutions do rely on storage subsystem features such as FlashCopy.

To protect the data in case of a disaster, the SAP HANA database content can be replicated on database level using SAP HANA System Replication or a storage subsystem mirror to a secondary site. The mirroring technology must guarantee a logical order in sense of I/O requests. Details can be found in the Introduction to High Availability for SAP HANA document from SAP.

Quick Reference: Find valid Storage Subsystem

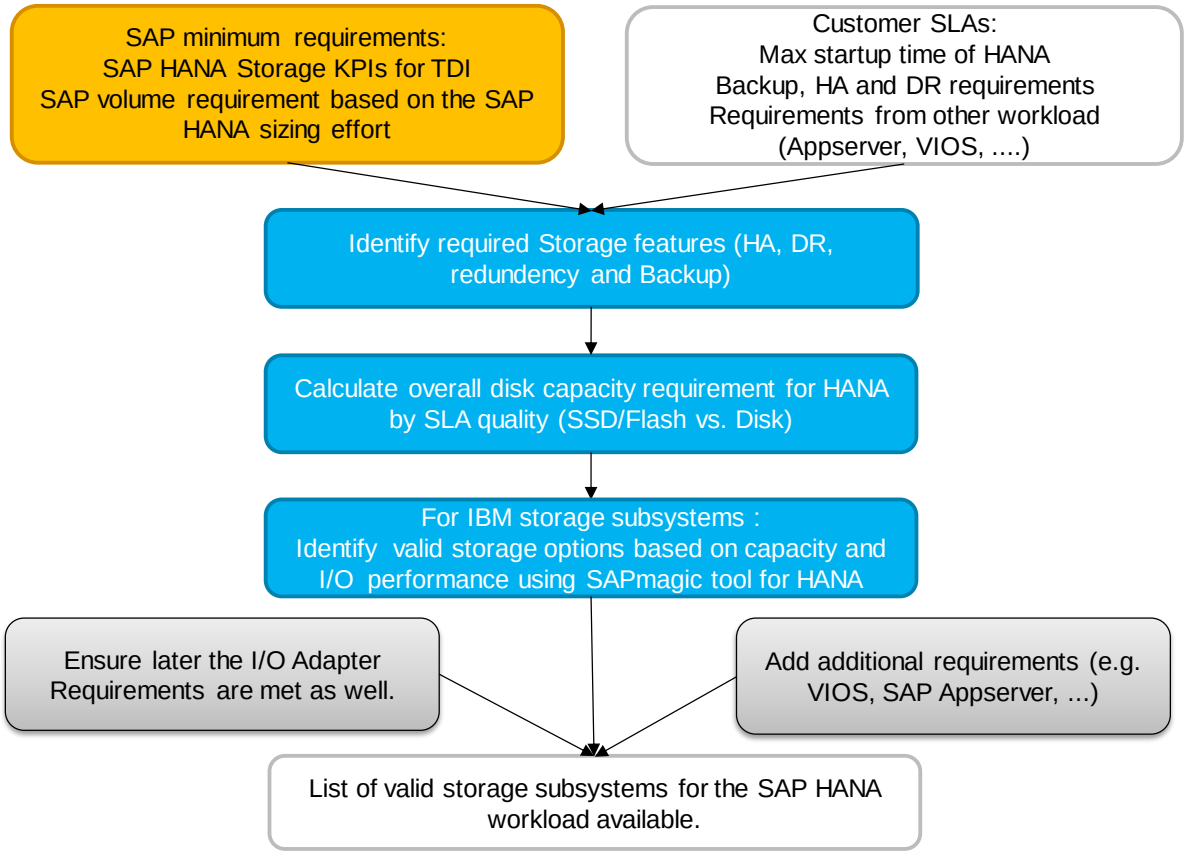

Figure 9. Quick Reference: Find valid Storage Subsystem

Links, References and Tools

SAP Documentation:

SAP HANA – Storage Requirements
SAP Certified Enterprise Storage Hardware for SAP HANA
SAP HANA Administration Guide
Introduction to High Availability for SAP HANA

SAP Note 1943937 - Hardware Configuration Check Tool - Central Note (defines also the SAP KPIs)

SAP Active Global Support offers the SAP HANA Going-Live Check which – among other tests – conducts a data throughput test using the "SAP HANA Hardware Configuration Check Tool".

IBM Documentation:
IBM System Storage Architecture and Configuration Guide for SAP HANA TDI

Tools:
Quick Sizer Tool
SAPmagic - Storage Sizing Tool for SAP landscapes

Planning Sheets: Storage

Table 4. Storage Planning Sheet

No	Storage planning Sheet	Description	Notes
1	IBM Spectrum Virtualize[4] configuration		E.g.no, yes or Stretched
2	#/Storage Type/Model/Purpose		e.g. 1/Flash System/V840/SAP HANA Log
3	#/Storage Type/Model/Purpose		e.g. 2/XiV/Gen4/all except SAP HANA Log
4	IP(s) for Storage		Consider redundant access for HA purposes
5	Required Storage licenses		e.g. Storage Mirroring, FlashCopy, … . See also "Optional Software and Hardware Considerations"
6	Additional Space for Backup, HA, …		

SAP HANA Node Connectivity (I/O Adapter Definition)

The I/O requirements are identical to those of Intel based SAP HANA systems with external storage. However, for SAP HANA on POWER landscapes, these adapters can either be used as dedicated or shared (VIO attached) adapters. By using PowerVM, additional workload can be put on the same server which will introduce additional requirements for the overall planning. The design of the SAP HANA node connectivity needs to reflect zoning, security, and throughput considerations. In particular aggregate fiber channel bandwidth needs to cope with the throughput requirements of the storage layout designed in the previous step.

In any case, all I/O adapters have to be configured redundantly in order to meet resiliency requirements of a production enterprise database. For shared adapters this always implies a dual-VIO server setup.

[4] Formerly: SAN Volume Controller (SVC)

Adapter requirements for an SAP HANA instance look different for single-host (scale-up) and multi-host (scale-out) SAP HANA systems. Initially in 2015, only single-host will be supported for SAP HANA on POWER. But we also include guidelines for multi-host systems here, helping to plan and feature initial single-host systems for a later integration into a multi-host /scale-out environment (see SAP Note 2133369 for updates).

Individual sizing objectives are outlined in chapter Mapping SAP I/O KPIs to a Storage Design.

SAP HANA network planning need to consider bandwidth requirements for the following communication paths[5]:

- Communication - LAN
  - SAP HANA database tier to SAP application server tier
  - SAP HANA inter-node communication (scale-out only)
  - SAP HANA System Replication Communication
  - SAP HANA share (for CTS+ and/or scale-out)
  - Administrator network
- Storage – SAN

Planning Considerations for Virtual IPs

Similar to SAP NetWeaver systems, an SAP HANA database can be installed using a virtual IP address. Beside the standard of using virtual IPs for SAP applications there are two cases where a virtual IP for the SAP HANA Database becomes mandatory:

- SAP management tools such as SAP Landscape Virtualization Management (LVM) rely on virtual IPs to operate on the SAP instances.
- Most cluster solutions require having a virtual IP to failover a SAP HANA System Replication. SAP HANA itself also provides such capabilities. If it is mandatory to use virtual IPs or if other ways have to be pursued has to be verified with the cluster vendor.

Planning considerations for VIOS I/O virtualization

VIOS is a strategic component for IBM and most customers when deploying partitions on IBM Power Servers. VIOS based deployments are mandatory for consolidation, Life Partition Mobility (LPM[6]) and other features.

For fibre channel virtualization, NPIV capable deployments should to be chosen to take advantage of functionality in the larger ECO system and ease of use.

For Ethernet there are several facets to consider:

- I/O sensitive internode communication does not exist for scale-up. Using the full 10Gb Ethernet bandwidth is not critical for scale-up deployments.
- SR-IOV capable adapters are recommended when new hardware is ordered.

[5] This does not take GPFS planning into account.
[6] Considering the large memory footprint LPM can only be done under load conditions allowing the memory to be transferred in a reasonable amount of time.

- Jumbo frames together with a MTU size of 9000are required for native and VIOS attached Ethernet cards to get reasonable throughput. This has to be enabled end-to-end including the switches.
- VIOS in a mixed environment using AIX and Linux require having same large_send and large_receive settings end-to-end using the same infrastructure/VIOS adapter.

Planning Considerations Single-Host SAP HANA (scale-up)

As part of the Power System configuration process, adapters need to be selected that contain sufficient ports of the specified connection speed. These need to fit into available PCI slots of the planned server.
Additional adapters should be considered when planning for a later multi-host landscape for growth or resiliency reasons or additional workload (see subsequent chapter).

Minimum I/O adapter requirements for a production SAP HANA system using **dual-VIOS** are[7]:

Table 5. Minimum Single-Host SAP HANA I/O adapters for production (floor configuration)

	VIOS #1	VIOS #2	Function
LAN / Ethernet	1* 10 Gb port	1* 10 Gb port	SAP HANA database to app server
	1* 1 Gb port	1* 1 Gb port	Administrator and SAP HANA share network
	Peak loads up to 300MB/s per HANA node.[8]	Peak loads up to 300MB/s per HANA node.[8]	SAP HANA System Replication (optional)
SAN / fibre channel	2 ports	2 ports	Attachment to data and log persistency

The network ports shown in Table 5 are a starting point and need adaptation for the specific installation. The pattern can be mapped into any supported Power System which fulfills previous sizing criteria and has sufficient free adapter slots. It makes no difference whether this is applied to a dedicated SAP HANA on POWER server, or to a partition in a larger consolidation system.

Planning Considerations Multi-Host SAP HANA (scale-out)

Note: *Verify the current support status of this feature (SAP Note: 2133369) .*

Multi-Host SAP HANA systems in a shared-nothing cluster (compared to a “shared cluster” which is based on a clustered file system such as GPFS), meaning each cluster member needs access to the LAN and its own set of disks. Since the members need to coordinate their workload and disk access during a query, additional dedicated LAN segments are required per SAP SE design guideline.

[7] When using dedicated adapters attached natively to the partition, **each HANA node** requires the same amount of adapters as a dual VIOS setup would require. However, if a HANA node uses the entire server, native attachment is a reasonable option if no VIOS features (e.g. live partition migration (LPM)) are used.
[8] The peak load documented is the highest known number. Campus solutions where both sides are synchronously replicated to avoid data loss in a HA case have to deal with the individual peak loads. DR setups between sides typically have an intentional delay between tiers and by that the need to cover peak loads is lower.

Minimum I/O adapter requirements for a production SAP HANA system using **dual-VIOS** are:

Table 6. Minimum Multi-Host SAP HANA I/O Adapters per Server (floor configuration)

	VIOS #1	VIOS #2	Function
LAN / Ethernet	1* 10 Gb port	1* 10 Gb port	SAP HANA database to application server
	1* 1 Gb port	1* 1 Gb port	Administrator network
	2* 10 Gb port	2* 10 Gb port	SAP HANA inter-node connect
	<under investigation>	<under investigation>	GPFS[9] network (optional)[10]
	Peak loads up to 300MB/s per HANA node.[8]	Peak loads up to 300MB/s per HANA node.[8]	SAP HANA System Replication (optional)
SAN / Fibre Channel	2 ports	2 ports	Attachment to data and log persistency (SAN)

Same as in previous paragraph applies for mapping these ports to proposed hardware.

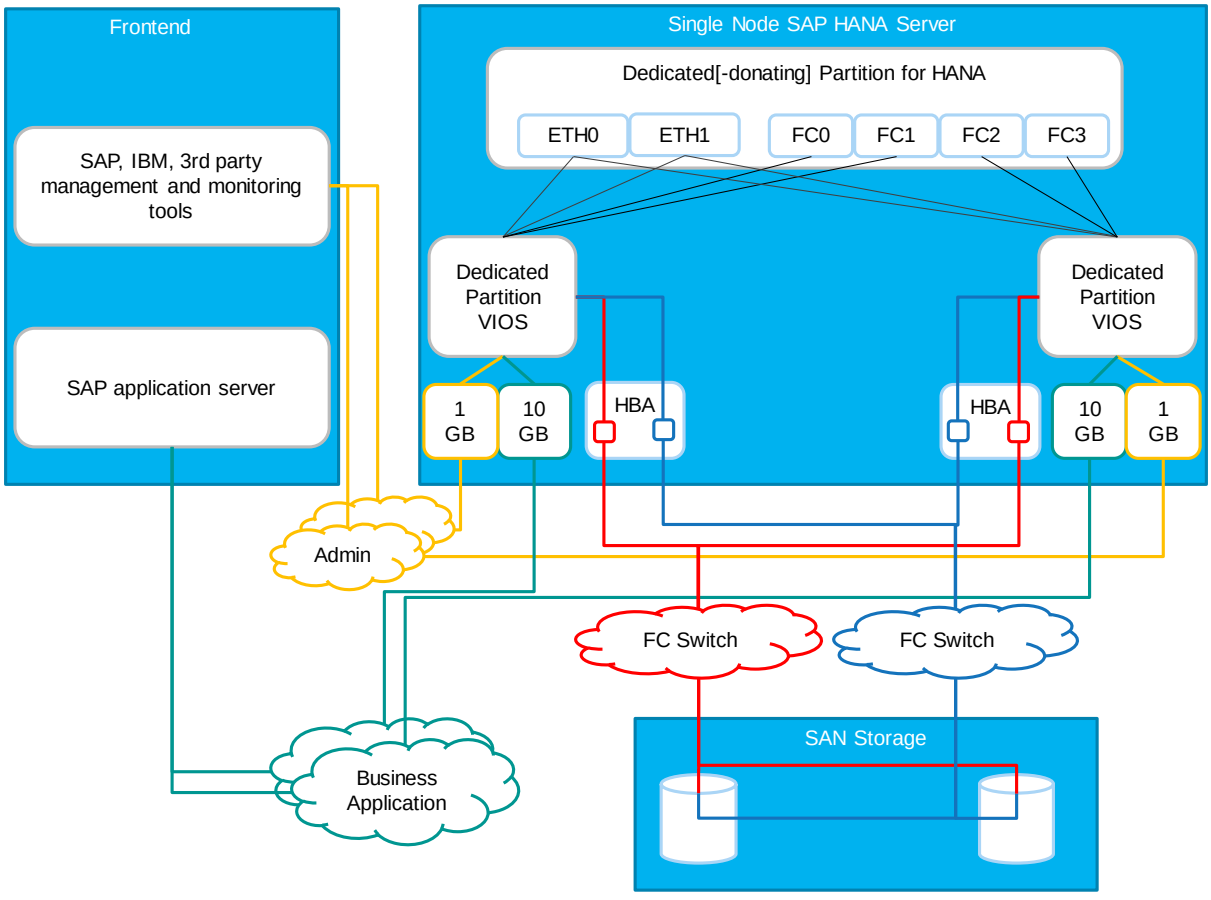

Figure 10. Minimum Single-Node SAP HANA Connectivity Setup with SAN Storage and Dual-VIOS

[9] Support for GPFS is handled by IBM PMRs. GPFS in SAP HANA on POWER deployments is not pre-evaluated for SAP HANA data and log files and by that no direct SAP solution support is granted.

10 The requirements may differ compared to Intel deployments. Details will be provided along with the GA of the scale-out solution.

Quick Reference: I/O Adapter Definition

Calculate the fibre channel throughput to meet the desired start time to load the data into memory. This value must not be smaller than the SAP provided KPIs.

The client and SAP HANA node communication requirements are defined by SAP in the TDI deployment guides.

Links, References and Tools

IBM System Storage Architecture and Configuration Guide for SAP HANA TDI
SAP HANA – Network Requirements

Planning Sheets: Connectivity

The planning sheets below can be used to plan and document the SAP HANA environment in a Power infrastructure. The planning has to be done for each Server unless all are identical.

Table 7. VIOS Server Resource Planning Sheet

No	VIOS Server planning sheet	I/O virtualization	Notes
1	VIOS Release		Min. 2.2
2	VIOS Partition Type		Dedicated partitions are recommended.
3	Ethernet Virtualization		
4	FC Virtualization		NPIV for MPIO
5	CPU for each VIOS		Min 1
6	Memory for each VIOS		Min 4GB

Table 8. Ethernet Connectivity Planning Sheet

No	Ethernet planning Sheet	Zone	Adapter/Speed/#	Notes
1	SAP HANA network			Only for scale-out
2	Admin network			
3	Appserver connect			
4	SAP HANA share			Typically NFS or GPFS
5	GPFS (Eth or IB)			

Table 9. Fibre Channel Planning Sheet

No	FC Planning sheet per Server	Sizing	Notes
1	Required Ports		Min 4 Ports on 2 HBAs
2	Switch Model/Speed		
3	Switch/Zone 1		
4	Switch/Zone 2		

Software and Operating System

The Linux setup of SAP HANA on POWER does not differ in essence from any Intel SAP HANA deployment. The central SAP document to follow is the SAP HANA Server Installation Guide.

Operating System

The basis of operating system setup is the same as for all other SAP supported Linux distributions. Ensure appropriate licensing, versions of SUSE or RedHat and configurations as documented in SAP Notes listed in the "Links, References and Tools" section in this chapter.

Planning Considerations

Select any documented Linux distribution as documented in SAP Note 2055470.

When running on POWER8 production nodes it is important to ensure the OS supports POWER8 native mode for performance reasons.

Quick Reference: OS Planning

Refer to the SAP manuals to setup Linux for SAP HANA and the SAP HANA on POWER Implementation Guide. Both are referenced in the subchapter "Links, References and Tools". In addition appropriate OS license and install media have to be in place.

Links, References and Tools

Installation Guides:

SAP HANA Server Installation Guide
SUSE LINUX Enterprise Server Deployment Guide

SUSE Knowledge Base

SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides)

SAP Notes:

SAP Note 2055470 - HANA on POWER planning and installation specifics - central note
SAP Note 1944799 - SAP HANA Guidelines for SLES Operating System Installation
SAP Note 1310037 - SUSE LINUX Enterprise Server 11: Installation notes
SAP Note 171356 - SAP Software on Linux: General information
SAP Note 1599888 - SAP HANA: Operational Concept

File System

Beside the root file system, optional SAP HANA backup file systems, /usr/sap and file systems for other applications, a special thought has to be given to /hana/data, /hana/shared and /hana/log.

The /hana/shared is a shared file system for transport between PRD, QAS, and TST SAP HANA Servers, and to exchange data between nodes of a scale-out solution. Typical solutions are based on GPFS or NFS.

Decisions made for /hana/data and /hana/log will have a direct effect on storage, network, HA and DR solutions as well as backups[11].

The size of the SAP HANA file systems was already determined during the sizing effort documented in the "Hardware Planning" chapter. Basis for the file system sizes is the SAP HANA Administration Guide providing detailed pictures of the file system tree and the SAP HANA Quicksizer output.

Planning Considerations

Using XFS with multi-pathing and LVM striping provides options to optimize the I/O characteristics. This chapter will explain how fibre channel connectivity, zoning and multi-pathing have an effect on the LUN layout planning.

Note:
The minimum number of paths, volumes and disks determined in the sizing process is the absolute minimum even if in the following planning process less might be sufficient.

To optimize the implementation on Linux the following considerations should be taken into account:

- When increasing the number of ports, the minimum number of LUNs should be equal to the number of active fibre-channel ports (size adjusted accordingly).
- When increasing the number of LUNs, they should be a multiple of the number of FC ports. This will later ensure to optimize the LVM striping.
- The number of logical volume stripes should match the number of LUNs

Quick Reference: File System Definition

Follow the SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides) when using XFS or use appropriate file system documentation.

Run the verification prior to the installation of SAP HANA.

Links, References and Tools

SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides)

[11] Technically a single-node SAP HANA can be installed on top of GPFS. In this case it has to be ensured by the customer that the setup still meets the SAP KPI criteria (HWCCT). A move from an XFS file-system to GPFS at a later time is possible using SAP HANA System Replication or GPFS methods. GPFS on SAN is very sensitive in regards to how the storage is configured and formatted down to the ranks. Please involve GPFS specialists to create a valid setup from the disk up to GPFS and workload tuning as improper setups can impact the systems I/O performance by a factor of 10 or more.

Planning Sheets: File System

Table 10. SAP HANA File System

No	Mount point	Description	FS	size	Comment
1		OS root file system			Supported by OS
2		SAP HANA Data			Min 1* RAM
3		SAP HANA Log			Min. 1* Ram
4		SAP HANA share			
5		SAP HANA FS Backup target			Optional. Depends on Backup Software
6		SAP HANA Binaries			

SAP HANA Software

The SAP HANA database should be installed according to the SAP Installation Guides.

Planning Considerations

To be able to move the business data to an SAP HANA deployment, verify the minimum SAP application levels need to be met. Please verify with SAP to get the latest minimum releases or check the SAP PAM.

For the SAP HANA installation the hdblcm tools must be used (do not use hdbinst anymore).

Quick Reference: SAP HANA Software.

Please follow the below referenced SAP Installation Guide and the SAP HANA on IBM Power Systems and IBM System Storage Supplemental IBM Installation Guide.

Links, References, and Tools

SAP Note 2133369 - SAP HANA on Power: Central Release Note

SAP HANA Server Installation Guide

SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides)

Planning Sheets: Software and OS

Table 11. SAP Software Planning Sheet

No	SAP Software planning Sheet	Description	Notes
1	SAP HANA Release		SAP Note 2133369
2	HWCCT update		SAP Note 1943937
3	SAP Application / Release		SAP Note 2133369
4	Linux		SAP Note 2055470

Table 12. SAP HANA Installation Planning Sheet

No	SAP HANA Installation planning sheet	Description	Notes
1	SAP HANA SID		
2	SAP HANA Instance Number		
3	Virtual IP(s)		• “ Planning Considerations for Virtual IPs” and “SAP System Replication requirements”

Verification

The basis compliance to SAP minimum requirements can be verified with the SAP HANA Hardware Configuration Check Tool (HWCCT). It provides several modules to test the deployment.

For SAP HANA on POWER in a scale-up deployment only the Landscape- and the Filesystem-Test are relevant to validate the deployment before go life or after changes.
Ensure to keep ongoing records of the HWCCT documentation containing the KPIs for the file-system test and the HWCCT version used. This is useful in case of support situations and for regular health checks.
It is recommended - especially for the Landscape-Test - to regularly verify the system with the latest version of HWCCT. Especially when changing the deployment or update SAP Software.

The HWCCT tool:

- MUST be used for go life
- SHOULD be used after each change in the landscape
- Is RECOMMENDED to be used for regular health checks

The minimum KPI values and instructions about how to run and configure HWCCT can be found in SAP Note 1943937.

Optional Software and Hardware Considerations

This section lists IBM products which can bring advantages to the SAP HANA on POWER SAP landscape. Other vendors might provide similar products which can be used, too.

Migration

SAP SUM (Software Upgrade Manager) tool with the DMO option can be used to migrate from a traditional database to the SAP HANA In-Memory database.

SAP HANA System Replication can be used for zero downtime migration between servers with same endianess. Use cases are:

- From scale-up to scale-out
- From XFS to GPFS file system
- Between Power Servers

SAP HANA heterogeneous system copy can be used to move the data to a new database independent from endianess.

Starting with SPS9 HANA Software additional upgrade options are available as documented by SAP.

The SAP HANA Administration Guide and SAP HANA Master Guide provide the necessary SAP information. IBM specifics are documented in the SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides)

Backup

SAP HANA provides several methods for data protection with their pros and cons. The major differences between these are:

- how to order, maintain, schedule and re-apply the backups in case needed.
- Which product is used to store the backups in a secure and safe location

These methods are the same for Intel and Power. Below some products are highlighted which can be considered as a useful extension.

IBM Spectrum Protect[12]

IBM® Spectrum® Protect provides a flexible file-system based backup method working for XFS as well as for GPFS file -systems. The traditional backup-archive client can be used to make file system based backups of SAP HANA data and log as well the required configuration files. The source to backup can be a SAP HANA file system backup, a SAP HANA snapshot target or directly from the offline database.

It can be also used to cleanup growing archive logs of the database to prevent from full file -systems.

To perform SAP HANA snapshot functionality, check the IBM FlashCopy backup solution for SAP HANA TDI documentation. It describes the required setup and outlines the process including scripts to reuse on an SVC based sample setup.

SAN Infrastructure and SAP HANA File System Backup

For SAP HANA file system backup, a target file system for the backups has to be planned. When scheduling automated backups, it will be vital to monitor for full log backup directories, as full target file systems will suspend SAP HANA database operations. With SAN implementations, the target file systems can be easily located to a second storage system to protect the data physically.

SAP HANA Snapshots

SAP HANA Snapshots is an option provided and supported by SAP HANA to create a fast copy of SAP HANA production data with minimal interruption in writing the persistency backup. This option requires a FlashCopy license for the SAP HANA data area on the storage subsystem. It has to be ensured to transport the snaps to a backup archive location.

[12] Formerly: Tivoli Storage Manager (TSM)

GPFS and IBM Spectrum Scale

GPFS[9] has native snapshot and encryption functionality which can be exploited performing SAP HANA Snapshots.

High Availability and Disaster Recovery

All native SAP HANA High Availability (HA) and Disaster Recovery (DR) methods can be used for SAP HANA on POWER deployments as documented by SAP.

The following SAP Documentation gives a good overview: Introduction to High Availability for SAP HANA

SAP HANA System Replication (Multi-tier)

The key functionality in SAP HANA in regards to High Availability and/or Disaster Recovery is the SAP HANA System Replication. This is also available in a multi-tier version, providing the option to have both a near standby and a remote standby.

For pure DR a manual takeover is sufficient. Automated failure detection and takeover procedures are required to minimize the operational costs and the takeover time (RTO) for HA purposes.

IBM Tivoli System Automation Multi-Platform (SA MP) can be used to cluster SAP HANA System Replication instances. It also provides products to automate the HA setup for the required application servers out of the box. Looking towards enhanced options SA MP is GPFS aware and can support up to 128 nodes for scale-out deployments. For DS8000 also a HyperSwap deployment can be considered for native storage attachments using SA MP.

SAP HANA Auto Restart, Auto Host failover, Failover Hooks

SAP HANA supports out of the box HA capabilities. They can be used for both – scale-up and scale-out. This requires appropriate SAN zoning or GPFS.

IBM Storage Replication

The IBM Storage Subsystems can be used to mirror SAP HANA data to a DR site using consistency groups. Synchronous and asynchronous methods can be applied.

Management and Monitoring

PowerVC

IBM® PowerVC Virtualization Center is an advanced virtualization management offering, built on OpenStack, that provides simplified virtualization management for IBM AIX®, IBM i and Linux running on IBM Power Systems™.

PowerVC is designed to improve administrator productivity and simplify the management of VMs and LPARs on Power Systems servers. PowerVC provides the foundation for Power Systems scalable cloud management, including integration to higher-level cloud managers based on OpenStack technology.

PowerVC can be used to rapidly deploy partitions including zoning and disk provisioning. It builds a good match to other OpenStack components and is pure Power focused and by that well integrated into the technology options.

Support and Services

Getting help and information from the World Wide Web for IBM products

On the World Wide Web, the IBM website has up-to-date information about IBM systems, optional devices, services, and support. You can find service information for IBM systems and optional devices at http://www.ibm.com/supportportal.

Getting help and information for IBM Server and Storage mapping

People responsible for SAP HANA sizing who are not familiar with the SAP process and have not received quantified system requirements (memory GB, cores or SAPS) for the SAP HANA project can contact their responsible IBM TechLine, FTSS, or ATS team for guidance through the official SAP sizing process.

Standard Support Flow

Not using the centralized IBM service, support and operation offerings for SAP HANA it has to be verified the product owner provides sufficient support. Figure 11 outlines the standard support ownership of SAP HANA, the operating system and the hardware stack. Figure 12 brings the typical responsibilities into the context of SAP Support.

Note:
To collect OS and HANA system configuration information use the sapsysinfo and HWCCT tool available through following SAP Notes:
SAP Note 618104 - "sapsysinfo" - Compiling system information on Linux
SAP Note 1943937 - Hardware Configuration Check Tool - Central Note

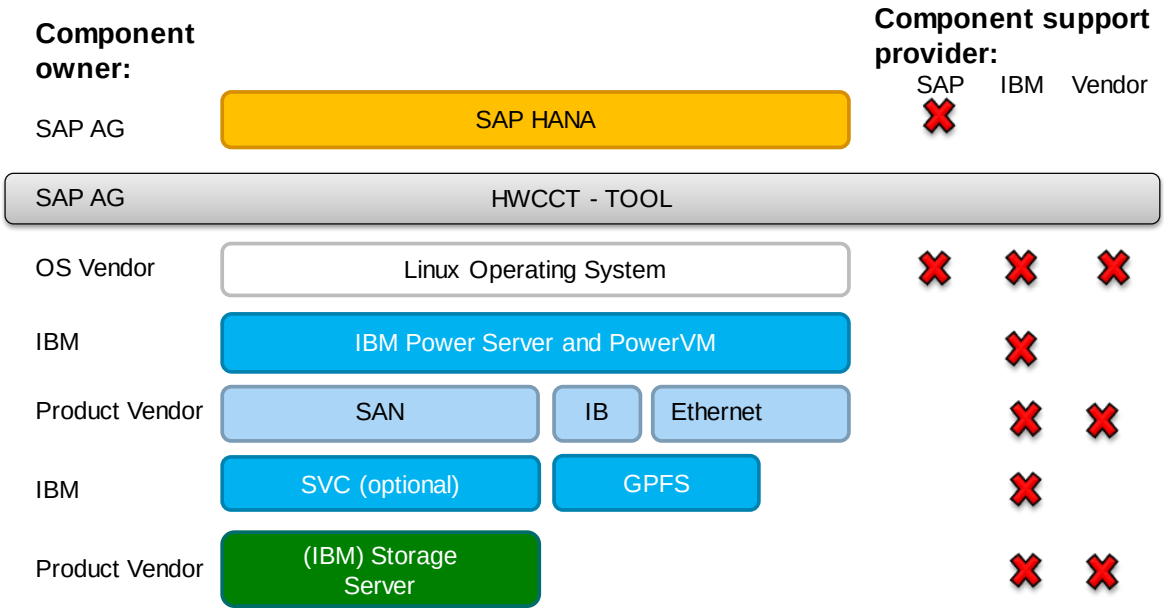

Figure 11. Standard Support ownership of SAP HANA and Hardware Stack

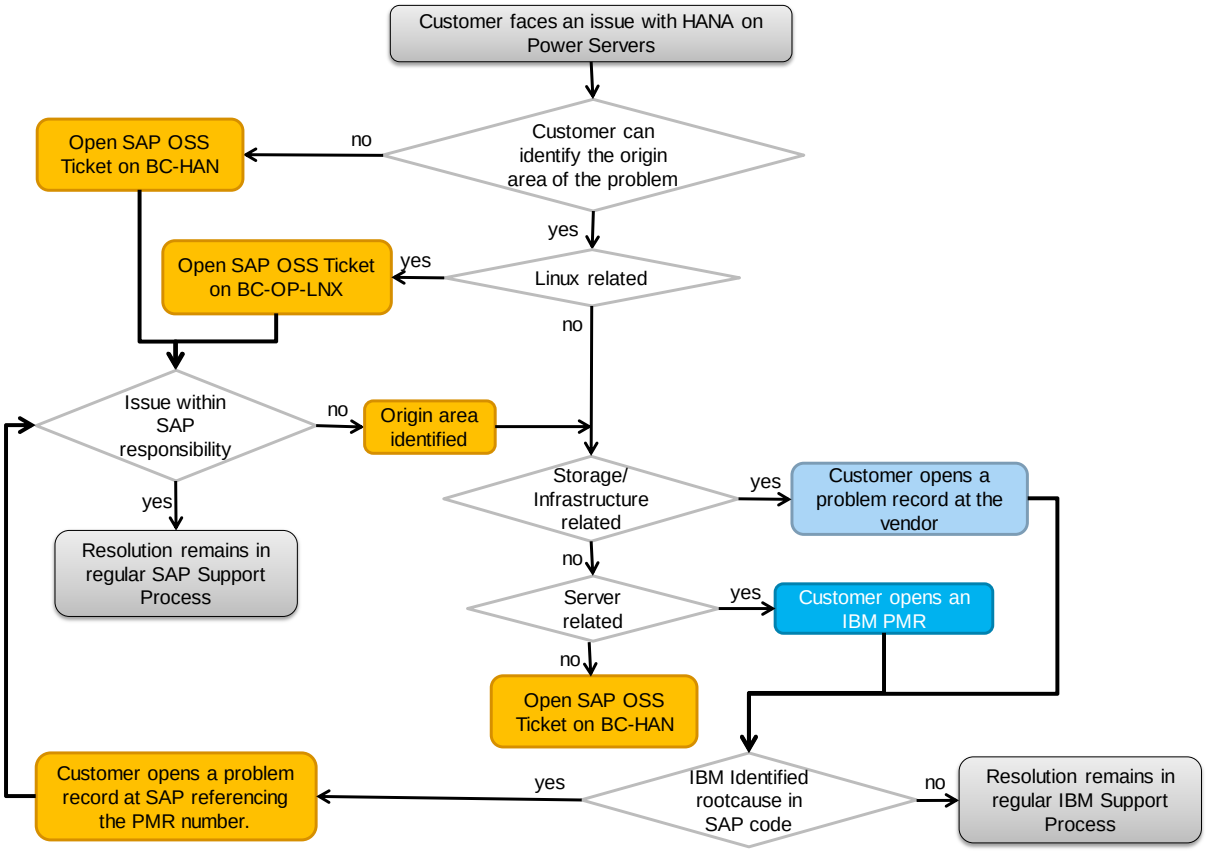

Figure 12 Support Flow for HANA on Power Solution Stack

IBM Services, Support and Operation offerings for SAP HANA on Power

Besides the SAP support and standard IBM support for the infrastructure components, IBM intends to provide at GA a more comprehensive set of services to best support customers for SAP HANA on Power systems.

The following areas will be addressed by the services

Planning and Installation

The planning process introduced in this paper which is based on a SAP sizing and an IBM mapping supported by the IBM TechLine Enablement (SAP Sizing Questionnaire for Suite and BW) can be enriched by the IBM Systems Lab Services. These services will offer clients services for on-site SAP HANA Installations.

To engage IBM Systems Lab Services for SAP Hana on Power please contact Michael Barenys barenys@us.ibm.com for all countries except in Europe, whose contact is Virginie Cohen VirginieCohen@fr.ibm.com.

Integrated Support

For the operation phase IBM plans to provide with GA a solution support approach which contains:

- Integrated support HW/SW for the HANA on power infrastructure stack
- Single point of Entry
- Set of remote and onsite proactive services (eg. Health Check, system validation)

Details are planned to be available with the general availability of SAP HANA on Power announcement.

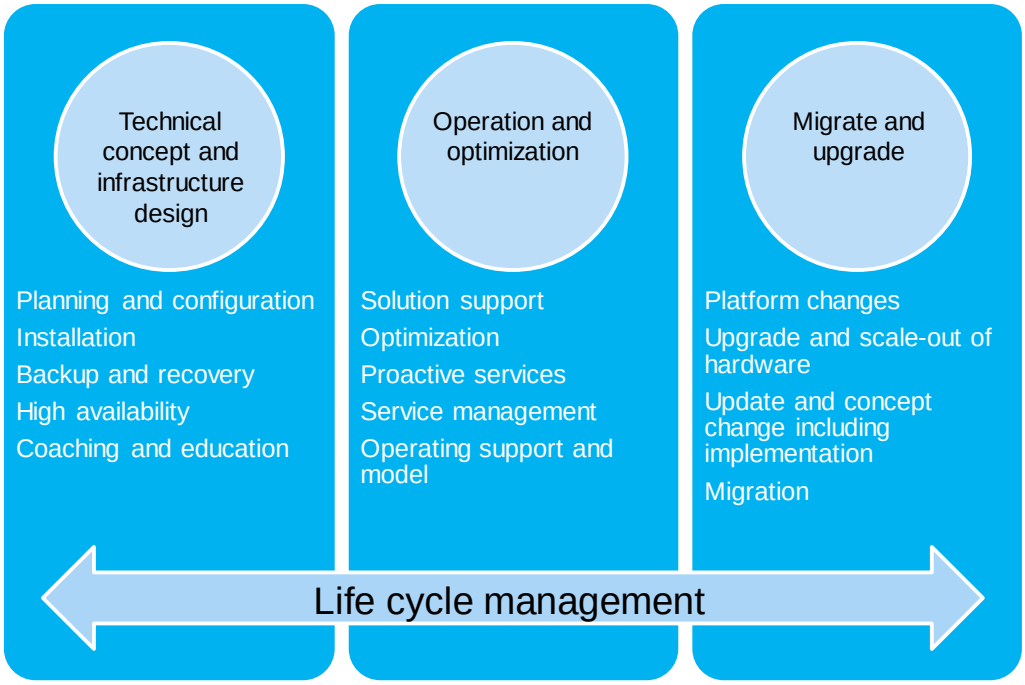

Figure 13. IBM Services for SAP HANA on POWER Environments

Referenced documents

This is a full list of documents used to write this planning Guide. Some of these require special permissions. Collaborating with IBM, SAP or your Business Partner will provide access to all of them.

SAP Notes:

- SAP Note 618104 - "sapsysinfo" - Compiling system information on Linux
- SAP Note 1310037 - SUSE LINUX Enterprise Server 11: Installation notes
- SAP Note 1599888 - SAP HANA: Operational Concept
- SAP Note 1514966 - SAP HANA 1.0: Sizing SAP In-Memory Database
- SAP Note 171356 - SAP Software on Linux: General information
- SAP Note 1736976 - Sizing Report for BW on HANA (SAP Note 1637145 outdated)
- SAP Note 1813548 - Database Migration Option (DMO) of SUM
- SAP Note 1872170 - Suite on HANA sizing report (earlier SAP Note 1793345)
- SAP Note 1943937 - Hardware Configuration Check Tool - Central Note
- SAP Note 1954788 - SAP HANA DB: Recommended OS settings for SLES 11 / SLES for SAP Applications 11 SP3
- SAP Note 1944799 - SAP HANA Guidelines for SLES Operating System Installation
- SAP Note 2055470 - HANA on POWER planning and installation specifics - central note
- SAP Note 2130682 - SAP HANA on Power Documentation for Rampup
- SAP Note 2133369 - SAP HANA on Power: Central Release Note

SAP Documents:

- Sizing:
  - SAP HANA sizing (SAP Community Network, Registered S-Users)
  - Sizing Approaches for SAP HANA – Lessons Learned
  - How to size SAP BW on SAP HANA
  - Sizing for SAP Business Suite powered by SAP HANA
  - Quick Sizer Tool (ensure to use the HANA Quick Sizer)

- Storage and High Availability
  - SAP HANA – Storage Requirements
  - SAP Certified Enterprise Storage Hardware for SAP HANA
  - SAP HANA – Network Requirements
  - Introduction to High Availability for SAP HANA
- Architecture
  - SAP HANA Platform (all HANA related documents as in scope accordingly to SAP Note 2130682)
    - SAP HANA Server Installation Guide
    - SAP HANA Administration Guide
    - SAP HANA Master Guide
    - SAP HANA Security Guide
    - …

  - IT Planning Documents
  - SUSE LINUX Enterprise Server Deployment Guide
  - SUSE Knowledge Base

IBM Documents:

- Assistance
  - IBM TechLine support
  - SAP Sizing Questionnaire for Suite and BW
  - ISICC SAP HANA on Power Systems (IBM only)

- Storage
  - IBM System Storage Architecture and Configuration Guide for SAP HANA TDI
  - SAPmagic - Storage Sizing Tool for SAP landscapes (IBM and BP only)

- Hardware mapping:
  - ISICC SAPS Capacity Tables for Power Systems (IBM only, BPs and customers should contact the IBM TechLine for support)
  - POWER8 Facts and features
  - POWER7+ Facts and features
  - *Sales Support Information* ***(SSI)*** *(IBM only)*

- Deployment
  - SAP HANA on IBM Power Systems and IBM System Storage (Supplemental IBM Installation Guide to the SAP HANA Master, Implementation and Administration Guides)
  - IBM FlashCopy backup solution for SAP HANA TDI

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