High Availability for SAP HANA database on Azure using SIOS Protection Suite

for RHEL & SUSE Linux

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Introduction

HANA System Replication is the only supported high availability solution on Azure virtual machines (VMs). SAP HANA Replication consists of one primary node and at least one secondary node. Changes to the data on the primary node are replicated to the secondary node synchronously or asynchronously.

Please refer to SAP Note 1662610 Support details for SIOS Protection Suite for Linux

SIOS Protection Suite

SIOS Protection Suite (SPS) for Linux integrates high availability clustering with innovative data replication functionality in a single, enterprise-class solution.

Components of SIOS Protection Suite

1. SIOS LifeKeeper Core
   Provides protection of specific resources on a server

2. Witness/Quorum
   Provides functionality in LifeKeeper to prevent multiple nodes from becoming active at the same time

3. SAP HANA Recovery Kit
   Provides a mechanism to perform takeover SAP HANA DB from a failed primary server to a secondary server in a LifeKeeper environment and configure reverse replication

4. IP Recovery Kit
   Provides a mechanism to recover an IP address from a failed primary server to a backup server in a LifeKeeper environment

5. IP-Gen-App
   Provides a mechanism to move azure IP resource from one VM to another VM in a LifeKeeper environment

SIOS LifeKeeper

The LifeKeeper family of products includes software that allows you to provide failover protection for a range of system resources.

Witness/Quorum

The Quorum/Witness Server Support Package for LifeKeeper (steeleye-IkQWK, hereinafter “Quorum/Witness Package”) combined with the existing failover process of the LifeKeeper core allows system failover to occur with a greater degree of confidence in situations where total network failure could be common. This effectively means that local site failovers and failovers to nodes across a WAN can be done while greatly reducing the risk of split-brain situations.
**SAP HANA Recovery Kit**

SAP HANA provides three different mechanisms to increase the availability.

Host Auto-Failover – At least one standby node added to a SAP HANA system. These nodes are configured to work in standby mode (SAP HANA scale-out).

Storage Replication – The storage used on the SAP HANA node replicates all data to another SAP HANA node. This replication works without a control process from the SAP HANA system. The Storage Replication is provided by hardware partners.

System Replication – SAP HANA replicates all data by using their own feature to a secondary SAP HANA node. Data is constantly pre-loaded on the secondary SAP HANA node. (SAP HANA scale-up)

With this SAP HANA Recovery Kit SAP HANA systems can be controlled through an activated system replication in SIOS LifeKeeper.

**IP Recovery Kit**

The SIOS Protection Suite for Linux Internet Protocol (IP) Recovery Kit provides a mechanism to recover an IP address from a failed primary server to a backup server in a LifeKeeper environment. The IP Recovery Kit can define an IP address that can be used to connect to a LifeKeeper-protected application. As with other LifeKeeper resources, IP resource switchovers can be initiated automatically as a result of a failure or manually by an administrative action.

**IP-Gen-App (optional) Provided As-Is**

The IP-Gen-App is a generic application recovery kit used in order to actively communicate with the Azure CLI. It is used to switch the Azure layer IP resource from one node to the other in a switchover or failover event.

**Support**

**SAP Support**

Support for SAP products is provided by the customer’s SAP support agreement directly from SAP. SIOS does not replace the need for an SAP support agreement.

**SIOS Support**

As a SIOS Technology Corp. customer with a valid Support contract, you are eligible for support as outlined by the SIOS Technical Support Agreement. The SIOS Technical Support Agreement is provided to each customer with the software purchase.
Implementation

Note:

SLES 12 SP4 with SIOS Protection Suite for Linux 9.3.2 is used in this illustration.

Please refer SAP Note [1662610](https://support.sap.com) for other supported operation systems on Azure

This section describes how to deploy and configure the virtual machines, install the cluster framework, and install and configure SAP HANA System Replication. In the example configurations, installation commands, instance number 00, and HANA System ID S4D are used.

The following list shows the configuration of the HANA & Witness Node IP addresses and Virtual Hostnames configured in DNS.

<table>
<thead>
<tr>
<th>Components</th>
<th>hostname</th>
<th>IP address</th>
<th>VIP</th>
<th>VHOSTNAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP DB Pool</td>
<td>azsuhana1</td>
<td>11.1.2.51</td>
<td>11.1.2.50</td>
<td>s4db</td>
</tr>
<tr>
<td></td>
<td>azsuhana2</td>
<td>11.1.2.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIOS Witness</td>
<td>azsusapwit2</td>
<td>11.1.2.66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SAP HANA System Replication setup uses a dedicated virtual hostname and virtual IP addresses. On Azure, a load balancer is required to use a virtual IP address. The following list shows the configuration of the load balancer:

The IP address for the front-end configuration is 11.1.2.50 for s4dbb

For the back-end configuration, connect the load balancer to primary network interfaces of all virtual machines that should be part of HANA System Replication

Probe Port: Port 62503

Load-balancing rules: 30313 TCP, 30315 TCP, 30317 TCP

Deploy Infrastructure
Please refer corresponding azure docs to provision you infrastructure, Install HANA and configure HSR

SLES
RHEL

Install SIOS Protection Suite & Recovery Kits
The following SIOS components are installed in respective nodes.

LifeKeeper Core

- azsuhana1
- azsuhana2
- azsusapwit2

Witness/Quorum

- azsusapwit2

Note: - recommended to use 1 witness/cluster

SAP HANA 2.0 Application Recovery Kit & IP Recovery Kit

- azsuhana1
- azsuhana2

Install SIOS Protection Suite
See http://docs.us.sios.com/spslinux/9.3.2/en/topic/installing-the-software

Preparing Installation Media

- download the following media from the FTP link sent by SIOS
- download the SIOS Protection Suite’s - sps.img
• download the HANA Application Recovery Kit based on your HANA version - HANA2-ARK.run
• download the Azure IP Recovery kit - SIOS_enhancedAzure_gen_app-02.02.00.tgz

PLEASE NOTE: The file name may vary based on the version

Mount the Installation Media

dir -p /DVD

mount /sapmedia/SIOS931/sps.img /DVD -t iso9660 -o loop

mount: /dev/loop0 is write-protected, mounting read-only

Install SIOS Protection Suite - Witness Nodes

cd /DVD

./setup

Please proceed with the installation steps as shown below:
Please repeat the steps for all witness nodes.

**Install SIOS Protection Suite - SAP Recovery Kit**

Install SAP Recovery Kit in HANA Nodes change directory to SIOS installation media which was mounted as /DVD

```
cd /DVD
./setup
```
**FIGURE 1 - SELECT “INSTALL LICENSE KEY”**

**FIGURE 2 - ENTER THE LICENSE PATH & CLICK “OK”**
FIGURE 3 - SELECT “RECOVERY KIT SELECTION MENU”

FIGURE 4 - SELECT “APPLICATION SUITE”
**Figure 5** - Select “Lifekeeper SAP Recovery Kit”

**Figure 6** - Select “Lifekeeper Startup after install” & Select “Done”
FIGURE 7 - SELECT “YES” & PRESS “ENTER”

FIGURE 8 - INSTALLATION COMPLETED

FIGURE 9 - LICENSE CHECK MESSAGE

Please repeat the steps on all cluster nodes

Install SAP HANA Application Recovery Kit
Install the rpm downloaded into the /tmp directory.

```
rpm -ivh /tmp/steeleye-IkHOTFIX-HANA-SP1-9.1.0-6538.noarch.rpm
```


---

**Install SIOS Enhanced Azure IP Gen Application (Optional) *Provided as is**

You will receive the FTP link to download the tgz file.

- Use gunzip to unzip the tar file.
- Use command “tar -xvf” to untar the file.
- Run the setup program.
- NOTE: Make sure you put the files in a folder that is safe to execute. On some installations, programs need to be authorized to execute from certain folders. You can make sure that the setup program has execute permission (chmod +x setup.)
- Repeat these steps on the other node.
- Note the folder where the files are stored (e.g. /root/folder)

---

**Configure HANA System Replication**

**Backup HANA Database**

Back up the databases as <hanasid>adm:

```
hdbsql -d SYSTEMDB -u SYSTEM -p "passwd" -i 00 "BACKUP DATA USING FILE ('initialbackupSYS')"
hdbsql -d S4D -u SYSTEM -p "passwd" -i 00 "BACKUP DATA USING FILE ('initialbackupS4D')"
```

Copy the system PKI files to the secondary site:

```
scp /usr/sap/S4D/SYS/global/security/rsecssfs/data/SSFS_S4D.DAT azsuhana2:/usr/sap/S4D/SYS/global/security/rsecssfs/data/
scp /usr/sap/S4D/SYS/global/security/rsecssfs/key/SSFS_S4D.KEY azsuhana2:/usr/sap/S4D/SYS/global/security/rsecssfs/key/
```

Create the primary site:

```
hdbnsutil -sr_enable --name=left
```
Configure System Replication on the second node:

Register the second node to start the system replication. Run the following command as `<hanasid>adm`:

```
sapcontrol -nr 00 -function StopWait 600 10
hdbnsutil -sr_register --remoteName=left --remoteHost=azsuhana1 --remoteInstance=00 --replicationMode=syncmem --operationMode=logreplay --name=right
```

Create HANA Cluster Resource

Create Communication Path between Cluster Nodes and Witness

A communication path or comm path is a key part of the SIOS Protection Suite fault detection mechanism. The comm path defines the path over which SIOS sends periodic heartbeat signals between servers. This regular heartbeat signal tells each connected server, as defined by the comm paths, that the other server is still alive and active. Comm paths can be tuned via parameters to increase the heartbeat interval or detection interval, see the [SIOS Parameters documentation](https://us.sios.com).
It may take a few seconds while a communication path is initializing. Before the state of the communication path shows that it is ALIVE and functioning normally.
Create Communication Path
Local Server: aatsuhez1
Local IP: 11.1.2.1
Remote Server: aatsuhez2
Remote IP: 11.1.2.2

Creating TCP Communication Path between aatsuhez1 (11.1.2.1) and aatsuhez2 (11.1.2.2)
Successfully created network connection
Of type "TCP"
From aatsuhez1 (11.1.2.1)
To aatsuhez2 (11.1.2.2)

It may take a few seconds while a communication path is initializing before the state of the communication path shows that it is Alive and functioning normally.
Create Azure IP Gen App for HANA (Optional)

Install Azure CLI

Install Azure CLI on the (A)SCS cluster nodes which is a pre-requisite for SIOS Enhanced Azure IP GenApp. Please refer to the installation procedure respective to OS

- **RHEL**
- **SLES**

Please login to portal.azure.com from the server.

```
az login --use-device-code
```

To sign in, use a web browser to open the page https://microsoft.com/devicelogin and enter the code “B3D42JUFD” to authenticate
Create Azure IP Gen App

Please Select Recovery Rm: Generic Application

Server: aazuhana1

Enter the path name for the shell script or object program which starts the application. The start script is responsible for bringing a protected application resource in service. The start script should not impact an active resource application when invoked.

Valid characters allowed in the script path name are letters, digits, and the following special characters: - , /

A copy of this script or program will be saved under:
app/ftp/keepsys/apps/genericresources/applications
Whenever this resource is submitted to a new server, the copy will be passed to that server.

Remove Script: scriptpath...genappremove

QuickCheck Script (optional): scriptpath...genapp/quickcheck

Enter the path name for the shell script or object program which monitors the application. The quickCheck script is called periodically, and is responsible for performing a health check of the protected application.

The quickCheck script is optional. If one is not provided it will always be assumed that the application is in an OK state.

Valid characters allowed in the script path name are letters, digits, and the following special characters: - , /

A copy of this script or program will be saved under:
app/ftp/keepsys/apps/genericresources/applications
Whenever this resource is submitted to a new server, the copy will be passed to that server.
Enter the pathname for the shell script or object program which will attempt to recover a failed application on the local server. This may require stopping and removing the application.

The *local recovery script* is optional - if you do not want to provide one, simply clear the entry field. If no local recovery script is provided, the prompted application will always fail over to the target when a quietCheck error occurs.

Valid characters allowed in the script pathname are letters, digits, and the following special characters:

```
  ":/\-\r\n\t"
```

A copy of this script or program will be saved under:

```
 <opt://user/keeper/<appname>/apprecover
```

Wherever this resource is extended to access servers, the copy will be passed to that server.

Bring Resource In Service: Yes

This field allows the user to specify if the resource should be brought in service following a successful create.

- A user may want to select No if the dependent resources have not been created and the restore command would fail. If No is selected, the resource will be created but will not be brought in service. The resource cannot be extended until the hierarchy has been placed in service.
- Selecting Yes will cause the user provided restore script to be invoked after the resource has been created.

Creating preextend resource <ip>:11.12.50 on <hierarchy>

```
BEGIN create of [arp-11.12.10] 
resource "arp-11.12.10" successfully created 
restoring resource "arp-11.12.10" 
INFORMATION: BEGIN restore of arp-11.12.50 on <hierarchy>
```

You have successfully created the resource hierarchy <ip>:11.12.50 on <hierarchy>. Select target server to which the hierarchy will be extended.

If you cancel before extending <ip>:11.12.50 to at least one other server, LifeKeeper will provide no protection for the applications in the hierarchy.
Create IP Resource for HANA

Please select Recovery: IP

Switchback Type: Intelligent

Server: ssushana1

IP Resource: 111.11.1.50

Enter the IP address or symbolic name to be watched by LifeKeeper. This is used by client applications to login into the parent application over a specific network interface. If a symbolic name is used, it must exist in the local /etc/hosts file or in an accessible name service (DNS). Any valid hosts file entry, including aliases, is acceptable. If the address cannot be determined or if it is found to be already in use, it will be rejected. If a symbolic name is given, it is used to translate to an IP address and is not required by LifeKeeper. Both IPv4 and IPv6 static addresses are supported.

Network Interface: eth0

Enter or select a network mask for the IP resource. Any valid network mask for the class of the specified IP resource address is valid (IPv4 or IPv6 style addresses).

Note: The choice of network, combined with the address, determines the subnet to be used by the IP resource and should be consistent with the network configuration.
Create HANA Cluster Resource
Please Select Recovery Kit: Generic Application

Switchback Type: intelligent
Server: azsuhana1

/opt/LifeKeeper/HANA2-ARK/restore.pl
/opt/LifeKeeper/HANA2-ARK/remove.pl
/opt/LifeKeeper/HANA2-ARK/quickCheck.pl
/opt/LifeKeeper/HANA2-ARK/recover.pl
Create gen/app Resource@azsuhana1

Enter the pathname for the shell script or object program which starts the application. The **restore** script is responsible for bringing a protected application resource in-service. The **restore** script should not impact an active resource application when invoked.

Valid characters allowed in the script pathname are letters, digits, and the following special characters: 
- `.`
- `/`

A copy of this script or program will be saved under:

`/opt/LifeKeeper/subsys/gen/resources/app/actions`

Whenever this resource is extended to a new server, the copy will be passed to that server.

Create gen/app Resource@azsuhana1

Enter the pathname for the shell script or object program which stops the application. The **remove** script is responsible for stopping a protected application resource and putting it in the out-of-service state.

Valid characters allowed in the script pathname are letters, digits, and the following special characters: 
- `.`
- `/`

A copy of this script or program will be saved under:

`/opt/LifeKeeper/subsys/gen/resources/app/actions`

Whenever this resource is extended to a new server, the copy will be passed to that server.
QuickCheck Script [optional] /opt/LifeKeeper/HANA2-ARK/quickCheck.pl

Enter the pathname for the shell script or object program which monitors the application. The quickCheck script is called periodically, and is responsible for performing a health check of the protected application.

The quickCheck script is optional. If one is not provided it will always be assumed that the application is in an OK state.

Valid characters allowed in the script pathname are letters, digits, and the following special characters: -_./

A copy of this script or program will be saved under:
/opt/LifeKeeper/subsys/gen/resources/app/actions

Whenever this resource is extended to a new server, the copy will be passed to that server.

---

Local Recovery Script [optional] /opt/LifeKeeper/HANA2-ARK/recover.pl

Enter the pathname for the shell script or object program which will attempt to recover a failed application on the local server. This may require stopping and restarting the application.

The local recovery script is optional - if you do not want to provide one, simply clear the entry field. If no local recovery script is provided, the protected application will always fail over to the target when a quickCheck error occurs.

Valid characters allowed in the script pathname are letters, digits, and the following special characters: -_./

A copy of this script or program will be saved under:
/opt/LifeKeeper/subsys/gen/resources/app/actions

Whenever this resource is extended to a new server, the copy will be passed to that server.
Enter any optional data for the application resource instance that may be needed by the `restore` and `remove` scripts.

The valid characters allowed for the data field are letters, digits, and the following special characters:
- `-._ /` = [space]

This field allows the user to specify if the resource should be brought in-service following a successful create.

- A user may want to select `No` if the dependent resources have not been created and the `restore` command would fail. If `No` is selected, the resource will be created but will not be brought in-service. The resource cannot be extended until the hierarchy has been placed in-service.
- Selecting `Yes` will cause the user provided `restore` script to be invoked after the resource has been created.
Enter a unique name for the resource instance on **azsuhana1**. The valid characters allowed for the tag are letters, digits, and the following special characters:
- _ /

Creating gen/app resource **HANA-S4D** on **azsuhana1**

```plaintext
BEGIN create of "HANA-S4D"
creating resource "HANA-S4D"
resource "HANA-S4D" successfully created
restoring resource "HANA-S4D"
BEGIN restore of "HANA-S4D"
restore for HANA-S4D started
SAP host agent is running on node azsuhana1
sapsystem for instance S4D_00 is running on node azsuhana1
The node azsuhana1 is already PRIMARY Master
HANA-DB S4D_00 is already running on node azsuhana1
Restore for resource HANA-S4D finished
END successful restore of "HANA-S4D"
resource "HANA-S4D" restored
END successful create of "HANA-S4D"
```

Messages produced while creating **HANA-S4D** will be displayed in this dialog and the output panel (if open), and logged on **azsuhana1**.
You have successfully created the resource hierarchy HANA-S4D on azsuhana1. Select a target server to which the hierarchy will be extended.

If you cancel before extending HANA-S4D to at least one other server, LifeKeeper will provide no protection for the applications in the hierarchy.
Template Priority: 1

Target Priority: 10
Enter a unique name for the resource instance on azsuhana2.

The valid characters allowed for the tag are letters, digits, and the following special characters:
- _ /

Enter any optional data for HANA-S4D that may be needed by the restore and remove scripts on azsuhana2.

The valid characters allowed for the data field are letters, digits, and the following special characters:
- _ / [space]
Extending resource hierarchy HANA-S4D to server azsuhana2
Extending resource instances for HANA-S4D
BEGIN extend of "HANA-S4D"
END successful extend of "HANA-S4D"
Creating dependencies
Setting switchback type for hierarchy
Creating equivalencies
LifeKeeper Admin Lock (HANA-S4D) Released
Hierarchy successfully extended

Verifying Integrity of Extended Hierarchy...
Examining hierarchy on azsuhana2
Hierarchy Verification Finished
Create Dependency to HANA & IP Resource

Operations

Cluster Failover Test

Controlled failover
## Sions

<table>
<thead>
<tr>
<th>Service</th>
<th>Status</th>
<th>Packet Forwarding</th>
<th>Ports</th>
</tr>
</thead>
</table>
| HA|||TCP 133.2.50, TCP 133.2.50 |}

- **HA**: High Availability
- **TCP**: Transmission Control Protocol

### Details
- **IP Address**: 133.2.50
- **Ports**: TCP 133.2.50, TCP 133.2.50

---

### Additional Information
- **Service Status**: Active
- **Protocols**: TCP

---

### Notes
- This is a snapshot of the network service status.
- The service is currently active and running on the specified ports.
- Further details can be found in the attached documents or through the provided links.

---

#### Related Links
- [More Information](https://us.sios.com)
Kernel Panic
Enter the following command

```
echo c > /proc/sysrq-trigger
```

Appendix

Important reads
Read the following SAP Notes and papers first: SAP Note 1662610 Support details for SIOS Protection Suite for Linux

SAP Note 1928533, which has:

- The list of Azure VM sizes that are supported for the deployment of SAP software.
- Important capacity information for Azure VM sizes.
- The supported SAP software, and operating system (OS) and database combinations.
- The required SAP kernel version for Windows and Linux on Microsoft Azure.

SAP Note 2015553 lists the prerequisites for SAP-supported SAP software deployments in Azure.

SAP Note 2205917 has recommended OS settings for SUSE Linux Enterprise Server for SAP Applications.

SAP Note 2009879 has SAP HANA Guidelines for Red Hat Enterprise Linux

SAP Note 1944799 has SAP HANA Guidelines for SUSE Linux Enterprise Server for SAP Applications.

SAP Note 2178632 has detailed information about all of the monitoring metrics that are reported for SAP in Azure.

SAP Note 2191498 has the required SAP Host Agent version for Linux in Azure.

SAP Note 2243692 has information about SAP licensing on Linux in Azure.

SAP Note 1984787 has general information about SUSE Linux Enterprise Server 12.

SAP Note 1999351 has additional troubleshooting information for the Azure Enhanced Monitoring Extension for SAP.

SAP Note 401162 has information on how to avoid “address already in use” when setting up HANA System Replication.

SAP Community WIKI has all the required SAP Notes for Linux.

SAP HANA Certified IaaS Platforms

Azure Virtual Machines planning and implementation for SAP on Linux guide.
Azure Virtual Machines deployment for SAP on Linux (this article).

Azure Virtual Machines DBMS deployment for SAP on Linux guide.

SUSE Linux Enterprise Server for SAP Applications 12 SP3 best practices guides

Setting up an SAP HANA SR Performance Optimized Infrastructure (SLES for SAP Applications 12 SP1). The guide contains all the required information to set up SAP HANA System Replication for on-premises development. Use this guide as a baseline.

Setting up an SAP HANA SR Cost Optimized Infrastructure (SLES for SAP Applications 12 SP1)