IBM® System Storage™ Architecture and Configuration Guide
for
SAP® HANA™
Tailored Datacenter Integration

location of this document:

https://www.ibm.com/support/pages/node/6355415

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Contents

1   Preface

This paper is intended as an architecture and configuration guide to setup the IBM® System Storage™ for the SAP® HANA™ tailored datacenter integration (SAP HANA TDI) within a SAN environment.

This document has been written for IT technical specialists and architects, with advanced skill levels on SUSE® Linux™ Enterprise Server or Red Hat LINUX® and IBM System Storage, with a focus on architecting and setting up an IBM System Storage environment for SAP HANA TDI. The SAP HANA TDI allows the SAP customer to use external storage to attach to the SAP HANA server.

This document provides the necessary information to select, verify and connect IBM System Storage to the SAP HANA server through a SAN (fiber channel) attached storage network. The recommendations in this guideline apply to both single node and scale out configurations, as well as Intel® or IBM POWER® based SAP HANA systems.

For a list of all storage systems certified for SAP HANA production please visit:

https://www.sap.com/dmc/exp/2014-09-02-hana-hardware/enEN/#/solutions?filters=v:deCertified;storage;ve:6

2   IBM storage architecture for SAP HANA TDI

The IBM System Storage needs to be connected through a SAN network with the SAP HANA server. IBM recommends – but not requires – the use of the IBM Spectrum Virtualize (SAN Volume Controller, SVC) as virtualization layer, enabling to centralize the management of the storage systems, as well as to provide easily high availability and disaster recovery functionality, as well as IBM FlashCopy backup and tiered storage pooling. For smaller HANA TDI deployments you can also use the IBM FlashSystem, which is based on the same functions of SVC, and inherits its advantages described above.

IBM Storage Systems certified for SAP HANA TDI production are:

- IBM Spectrum Virtualize (SAN Volume Controller, IBM FlashSystem)

- IBM DS8900F Family

For non-prod SAP HANA systems, any storage system can be used.

3   The central theme

Below the generic workflow describes how to setup SAP HANA TDI with IBM storage:

I. Verify all server & storage components and firmware requirements given by SAP are met
II. Install SLES or Red Hat operating system on all SAP HANA nodes
III. If required: setup NFS services for the SAP HANA shared directory
IV. Setup SAN storage systems
V. Create SAN zone for SAP HANA environment
VI. On the storage systems map the storage volumes (LUNs)
to all target SAP HANA nodes. Volumes must be attached via the SCSI protocol. NVMe is not supported by SAP HANA.
VII. Perform Linux setup and tuning, e.g. multipath, IO scheduler, …
VIII. On each LINUX host create the file systems for *SAP HANA data, log, shared*
IX. Setup of /hana/shared/global.ini for HANA scale out or HANA node failover
X. Install and configure the SAP HANA software
XI. Optional: HA, DR, and Backup considerations

4   Requirements

Before starting to deploy SAP HANA TDI, ensure that the following key items have are in place:

- A SAN environment is required to attach IBM System Storage through fiber channel with the SAP HANA TDI nodes.
- SAP requires a storage validation for SAP HANA TDI according to their KPI (key Performance Indicators) – please contact SAP for further details.
- The SAP HANA nodes must be sized and configured according to SAPs specification (Bill of Material for SAP HANA node), in addition each SAP HANA TDI system needs to have min 4 FC ports, recommended are 8 FC ports.

Naming: The term "node" is use for a single HANA instance: if for instance 4 HANA instances are deployed on a single IBM POWER server, or 4 HANA instances are deployed into four single LPAR, then this reflects 4 nodes.

5   Installation of SUSE SLES or Red Hat RHEL

Install the Linux operating System accordingly to the SAP PAM for the chosen SAP HANA version, see SAP note https://launchpad.support.sap.com/#/notes/2235581

6   Setup of shared access for the /hana/shared/ directory

SAP HANA scale-out and HANA HA node fail-over require that the directory /hana/shared/ must be accessible from all nodes, else this directory can be setup as local file system from type xfs.

The shared access can be achieved most easily through NFS. If such setup does not already exist, one of the following options can be used to implement it:

> Highly Available NFS service with DRBD and Pacemaker with SUSE Linux Enterprise High Availability Extension.

Setup these systems according to the appropriate implementation guides and make the shared NFS file system available on all HANA nodes, including the spare nodes.

Setup the NFS Server by adding the following line to file /etc/exports:

```
/hana/shared node1(fsid=0,crossmnt,rw,no_root_squash,sync,no_subtree_check)
node2(...) node3(...)
```

To configure the HANA nodes as NFS clients, add the following line to file /etc/fstab on each HANA node:

```
nfsserver:/hana/shared /hana/shared nfs4 rw,soft,intr,rsize=8192,wsize=8192 0 0
```

7   IBM System Storage sizing & configuration

This section covers the evaluated storage options.

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7.1   Recommended IBM System Storage combinations

To achieve the required storage performance according to SAP KPIs (key performance indicators) for SAP HANA TDI, one of the following configurations listed should be chosen – nevertheless all IBM systems listed can be used as stand-alone system as well, used for DATA and LOG.

Because IBM SAN Volume Controller, and for smaller configurations IBM FlashSystem, provisions *volumes* (LUNs) as a single volume type and single storage system, it will ease the administration of storage pool tiers with Flash, SSD, and HDD types; and optional tasks like setup of storage high availability, FlashCopy base backup, storage-based mirroring, or storage maintenance.

IBM recommends the use of FlashCore Modules (FCM) or NVMe flash drives for production workload. From expansion modules, SAS flash drives should be used.

SAS 10k or near line disk drives are suitable for archive data, or for backup as last-storage-pool.

7.2   NSE Considerations

SAP HANA Native Storage Extension (NSE) is an SAP HANA feature to keep so called warm data on disk instead of loading it into memory. NSE enabled data is loaded on demand only.

NSE requires to store the data on fast storage with low IO latencies. Therefore, the storage pool providing /hana/data should be formed of the fastest available drives of the storage system. For FlashSystem, we recommend using FlashCore Modules (FCM) or even better Storage Class Memory (SCM).

To avoid any movement of such data to lower storage tiers, ensure also that *IBM Storage Easy Tier* is disabled on the storage system.

For more information about using NSE with IBM FlashSystem, please refer to https://www.ibm.com/support/pages/ibm-flashsystem-sap-hana-native-storage-extension

7.3   IBM System Storage sizing

This chapter provides some general sizing guidelines.

All components of the SAN infrastructure must be configured to use a minimum 8GB link speed with 4 links. All listed storage configurations apply to active SAP HANA TDI nodes only; no additional storage configuration is required for any stand-by system. If SVC stretched cluster needs to be configured, all listed storage configuration must be doubled.

Maximal number of HANA production systems support per IBM System Storage:

IBM System Storage	# HANA Prod
IBM FlashSystem 5015/(5035 + 5045)/5200	4 / 18* / 72*
IBM FlashSystem 7300(H) 924	132*
IBM FlashSystem 9500(R)	164**
DS8910F / DS8950F / DS8980F	84 / 150 / 150
SVC 2145/2147 SV3, one / four node pairs	48 / 192
SVC 2145/2147 SA2, one / four node pairs	25 / 100

* with max. supported IOGroups

** IBM FlashSystem 9500 supports 2 IOGroups but doubles the performance of its pre-decessor, the 4 IOGroup capable IBM FlashSystem 9200

7.4   Flash Core Modules (FCM)

During lifetime of all kind of flash technology the capacity utilization should not exceed 80%. If the utilization approaches this limit, additional capacity of the same kind and device capacity need to be added. For capacity planning and sizing this should be considered seriously.

7.5   IBM storage performance sizing for HANA

This section provides sizing guideline how to size IBM storage for HANA.

If not stated otherwise (and if applicable), use distributed RAID 6.

The statement *"Supports up to xx HANA systems"* refer to SAP production systems, in case of non-prod systems, like Dev/Test/Sand much more HANA system can be used.

IBM SAN Volume Controller

- SV3: Each IO group (two nodes) can handle 48 HANA nodes, a four IO-group cluster is able to handle 192 HANA systems
- SA2: Each IO group (two nodes) can handle 25 HANA nodes, a four IO-group cluster is able to handle 100 HANA systems
- Use Pools (MDiskGroups) with at least 8 Backend LUNs (MDisks) for reasonable workload balancing

IBM FlashSystem 5015 / 5035 / 5045

> 12 SSD for every 6 HANA systems

IBM FlashSystem 5200

- 12 NVMe FCM for every 18 HANA systems

IBM FlashSystem 5200 / 7300

- 12 NVMe FCM for every 18 HANA systems

IBM FlashSystem 9500

- Supports up to 82 HANA production nodes
- It is recommended to use full equipped units only, with 48 NVMe Flash Core Modules.

IBM DS8000 family

- 16 Flash Cards for every 8 nodes

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7.6   Sizing tool MyFlash4HANA

IBM provides a tool to size in IBM storage systems for a given/planed HANA environment. This tool is available only to IBM and IBM Business Partner.

Please be so kind and ask your IBM sales representative or IBM Business Partner for a detailed IBM Storage sizing for SAP HANA.

7.7   Definitions of storage pools and volumes

Even though SAP HANA Data and Logs have different I/O characteristics, both workloads can be placed on the same SSD / Flash storage pool since Flash technology can handle any type of workload. With DRAID 6 there is no need to place DATA and LOGs in two different pools to protect against drive failure.

For all storage systems:

- Create 4 volumes for HANA DATA and 4 volumes for HANA LOG,
  for each SAP HANA node, recommendation: thin provisioned
- Switch on Volume / VDISK caching

SVC specific:

- Create at least 8 backend LUNs (MDisks). Increase the number (preferably by four) in case the system falls short in terms of capacity or performance. Backend LUNs should always be full provisioned volumes.

7.8   Advanced data reduction features

Implementing storage capacity saving strategies is one of the most wanted features when configuring new storage for SAP HANA. IBM FlashSystem and IBM SAN Volume Controller provide a rich bundle of data reduction features which are listed in detail below. For more detailed information about IBM FlashSystem Capacity Savings with SAP HANA, please refer to https://www.ibm.com/support/pages/node/6436843

7.8.1   Compression

IBM FlashSystem offers Real time Compression (RtC) and Data Reduction Pools (DRP) as features to enable data compression, either on VDisk or on Pool level. Because the data of the HANA database are "just" integers, the expected compression ratio is slightly small. Using VDisk or Storage Pool based compression is not recommended for production workloads.

7.8.2   Deduplication (DRP only)

The IBM storage systems provide the option to deduplicate data on Storage Pool level. Because the HANA database does internally deduplicate it's data, the additional capacity saving when using DRP is relatively small compared to other workloads. Using Deduplication is not recommended for production workloads.

7.8.3   IBM Flash Core Modules inline compression

The IBM Flash Core Modules, available for IBM FlashSystem, provides HW bases compression. Inline compression is transparent and has generally no performance impact. It is a built-in feature of FCM and it is always enabled.

7.9   Layout of storage pools and storage volumes

The following diagrams show the relationship between Linux file system, LINUX LV, VG, and PV, and the Virtual Volumes (VD, VDISK) and Managed Disks (MD, MDISK, RAIDs/Arrays) of a Storage Systems.
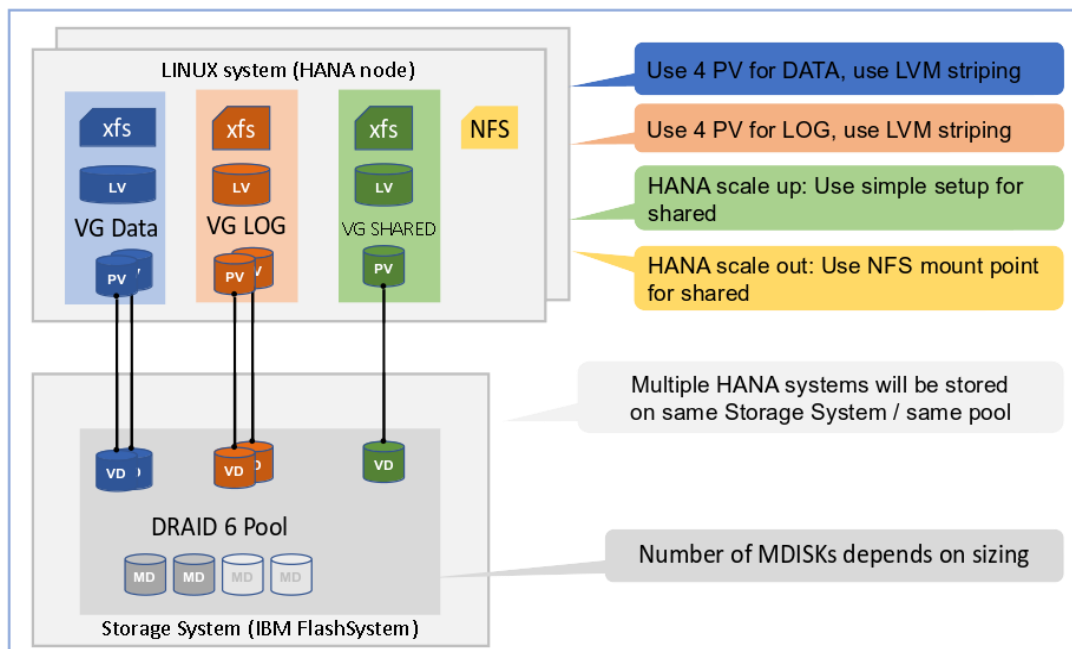
7.10 IBM SVC stretched cluster configuration

IBM SVC stretched cluster configuration with VDISK mirror is the standard implementation to gain best high availability (HA) solution for storage. The following picture illustrates the relationship between LINUX physical volumes with IBM Virtual and IBM Managed Disks.
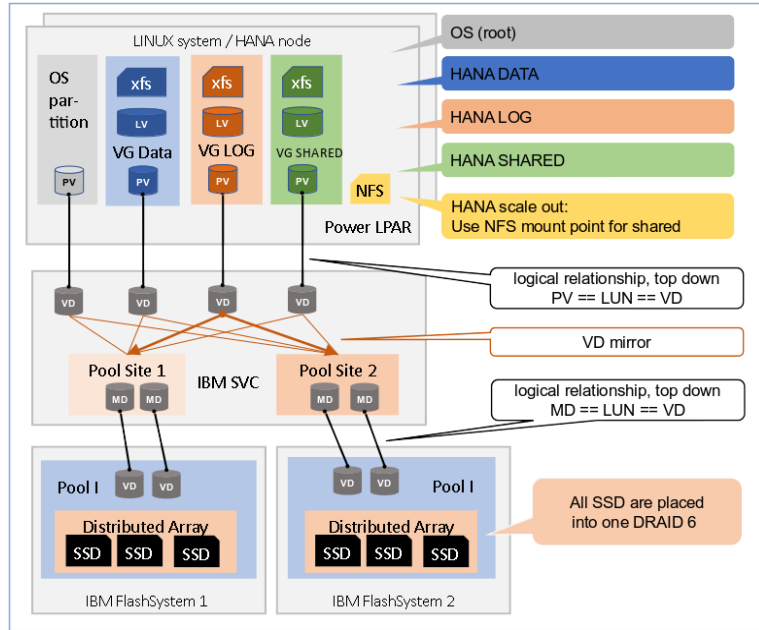
More details can be found in the IBM Redbook " Implementing the IBM System Storage SAN Volume Controller with IBM Spectrum Virtualize":

https://www.redbooks.ibm.com/abstracts/sg248465.html?Open

7.11 Competing storage utilization

Every IBM storage system can be shared between SAP HANA (production) and any other SAP or non-SAP (production) workload.

To do a proper sizing, the entire storage infrastructure needs be evaluated, including the configurations of RAID controller, number of HDD, SSD, or Flash Modules, number and type of HBA and FC ports/links.

8   Linux OS setup & tuning

General guidelines about required OS setup and tuning provided by SAP can be found here:

https://launchpad.support.sap.com/#/notes/2235581

8.1   Linux host attachment requirements

The Linux operating system default values for SAN attached SCSI devices need some adjustment prior setting up the host for SAP HANA. Please refer to https://www.ibm.com/docs/en/flashsystem-7x00/8.4.0?topic=htrlos-attachment-requirements-hosts-that-are-running-linux-operating-system in order to configure the required SCSI and udev timeouts correctly.

SAP HANA does not support NVMe host attachments, so make sure all LUNs are attached using the SCSI protocol. Please note that this restriction affects host attachments only.

8.2   Linux multipath configuration

IBM recommends specific multipath configurations for IBM Storage Systems. This documentation can be found in the IBM information web page by using the search function. For example, the multipath configuration for IBM FlashSystem 7200 is available here: https://www.ibm.com/docs/en/flashsystem-7x00/8.4.0?topic=system-settings-linux-hosts

It's recommended to follow the most recent host attachment guidelines!

8.2.1   Using alias for UUIDs in multipath.conf
The alias setting overrules the user_friendly_names setting.

Using alias makes managing and identifying volumes easier. If you want to use alias, please make sure that in the case of a multi-node environment, you fully understand the requirement and handling of consistent multipath device names across all nodes: The multipath.conf must be identical on all nodes (LINUX systems) belonging to the HANA instance.

```
multipaths {
      multipath {
              wwid            3600604800000283501312535394d303030
              alias           HANA_ANA_DATA_1
      }
      multipath {
              wwid            3600604800000283501312535394d303041
              alias           HANA_ANA_LOG_1
 }
```

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8.3   IO device tuning

The following tunable parameters can be considered in case I/O performance issues have been detected. <u>Do not change these in advance</u>. Consult a performance specialist to find a vital combination:

- Increase /sys/block/<device>/queue/nr_requests if the default (128) results in blocked I/O submission. This will indirectly help to optimize the blocking inside SAP HANA.
- Increase 'rr_min_io_rq ' to the power of 2 (4, 8, 16, 32) in multipath.conf
- Increase the queue depth of devices, e.g.
  echo 64 > cat /sys/bus/scsi/devices/<device>/queue_depth

8.4   IO scheduler (kernel parameter elevator)

The default scheduler (cfq) isn't optimal in terms of IO performance for multiple (parallel) streaming read processes, therefore it is not recommended for multipath setups. The NOOP scheduler is recommended for setups with devices that do I/O scheduling themselves, such as intelligent storage or in multi-pathing environments. The DEADLINE scheduler can provide a superior throughput over the CFQ I/O scheduler in cases where several threads do reads and writes, and fairness is not an issue. An example for such a use case are parallel readers from a SAN attached disk via multipathing. Recent Linux kernels have implemented a true multiqueue I/O scheduling ("blk_mq"). If this is being used the correct IO scheduler is NONE. Anyway, the choice of the IO scheduler depends on the installed Linux distribution and it might also differ between several versions of the same product.

Please ask your Linux vendor for configuring the best IO scheduler.

9   SAN zoning and volume mapping

Apply standard, best practices zoning within the SAN.

If HANA High Availability node-fail over or HANA scale-out is used, then, and only then, it is required to map all Data and Log volumes to all SAP Hana Nodes.

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10 Setup of file systems for DATA and LOG

Create the DATA, LOG, and SHARED file system needed by SAP HANA according to the *SAP HANA Storage Requirements* documentation from SAP.

- Use the xfs file system type with a 4KB block size for the DATA and LOG file systems
- To use LVM 2 use this schema:
  vgcreate → lvreate → mkfs.xfs
- Use telling names for volume groups and logical volumes.
- Do not use the hyphen (minus) character '-' as part of the name, because the LINUX device mapper uses this as a separator between VG and LV name when it creates device names for the LV.
- Create Volume Groups and Logical Volumes for DATA and LOG, for each HANA mount point (as listed in global.ini) create one Volume Group with exactly one Logical Volume.

It has turned out that these settings are most beneficial for SAP HANA workload:

DATA

1. Use 4 PV for Volume Group DATA
   ```
   pvcreate –dataalignment 1M /dev/mapper/WWID_1 /dev/mapper/WWID_2…
   ```
2. Create a volume group with an extent size of 1MB and an alignment size of 1MB
   ```
   vgcreate -s 1M --dataalignment 1M VG_ANA_DATA_1 /dev/mapper/WWID_1 \ /dev/map-
   per/WWID_2 ...
   ```
3. Create a logical volume with a stripe size of 256KB
   ```
   lvcreate -i 4 -I 256K -l 100%VG -n LV_ANA_DATA_1 VG_ANA_DATA_1
   ```
4. Create the file system
   ```
   mkfs.xfs -b size=4096 -s size=4096 /dev/mapper/VG_ANA_DATA_1-LV_ANA_DATA_1
   ```
5. Mount the file system
   ```
   mount /dev/mapper/VG_ANA_DATA_1-LV_ANA_DATA_1 /hana/data/ANA
   ```

LOG:

1. Use 4 PV for Volume Group LOG:
   ```
   pvcreate –dataalignment 1M /dev/mapper/WWID_1 /dev/mapper/WWID_2…
   ```
2. Create a volume group with an alignment size of 1MB
   ```
   vgcreate -s 1M --dataalignment 1M VG_ANA_LOG_1 /dev/mapper/WWID_1 ...
   ```
3. Create a striped logical volume with a stripe size of 256KB
   ```
   lvcreate -i 4 -I 256K -l 100%VG -n LV_ANA_LOG_1 VG_ANA_LOG_1
   ```

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4. Create the file system
   ```
   mkfs.xfs -b size=4096 -s size=4096 /dev/mapper/VG_ANA_LOG_1-LV_LOG_1
   ```
5. Mount the file system
   ```
   mount /dev/mapper/VG_ANA_LOG_1-LV_ANA_LOG_1 /hana/log/ANA
   ```

SHARED (local, non-failover):

1. Use 1 PV for Volume Group SHARED
   ```
   pvcreate –dataalignment 1M /dev/mapper/WWID_1
   ```
2. Create a volume group:
   ```
   vgcreate -s 1M --dataalignment 1M VG_SHARED /dev/mapper/WWID_1
   ```
3. Create a logical volume (without striping)
   ```
   lvcreate -l 100%VG -n LV_SHARED VG_SHARED
   ```
4. Create the file system
   ```
   mkfs.xfs -b /dev/mapper/VG_SHARED-LV_SHARED
   ```
5. Mount the file system
   ```
   mount /dev/mapper/VG_SHARED-LV_SHARED /hana/shared
   ```

If HANA scale-out or HA node fail-over is used, do not add the DATA & LOG file system to /etc/fstab, mounting will be done by SAP HANA.
Add the /hana/shared file system always to /etc/fstab.

11 VMware

The same setup applies like for LINUX native installation as described in chapter 10; the only deviation is that VMware™ ESX© server controls the SAN multipath, not the LINUX OS. The volumes are typically accessible under the path:

/dev/sd… instead of /dev/mapper/…

Please have a look in the following IBM Redpaper how to setup VMware VVols with IBM storage:

https://www.redbooks.ibm.com/redpapers/pdfs/redp5321.pdf

12 Setup of global.ini

A dedicated global.ini file (located in /hana/shared/…) is only needed if you want to use the node fail-over functionality provided by SAP HANA software and for HANA scale-out; else the HANA installer will create a global.ini file.

12.1 Setup for recent versions of HANA 2.0

SAP HANA 2 supports since SPS 05 Rev 53 SCSI persistent reservations on multipath level. Usually, SCSI reservations are bound to single paths, which makes it difficult to add SCSI paths to existing volumes while there are SCSI reservations registered. Using the "mpathpersist" utility allows to deal with this fact.
We recommend using the hdb.ha.fcClientLVMMpath driver, as it gives you a more powerful protection against double failures (e.g. path failure plus node failover).
Enter the Logical Volume names as shown in directory /dev/mapper into global.ini :

```
[communication]
listeninterface = .global

[persistence]
basepath_datavolumes = /hana/data/ANA
basepath_logvolumes  = /hana/log/ANA

[storage]
ha_provider             = hdb_ha.fcClientLVMMpath
partition_*_*__prtype    = 5
partition_1_data__lvmname = VG_ANA_DATA_1-LV_ANA_DATA_1
partition_1_log__lvmname  = VG_ANA_LOG_1-LV_ANA_LOG_1
partition_2_data__lvmname = VG_ANA_DATA_2-LV_ANA_DATA_2
partition_2_log__lvmname  = VG_ANA_LOG_2-LV_ANA_LOG_2
```

The mpathpersist utility requires predefined SCSI reservation keys dedicated to each host. The multipath.conf file needs to be modified for using those predefined keys by adding the reservation_key parameter and an individual value to the defaults section:

```
defaults {
        find_multipaths yes
        user_friendly_names yes
        reservation_key e4e4063da487427d
}
```

For more information, please refer to the [SAP HANA™ Fiber Channel Storage Connector Admin Guide](#) provided by SAP.

12.2 Setup for HANA 2 < SPS 05 Rev 53

Older HANA 2 revisions do not work with the mpathpersist utility. Therefore, the former LVM driver must be used. Please note that using this driver is still supported by recent HANA 2 revisions, it's not mandatory to update the storage connector after updating your HANA DB. This is how a typical global.ini file using the standard LVM storage connector looks like:

```
[communication]
listeninterface = .global

[persistence]
basepath_datavolumes = /hana/data/ANA
basepath_logvolumes  = /hana/log/ANA

[storage]
ha_provider             = hdb_ha.fcClientLVM
partition_*_*__prtype    = 5
partition_1_data__lvmname = VG_ANA_DATA_1-LV_ANA_DATA_1
partition_1_log__lvmname  = VG_ANA_LOG_1-LV_ANA_LOG_1
partition_2_data__lvmname = VG_ANA_DATA_2-LV_ANA_DATA_2
partition_2_log__lvmname  = VG_ANA_LOG_2-LV_ANA_LOG_2
```

13 fileio parameter

IBM storage systems do not require a fileio setting (SAP note 2399079) for HANA 2.0. In case you experience performance issues with the SAP tool HCMT use these settings:

```
async_write_submit_active :  on
async_write_submit_blocks : all
async_read_submit         :  on
```

14 SAP HANA High Availability setup with IBM System Storage

The SAP HANA system gains high availability through an N+1 concept – one or more server act as standby SAP HANA node – with dedicated storage for each active node. If one active SAP HANA node fails, the SAP HANA cluster software initiates a failover to the standby node, and the standby node will mount the data and log from the failed node.

For more details, please read the SAP document SAP HANA – High Availability.

To improve storage availability, IBM recommends to setup the storage environment as SVC stretched cluster with symmetric VDISK mirroring.

15 SAP HANA Disaster Recovery setup with IBM System Storage

The disaster recovery capabilities of SAP HANA are documented on [SAP HANA – High Availability](#).

If IBM Global Mirror (asynchronous mirroring) is used for storage replication for SAP HANA TDI, all DATA and all LOG volumes of all nodes from one HANA system must be included in one storage Consistency Group.

That implies (when using native attached storage) that both – Data and Log – must be provided by the same storage unit.

16 SAP HANA backup with IBM Spectrum Protect

The product *IBM Spectrum Protect for Enterprise Resource Planning* includes support to backup SAP HANA online.

Please see current product information how to install, configure, and run this integrated solution:

https://www.ibm.com/docs/en/spferp/8.1.11

17 Change History

V1	Initial version
V1.2	Update of chapter 10 to clarify files system setup
V1.3	Included new Storwize V5000
V1.4	Specified NFS section to be used only for /hana/shared/
V1.5	Minor updates – add some clarifications
V1.6	Add setup of multipath and global.ini
V1.7	Rework of document
V1.8	Added LINUX LVM2 & list of certified IBM storage systems
V2.1	Added IBM DS8000 system as certified for SAP HANA TDI
V2.2	Added IBM FlashSystem 900 & V9000
V2.3	Changed sizing rules, added recommendation for multipath and VG/LV settings.
V2.5	Changed /etc/multipath setting
V2.6	Added fileio parameter for hdbparam
V2.7	Added A9000R & DS8880; info on LINUX LVM settings for HANA LOG
V2.8	Added chapter on Storage RtC, changes in storage sizing
V2.9	Added paragraph about VMware VVols
V2.10	Updated multipath section
V2.11	Update default disk type to RI SSD.
V2.12	Storwize: New sizing, 4 PV for LOG VG
V2.13	Add SVC 2145/2147 SV1
V2.14	Add FS9100, updated sections 7.7 and 7.9,
V2.15	Add V7000G3, minor update to multipath
V2.16	Add V5000E, adding FCM and DRP
V2.17	Minor changes in supported storage systems
V2.18	Minor changes in supported storage systems
V2.19	Adding new IBM FlashSystem models, update DRP section
V2.20	Updating max. numbers of supported systems for FlashSystem, changed DMMP config
V2.21	Minor change: update contact email address
V2.22	Adding NSE section
V2.23	discarded
V2.24	Updating IBM FlashSystem models, major changes in Linux OS setup & tuning section.
V2.25	Minor changes in supported storage systems
V2.26	Added missing content to § 7.7
V2.27	Added max. numbers of supported Systems for IBM SAN Volume Controller SV1 and SA2
V2.28	Adding new IBM Spectrum Virtualize based models
V2.29	Adding section for SCSI multipath reservation configuration, new DS8900 max. sup. DBs
V2.30	Adding updated IBM FlashSystem model 5045

18 Resources

For any product or documentation provided by SAP please contact SAP.

For any product or documentation provided by SUSE please contact SUSE.

For any product or documentation provided by Red Hat please contact RedHat.

For questions about products or documentation provided by IBM regarding SAP send an email to:

 sapevent@de.ibm.com

For questions regarding this guide please send an email to:

escc.isv-services@de.ibm.com

SAP HANA on IBM Power Systems and IBM Storage:

SAP HANA on IBM Power Systems and IBM System Storage

IBM FlashSystem product manuals:

IBM FlashSystem 5200
IBM FlashSystem 7300
IBM FlashSystem 9200

IBM Spectrum Protect for ERP:

IBM Spectrum Protect for Enterprise Resource Planning Data Protection for SAP and Oracle (V8.1)

SAP documentation:

SAP HANA FAQ
SAP HANA™ Fiber Channel Storage Connector Admin Guide

SUSE documentation:

https://documentation.suse.com/

Red Hat documentation:

https://access.redhat.com/documentation/en-us/

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