SAP

Best Practices

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Best Practices

SAP HANA Intra-Availability Zone HA Deployment (Based on SLES HAE)

SAP HANA Intra-Availability Zone HA Deployment (Based on SLES HAE)

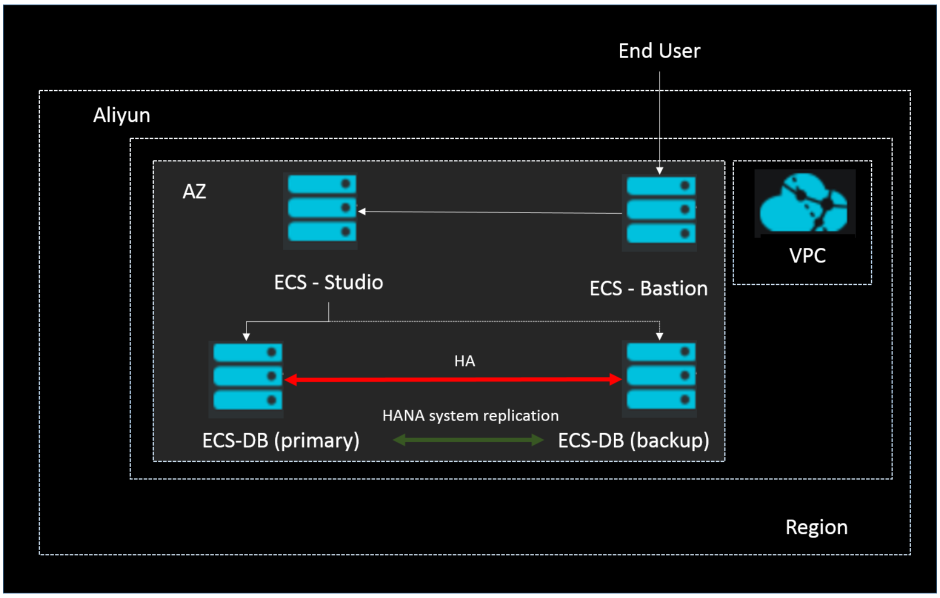
- Configure HANA system replication
- Install and configure SLES 12 Cluster HA
    - Install the SUSE HAE software
    - Configure the cluster
- Integrate SAP HANA with SUSE HA
    - Add SAP HANA resources
    - Verify the cluster status
- Test the SAP HANA HA failover
    - Test the HANA primary node failure
    - Recover the HANA primary node

Overview

This document describes how to deploy SAP HANA high availability (HA) within an availability zone (zone for short) of Alibaba Cloud.

HANA HA architecture

The architecture in this deployment is as follows:



Preparations

Installation media

Installation Package	File or Path	Description

SUSE for SAP	SLE-12-SP2-SAP-x86_64-GM-DVD1.iso	The SUSE can be downloaded from the SuSE official website, and the software has a 60-day trial period.
SUSE for SAP	SLE-12-SP2-SAP-x86_64-GM-DVD2.iso	The SUSE can be downloaded from the SuSE official website, and the software has a 60-day trial period.
SAP HANA database installation package	HDB_SERVER_LINUX_X86_64	
SAP HANA client installation package	HDB_CLIENT_LINUX_X86_64	
SAP HANA Studio installation package	HDB_STUDIO_WINDOWS_X86	For Windows

Access to installation media

Access Method	Process	Remarks
Direct upload	Directly upload the package to the ECS	Upload through EIP or VPC
OSS + ossutil	Upload the package to OSS and then download it to ECS.	
OSS + ossfs	Upload the package to the OSS, and then use OSSFS to access the installation media in the OSS.	The source code is required for OSSFS installation on SUSE.

VPC planning

Network planning

Network	Location	Usage	Allocated Subnet
Service network	East China 2 zone A	For Business	192.168.10.0/24
Heartbeat network (redundant)	East China 2 zone A	For SR/HA	192.168.20.0/24

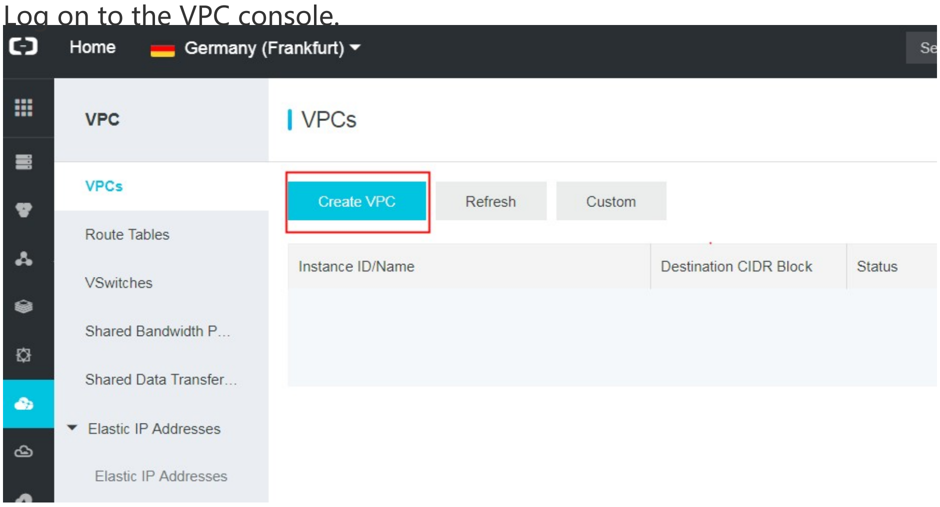
Host Name	Role	Heartbeat Address	Service Address	Virtual Address
hana01.poc.co	Hana primary	192.168.20.19	192.168.10.214	192.168.10.12

m	node			
hana02.poc.com	Hana backup node	192.168.20.20	192.168.10.215	192.168.10.12
HanaStudio	Hana Studio	None	192.168.10.210	None

Create a VPC

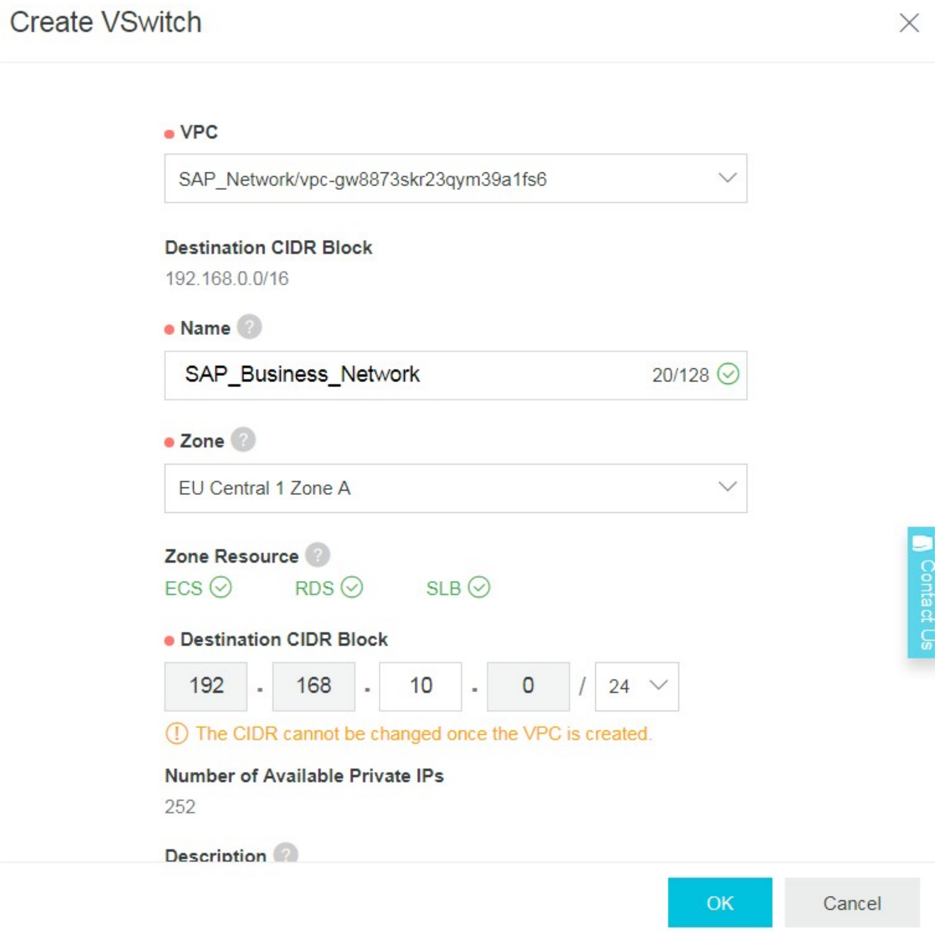
The Virtual Private Cloud (VPC) is an isolated network environment built on Alibaba Cloud. VPCs are logically isolated from each other. The VPC is your dedicated private network on the cloud. You have full control over your own VPC instance, including choosing the IP address range and configuring the route table and gateway. For more information and related documents, see the product documentation.

Log on to the VPC console.



Create a service network

Create a service subnet as planned.



Create VSwitch

● VPC

SAP_Network/vpc-gw8873skr23qym39a1fs6

Destination CIDR Block

192.168.0.0/16

● Name

SAP_Business_Network 20/128

● Zone

EU Central 1 Zone A

Zone Resource

ECS ✓ RDS ✓ SLB ✓

● Destination CIDR Block

192 . 168 . 10 . 0 / 24

The CIDR cannot be changed once the VPC is created.

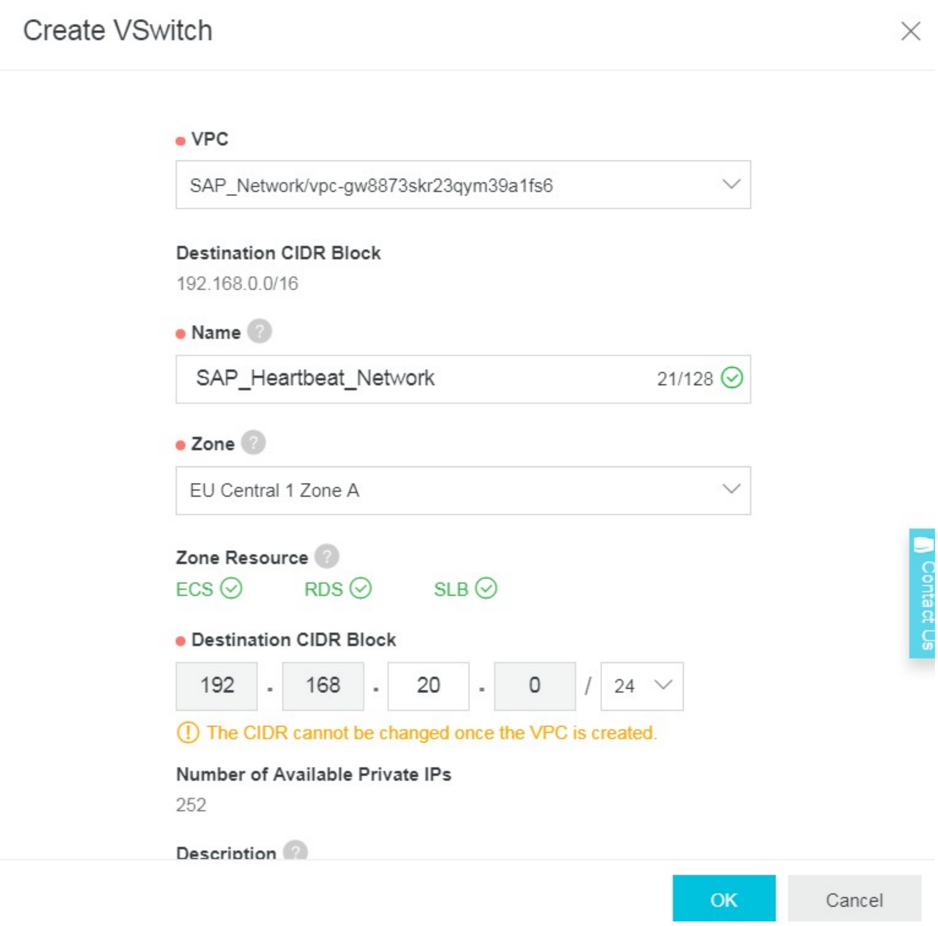
Number of Available Private IPs

252

Description

Create a heartbeat network

Create a heartbeat subnet as planned.



Create VSwitch

VPC: SAP_Network/vpc-gw8873skr23qym39a1fs6

Destination CIDR Block: 192.168.0.0/16

Name: SAP_Heartbeat_Network 21/128

Zone: EU Central 1 Zone A

Zone Resource: ECS ✓ RDS ✓ SLB ✓

Destination CIDR Block: 192 . 168 . 20 . 0 / 24

The CIDR cannot be changed once the VPC is created.

Number of Available Private IPs: 252

Description

Create HANA ECS instance

Create HANA primary node ECS

ECS purchasing page

Access https://www.aliyun.com/product/ecs to open the purchasing page. Select an instance type under SAP HANA and click Buy.

Select a payment method

Select either of the following payment methods: Subscription and Pay-As-You-Go.

Select the region and zone.

Select the region and zone. By default, the zones are allocated randomly. You can select a zone according to your needs. For details about the region and zone selection, see Region and Zone.

In this example, China East 2 zone A is selected.

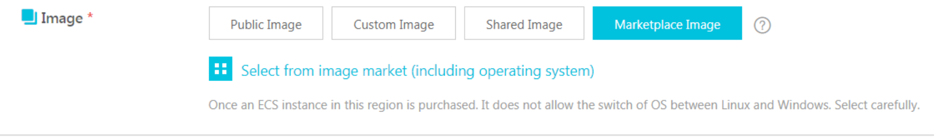
Select instance specifications

Select an instance type certified by SAP HANA, namely, 56 vCPU 480GB (ecs.se1.14xlarge) in series III - Memory type se1 instance type family, or 80 vCPU 960GB (ecs.re4.20xlarge) in the enhanced memory type re4 instance type family. In this example, ecs.se1.14xlarge is selected.

Select image

You can select the public, custom, or shared image, or select an image from the market.
The SUSE linux for SAP-12SP2 selected from the market is recommended for SAP HANA.

Note: Select the SUSE for SAP edition, instead of the SUSE 12 standard edition on the official website.



Once an ECS instance in this region is purchased. It does not allow the switch of OS between Linux and Windows. Select carefully.

Click Marketplace Image to enter the image market. Enter the keyword sap for searching and select SUSE linux for SAP-12SP2.

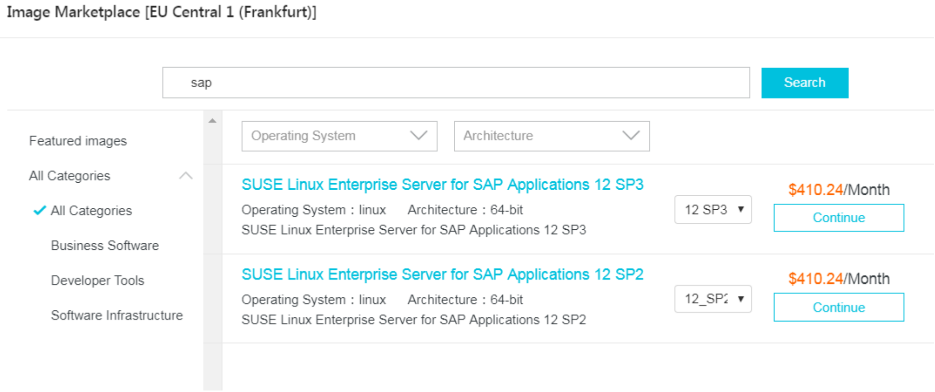


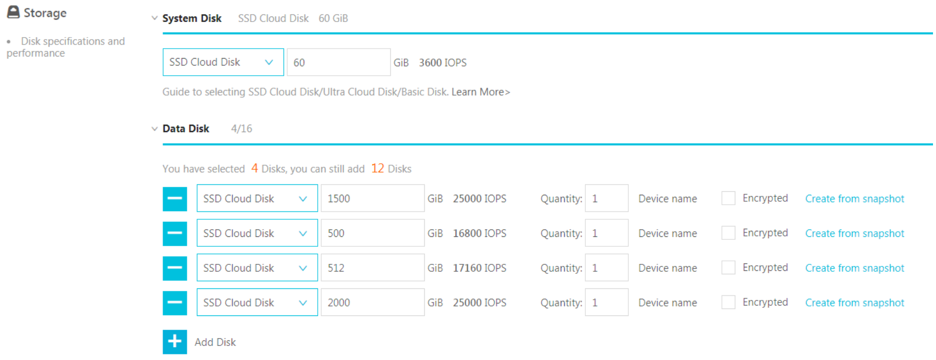
Image Marketplace [EU Central 1 (Frankfurt)]

SUSE Linux Enterprise Server for SAP Applications 12 SP3
Operating System：linux Architecture：64-bit
SUSE Linux Enterprise Server for SAP Applications 12 SP3
$410.24/Month

SUSE Linux Enterprise Server for SAP Applications 12 SP2
Operating System：linux Architecture：64-bit
SUSE Linux Enterprise Server for SAP Applications 12 SP2
$410.24/Month

Configure storage

System disk：Mandatory. Used to install the operating system. You need to specify the cloud disk type and capacity of the system disk.
Data disk：Optional. If you create a cloud disk as a data disk, you must specify the cloud disk type, capacity, quantity, and whether to encrypt. You can create an empty cloud disk, or use snapshot to create a cloud disk. A maximum of 16 cloud disks can be configured as the data disks.
The capacity of data disks needs to be adjusted according to the number of HANA instances.



Storage

- Disk specifications and performance

System Disk SSD Cloud Disk 60 GiB

SSD Cloud Disk | 60 GiB 3600 IOPS

Guide to selecting SSD Cloud Disk/Ultra Cloud Disk/Basic Disk. Learn More>

Data Disk 4/16

You have selected 4 Disks, you can still add 12 Disks

−	SSD Cloud Disk	1500	GiB 25000 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot
−	SSD Cloud Disk	500	GiB 16800 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot
−	SSD Cloud Disk	512	GiB 17160 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot
−	SSD Cloud Disk	2000	GiB 25000 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot

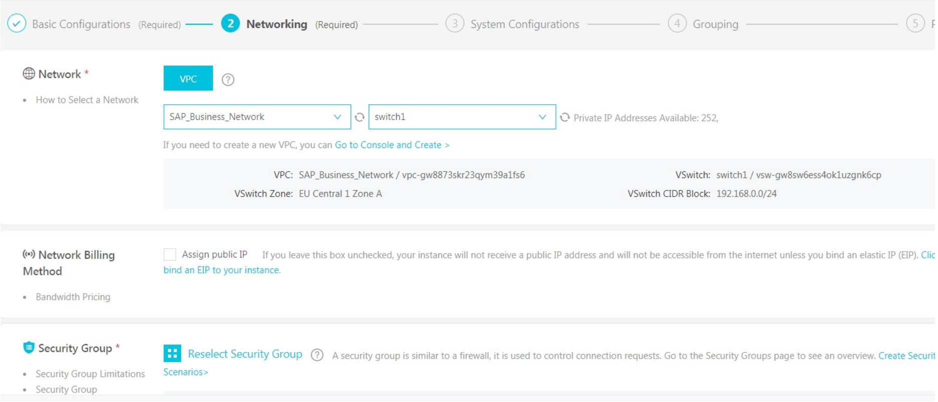
+ Add Disk

Select a network type

Click Next: Network and Security Group to configure the network and security group. :

1. Select a network type.
VPC , Select the VPC and switch. If you do not create the VPC or switch, you can retain the default VPC and switch.

2. Set the public network bandwidth.
If your instance does not need to access the public network or your VPC-type ECS instance uses an elastic public IP address (EIP) to access the public network, you do not need to assign a public IP address to your instance. The EIP can be unbind from the instance anytime.
Note: SAP HANA does not provide external services directly, so the instance does not need a public IP address.



Network *

- How to Select a Network

VPC

SAP_Business_Network | switch1 | Private IP Addresses Available: 252,

If you need to create a new VPC, you can Go to Console and Create >

VPC: SAP_Business_Network / vpc-gw8873skr23qym39a1fs6
VSwitch Zone: EU Central 1 Zone A
VSwitch: switch1 / vsw-gw8sw6ess4ok1uzgnk6cp
VSwitch CIDR Block: 192.168.0.0/24

Network Billing Method

- Bandwidth Pricing

□ Assign public IP If you leave this box unchecked, your instance will not receive a public IP address and will not be accessible from the internet unless you bind an elastic IP (EIP). Clic bind an EIP to your instance.

Security Group *

- Security Group Limitations
- Security Group

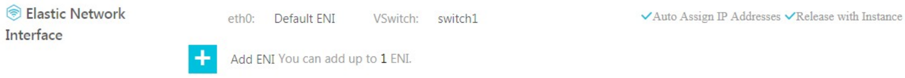
Reselect Security Group A security group is similar to a firewall, it is used to control connection requests. Go to the Security Groups page to see an overview. Create Securit Scenarios>

Select security group

Select a security group. If you do not create a security group, retain the default security group. For the rules of the default security group, see Default security group rules。

ENI configuration

Note: The second ENI should be added after the ECS instance is successfully created.



Elastic Network Interface

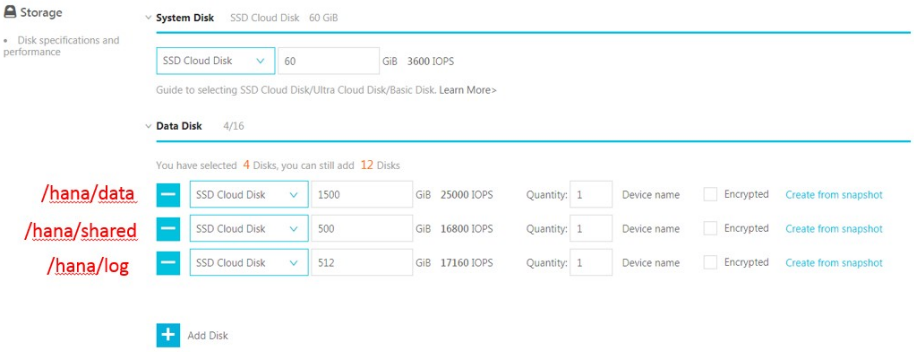
eth0: Default ENI VSwitch: switch1 ✓Auto Assign IP Addresses ✓Release with Instance

Add ENI You can add up to 1 ENI.

Complete the system configuration, grouping, and ECS purchasing.

Create HANA backup node ECS

The creation of HANA backup node ECS is the same as that of HANA primary node ECS, except that the storage space allocation method is different. We recommend that the HANA backup node not be attached to an HANA backup volume as long as the HANA data storage space is sufficient.



Storage

- Disk specifications and performance

System Disk SSD Cloud Disk 60 GiB

SSD Cloud Disk | 60 GiB 3600 IOPS

Guide to selecting SSD Cloud Disk/Ultra Cloud Disk/Basic Disk. Learn More>

Data Disk 4/16

You have selected 4 Disks, you can still add 12 Disks

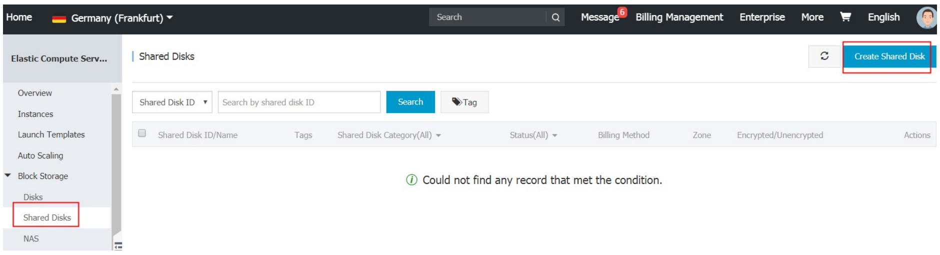
/hana/data	SSD Cloud Disk	1500	GiB 25000 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot
/hana/shared	SSD Cloud Disk	500	GiB 16800 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot
/hana/log	SSD Cloud Disk	512	GiB 17160 IOPS	Quantity: 1	Device name	□ Encrypted	Create from snapshot

Add Disk

Configure shared storage

ECS shared block storage refers to the data block-level storage device that allows multiple ECS instances to read and write data concurrently. It features high concurrency rate, high performance, and high reliability. A single block can be attached to a maximum of 16 ECS instances. For the operation procedure, watch the video Attach a Shared Block to Multiple ECS Instances。
In this example, the shared block is used as the STNOITH of a HA cluster. Select the same zone as the ECS instance and attach the block to the ECS instance of the HA cluster.

Create shared block storage



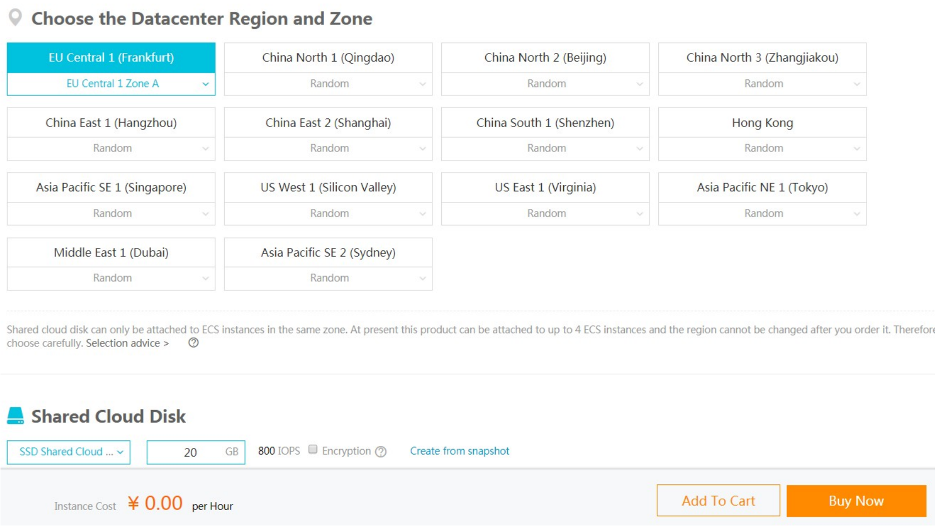
Shared Disks

Shared Disk ID | Search by shared disk ID

Shared Disk ID/Name	Tags	Shared Disk Category(All)	Status(All)	Billing Method	Zone	Encrypted/Unencrypted	Actions

Could not find any record that met the condition.

Select at least 20 GB SSD for the STONITH.



Choose the Datacenter Region and Zone

EU Central 1 (Frankfurt) EU Central 1 Zone A	China North 1 (Qingdao) Random	China North 2 (Beijing) Random	China North 3 (Zhangjiakou) Random
China East 1 (Hangzhou) Random	China East 2 (Shanghai) Random	China South 1 (Shenzhen) Random	Hong Kong Random
Asia Pacific SE 1 (Singapore) Random	US West 1 (Silicon Valley) Random	US East 1 (Virginia) Random	Asia Pacific NE 1 (Tokyo) Random
Middle East 1 (Dubai) Random	Asia Pacific SE 2 (Sydney) Random		

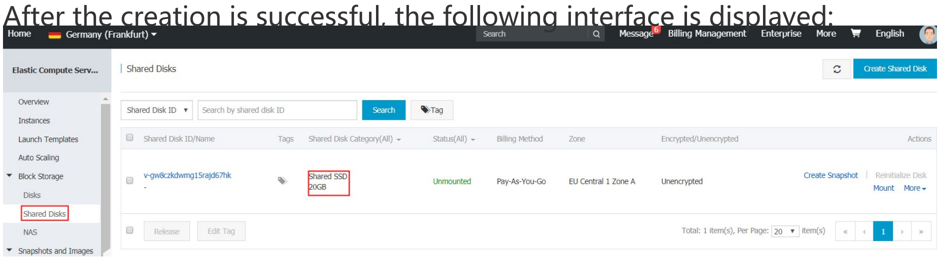
Shared cloud disk can only be attached to ECS instances in the same zone. At present this product can be attached to up to 4 ECS instances and the region cannot be changed after you order it. Therefore choose carefully. Selection advice >

Shared Cloud Disk

SSD Shared Cloud ... 20 GB 800 IOPS □ Encryption Create from snapshot

Instance Cost ￥0.00 per Hour

After the creation is successful, the following interface is displayed:



Shared Disks

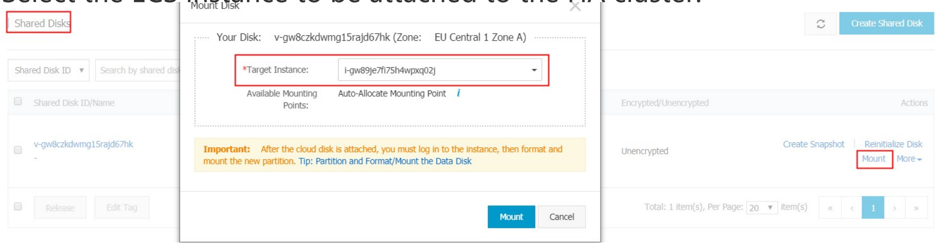
Shared Disk ID ▾ Search by shared disk ID

□	Shared Disk ID/Name	Tags	Shared Disk Category(All)	Status(All)	Billing Method	Zone	Encrypted/Unencrypted	Actions
□	v-gw8czkdwmg15rajd67hk -		Shared SSD 20GB	Unmounted	Pay-As-You-Go	EU Central 1 Zone A	Unencrypted	Create Snapshot | Reinitialize Disk Mount More

Total: 1 item(s), Per Page: 20 item(s) « ‹ 1 › »

Attach shared block storage

Select the ECS instance to be attached to the HA cluster.



Mount Disk

Your Disk: v-gw8czkdwmg15rajd67hk (Zone: EU Central 1 Zone A)

*Target Instance: i-gw89je7fi75h4wpxq02j

Available Mounting Points: Auto-Allocate Mounting Point

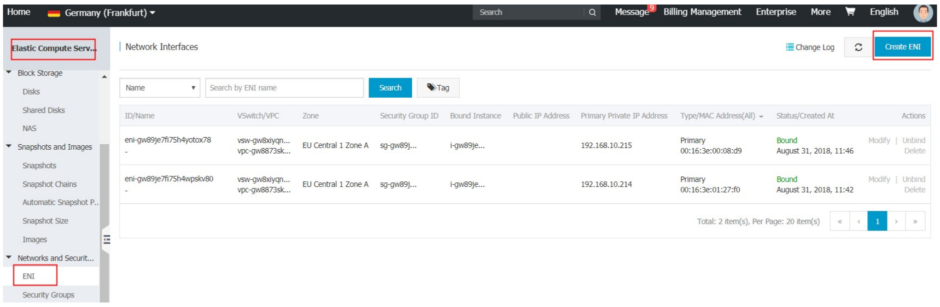
Important: After the cloud disk is attached, you must log in to the instance, then format and mount the new partition. Tip: Partition and Format/Mount the Data Disk

Configure ENI

ENI is a virtual network card that can be appended to an ECS instance in a VPC. With ENI, you can build highly available clusters, implement failover at a low cost, and achieve refined network management. All regions support the ENI. For more information, see ENI。

Create an ENI

Log on to the **ECS console**， Select **Network and Security** > **ENI** from the left navigation bar. Select a region. Click **Create an ENI**.

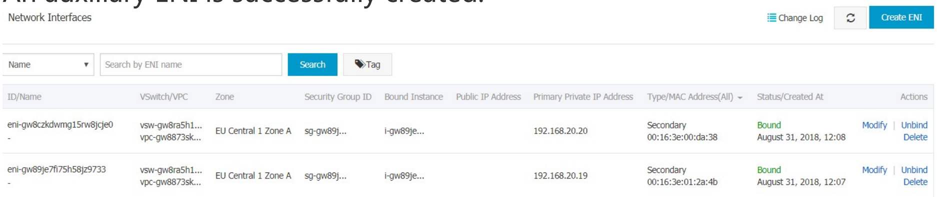


Network Interfaces

ID/Name	VSwitch/VPC	Zone	Security Group ID	Bound Instance	Public IP Address	Primary Private IP Address	Type/MAC Address(All)	Status/Created At	Actions
eni-gw89je7fi75h4yotox78 -	vsw-gw8xiyqn... vpc-gw8873sk...	EU Central 1 Zone A	sg-gw89j...	i-gw89je...		192.168.10.215	Primary 00:16:3e:00:08:d9	Bound August 31, 2018, 11:46	Modify | Unbind Delete
eni-gw89je7fi75h4wpskv80 -	vsw-gw8xiyqn... vpc-gw8873sk...	EU Central 1 Zone A	sg-gw89j...	i-gw89je...		192.168.10.214	Primary 00:16:3e:01:27:f0	Bound August 31, 2018, 11:42	Modify | Unbind Delete

Total: 2 item(s), Per Page: 20 item(s)

An auxiliary ENI is successfully created.

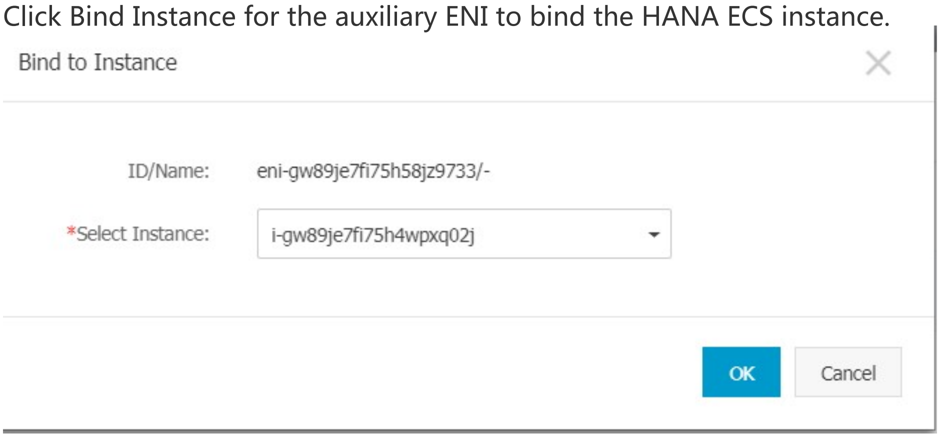


Network Interfaces

ID/Name	VSwitch/VPC	Zone	Security Group ID	Bound Instance	Public IP Address	Primary Private IP Address	Type/MAC Address(All)	Status/Created At	Actions
eni-gw8czkdwmg15rw8jcje0 -	vsw-gw8ra5h1... vpc-gw8873sk...	EU Central 1 Zone A	sg-gw89j...	i-gw89je...		192.168.20.20	Secondary 00:16:3e:00:da:38	Bound August 31, 2018, 12:08	Modify | Unbind Delete
eni-gw89je7fi75h58jz9733 -	vsw-gw8ra5h1... vpc-gw8873sk...	EU Central 1 Zone A	sg-gw89j...	i-gw89je...		192.168.20.19	Secondary 00:16:3e:01:2a:4b	Bound August 31, 2018, 12:07	Modify | Unbind Delete

Bind the HANA ECS instance.

Click Bind Instance for the auxiliary ENI to bind the HANA ECS instance.



Bind to Instance

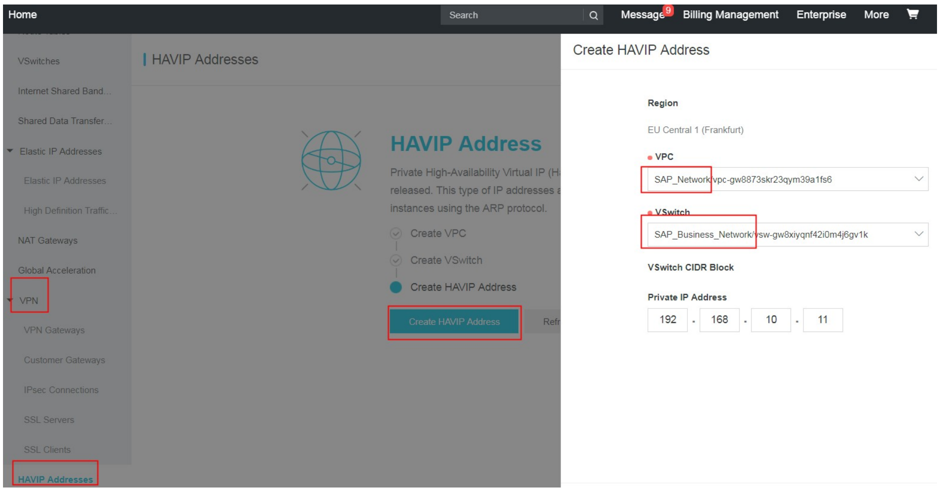
ID/Name: eni-gw89je7fi75h58jz9733/-

*Select Instance: i-gw89je7fi75h4wpxq02j

Configure HaVip

Private High-Availability Virtual IP Address (HaVip) is a private IP resource which can be created and released independently. The uniqueness of HaVip is that you can broadcast the IP address on ECS using ARP. In this deployment, the HaVip is used as the virtual IP address of the cluster and is attached to each node in the cluster.

Create HaVip



HAVIP Address

Private High-Availability Virtual IP (H
released. This type of IP addresses a
instances using the ARP protocol.

Create HAVIP Address

Region: EU Central 1 (Frankfurt)

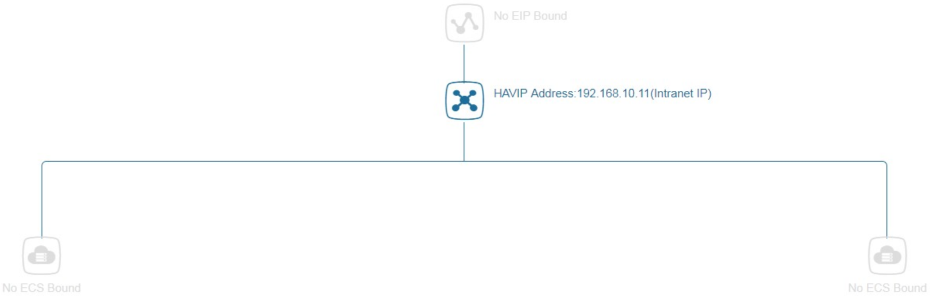
VPC: SAP_Network/vpc-gw8873skr23qym39a1fs6

VSwitch: SAP_Business_Network/vsw-gw8xiyqnf42i0m4j6gv1k

VSwitch CIDR Block

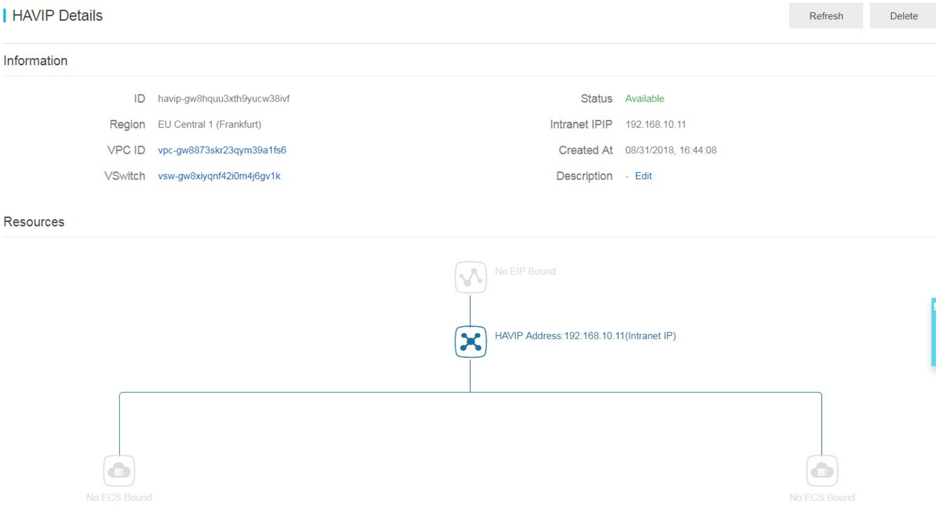
Private IP Address: 192 . 168 . 10 . 11

The HaVip is used by the HANA instance to provide service, and is an IP address on the service subnet.



Bind HaVip

Click the ECS instance bound to the HA cluster. Ensure that each ECS instance in the cluster is bound.



HAVIP Details

Information

ID: havip-gw8hquu3xth9yucw38ivf

Region: EU Central 1 (Frankfurt)

VPC ID: vpc-gw8873skr23qym39a1fs6

VSwitch: vsw-gw8xiyqnf42i0m4j6gv1k

Status: Available

Intranet IPIP: 192.168.10.11

Created At: 08/31/2018, 16:44:08

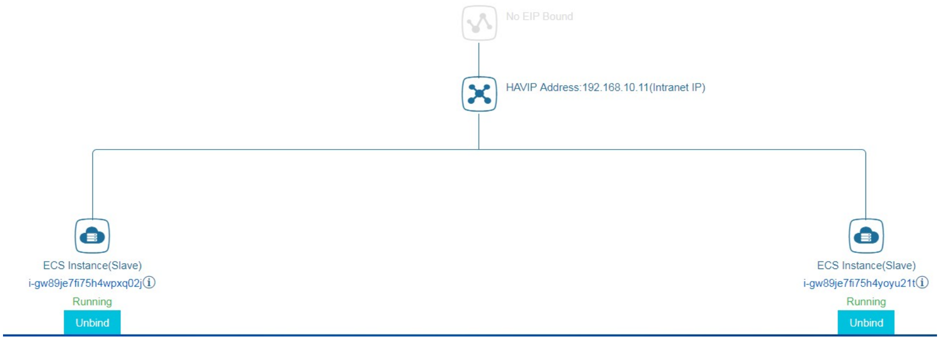
Description: - Edit

Resources

Associate the HANA primary and backup nodes

Access the management page of the created HaVIP.

Click + to add the ECS instances to be associated with, and associate the HANA primary and backup nodes with the HaVip.



Configure HANA ECS

Modify the host name

Configure domain name resolution on the two HANA servers of the HA cluster. Modify the host names as follows:

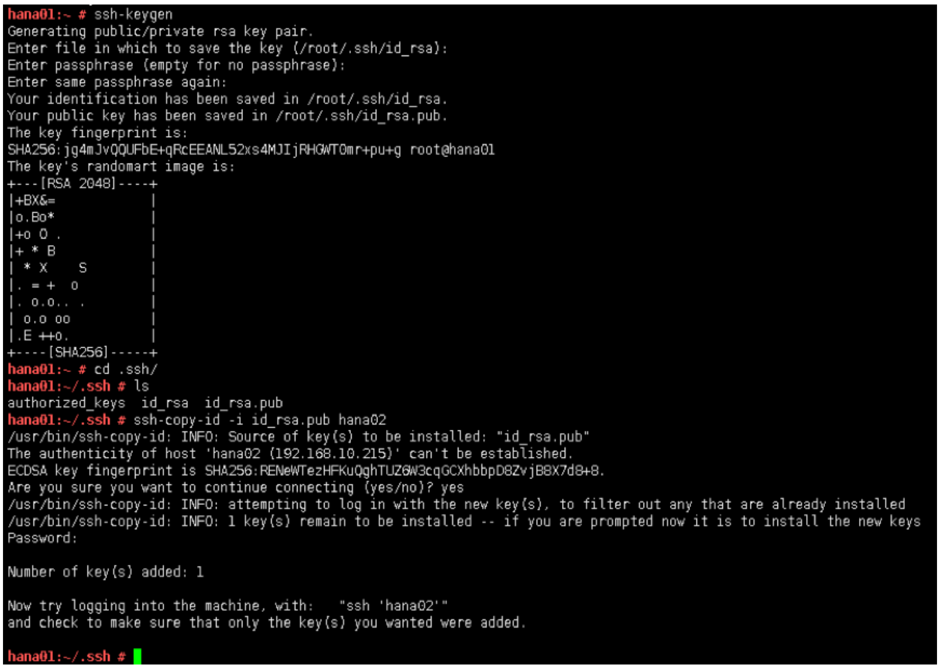
- Edit /etc/hostname.
- Set hostname
- Edit /etc/hosts and comment out the IPv6 part

Configure SSH password-free connection service

The SSH password-free connection service must be configured on the two HANA servers. The operation is as follows:

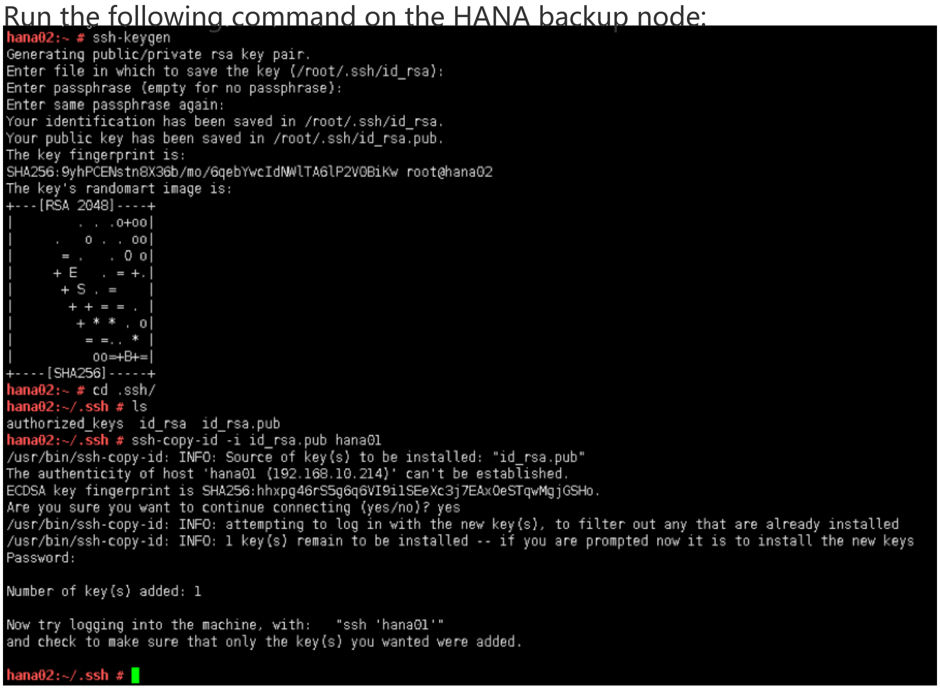
Configure the authentication public key

Run the following command on the HANA primary node:



```
hana01:~ # ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:jg4mJvQQUFbE+qRcEEANL52xs4MJIjRHGWTOmr+pu+g root@hana01
The key's randomart image is:
+---[RSA 2048]----+
|+BX&=            |
|o.Bo*            |
|+o O .           |
|+ * B            |
| * X    S        |
|. = +  o         |
|. o.o.. .        |
| o.o oo          |
|.E ++o.          |
+----[SHA256]-----+
hana01:~ # cd .ssh/
hana01:~/.ssh # ls
authorized_keys  id_rsa  id_rsa.pub
hana01:~/.ssh # ssh-copy-id -i id_rsa.pub hana02
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "id_rsa.pub"
The authenticity of host 'hana02 (192.168.10.215)' can't be established.
ECDSA key fingerprint is SHA256:RENeWTezHFKuQghTUZ6W3cqGCXhbbpD8ZvjB8X7d8+8.
Are you sure you want to continue connecting (yes/no)? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
Password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'hana02'"
and check to make sure that only the key(s) you wanted were added.

hana01:~/.ssh #
```

Run the following command on the HANA backup node:

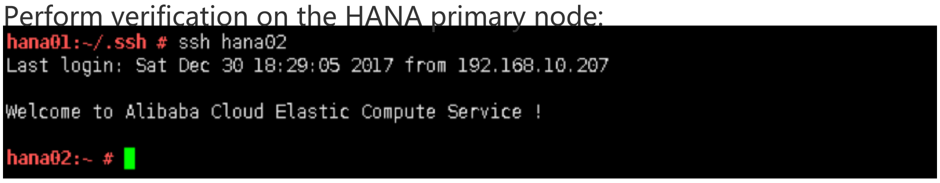


```
hana02:~ # ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:9yhPCENstn8X36b/mo/6qebYwcIdNWlTA6lP2V0BiKw root@hana02
The key's randomart image is:
+---[RSA 2048]----+
|        . . .o+oo|
|     .   o . . oo|
|      = .   . O o|
|     + E   . = +.|
|      + S . =    |
|       + + = = . |
|        + * * . o|
|         = =.. * |
|          oo=+B+=|
+----[SHA256]-----+
hana02:~ # cd .ssh/
hana02:~/.ssh # ls
authorized_keys  id_rsa  id_rsa.pub
hana02:~/.ssh # ssh-copy-id -i id_rsa.pub hana01
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "id_rsa.pub"
The authenticity of host 'hana01 (192.168.10.214)' can't be established.
ECDSA key fingerprint is SHA256:hhxpg46rS5g6q6VI9ilSEeXc3j7EAx0eSTqwMgjGSHo.
Are you sure you want to continue connecting (yes/no)? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
Password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'hana01'"
and check to make sure that only the key(s) you wanted were added.

hana02:~/.ssh #
```

Verify the configurations.

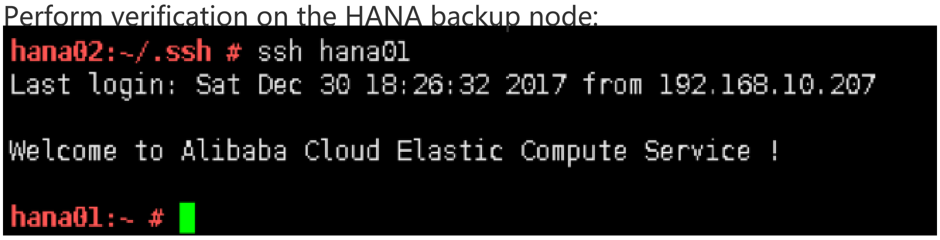
Verify the SSH password-free connection service: Log on to the nodes from each other through SSH. If both logon processes do not need a password, the service is successful.

Perform verification on the HANA primary node:



```
hana01:~/.ssh # ssh hana02
Last login: Sat Dec 30 18:29:05 2017 from 192.168.10.207

Welcome to Alibaba Cloud Elastic Compute Service !

hana02:~ #
```

Perform verification on the HANA backup node:



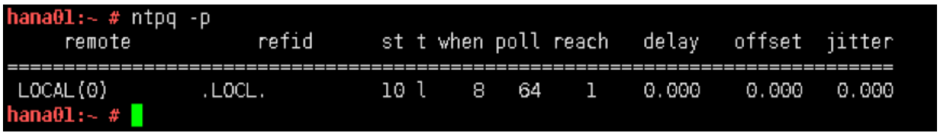
```
hana02:~/.ssh # ssh hana01
Last login: Sat Dec 30 18:26:32 2017 from 192.168.10.207

Welcome to Alibaba Cloud Elastic Compute Service !

hana01:~ #
```

Configure the NTP service

The nodes in the cluster need to synchronize time. In this example, the HANA primary node is configured as the NTP server, and the backup node is configured as the client.

HANA primary node:

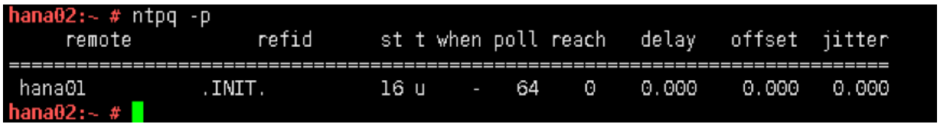
```
# vim /etc/ntp.conf
server 127.127.1.0 # local clock (LCL)
fudge 127.127.1.0 stratum 10 # LCL is unsynchronized
# systemctl restart ntpd.service
# ntpq -p
```



```
hana01:~ # ntpq -p
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
 LOCAL(0)        .LOCL.          10 l    8   64    1    0.000    0.000   0.000
hana01:~ #
```

HANA backup node:

```
# vim /etc/ntp.conf
server hana01 iburst
# systemctl restart ntpd.service
# ntpq -p
```



```
hana02:~ # ntpq -p
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
 hana01          .INIT.          16 u    -   64    0    0.000    0.000   0.000
hana02:~ #
```

Note: If the offset between local time and NTP server time exceeds 1000 seconds, run the systemctl stop ntpd.service command to stop the ntpd service, and run ntpdate 192.168.20.9 (replace 192.168.20.9 with the NTP server address) to synchronize the time manually. Then run systemctl start ntpd.service to restart the ntdp service.

Partition the HANA file system

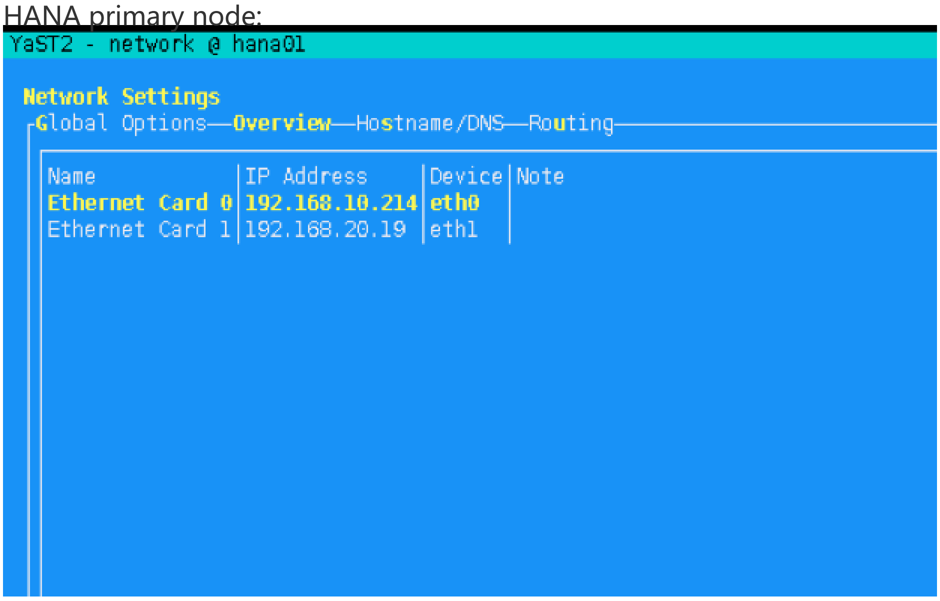
File system partitioning differences between HANA primary and backup nodes:

HANA Node	File System Partition
HANA primary node	OS disk
HANA primary node	/hana/data
HANA primary node	/hana/log
HANA primary node	/hana/shared
HANA primary node	/hana/backup
HANA primary and backup nodes	Arbitration disk
HANA backup node	OS disk
HANA backup node	/hana/data
HANA backup node	/hana/log
HANA backup node	/hana/shared

Configure the heartbeat network

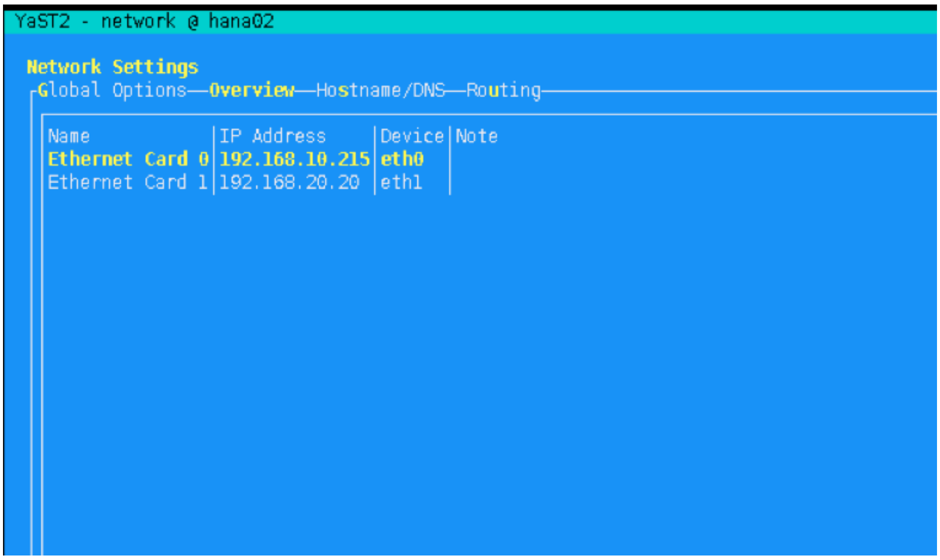
```
HANA01:~ # yast network
```

HANA primary node:



```
YaST2 - network @ hana01

Network Settings
Global Options—Overview—Hostname/DNS—Routing

Name             |IP Address     |Device|Note
Ethernet Card 0  |192.168.10.214 |eth0  |
Ethernet Card 1  |192.168.20.19  |eth1  |
```

HANA backup node::

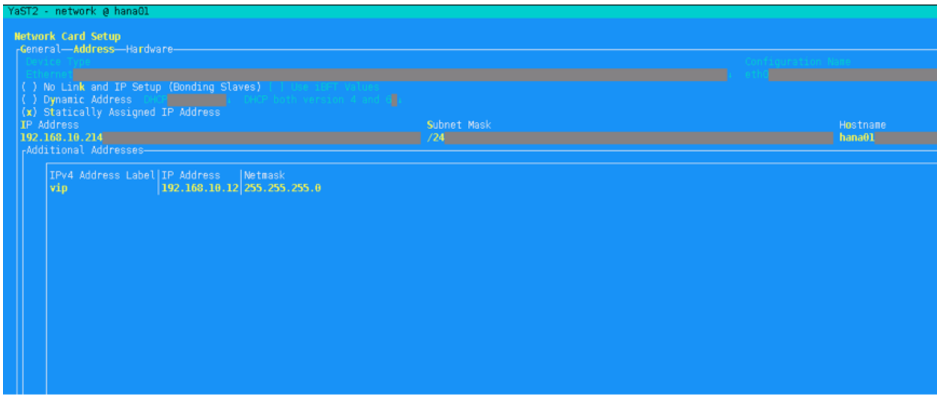


```
YaST2 - network @ hana02

Network Settings
Global Options—Overview—Hostname/DNS—Routing

Name             |IP Address    |Device|Note
Ethernet Card 0|192.168.10.215|eth0  |
Ethernet Card 1|192.168.20.20 |eth1  |
```

Configure the HaVip primary node

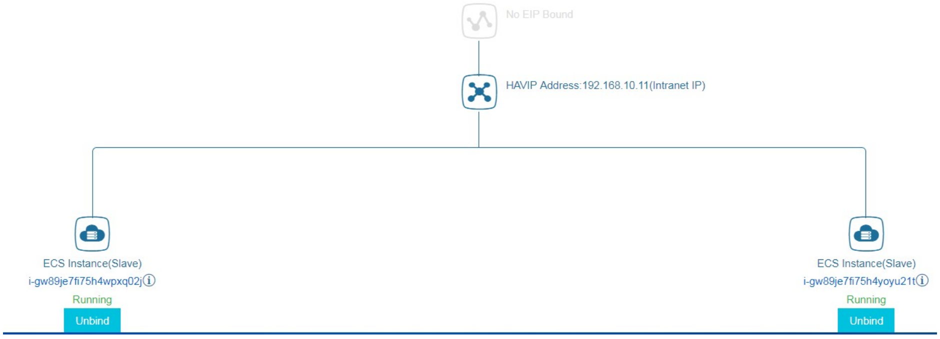
After the HaVip is configured on Alibaba Cloud, the two ECS instances are in backup mode by default. The HaVip cannot be used for communication. It takes effect only after the HaVip primary node is configured. Therefore, you need to configure the HANA primary node to the HaVip primary node. Assign the HaVip to the ENI of the HANA primary node. This IP address is the additional address (or Linux subinterface) of the corresponding ENI.

```
HANA01:~ # yast network
```



```
YaST2 - network @ hana01

Network Card Setup
General—Address—Hardware
 Device Type                                            Configuration Name
 Ethernet                                               eth0
( ) No Link and IP Setup (Bonding Slaves) [ ] Use iBFT Values
( ) Dynamic Address  DHCP         DHCP both version 4 and 6
(x) Statically Assigned IP Address
IP Address                          Subnet Mask                          Hostname
192.168.10.214                      /24                                  hana01
Additional Addresses

   IPv4 Address Label|IP Address    |Netmask
   vip               |192.168.10.12|255.255.255.0
```

After the configuration, the instance bound with HaVip turns into the primary state.



Install the HANA database

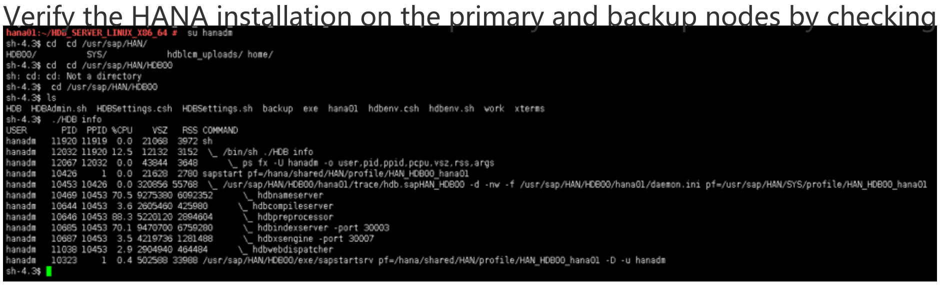
> Note: HANA primary and backup nodes must have consistent system ID and instance ID. In this example, the system ID is HAN and instance ID is 00.

Check whether hdblcm is an executable program. Install the HANA instances on the primary and backup nodes.

```
hana01:~/HDB_SERVER_LINUX_X86_64 # ./hdblcm


SAP HANA Lifecycle Management - SAP HANA Database 2.00.020.00.1500920972
***************************************************************************

Scanning software locations...
Detected components:
SAP HANA Database (2.00.020.00.1500920972) in /root/HDB_SERVER_LINUX_X86_64/server


Choose an action

Index | Action | Description
-----------------------------------------------
1 | install | Install new system
2 | extract_components | Extract components
3 | Exit (do nothing) |

Enter selected action index [3]: 1

Enter Installation Path [/hana/shared]:
Enter Local Host Name [hana01]:
Do you want to add hosts to the system? (y/n) [n]:
Enter SAP HANA System ID: HAN
Enter Instance Number [00]:
Enter Local Host Worker Group [default]:

Index | System Usage | Description
-------------------------------------------------------------------------------
1 | production | System is used in a production environment
```

```
2 | test | System is used for testing, not production
3 | development | System is used for development, not production
4 | custom | System usage is neither production, test nor development

Select System Usage / Enter Index [4]: 2
Enter Location of Data Volumes [/hana/data/HAN]:
Enter Location of Log Volumes [/hana/log/HAN]:
Restrict maximum memory allocation? [n]:
Enter Certificate Host Name For Host 'hana01' [hana01]:
Enter SAP Host Agent User (sapadm) Password:
Confirm SAP Host Agent User (sapadm) Password:
Enter System Administrator (hanadm) Password:
Confirm System Administrator (hanadm) Password:
Enter System Administrator Home Directory [/usr/sap/HAN/home]:
Enter System Administrator Login Shell [/bin/sh]:
Enter System Administrator User ID [1000]:
Enter ID of User Group (sapsys) [79]:
Enter System Database User (SYSTEM) Password:
Confirm System Database User (SYSTEM) Password:
Restart system after machine reboot? [n]:

Summary before execution:
=========================

SAP HANA Database System Installation
Installation Parameters
Remote Execution: ssh
Database Isolation: low
Installation Path: /hana/shared
Local Host Name: hana01
SAP HANA System ID: HAN
Instance Number: 00
Local Host Worker Group: default
System Usage: test
Location of Data Volumes: /hana/data/HAN
Location of Log Volumes: /hana/log/HAN
Certificate Host Names: hana01 -> hana01
System Administrator Home Directory: /usr/sap/HAN/home
System Administrator Login Shell: /bin/sh
System Administrator User ID: 1000
ID of User Group (sapsys): 79
Software Components
SAP HANA Database
Install version 2.00.020.00.1500920972
Location: /root/HDB_SERVER_LINUX_X86_64/server

Do you want to continue? (y/n): y

Installing components...
Installing SAP HANA Database...
Preparing package 'Saphostagent Setup'...
Preparing package 'Python Support'...
Preparing package 'Python Runtime'...
Preparing package 'Product Manifest'...
Preparing package 'Binaries'...
Preparing package 'Data Quality'...
Preparing package 'Krb5 Runtime'...
Preparing package 'Installer'...
Preparing package 'Ini Files'...
Preparing package 'HWCCT'...
Preparing package 'Documentation'...
Preparing package 'Delivery Units'...
Preparing package 'Offline Cockpit'...
Preparing package 'DAT Languages (EN, DE)'...
Preparing package 'DAT Languages (other)'...
Preparing package 'DAT Configfiles (EN, DE)'...
Preparing package 'DAT Configfiles (other)'...
Creating System...
Extracting software...
Installing package 'Saphostagent Setup'...
Installing package 'Python Support'...
Installing package 'Python Runtime'...
Installing package 'Product Manifest'...
Installing package 'Binaries'...
Installing package 'Data Quality'...
Installing package 'Krb5 Runtime'...
Installing package 'Installer'...
Installing package 'Ini Files'...
Installing package 'HWCCT'...
Installing package 'Documentation'...
Installing package 'Delivery Units'...
Installing package 'Offline Cockpit'...
Installing package 'DAT Languages (EN, DE)'...
Installing package 'DAT Languages (other)'...
Installing package 'DAT Configfiles (EN, DE)'...
Installing package 'DAT Configfiles (other)'...
Creating instance...
Installing SAP Host Agent version 7.21.26...
Starting SAP HANA Database system...
Starting 4 processes on host 'hana01' (worker):
Starting on 'hana01': hdbcompileserver, hdbdaemon, hdbnameserver, hdbpreprocessor
Starting 7 processes on host 'hana01' (worker):
Starting on 'hana01': hdbcompileserver, hdbdaemon, hdbindexserver, hdbnameserver, hdbpreprocessor,
hdbwebdispatcher, hdbxsengine
Starting on 'hana01': hdbdaemon, hdbindexserver, hdbwebdispatcher, hdbxsengine
Starting on 'hana01': hdbdaemon, hdbwebdispatcher, hdbxsengine
Starting on 'hana01': hdbdaemon, hdbwebdispatcher
All server processes started on host 'hana01' (worker).
Importing delivery units...
Importing delivery unit HCO_INA_SERVICE
Importing delivery unit HANA_DT_BASE
Importing delivery unit HANA_IDE_CORE
Importing delivery unit HANA_TA_CONFIG
Importing delivery unit HANA_UI_INTEGRATION_SVC
Importing delivery unit HANA_UI_INTEGRATION_CONTENT
Importing delivery unit HANA_XS_BASE
Importing delivery unit HANA_XS_DBUTILS
Importing delivery unit HANA_XS_EDITOR
Importing delivery unit HANA_XS_IDE
Importing delivery unit HANA_XS_LM
Importing delivery unit HDC_ADMIN
Importing delivery unit HDC_BACKUP
Importing delivery unit HDC_IDE_CORE
Importing delivery unit HDC_SEC_CP
Importing delivery unit HDC_SYS_ADMIN
Importing delivery unit HDC_XS_BASE
Importing delivery unit HDC_XS_LM
Importing delivery unit SAPUI5_1
Importing delivery unit SAP_WATT
Importing delivery unit HANA_SEC_CP
Importing delivery unit HANA_BACKUP
Importing delivery unit HANA_HDBLCM
Importing delivery unit HANA_SEC_BASE
Importing delivery unit HANA_SYS_ADMIN
Importing delivery unit HANA_ADMIN
Importing delivery unit HANA_WKLD_ANLZ
Installing Resident hdblcm...
Updating SAP HANA Database Instance Integration on Local Host...
Regenerating SSL certificates...
Deploying SAP Host Agent configurations...
Creating Component List...
SAP HANA Database System installed
You can send feedback to SAP with this form: https://hana01:1129/lmsl/HDBLCM/HAN/feedback/feedback.html
Log file written to '/var/tmp/hdb_HAN_hdblcm_install_2017-12-30_20.55.04/hdblcm.log' on host 'hana01'.
```

Verify the HANA installation on the primary and backup nodes by checking the HANA process status.

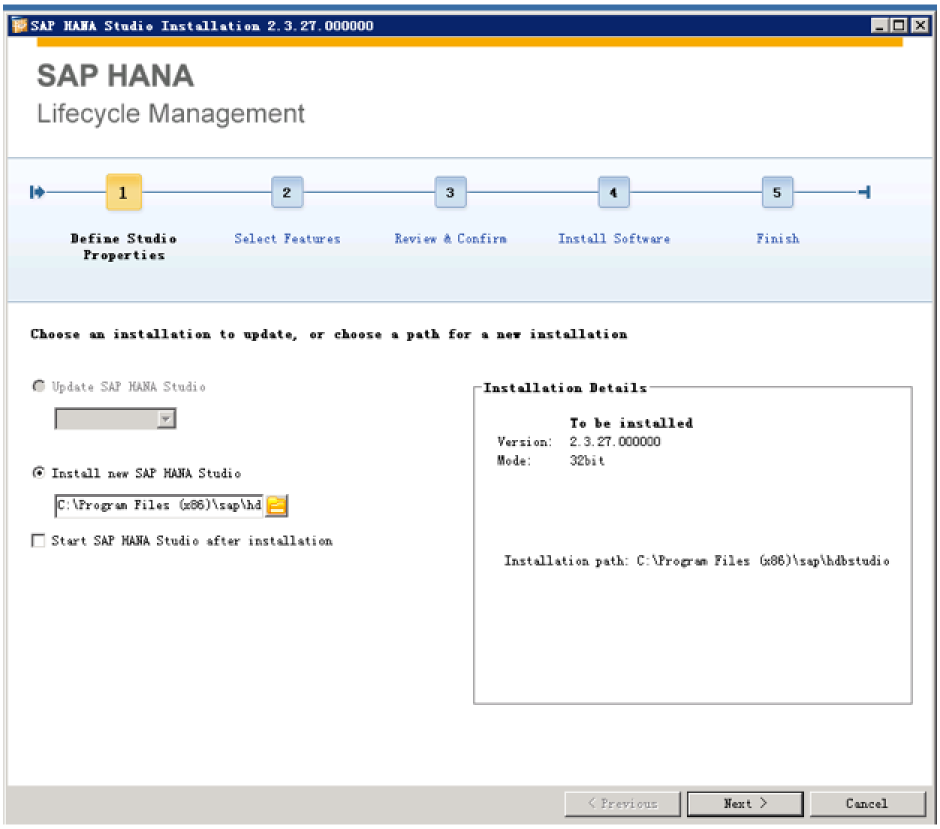


```
hana01:~/HDB_SERVER_LINUX_X86_64 #  su hanadm
sh-4.3$ cd  cd /usr/sap/HAN/
HDB00/          SYS/            hdblcm_uploads/ home/
sh-4.3$ cd  cd /usr/sap/HAN/HDB00
sh: cd: cd: Not a directory
sh-4.3$  cd /usr/sap/HAN/HDB00
sh-4.3$ ls
HDB  HDBAdmin.sh  HDBSettings.csh  HDBSettings.sh  backup  exe  hana01  hdbenv.csh  hdbenv.sh  work  xterms
sh-4.3$  ./HDB info
USER       PID  PPID %CPU    VSZ   RSS COMMAND
hanadm   11920 11919  0.0  21068  3972 sh
hanadm   12032 11920 12.5  12132  3152  \_ /bin/sh ./HDB info
hanadm   12067 12032  0.0  43844  3648      \_ ps fx -U hanadm -o user,pid,ppid,pcpu,vsz,rss,args
hanadm   10426     1  0.0  21628  2780 sapstart pf=/hana/shared/HAN/profile/HAN_HDB00_hana01
hanadm   10453 10426  0.0 320856 55768  \_ /usr/sap/HAN/HDB00/hana01/trace/hdb.sapHAN_HDB00 -d -nw -f /usr/sap/HAN/HDB00/hana01/daemon.ini pf=/usr/sap/HAN/SYS/profile/HAN_HDB00_hana01
hanadm   10469 10453 70.5 9275380 6092352      \_ hdbnameserver
hanadm   10644 10453  3.6 2605460 425980      \_ hdbcompileserver
hanadm   10646 10453 88.3 5220120 2894604      \_ hdbpreprocessor
hanadm   10685 10453 70.1 9470700 6759280      \_ hdbindexserver -port 30003
hanadm   10687 10453  3.5 4219736 1281488      \_ hdbxsengine -port 30007
hanadm   11038 10453  2.9 2904940 464484      \_ hdbwebdispatcher
hanadm   10323     1  0.4 502588 33988 /usr/sap/HAN/HDB00/exe/sapstartsrv pf=/hana/shared/HAN/profile/HAN_HDB00_hana01 -D -u hanadm
sh-4.3$
```

Install the HANA Studio

Configure a Windows ECS

Double-click the hdbsetup executable file in the Studio installation package.



Choose an installation to update, or choose a path for a new installation

○ Update SAP HANA Studio

● Install new SAP HANA Studio

C:\Program Files (x86)\sap\hd

□ Start SAP HANA Studio after installation

Installation Details

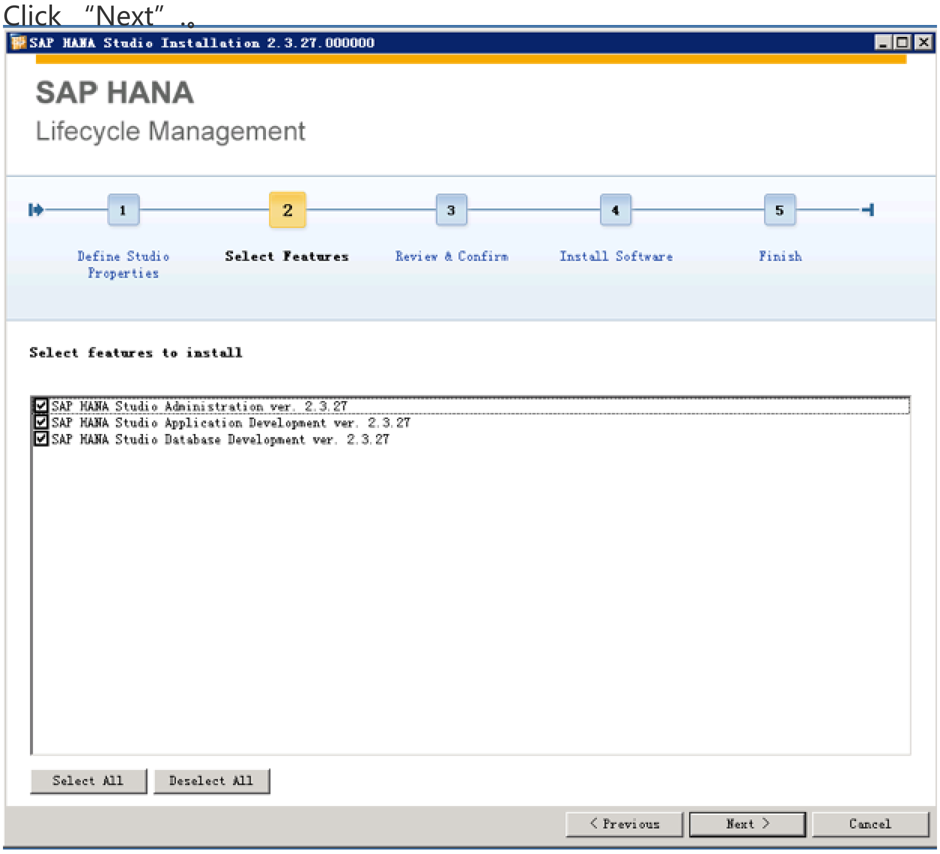
To be installed

Version: 2.3.27.000000

Mode: 32bit

Installation path: C:\Program Files (x86)\sap\hdbstudio

Click “Next”。



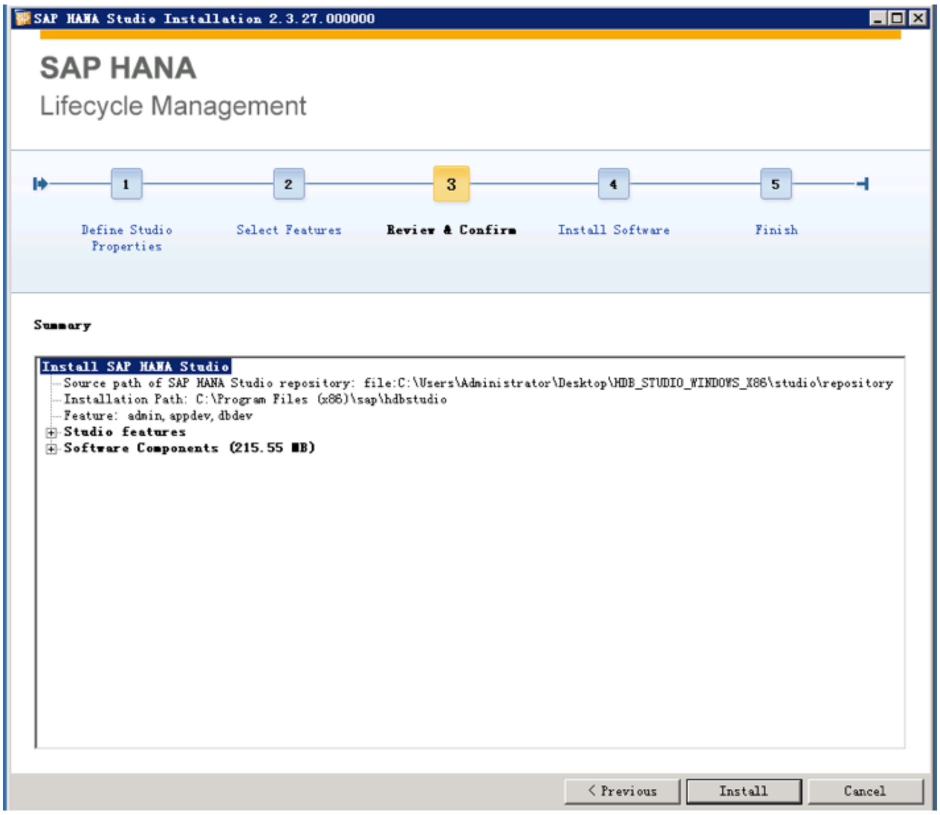
Select features to install

☑ SAP HANA Studio Administration ver. 2.3.27

☑ SAP HANA Studio Application Development ver. 2.3.27

☑ SAP HANA Studio Database Development ver. 2.3.27

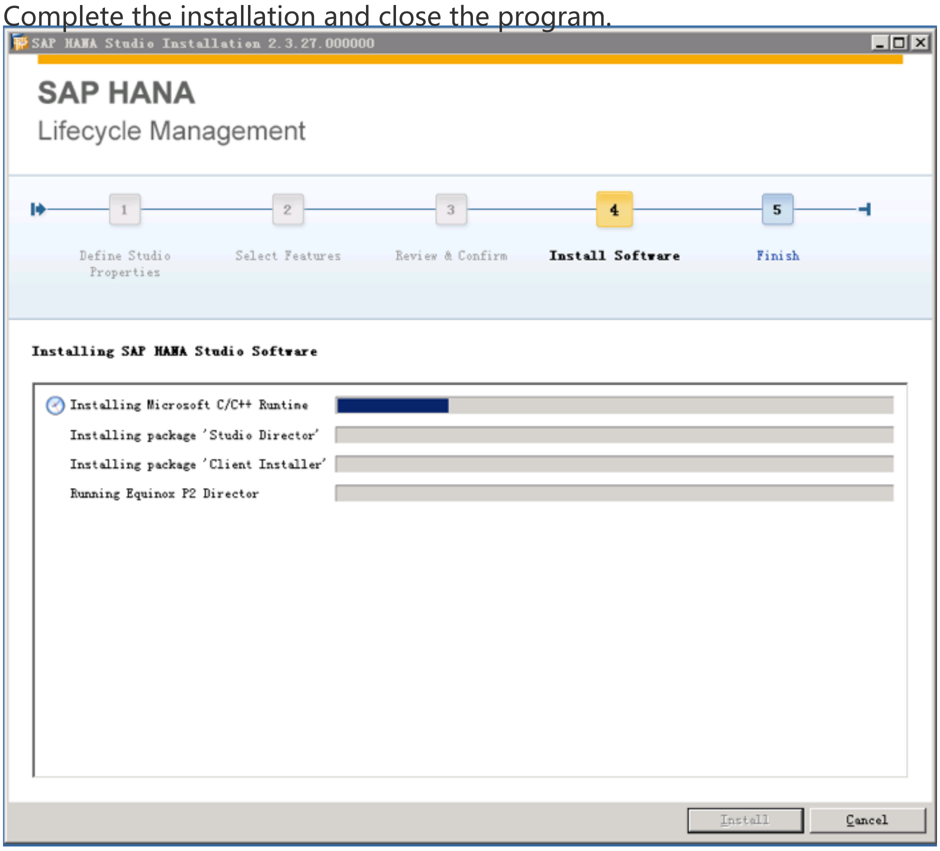
Click “Install”。



Summary

```
Install SAP HANA Studio
  Source path of SAP HANA Studio repository: file:C:\Users\Administrator\Desktop\HDB_STUDIO_WINDOWS_X86\studio\repository
  Installation Path: C:\Program Files (x86)\sap\hdbstudio
  Feature: admin, appdev, dbdev
+ Studio features
+ Software Components (215.55 MB)
```

Complete the installation and close the program.



Installing SAP HANA Studio Software

Installing Microsoft C/C++ Runtime

Installing package 'Studio Director'

Installing package 'Client Installer'

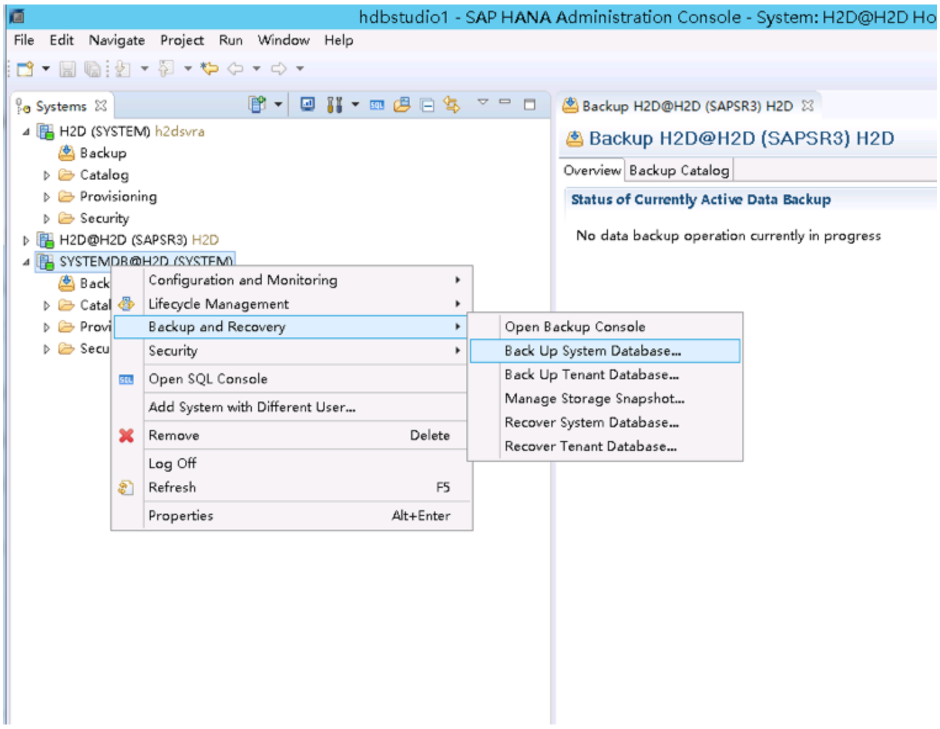
Running Equinox P2 Director

Configure HANA system replication

Back up the database

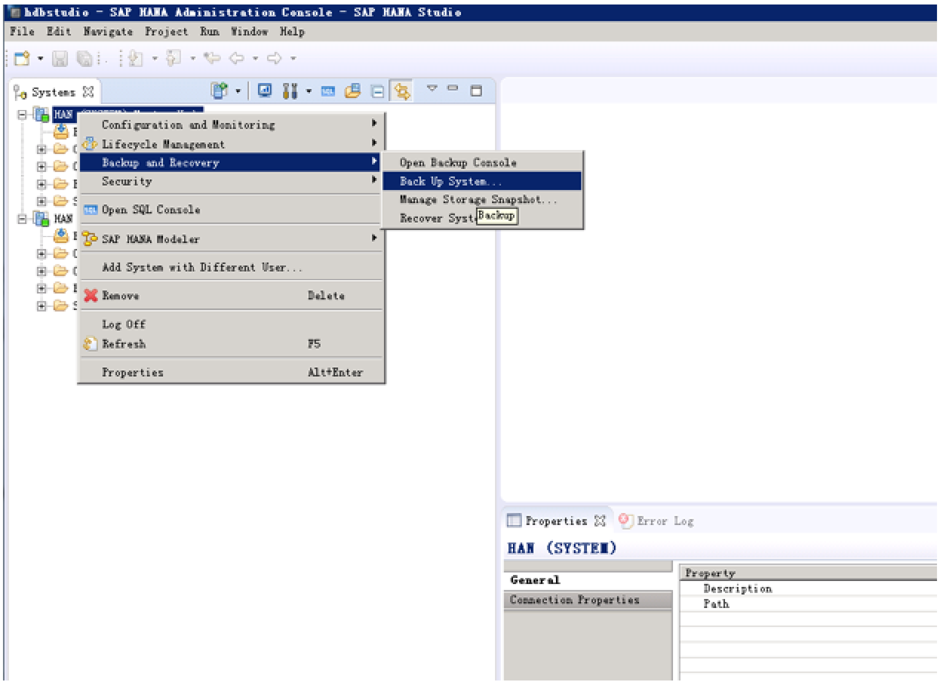
Connect the HANA Studio to the HANA primary node to back up the database.

System-level database backup


hdbstudio1 - SAP HANA Administration Console - System: H2D@H2D Ho
File Edit Navigate Project Run Window Help
Systems
H2D (SYSTEM) h2dsvra
Backup
Catalog
Provisioning
Security
H2D@H2D (SAPSR3) H2D
SYSTEMDB@H2D (SYSTEM)
Configuration and Monitoring
Lifecycle Management
Backup and Recovery
Security
Open SQL Console
Add System with Different User...
Remove Delete
Log Off
Refresh F5
Properties Alt+Enter
Open Backup Console
Back Up System Database...
Back Up Tenant Database...
Manage Storage Snapshot...
Recover System Database...
Recover Tenant Database...
Backup H2D@H2D (SAPSR3) H2D
Overview
Backup Catalog
Status of Currently Active Data Backup

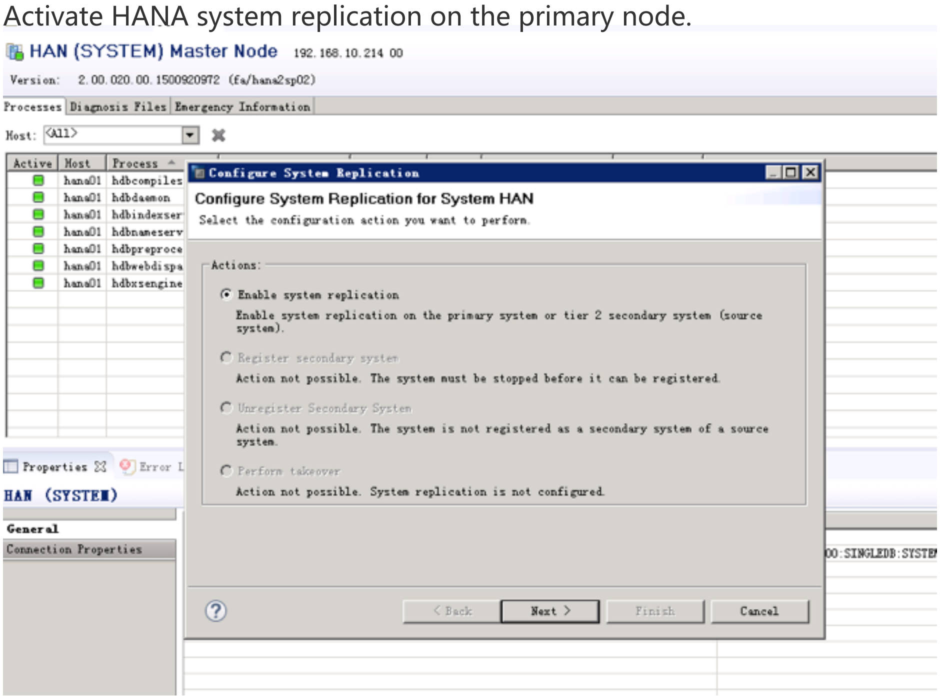
No data backup operation currently in progress

Tenant-level database backup



Enable HANA system replication on the primary node

Activate HANA system replication on the primary node.



Configure System Replication

Configure System Replication for System HAN

Select the configuration action you want to perform.

Actions:

● Enable system replication

Enable system replication on the primary system or tier 2 secondary system (source system).

○ Register secondary system

Action not possible. The system must be stopped before it can be registered.

○ Unregister Secondary System

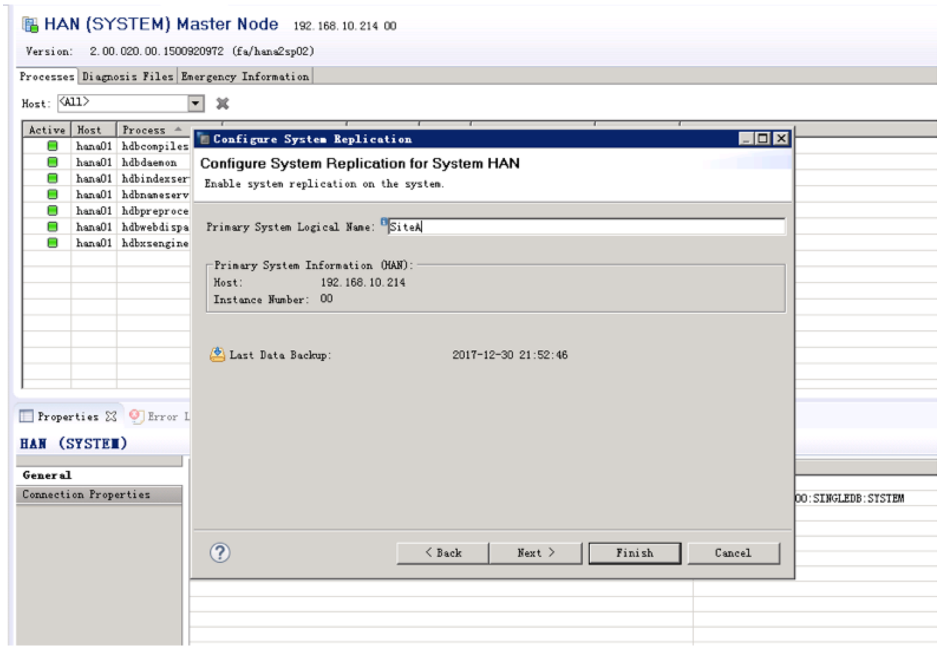
Action not possible. The system is not registered as a secondary system of a source system.

○ Perform takeover

Action not possible. System replication is not configured.

< Back | Next > | Finish | Cancel

Maintain the logic names on the primary node.



Active	Host	Process
🟩	hana01	hdbcompiles
🟩	hana01	hdbdaemon
🟩	hana01	hdbindexser
🟩	hana01	hdbnameserv
🟩	hana01	hdbpreproce
🟩	hana01	hdbwebdispa
🟩	hana01	hdbxsengine

Configure System Replication

Configure System Replication for System HAN

Enable system replication on the system.

Primary System Logical Name: SiteA

Primary System Information (HAN):
Host: 192.168.10.214
Instance Number: 00

Last Data Backup: 2017-12-30 21:52:46

Register the backup node to the primary node

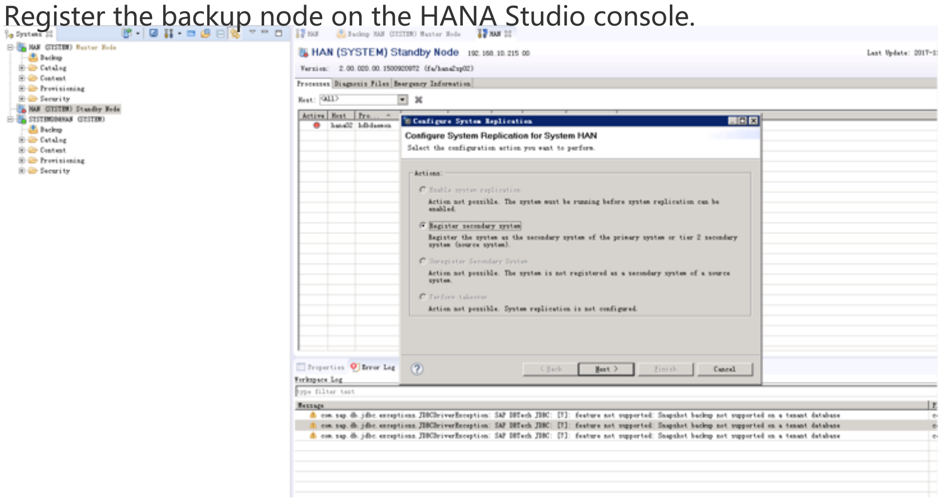
Copy the PKI SSFS file on the primary node to the corresponding location on the backup node :

```
/usr/sap/<SID>/SYS/global/security/rsecssfs/data/SSFS_<SID>.DAT
/usr/sap/<SID>/SYS/global/security/rsecssfs/key/SSFS_<SID>.KEY
```

Location of the PKI SSFS file on the primary node:
/usr/sap/HAN/SYS/global/security/rsecssfs/data
/usr/sap/HAN/SYS/global/security/rsecssfs/key

> Note: When copying the file, do not delete the original file owner; otherwise, some operations may be failed due to insufficient rights.

Register the backup node on the HANA Studio console.



Configure System Replication

Configure System Replication for System HAN

Select the configuration action you want to perform.

Actions:

○ Enable system replication
Action not possible. The system must be running before system replication can be enabled.

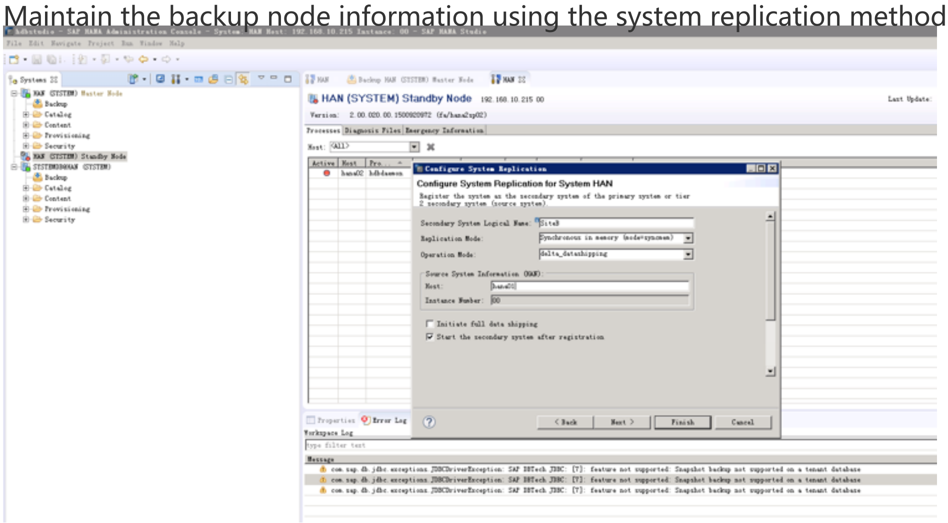
● Register secondary system
Register the system as the secondary system of the primary system or tier 2 secondary system (source system).

○ Unregister Secondary System
Action not possible. The system is not registered as a secondary system of a source system.

○ Perform takeover
Action not possible. System replication is not configured.

```
Message
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
```

Maintain the backup node information using the system replication method.



HAN (SYSTEM) Standby Node 192.168.10.215 00

Version: 2.00.020.00.1500920972 (fa/hana2sp02)

Configure System Replication for System HAN

Register the system as the secondary system of the primary system or tier 2 secondary system (source system).

Secondary System Logical Name: SiteB

Replication Mode: Synchronous in memory (mode=syncmem)

Operation Mode: delta_datashipping

Source System Information (HAN):

Host: hana01

Instance Number: 00

☐ Initiate full data shipping

☑ Start the secondary system after registration

```
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
com.sap.db.jdbc.exceptions.JDBCDriverException: SAP DBTech JDBC: [7]: feature not supported: Snapshot backup not supported on a tenant database
```

Check the HANA system replication status.

Install and configure SLES 12 Cluster HA

Install the SUSE HAE software

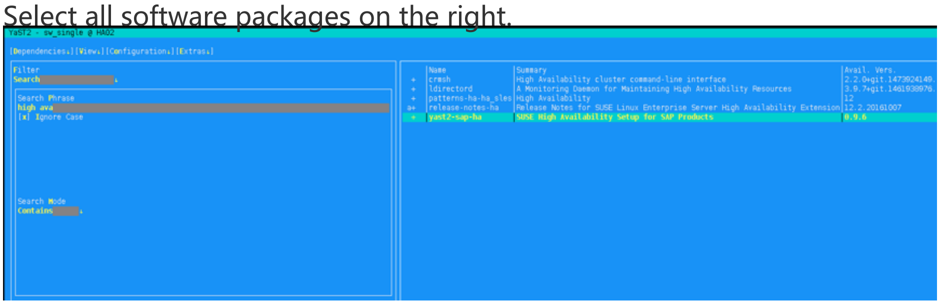
Add the local source to the primary and backup nodes.

```
#zypper addrepo iso:/?iso=/root/SLE-12-SP2-HA-DVD-x86_64-GM-CD1.iso  SAP1
#zypper addrepo iso:/?iso=/root/SLE-12-SP2-HA-DVD-x86_64-GM-CD2.iso SAP2
```

Note: The ISO path needs to be adjusted.

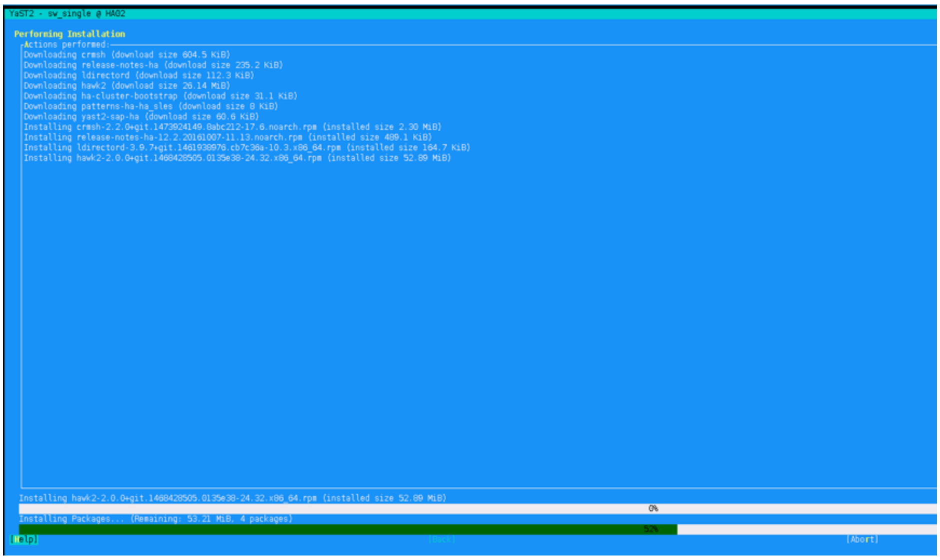
```
hana01#yast
```

Select all software packages on the right.



```
YaST2 - sw_single @ HA02

[Dependencies↓][View↓][Configuration↓][Extras↓]

Filter                    Name               Summary                                                           Avail. Vers.
Search          ↓      +  crmsh              High Availability cluster command-line interface                  2.2.0+git.1473924149.
                       +  ldirectord         A Monitoring Daemon for Maintaining High Availability Resources   3.9.7+git.1461938976.
Search Phrase          +  patterns-ha-ha_sles High Availability                                                12
high ava               a+ release-notes-ha   Release Notes for SUSE Linux Enterprise Server High Availability Extension 12.2.20161007
[x] Ignore Case        +  yast2-sap-ha       SUSE High Availability Setup for SAP Products                     0.9.6

Search Mode
Contains      ↓
```

Select the dependent package and click Accept.



```
YaST2 - sw_single @ HA02

Performing Installation
Actions performed:
Downloading crmsh (download size 604.5 KiB)
Downloading release-notes-ha (download size 235.2 KiB)
Downloading ldirectord (download size 112.3 KiB)
Downloading hawk2 (download size 26.14 MiB)
Downloading ha-cluster-bootstrap (download size 31.1 KiB)
Downloading patterns-ha-ha_sles (download size 8 KiB)
Downloading yast2-sap-ha (download size 60.6 KiB)
Installing crmsh-2.2.0+git.1473924149.8abc212-17.6.noarch.rpm (installed size 2.30 MiB)
Installing release-notes-ha-12.2.20161007-11.13.noarch.rpm (installed size 489.1 KiB)
Installing ldirectord-3.9.7+git.1461938976.cb7c36a-10.3.x86_64.rpm (installed size 164.7 KiB)
Installing hawk2-2.0.0+git.1468428505.0135e38-24.32.x86_64.rpm (installed size 52.89 MiB)

Installing hawk2-2.0.0+git.1468428505.0135e38-24.32.x86_64.rpm (installed size 52.89 MiB)
                                                                  0%
Installing Packages... (Remaining: 53.21 MiB, 4 packages)
                                                                  52%
```

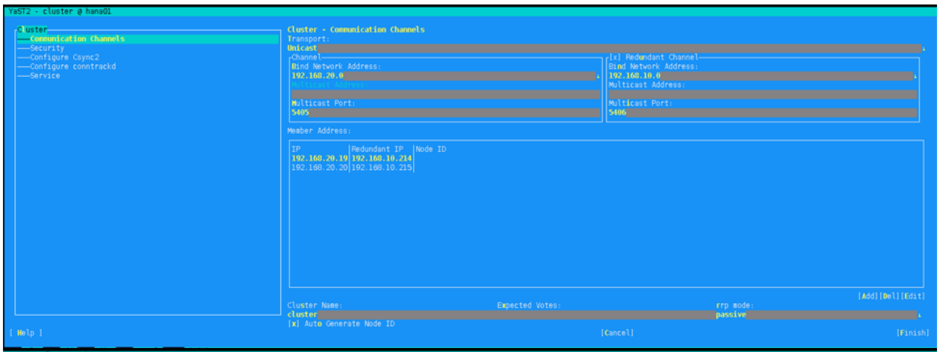
Configure the cluster

Generate the cluster configuration file

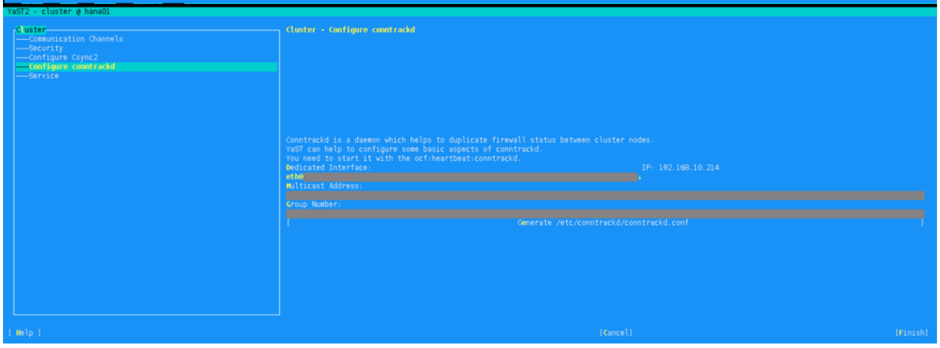
Generate the corosync.conf file on the HANA primary node.

```
hana01:~ # yast cluster
```

The configuration is as follows. Other configuration options retain the default values.



```
YaST2 - cluster @ hana01

Cluster - Communication Channels
Transport:
Unicast
Channel                                [x] Redundant Channel
Bind Network Address:                  Bind Network Address:
192.168.20.0                           192.168.10.0
Multicast Address:                     Multicast Address:

Multicast Port:                        Multicast Port:
5405                                   5406

Member Address:
IP          |Redundant IP  |Node ID
192.168.20.19|192.168.10.214|
192.168.20.20|192.168.10.215|

Cluster Name:          Expected Votes:          rrp mode:
cluster                                         passive
[x] Auto Generate Node ID
```



```
YaST2 - cluster @ hana01

Cluster - Configure conntrackd

Conntrackd is a daemon which helps to duplicate firewall status between cluster nodes.
YaST can help to configure some basic aspects of conntrackd.
You need to start it with the ocf:heartbeat:conntrackd.
Dedicated Interface:                                   IP: 192.168.10.214
eth0
Multicast Address:

Group Number:

[                  Generate /etc/conntrackd/conntrackd.conf                  ]
```

Copy the corosync.conf file to the HANA backup node.

```
hana01# scp /etc/corosync/corosync.conf hana02:/etc/corosync/corosync.conf
```

Start the cluster

Run the following commands on both nodes:

```
# rcpacemaker start
```

View the cluster status.

```
# crm_mon -1
Stack: corosync
Current DC: hana01 (version 1.1.16-4.8-77ea74d) - partition with quorum
Last updated: Tue Nov 7 23:13:06 2017
Last change: Tue Nov 7 23:13:05 2017 by hacluster via crmd on hana01

2 nodes configured
0 resources configured

Online: [ hana01 hana02 ] # Both nodes should be in online state.

No active resources
```

Close the STONITH (which will be configured later).

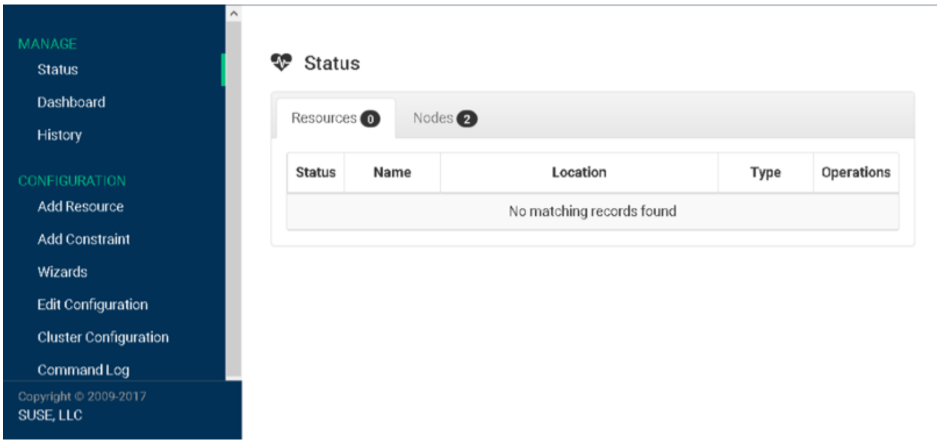
```
# crm
crm(live)# configure
crm(live)configure# property stonith-enabled=false
crm(live)configure# commit
```

Enable web-based configuration.

（1）Set the HA cluster user password on hana01 to hacluster.

```
# passwd hacluster
New password:
BAD PASSWORD: it is based on a dictionary word
Retype new password:
passwd: password updated successfully

# systemctl restart hawk.service
```

（2）Access https://192.168.10.214:7630/ (through HANA Studio ECS) with the user name and password hacluster.



Status	Name	Location	Type	Operations
No matching records found				

Configure the SBD arbitration disk.

Disable the cluster on hana01 and hana02.

```
# rcpacemaker stop
```

View disk information.

```
Hana01:~ # lsblk
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINT
sr0 11:0 1 1024M 0 rom
vda 253:0 0 60G 0 disk
└─vda1 253:1 0 60G 0 part /
vdb 253:16 0 1024G 0 disk
└─vdb1 253:17 0 1024G 0 part /hana/data
vdc 253:32 0 512G 0 disk
└─vdc1 253:33 0 512G 0 part /hana/log
vdd 253:48 0 512G 0 disk
└─vdd1 253:49 0 512G 0 part /hana/shared
vde 253:64 0 20G 0 disk
```

The cloud disk vde uses shared block storage.。

Configure watchdog on hana01 and hana02.

```
# echo softdog > /etc/modules-load.d/watchdog.conf
# systemctl restart systemd-modules-load
# systemctl status systemd-modules-load
● systemd-modules-load.service - Load Kernel Modules
Loaded: loaded (/usr/lib/systemd/system/systemd-modules-load.service; static; vendor preset: disabled)
Active: active (exited) since Mon 2018-01-01 21:18:41 CST; 8s ago
Docs: man:systemd-modules-load.service(8)
man:modules-load.d(5)
Process: 2300 ExecStart=/usr/lib/systemd/systemd-modules-load (code=exited, status=0/SUCCESS)
Main PID: 2300 (code=exited, status=0/SUCCESS)

Jan 01 21:18:41 s4hsvra systemd[1]: Starting Load Kernel Modules...
Jan 01 21:18:41 s4hsvra systemd[1]: Started Load Kernel Modules.
```

```
# lsmod | grep dog
softdog 16384 0

# vim /etc/init.d/boot.local
modprobe softdog

# vim /etc/sysconfig/sbd
SBD_DEVICE="/dev/vde"
SBD_OPTS="-W"
```

Create the SBD partition on hana01.

```
sbd -d /dev/vde -4 30 -1 15 create

# sbd -d /dev/vde dump
==Dumping header on disk /dev/vde
Header version : 2.1
UUID : 94d700ee-837b-46c7-95cc-27f3d1ffcf9f
Number of slots : 255
Sector size : 512
Timeout (watchdog) : 15
Timeout (allocate) : 2
Timeout (loop) : 1
Timeout (msgwait) : 30
==Header on disk /dev/vde is dumped
```

Description of msgwait timeout and watchdog timeout:
-4 indicates the msgwait timeout. In the preceding example, the msgwait timeout interval is 30s.
-1 indicates the watchdog timeout. In the preceding example, the watchdog timeout interval is 15s. The minimum value for simulated package detection is 15s.
If SBD stays in the multi-path group, the timeout interval required by SBD needs to be modified, because the MPIO detection along the path is time consuming. If msgwait times out, it is assumed that the message has been transmitted to the target node. For multi-path, the delay is the time for switching to the next path when MPIO detects a path failure. You may need to test this function in your system environment. If the SBD on the node does not reset the package detection timer in time, the node is automatically stopped. The watchdog timeout interval must be shorter than the msgwait timeout interval. The former should be a half of the later.
The following formula expresses the relationships between the three values:
Timeout (msgwait) = (Timeout (watchdog) * 2)
stonith-timeout = Timeout (msgwait) + 20%
For more information, run the man sbd command.

Configure SBD on hana01 and hana02.

```
# vim /etc/sysconfig/sbd
SBD_DEVICE="/dev/vde"
SBD_OPTS="-W"
```

The SBD program automatically starts on hana01 and hana02 when the system is started.

```
# systemctl enable sbd
```

Enable the cluster on hana01 and hana02.

```
# rcpacemaker start
```

Modify the cluster SBD parameters on hana01.

```
# crm configure
crm(live)configure# primitive stonith_sbd stonith:external/sbd params pcmk_delay_max=30
crm(live)configure# commit
crm(live)configure# exit
```

Enable STONITH.

```
# crm configure
crm(live)configure# property stonith-enabled="true"
crm(live)configure# property stonith-timeout="40s"
crm(live)configure# property no-quorum-policy="ignore"
crm(live)configure# property default-resource-stickiness="1000"
crm(live)configure# commit
crm(live)configure# exit
```

> Note: We recommend that you set stonith-timeout to 40s (calculated based on the previous formula).

View the SBD process and service on hana01 and hana02.

```
# ps -ef | grep sbd
root 5946 1 0 22:44 ? 00:00:01 sbd: inquisitor
root 5947 5946 0 22:44 ? 00:00:00 sbd: watcher: /dev/vde - slot: 0 - uuid: 94d700ee-837b-46c7-95cc-27f3d1ffcf9f
root 5948 5946 0 22:44 ? 00:00:01 sbd: watcher: Pacemaker
root 5949 5946 0 22:44 ? 00:00:00 sbd: watcher: Cluster
root 6915 2540 0 23:25 pts/0 00:00:00 grep --color=auto sbd

# systemctl status sbd
● sbd.service - Shared-storage based fencing daemon
Loaded: loaded (/usr/lib/systemd/system/sbd.service; enabled; vendor preset: disabled)
Active: active (running) since Tue 2017-12-26 22:44:51 CST; 41min ago
Process: 5934 ExecStart=/usr/sbin/sbd $SBD_OPTS -p /var/run/sbd.pid watch (code=exited, status=0/SUCCESS)
Main PID: 5946 (sbd)
Tasks: 4 (limit: 512)
CGroup: /system.slice/sbd.service
├─5946 sbd: inquisitor
├─5947 sbd: watcher: /dev/vde - slot: 0 - uuid: 94d700ee-837b-46c7-95cc-27f3d1ffcf9f
├─5948 sbd: watcher: Pacemaker
```

```
└─5949 sbd: watcher: Cluster

Dec 26 22:44:50 node001 systemd[1]: Starting Shared-storage based fencing daemon...
Dec 26 22:44:51 node001 systemd[1]: Started Shared-storage based fencing daemon.
```

Verify the SBD configuration.

> Note: Ensure that important processes on hana02 have been closed.

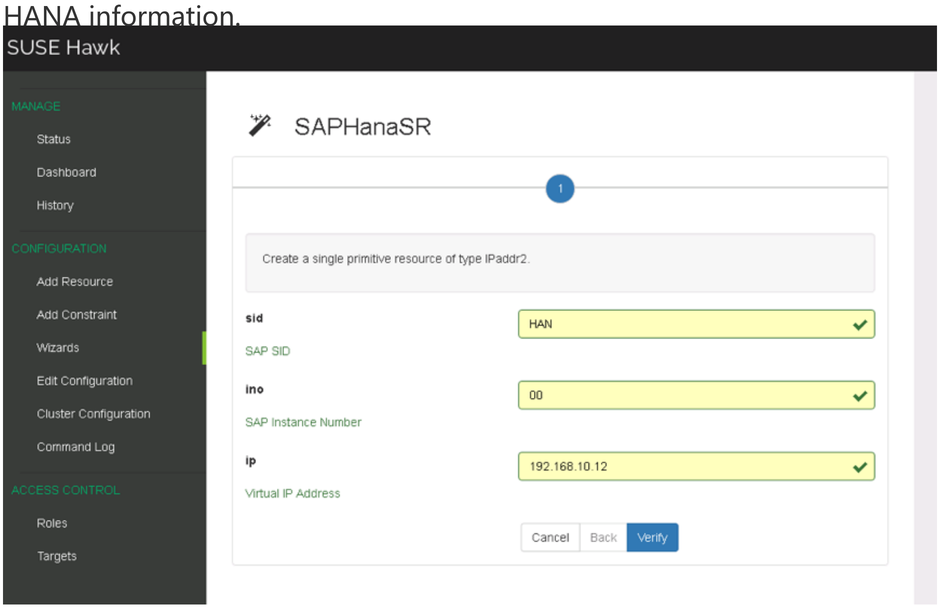
```
Hana01# sbd -d /dev/vde message hana02 reset
```

If hana2 is restarted properly, the SBD disk is successfully configured.

Integrate SAP HANA with SUSE HA

Add SAP HANA resources

Open the SUSE Hawk management interface, click Wizards, and select the HSR options to maintain HANA information.



SAPHanaSR

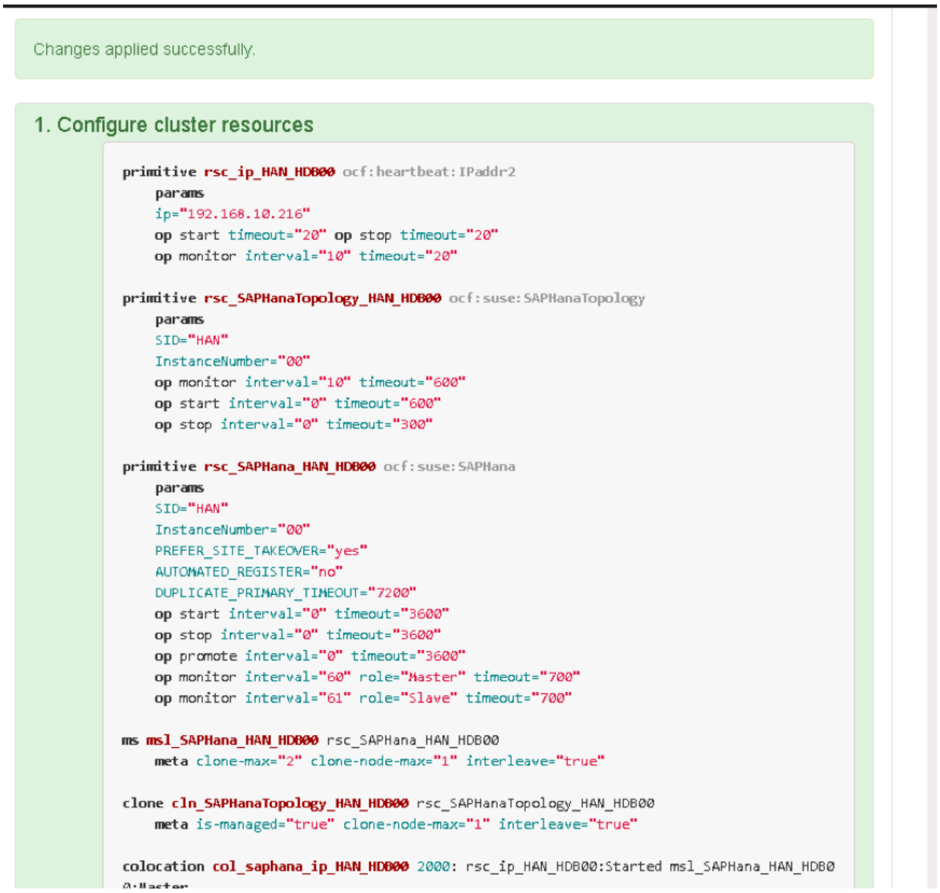
Create a single primitive resource of type IPaddr2.

sid
SAP SID
HAN

ino
SAP Instance Number
00

ip
Virtual IP Address
192.168.10.12

The script after successful configuration is as follows:



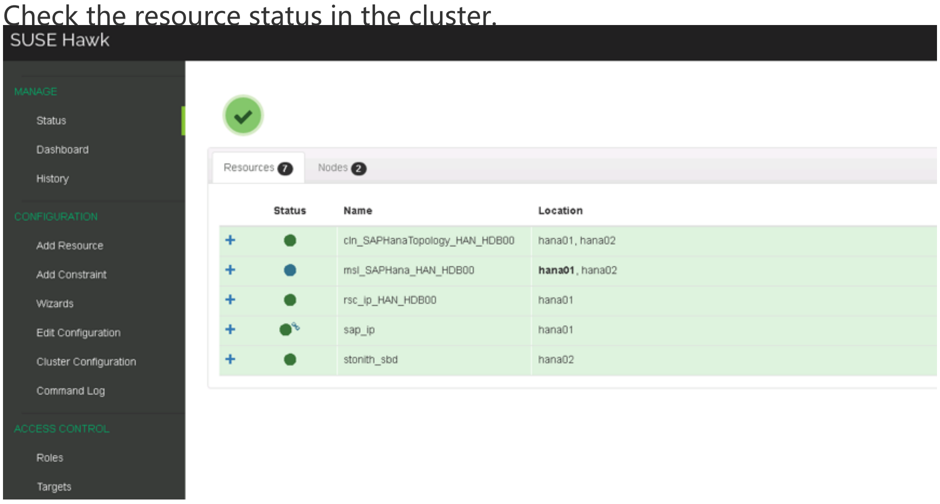
Changes applied successfully.

1. Configure cluster resources

```
primitive rsc_ip_HAN_HDB00 ocf:heartbeat:IPaddr2
    params
    ip="192.168.10.216"
    op start timeout="20" op stop timeout="20"
    op monitor interval="10" timeout="20"

primitive rsc_SAPHanaTopology_HAN_HDB00 ocf:suse:SAPHanaTopology
    params
    SID="HAN"
    InstanceNumber="00"
    op monitor interval="10" timeout="600"
    op start interval="0" timeout="600"
    op stop interval="0" timeout="300"

primitive rsc_SAPHana_HAN_HDB00 ocf:suse:SAPHana
    params
    SID="HAN"
    InstanceNumber="00"
    PREFER_SITE_TAKEOVER="yes"
    AUTOMATED_REGISTER="no"
    DUPLICATE_PRIMARY_TIMEOUT="7200"
    op start interval="0" timeout="3600"
    op stop interval="0" timeout="3600"
    op promote interval="0" timeout="3600"
    op monitor interval="60" role="Master" timeout="700"
    op monitor interval="61" role="Slave" timeout="700"

ms msl_SAPHana_HAN_HDB00 rsc_SAPHana_HAN_HDB00
    meta clone-max="2" clone-node-max="1" interleave="true"

clone cln_SAPHanaTopology_HAN_HDB00 rsc_SAPHanaTopology_HAN_HDB00
    meta is-managed="true" clone-node-max="1" interleave="true"

colocation col_saphana_ip_HAN_HDB00 2000: rsc_ip_HAN_HDB00:Started msl_SAPHana_HAN_HDB0
0:Master
```

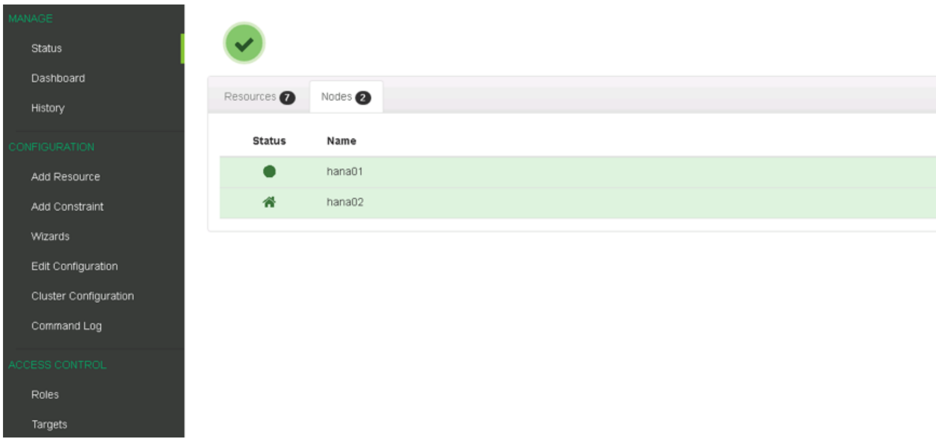
Verify the cluster status

Check the resource status in the cluster.



	Status	Name	Location
+	●	cln_SAPHanaTopology_HAN_HDB00	hana01, hana02
+	●	msl_SAPHana_HAN_HDB00	**hana01**, hana02
+	●	rsc_ip_HAN_HDB00	hana01
+	●	sap_ip	hana01
+	●	stonith_sbd	hana02

Check the node status in the cluster.



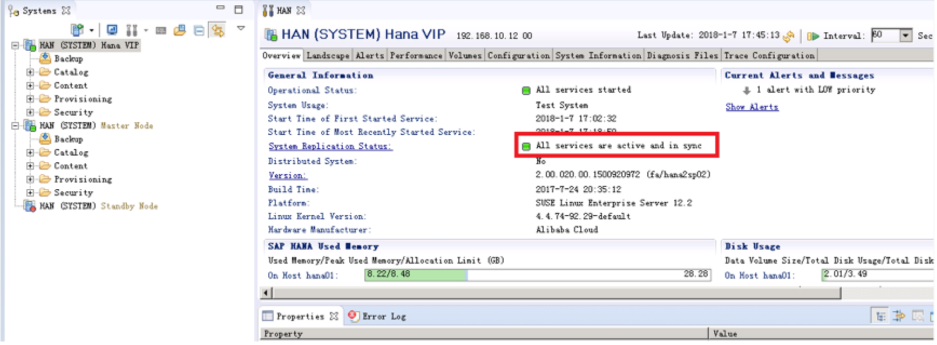
Status	Name
●	hana01
●	hana02

Test the SAP HANA HA failover

Test the HANA primary node failure

Ensure that HA works normally before the test.

Check the HANA node status.



HAN (SYSTEM) Hana VIP 192.168.10.12 00 Last Update: 2018-1-7 17:45:13 Interval: 60 Sec

General Information

Operational Status:	All services started
System Usage:	Test System
Start Time of First Started Service:	2018-1-7 17:02:32
Start Time of Most Recently Started Service:	2018-1-7 17:18:50
System Replication Status:	All services are active and in sync
Distributed System:	No
Version:	2.00.020.00.1500920972 (fa/hana2sp02)
Build Time:	2017-7-24 20:35:12
Platform:	SUSE Linux Enterprise Server 12.2
Linux Kernel Version:	4.4.74-92.29-default
Hardware Manufacturer:	Alibaba Cloud

Current Alerts and Messages

1 alert with LOW priority

Show Alerts

SAP HANA Used Memory

Used Memory/Peak Used Memory/Allocation Limit (GB)

On Host hana01: 8.22/8.48 28.28

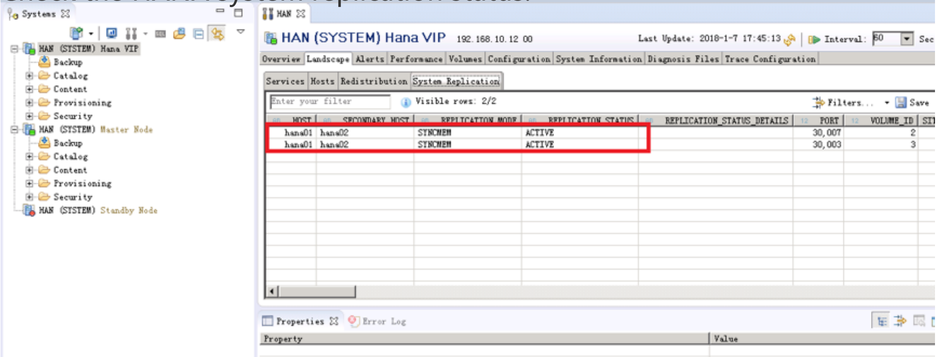
Disk Usage

Data Volume Size/Total Disk Usage/Total Disk

On Host hana01: 2.01/3.49

Property	Value

Check the HANA system replication status.



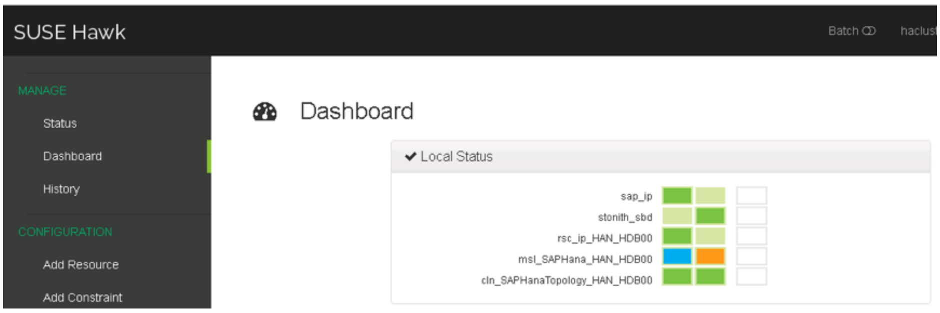
HAN (SYSTEM) Hana VIP 192.168.10.12 00 Last Update: 2018-1-7 17:45:13 Interval: 60 Sec

Enter your filter Visible rows: 2/2

HOST	SECONDARY_HOST	REPLICATION_MODE	REPLICATION_STATUS	REPLICATION_STATUS_DETAILS	PORT	VOLUME_ID	SIT
hana01	hana02	SYNCMEM	ACTIVE		30,007	2	
hana01	hana02	SYNCMEM	ACTIVE		30,003	3	

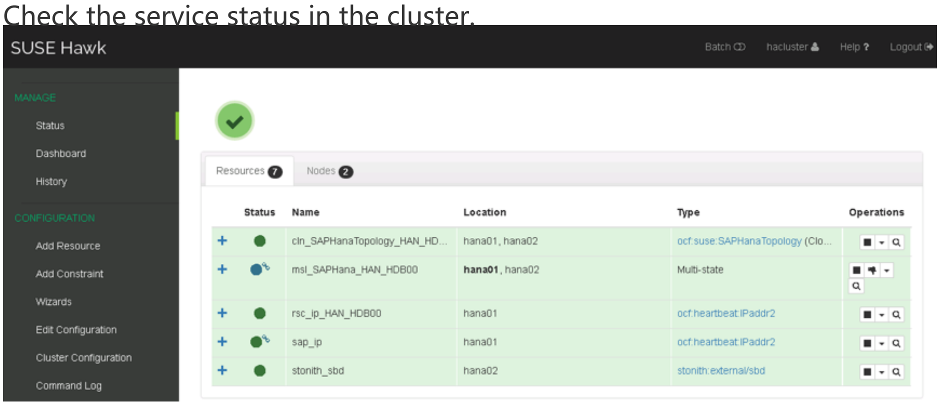
Property	Value

Check the cluster node column information.



sap_ip	🟩	🟩	□
stonith_sbd	🟩	🟩	□
rsc_ip_HAN_HDB00	🟩	🟩	□
msl_SAPHana_HAN_HDB00	🟦	🟧	□
cln_SAPHanaTopology_HAN_HDB00	🟩	🟩	□

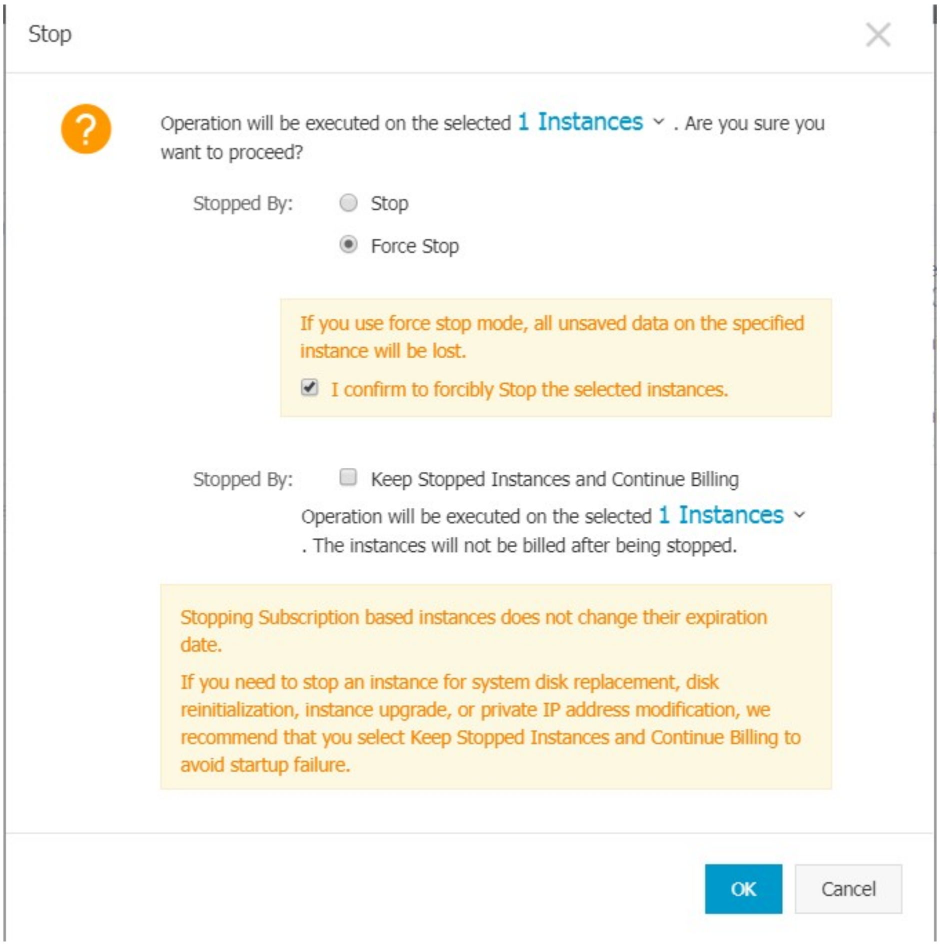
Check the service status in the cluster.



	Status	Name	Location	Type	Operations
+	●	cln_SAPHanaTopology_HAN_HD...	hana01, hana02	ocf:suse:SAPHanaTopology (Clo...	■ ▾ 🔍
+	●	msl_SAPHana_HAN_HDB00	**hana01**, hana02	Multi-state	■ ▾ 🔍
+	●	rsc_ip_HAN_HDB00	hana01	ocf:heartbeat:IPaddr2	■ ▾ 🔍
+	●	sap_ip	hana01	ocf:heartbeat:IPaddr2	■ ▾ 🔍
+	●	stonith_sbd	hana02	stonith:external/sbd	■ ▾ 🔍

Test the primary node failover.

Forcibly close hana01 on the ECS console.。



Stop

Operation will be executed on the selected 1 Instances . Are you sure you want to proceed?

Stopped By: ○ Stop ● Force Stop

If you use force stop mode, all unsaved data on the specified instance will be lost.

☑ I confirm to forcibly Stop the selected instances.

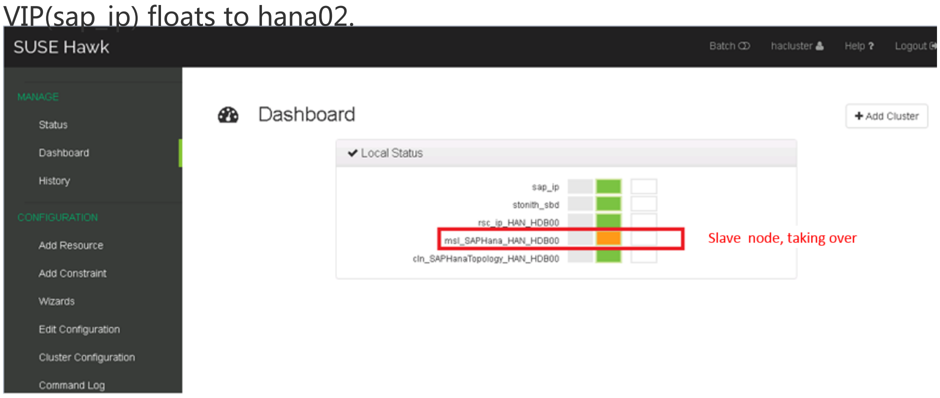
Stopped By: □ Keep Stopped Instances and Continue Billing

Operation will be executed on the selected 1 Instances . The instances will not be billed after being stopped.

Stopping Subscription based instances does not change their expiration date.

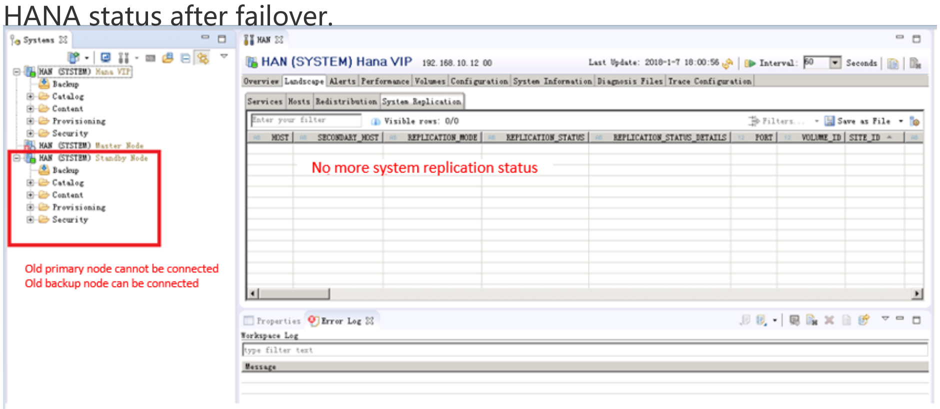
If you need to stop an instance for system disk replacement, disk reinitialization, instance upgrade, or private IP address modification, we recommend that you select Keep Stopped Instances and Continue Billing to avoid startup failure.

VIP(sap_ip) floats to hana02.



Slave node, taking over

HANA status after failover.



HAN (SYSTEM) Hana VIP 192.168.10.12 00 Last Update: 2018-1-7 18:00:56 Interval: 60 Seconds

Visible rows: 0/0

HOST	SECONDARY_HOST	REPLICATION_MODE	REPLICATION_STATUS	REPLICATION_STATUS_DETAILS	PORT	VOLUME_ID	SITE_ID

No more system replication status

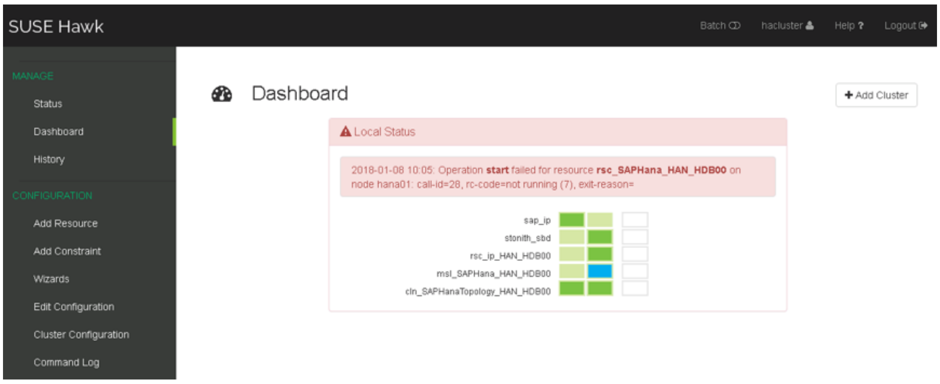
Old primary node cannot be connected
Old backup node can be connected

Recover the HANA primary node

Test the recovery of the HANA primary node.

Enable the ECS of hana01 and start the cluster software pacemaker.

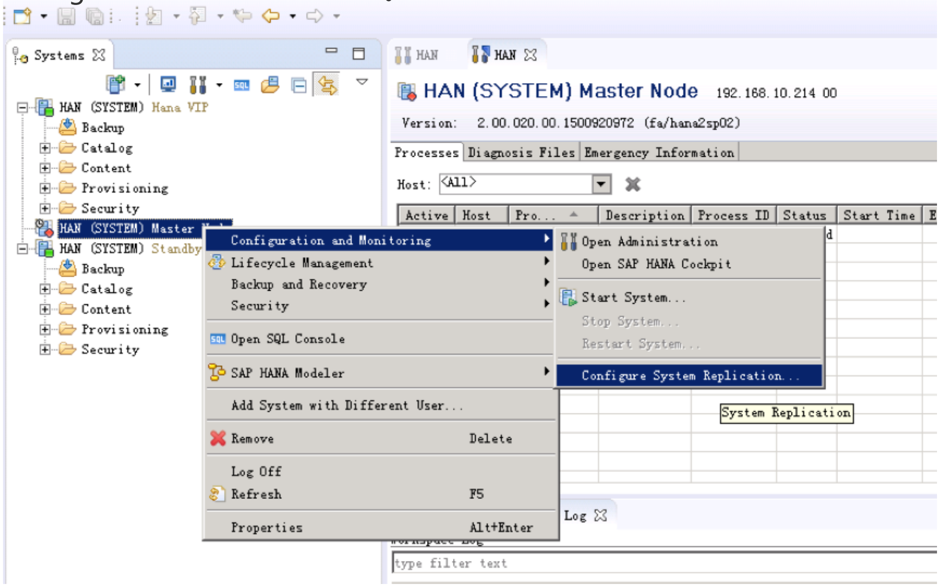
```
hana01:~ # rcpacemaker start
```



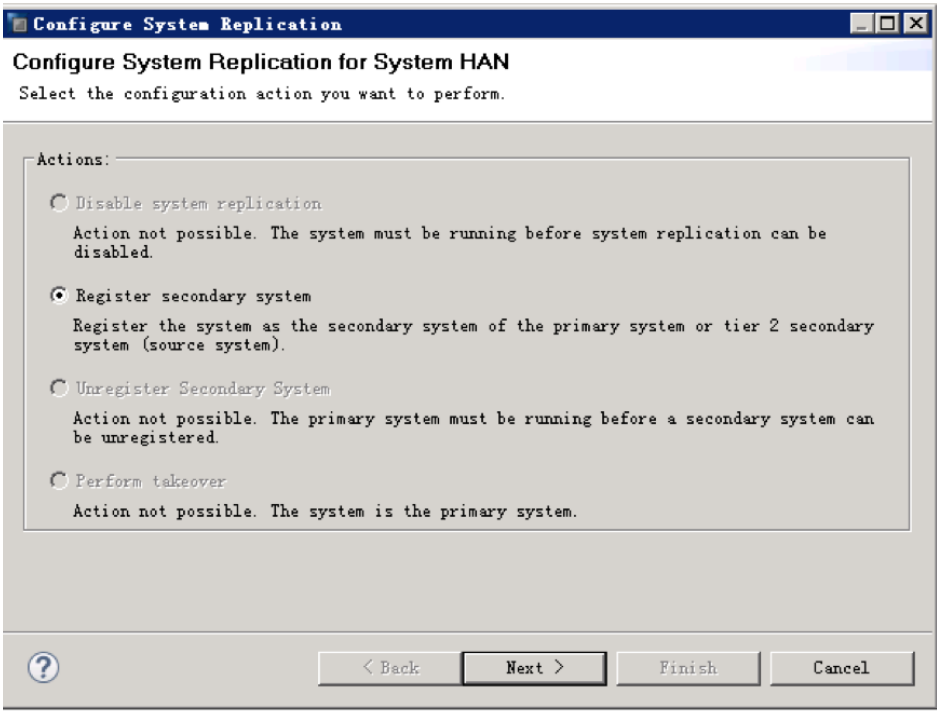
2018-01-08 10:05: Operation **start** failed for resource **rsc_SAPHana_HAN_HDB00** on node hana01: call-id=28, rc-code=not running (7), exit-reason=

sap_ip	🟩	🟩	□
stonith_sbd	🟩	🟩	□
rsc_ip_HAN_HDB00	🟩	🟩	□
msl_SAPHana_HAN_HDB00	🟩	🟦	□
cln_SAPHanaTopology_HAN_HDB00	🟩	🟩	□

Configure HSR on the console.。



Register hana01 as the backup node.。



Configure System Replication

Configure System Replication for System HAN

Select the configuration action you want to perform.

Actions:

○ Disable system replication

Action not possible. The system must be running before system replication can be disabled.

● Register secondary system

Register the system as the secondary system of the primary system or tier 2 secondary system (source system).

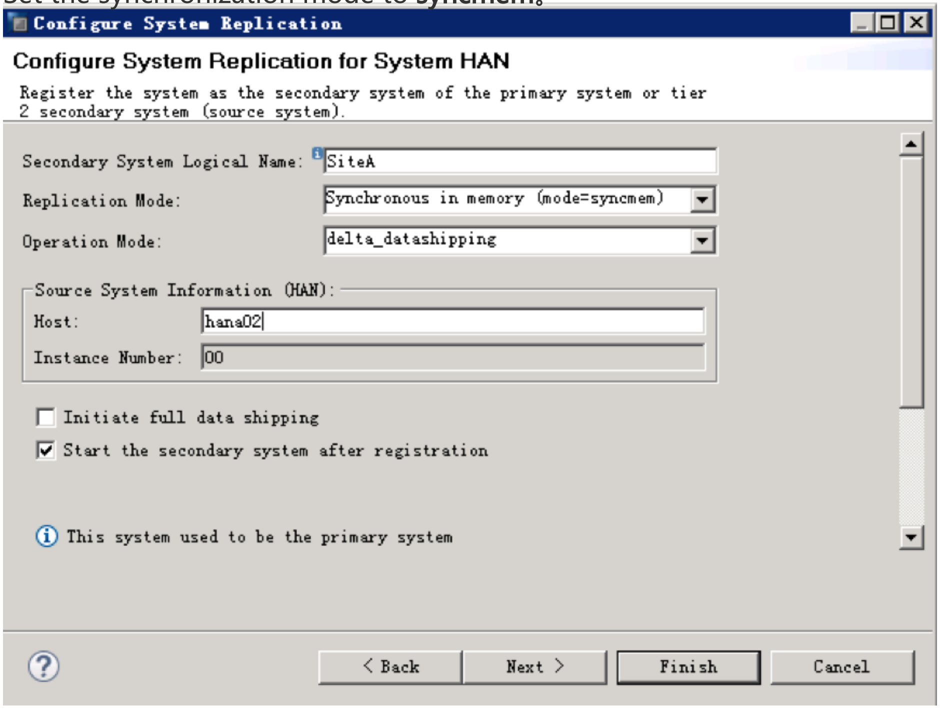
○ Unregister Secondary System

Action not possible. The primary system must be running before a secondary system can be unregistered.

○ Perform takeover

Action not possible. The system is the primary system.

Set the synchronization mode to **syncmem**。



Configure System Replication

Configure System Replication for System HAN

Register the system as the secondary system of the primary system or tier 2 secondary system (source system).

Secondary System Logical Name: SiteA

Replication Mode: Synchronous in memory (mode=syncmem)

Operation Mode: delta_datashipping

Source System Information (HAN):

Host: hana02

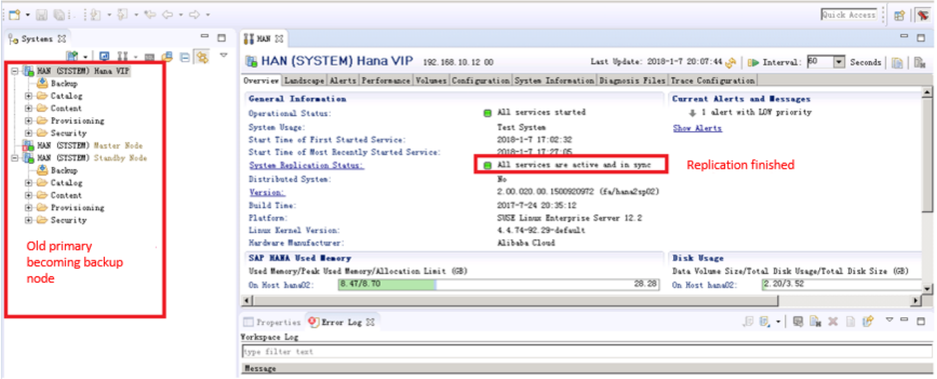
Instance Number: 00

□ Initiate full data shipping

☑ Start the secondary system after registration

This system used to be the primary system

Check the HANA node status.



Systems

- HAN (SYSTEM) Hana VIP
  - Backup
  - Catalog
  - Content
  - Provisioning
  - Security
- HAN (SYSTEM) Master Node
- HAN (SYSTEM) Standby Node
  - Backup
  - Catalog
  - Content
  - Provisioning
  - Security

Old primary becoming backup node

HAN (SYSTEM) Hana VIP 192.168.10.12 00 Last Update: 2018-1-7 20:07:44 Interval: 60 Seconds

General Information

Operational Status:	All services started
System Usage:	Test System
Start Time of First Started Service:	2018-1-7 17:02:32
Start Time of Most Recently Started Service:	2018-1-7 17:27:05
System Replication Status:	All services are active and in sync
Distributed System:	No
Version:	2.00.020.00.1500920972 (fa/hana2sp02)
Build Time:	2017-7-24 20:35:12
Platform:	SUSE Linux Enterprise Server 12.2
Linux Kernel Version:	4.4.74-92.29-default
Hardware Manufacturer:	Alibaba Cloud

Replication finished

Current Alerts and Messages

1 alert with LOW priority

Show Alerts

SAP HANA Used Memory

Used Memory/Peak Used Memory/Allocation Limit (GB)

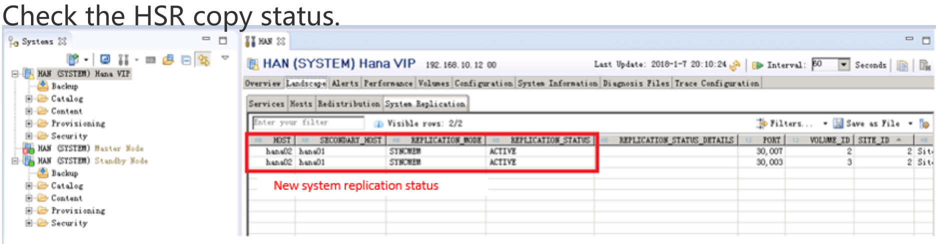
On Host hana02: 8.47/8.70 28.28

Disk Usage

Data Volume Size/Total Disk Usage/Total Disk Size (GB)

On Host hana02: 2.20/3.52

Check the HSR copy status.



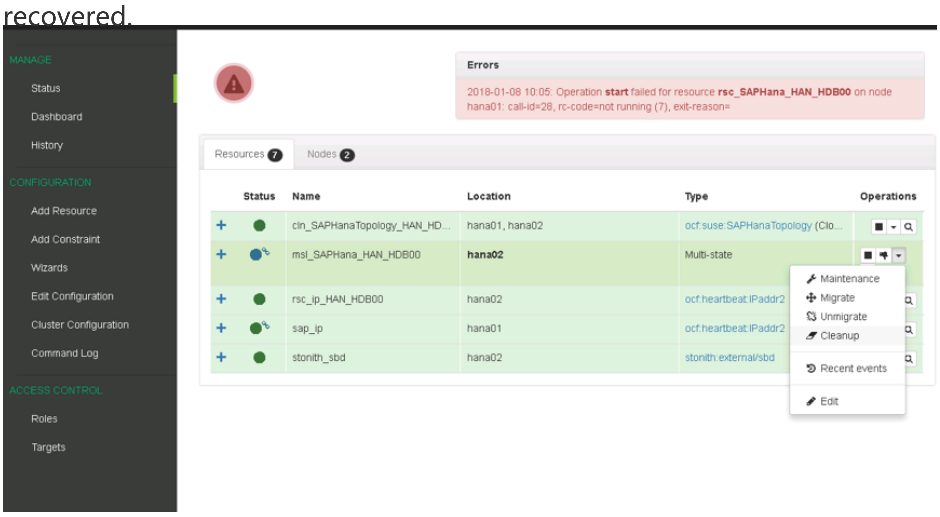
HAN (SYSTEM) Hana VIP 192.168.10.12 00 Last Update: 2018-1-7 20:10:24 Interval: 60 Seconds

Visible rows: 2/2

HOST	SECONDARY_HOST	REPLICATION_MODE	REPLICATION_STATUS	REPLICATION_STATUS_DETAILS	PORT	VOLUME_ID	SITE_ID
hana02	hana01	SYNCMEM	ACTIVE		30,007	2	2
hana02	hana01	SYNCMEM	ACTIVE		30,003	3	2

New system replication status

Check the HAE cluster status and clean up the nodes reporting errors. After cleanup, the cluster is recovered.

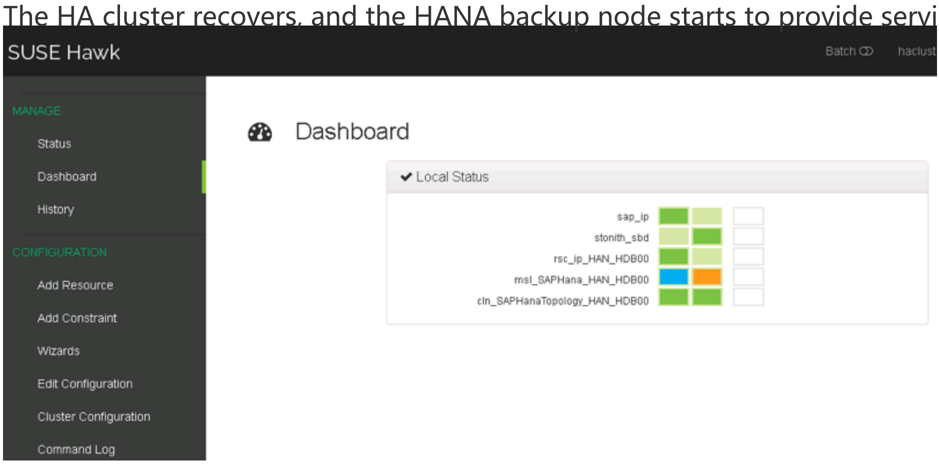


Errors

2018-01-08 10:05: Operation **start** failed for resource **rsc_SAPHana_HAN_HDB00** on node hana01: call-id=28, rc-code=not running (7), exit-reason=

Status	Name	Location	Type	Operations
●	cln_SAPHanaTopology_HAN_HD...	hana01, hana02	ocf:suse:SAPHanaTopology (Clo...	
●	msl_SAPHana_HAN_HDB00	hana02	Multi-state	
●	rsc_ip_HAN_HDB00	hana02	ocf:heartbeat:IPaddr2	
●	sap_ip	hana01	ocf:heartbeat:IPaddr2	
●	stonith_sbd	hana02	stonith:external/sbd	

The HA cluster recovers, and the HANA backup node starts to provide services.



SAP HANA HA Cross-Zone with SLES HAE

SAP HANA High Availability Cross-Zone solution on SUSE Linux Enterprise Server for SAP Applications

Version Control:

Version	Revision Date	Types Of Changes	Effective Date
1.0			2018/3/7
1.1	2018/7/04	Add corosync and cluster configuration example	2018/7/04
1.2	2018/12/05	Add Network	2018/12/05

		Diagram	

Solution Overview

SAP HANA System Replication

SAP HANA provides a feature called System Replication which is available in every SAP HANA installation offering an inherent disaster recovery support.

For details, please refer to SAP Help Portal HANA system replication.

High Availability Extension Included with SUSE Linux Enterprise Server for SAP Applications

The SUSE High Availability Extension is a high availability solution based on Corosync and Pacemaker. With SUSE Linux Enterprise Server for SAP Applications, SUSE provides SAP specific Resource Agents (SAPHana, SAPHanaTopology etc.) used by Pacemaker. This helps you to build your SAP HANA HA solution up more effectively.

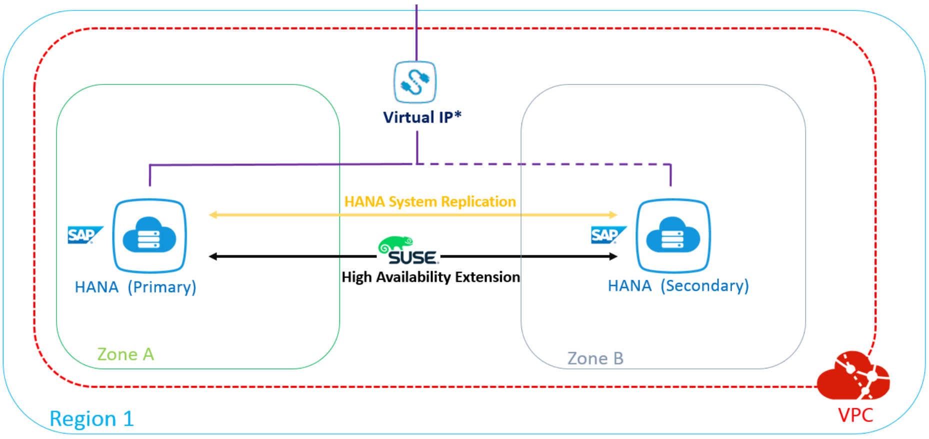
For details, please refer to latest version of SAP HANA SR Performance Optimized Scenario at SUSE documentation center.

Architecture Overview

This document guides you on how to deploy a SAP HANA HA solution cross different Zones. Following is a brief architecture:

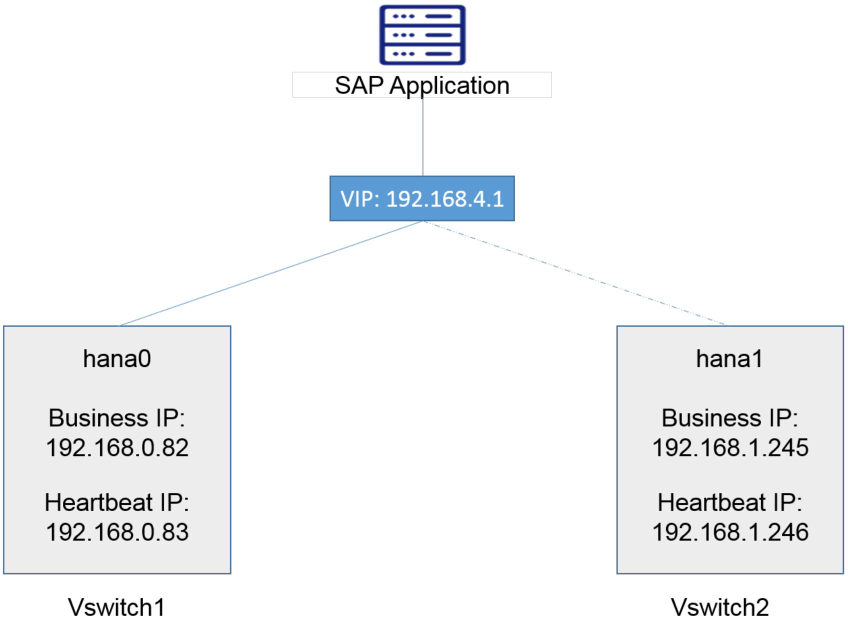
- The High Availability Extension included with SUSE Linux Enterprise Server for SAP Applications is used to set up the HA Cluster;
- SAP HANA System Replication is activated between the two HANA nodes;
- Two HANA nodes locates in different Zones of the same Region;
- Alibaba Cloud Specific Virtual IP Resource Agent is used to allow Moving IP automatically switched to Active SAP HANA node; Alibaba Cloud specific STONITH device is used for fencing;

Alibaba Cloud Architecture - Overview:



* **Virtual IP** – Alibaba Cloud provides a specific Resource Agent to switch Service IP across different ECS instances locates in different zones;

Network Architeture - Overview:



Network Design

hostname	role	heartbeat IP	business IP	virtual IP
hana0	Hana primary node	192.168.0.83	192.168.0.82	192.168.4.1
hana1	Hana secondary node	192.168.1.246	192.168.1.245	192.168.4.1
HanaStudio	Hana Studio	no	192.168.0.79	no

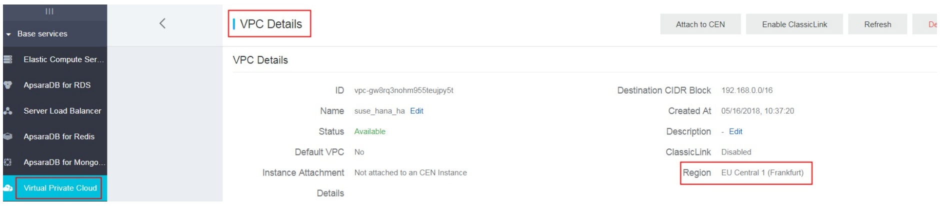
Infrastructure Preparation

Infrastructure List

- 1 VPC network;
- 2 ECS instances in different zones of the same VPC;
- 2 Elastic Network Interface (ENI), one for each ECS instance;
- Alibaba Cloud specific Virtual IP Resource Agent and STONITH device;
- NAT Gateway and SNAT entry;

Creating VPC

First, create a VPC via **Console→Virtual Private Cloud→VPCs→Create VPC**. In this example, a VPC named suse_hana_ha in the Region EU Central 1 (Frankfurt) has been created:



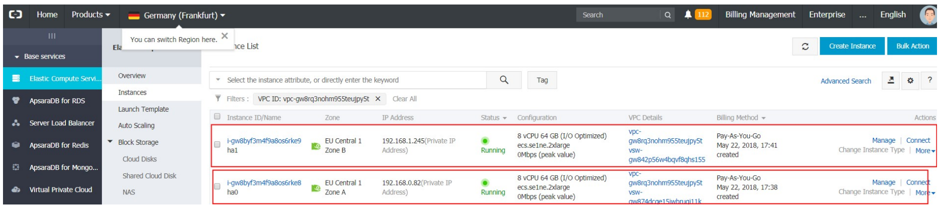
VPC Details

VPC Details

ID vpc-gw8rq3nohm955teujpy5t
Name suse_hana_ha Edit
Status Available
Default VPC No
Instance Attachment Not attached to an CEN Instance
Details
Destination CIDR Block 192.168.0.0/16
Created At 05/16/2018, 10:37:20
Description - Edit
ClassicLink Disabled
Region EU Central 1 (Frankfurt)

There should be at least 2 VSwitches(subnets) defined within the VPC network, each VSwitch bound to a different Zone. In this example, we have following 2 VSwitches(subnets):

- Switch1 192.168.0.0/24 Zone A, for SAP HANA Primary Node
- Switch2 192.168.1.0/24 Zone B, for SAP HANA Secondary Node



nce List

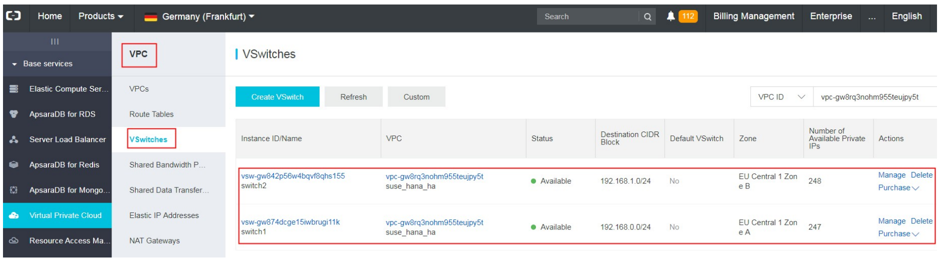
Filters : VPC ID: vpc-gw8rq3nohm955teujpy5t ✕ Clear All

Instance ID/Name	Zone	IP Address	Status	Configuration	VPC Details	Billing Method	Actions
i-gw8byf3m4f9a8os6rke9 ha1	EU Central 1 Zone B	192.168.1.245(Private IP Address)	Running	8 vCPU 64 GB (I/O Optimized) ecs.se1ne.2xlarge 0Mbps (peak value)	vpc-gw8rq3nohm955teujpy5t vsw-gw842p56w4bqvf8qhs155	Pay-As-You-Go May 22, 2018, 17:41 created	Manage | Connect Change Instance Type | More
i-gw8byf3m4f9a8os6rke8 ha0	EU Central 1 Zone A	192.168.0.82(Private IP Address)	Running	8 vCPU 64 GB (I/O Optimized) ecs.se1ne.2xlarge 0Mbps (peak value)	vpc-gw8rq3nohm955teujpy5t vsw-gw874dcqe15iwbrugi11k	Pay-As-You-Go May 22, 2018, 17:38 created	Manage | Connect Change Instance Type | More

Creating ECS Instances

Two ECS instances are created in different Zones of the same VPC via **Console→Elastic Compute Service ECS→Instances→Create Instance**. Choose the "SUSE Linux Enterprise Server for SAP Applications" image from the Image Market place.

In this example, 2 ECS instances (hostname: hana0 and hana1) are created in eu-central-1 Region, Zone A and Zone B, within VPC: suse_hana_ha, with SUSE Linux Enterprise Server for SAP Applications 12 SP2 image from the Image Market Place. Host hana0 is the primary SAP HANA database node, and hana1 is the secondary SAP HANA database node.



VSwitches

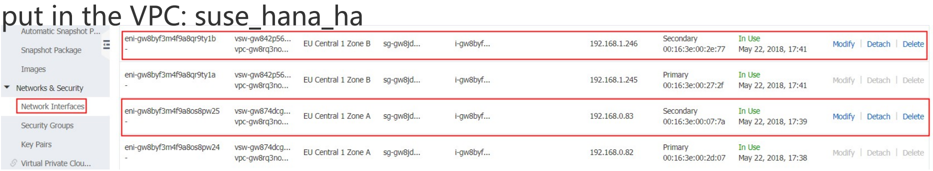
VPC ID: vpc-gw8rq3nohm955teujpy5t

Instance ID/Name	VPC	Status	Destination CIDR Block	Default VSwitch	Zone	Number of Available Private IPs	Actions
vsw-gw842p56w4bqvf8qhs155 switch2	vpc-gw8rq3nohm955teujpy5t suse_hana_ha	● Available	192.168.1.0/24	No	EU Central 1 Zone B	248	Manage Delete Purchase
vsw-gw874dcge15iwbrugi11k switch1	vpc-gw8rq3nohm955teujpy5t suse_hana_ha	● Available	192.168.0.0/24	No	EU Central 1 Zone A	247	Manage Delete Purchase

Creating ENIs and binding to ECS instances

Create two ENIs via **Console→ Elastic Compute Service ECS→Network and Security→ENI**, and attach one for each ECS instance, for HANA System Replication purposes. Configure the IP addresses of the ENIs to the subnet for HANA System Replication only.

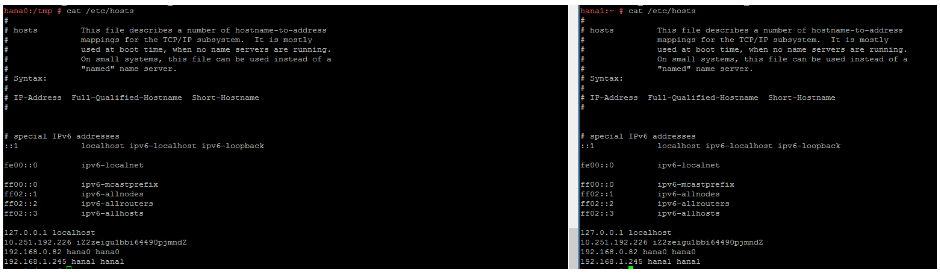
In this example, the ENIs are attached to ECS instances hana0 and hana1, and IP addresses are configured as 192.168.0.83 and 192.168.1.246 within the same VSwitches of hana0 and hana1, and put in the VPC: suse_hana_ha



eni-gw8byf3m4f9a8qr9ty1b -	vsw-gw842p56... vpc-gw8rq3no...	EU Central 1 Zone B	sg-gw8jd...	i-gw8byf...	192.168.1.246	Secondary 00:16:3e:00:2e:77	In Use May 22, 2018, 17:41	Modify | Detach | Delete
eni-gw8byf3m4f9a8qr9ty1a -	vsw-gw842p56... vpc-gw8rq3no...	EU Central 1 Zone B	sg-gw8jd...	i-gw8byf...	192.168.1.245	Primary 00:16:3e:00:27:2f	In Use May 22, 2018, 17:41	Modify | Detach | Delete
eni-gw8byf3m4f9a8os8pw25 -	vsw-gw874dcg... vpc-gw8rq3no...	EU Central 1 Zone A	sg-gw8jd...	i-gw8byf...	192.168.0.83	Secondary 00:16:3e:00:07:7a	In Use May 22, 2018, 17:39	Modify | Detach | Delete
eni-gw8byf3m4f9a8os8pw24 -	vsw-gw874dcg... vpc-gw8rq3no...	EU Central 1 Zone A	sg-gw8jd...	i-gw8byf...	192.168.0.82	Primary 00:16:3e:00:2d:07	In Use May 22, 2018, 17:38	Modify | Detach | Delete

Meanwhile, within the Guest OS, /etc/hosts should also be configured as well.In this example, please run following two commands on boths sites:

```
echo "192.168.0.82 hana0 hana0" >> /etc/hosts
echo "192.168.1.245 hana1 hana1" >> /etc/hosts
```

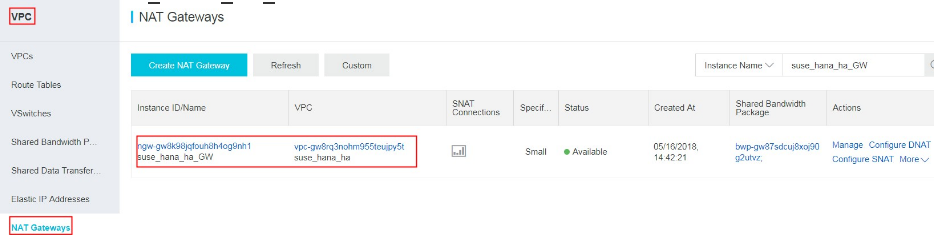


```
hana0:/tmp # cat /etc/hosts
#
# hosts         This file describes a number of hostname-to-address
#               mappings for the TCP/IP subsystem.  It is mostly
#               used at boot time, when no name servers are running.
#               On small systems, this file can be used instead of a
#               "named" name server.
# Syntax:
#
# IP-Address  Full-Qualified-Hostname  Short-Hostname
#


# special IPv6 addresses
::1             localhost ipv6-localhost ipv6-loopback

fe00::0         ipv6-localnet

ff00::0         ipv6-mcastprefix
ff02::1         ipv6-allnodes
ff02::2         ipv6-allrouters
ff02::3         ipv6-allhosts

127.0.0.1 localhost
10.251.192.226 iZ2zeigu1bbi64490pjmndZ
192.168.0.82 hana0 hana0
192.168.1.245 hana1 hana1
```

```
hana1:~ # cat /etc/hosts
#
# hosts         This file describes a number of hostname-to-address
#               mappings for the TCP/IP subsystem.  It is mostly
#               used at boot time, when no name servers are running.
#               On small systems, this file can be used instead of a
#               "named" name server.
# Syntax:
#
# IP-Address  Full-Qualified-Hostname  Short-Hostname
#


# special IPv6 addresses
::1             localhost ipv6-localhost ipv6-loopback

fe00::0         ipv6-localnet

ff00::0         ipv6-mcastprefix
ff02::1         ipv6-allnodes
ff02::2         ipv6-allrouters
ff02::3         ipv6-allhosts

127.0.0.1 localhost
10.251.192.226 iZ2zeigu1bbi64490pjmndZ
192.168.0.82 hana0 hana0
192.168.1.245 hana1 hana1
```

Creating NAT Gateway and configure SNAT entry

Now create an NAT Gateway attached to the given VPC. In the example at hand, an NAT Gateway named suse_hana_ha_GW has been created:



NAT Gateways

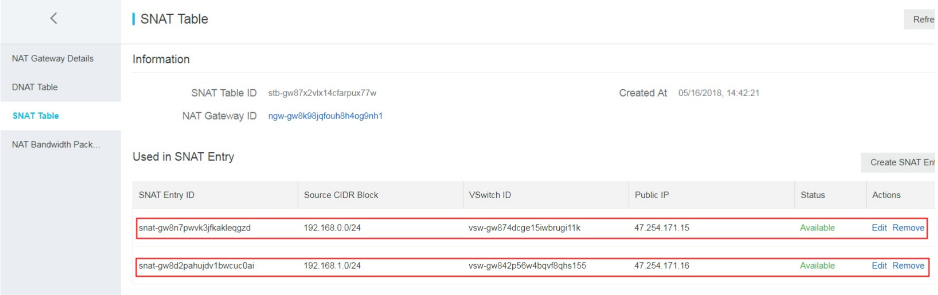
Instance Name: suse_hana_ha_GW

Instance ID/Name	VPC	SNAT Connections	Specif...	Status	Created At	Shared Bandwidth Package	Actions
ngw-gw8k98jqfouh8h4og9nh1 suse_hana_ha_GW	vpc-gw8rq3nohm955teujpy5t suse_hana_ha		Small	● Available	05/16/2018, 14:42:21	bwp-gw87sdcuj8xoj90g2utvz;	Manage Configure DNAT Configure SNAT More

After having creating the NAT Gateway, you need to create a corresponding SNAT entry to allow ECS instances within the VPC to access public addresses on the Internet.

(**Caution**: Alibaba Cloud specific STONITH device and Virtual IP Resource Agent are mandatory for cluster and they need to access Alibaba Cloud OpenAPI through a public domain);

In our example, we create to two SNAT entries, for ECS instances locates in different network range as follows:



SNAT Table

Information

SNAT Table ID stb-gw87x2vlx14cfarpux77w

Created At 05/16/2018, 14:42:21

NAT Gateway ID ngw-gw8k98jqfouh8h4og9nh1

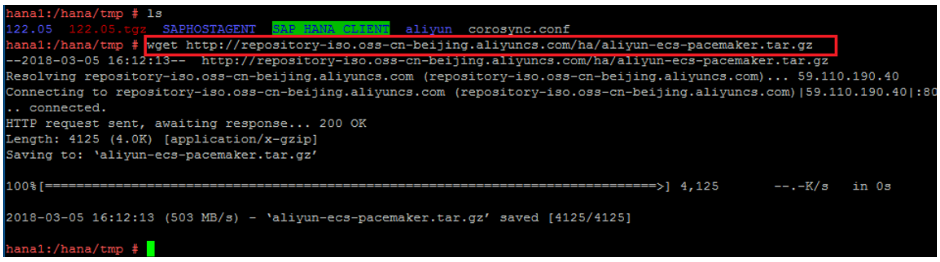
Used in SNAT Entry

SNAT Entry ID	Source CIDR Block	VSwitch ID	Public IP	Status	Actions
snat-gw8n7pwvk3jfkakleqgzd	192.168.0.0/24	vsw-gw874dcge15iwbrugi11k	47.254.171.15	Available	Edit Remove
snat-gw8d2pahujdv1bwcuc0ai	192.168.1.0/24	vsw-gw842p56w4bqvf8qhs155	47.254.171.16	Available	Edit Remove

Creating STONITH device and Virtual IP Resource Agent

1. Download software from with following command: wget http://repository-iso.oss-cn-beijing.aliyuncs.com/ha/aliyun-ecs-pacemaker.tar.gz

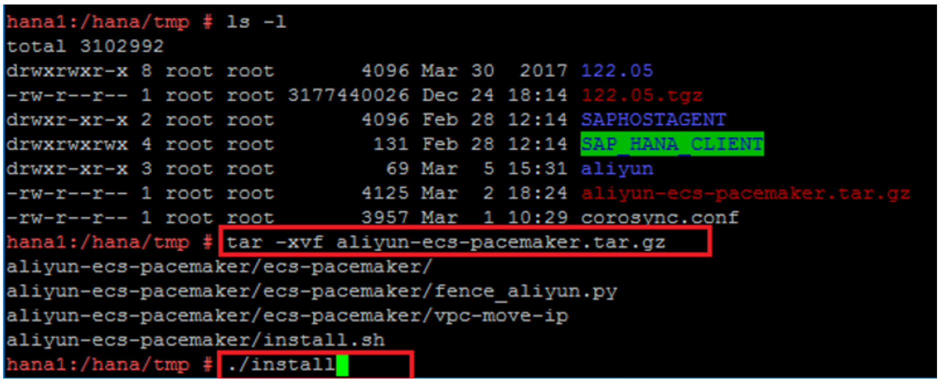
For an HA solution, a fencing device is an essential requirement. Alibaba Cloud provides its own STONITH device, which allows the servers in the HA cluster to shut down the node that is not responsive. The STONITH device leverages Alibaba Cloud OpenAPI underneath the ECS instance, which is similar to a physical reset / shutdown in an on-premise environment.



```
hana1:/hana/tmp # ls
122.05  122.05.tgz  SAPHOSTAGENT  SAP HANA CLIENT  aliyun  corosync.conf
hana1:/hana/tmp # wget http://repository-iso.oss-cn-beijing.aliyuncs.com/ha/aliyun-ecs-pacemaker.tar.gz
--2018-03-05 16:12:13--  http://repository-iso.oss-cn-beijing.aliyuncs.com/ha/aliyun-ecs-pacemaker.tar.gz
Resolving repository-iso.oss-cn-beijing.aliyuncs.com (repository-iso.oss-cn-beijing.aliyuncs.com)... 59.110.190.40
Connecting to repository-iso.oss-cn-beijing.aliyuncs.com (repository-iso.oss-cn-beijing.aliyuncs.com)|59.110.190.40|:80
.. connected.
HTTP request sent, awaiting response... 200 OK
Length: 4125 (4.0K) [application/x-gzip]
Saving to: 'aliyun-ecs-pacemaker.tar.gz'

100%[=================================================================================>] 4,125       --.-K/s   in 0s

2018-03-05 16:12:13 (503 MB/s) - 'aliyun-ecs-pacemaker.tar.gz' saved [4125/4125]

hana1:/hana/tmp #
```

Extract the package and install the software

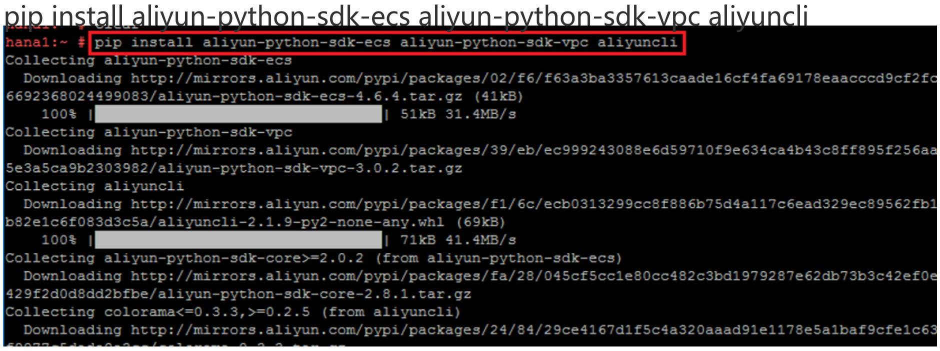
```
tar –xvf aliyun-ecs-pacemaker.tar.gz
./install
```



```
hana1:/hana/tmp # ls -l
total 3102992
drwxrwxr-x 8 root root       4096 Mar 30  2017 122.05
-rw-r--r-- 1 root root 3177440026 Dec 24 18:14 122.05.tgz
drwxr-xr-x 2 root root       4096 Feb 28 12:14 SAPHOSTAGENT
drwxrwxrwx 4 root root        131 Feb 28 12:14 SAP_HANA_CLIENT
drwxr-xr-x 3 root root         69 Mar  5 15:31 aliyun
-rw-r--r-- 1 root root       4125 Mar  2 18:24 aliyun-ecs-pacemaker.tar.gz
-rw-r--r-- 1 root root       3957 Mar  1 10:29 corosync.conf
hana1:/hana/tmp # tar -xvf aliyun-ecs-pacemaker.tar.gz
aliyun-ecs-pacemaker/ecs-pacemaker/
aliyun-ecs-pacemaker/ecs-pacemaker/fence_aliyun.py
aliyun-ecs-pacemaker/ecs-pacemaker/vpc-move-ip
aliyun-ecs-pacemaker/install.sh
hana1:/hana/tmp # ./install
```

Install Alibaba Cloud OpenAPI SDK

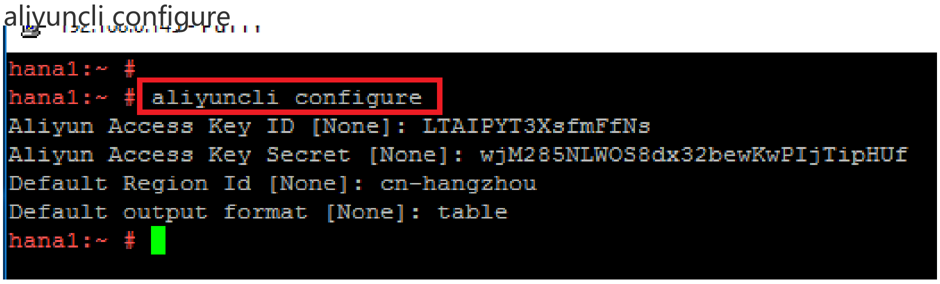
pip install aliyun-python-sdk-ecs aliyun-python-sdk-vpc aliyuncli



```
hana1:~ # pip install aliyun-python-sdk-ecs aliyun-python-sdk-vpc aliyuncli
Collecting aliyun-python-sdk-ecs
  Downloading http://mirrors.aliyun.com/pypi/packages/02/f6/f63a3ba3357613caade16cf4fa69178eaacccd9cf2fc
6692368024499083/aliyun-python-sdk-ecs-4.6.4.tar.gz (41kB)
    100% |████████████████████████████████| 51kB 31.4MB/s
Collecting aliyun-python-sdk-vpc
  Downloading http://mirrors.aliyun.com/pypi/packages/39/eb/ec999243088e6d59710f9e634ca4b43c8ff895f256aa
5e3a5ca9b2303982/aliyun-python-sdk-vpc-3.0.2.tar.gz
Collecting aliyuncli
  Downloading http://mirrors.aliyun.com/pypi/packages/f1/6c/ecb0313299cc8f886b75d4a117c6ead329ec89562fb1
b82e1c6f083d3c5a/aliyuncli-2.1.9-py2-none-any.whl (69kB)
    100% |████████████████████████████████| 71kB 41.4MB/s
Collecting aliyun-python-sdk-core>=2.0.2 (from aliyun-python-sdk-ecs)
  Downloading http://mirrors.aliyun.com/pypi/packages/fa/28/045cf5cc1e80cc482c3bd1979287e62db73b3c42ef0e
429f2d0d8dd2bfbe/aliyun-python-sdk-core-2.8.1.tar.gz
Collecting colorama<=0.3.3,>=0.2.5 (from aliyuncli)
  Downloading http://mirrors.aliyun.com/pypi/packages/24/84/29ce4167d1f5c4a320aaad91e1178e5a1baf9cfe1c63
```

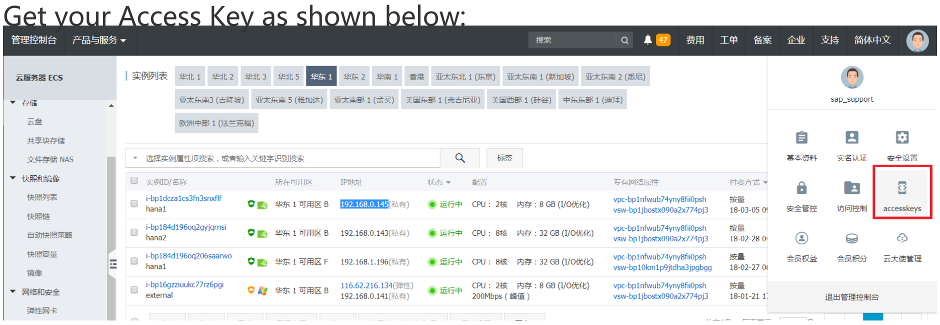
Configure Alibaba Cloud OpenAPI SDK and Client

aliyuncli configure



```
hana1:~ #
hana1:~ # aliyuncli configure
Aliyun Access Key ID [None]: LTAIPYT3XsfmFfNs
Aliyun Access Key Secret [None]: wjM285NLWOS8dx32bewKwPIjTipHUf
Default Region Id [None]: cn-hangzhou
Default output format [None]: table
hana1:~ #
```

Get your Access Key as shown below:



实例ID/名称	所在可用区	IP地址	状态	配置	专有网络属性	付费方式
i-bp1dcza1cs3fn3snxflf hana1	华东 1 可用区 B	192.168.0.145(私有)	运行中	CPU： 2核 内存：8 GB (I/O优化)	vpc-bp1nfwub74yny8fii0psh vsw-bp1jbostx090a2x774pj3	按量 18-03-05 0
i-bp184d196oq2gyjqrnsi hana2	华东 1 可用区 B	192.168.0.143(私有)	运行中	CPU： 8核 内存：32 GB (I/O优化)	vpc-bp1nfwub74yny8fii0psh vsw-bp1jbostx090a2x774pj3	按量 18-02-28 0
i-bp184d196oq206saarwo hana1	华东 1 可用区 F	192.168.1.196(私有)	运行中	CPU： 8核 内存：32 GB (I/O优化)	vpc-bp1nfwub74yny8fii0psh vsw-bp10km1p9jtdha3jpgbgg	按量 18-02-27 0

i-bp16gzziuukc77rz6pgi
external
	华东 1 可用区 B	116.62.216.134(弹性)
		192.168.0.141(私有)
			运行中	CPU： 2核 内存：8 GB (I/O优化)
				200Mbps (峰值)
					vpc-bp1nfwub74yny8fii0psh
					vsw-bp1jbostx090a2x774pj3
						按量
						18-01-21 1

Software Preparation

The next sections contain information about the required software.

Software List

The following software must be available:

- SUSE Linux Enterprise Server for SAP Applications 12 SP2
- HANA Installation Media
- SAP Host Agent Installation Media

High Availability Extension Installation

Both ECS instances are created with the SUSE Linux Enterprise Server for SAP Applications image. On both ECS instances, the High Availability Extension (with the major software components: Corosync and Pacemaker), and the package SAPHanaSR should be installed. To do so, you can use zypper.

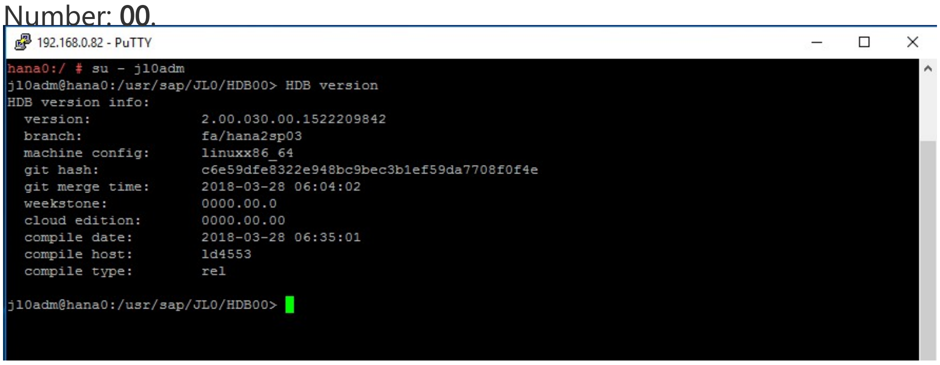
First, install the pattern High Availability Extension on both nodes:
zypper in -t pattern ha_sles

Now, install the Resource Agents for controlling the SAP HANA system replication on both cluster nodes:
zypper in SAPHanaSR SAPHanaSR-doc

SAP HANA Installation

Next, install the SAP HANA software on both ECS instances. Make sure the SAP HANA SID and Instance Number are the same (this is required by SAP HANA System Replication). It is recommended to use hdblcm to do the installation. For details refer to SAP HANA Server Installation and Update Guide.

In this example, both node are installed with SAP HANA (Rev. 2.00.030.00), and SID: **JL0**, Instance Number: **00**.

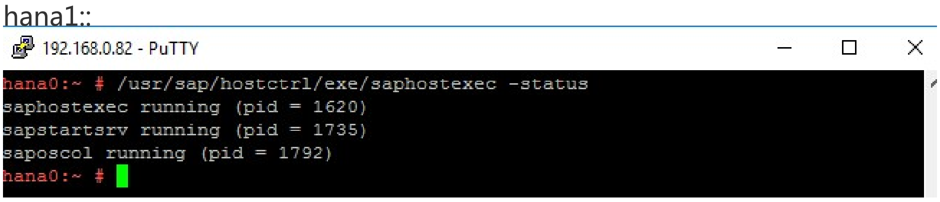


```
hana0:/ # su - jl0adm
jl0adm@hana0:/usr/sap/JL0/HDB00> HDB version
HDB version info:
  version:             2.00.030.00.1522209842
  branch:              fa/hana2sp03
  machine config:      linuxx86_64
  git hash:            c6e59dfe8322e948bc9bec3b1ef59da7708f0f4e
  git merge time:      2018-03-28 06:04:02
  weekstone:           0000.00.0
  cloud edition:       0000.00.00
  compile date:        2018-03-28 06:35:01
  compile host:        ld4553
  compile type:        rel

jl0adm@hana0:/usr/sap/JL0/HDB00>
```

SAP Host Agent Installation

When you have finished hana installation with hdblcm as mentioned above, the SAP Host Agent should already be installed on your server. In case you want to install it manually, please kindly refer to Installing SAP Host Agent Manually.
Check the SAP Host Agent status after you have installed SAP HANA with hdblcm on hana0 and

hana1::



```
hana0:~ # /usr/sap/hostctrl/exe/saphostexec -status
saphostexec running (pid = 1620)
sapstartsrv running (pid = 1735)
saposcol running (pid = 1792)
hana0:~ #
```

Configuring SAP HANA System Replication

The following sections detail how to configure SAP HANA System Replication.

Backup HANA on primary ECS instance

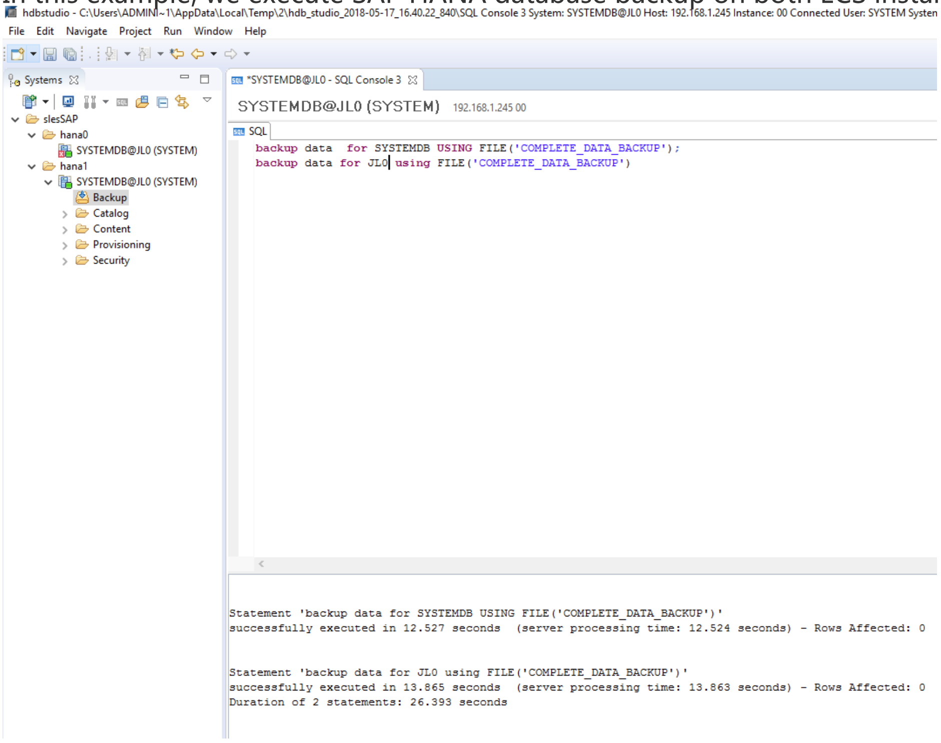
To do backup on HANA, you can either use SAP HANA studio or hdbsql as the client command tool. The backup command is:

- For HANA 1 single container mode:
  BACKUP DATA USING FILE('COMPLETE_DATA_BACKUP');
- For HANA 2 with multitenant as default mode (You should backup systemDB and also all tenantDB as shown below in our example):
  BACKUP DATA for <DATABASE> using FILE('COMPLETE_DATA_BACKUP')

Command line example:

BACKUP DATA for SYSTEMDB USING FILE('COMPLETE_DATA_BACKUP');
BACKUP DATA for JL0 using FILE('COMPLETE_DATA_BACKUP')

In this example, we execute SAP HANA database backup on both ECS instances as follows:



hdbstudio - C:\Users\ADMINI~1\AppData\Local\Temp\2\hdb_studio_2018-05-17_16.40.22_840\SQL Console 3 System: SYSTEMDB@JL0 Host: 192.168.1.245 Instance: 00 Connected User: SYSTEM Systen
File Edit Navigate Project Run Window Help
Systems
slesSAP
hana0
SYSTEMDB@JL0 (SYSTEM)
hana1
SYSTEMDB@JL0 (SYSTEM)
Backup
Catalog
Content
Provisioning
Security
*SYSTEMDB@JL0 - SQL Console 3
SYSTEMDB@JL0 (SYSTEM) 192.168.1.245 00
SQL

```
backup data  for SYSTEMDB USING FILE('COMPLETE_DATA_BACKUP');
backup data for JL0 using FILE('COMPLETE_DATA_BACKUP')
```

```
Statement 'backup data for SYSTEMDB USING FILE('COMPLETE_DATA_BACKUP')'
successfully executed in 12.527 seconds  (server processing time: 12.524 seconds) - Rows Affected: 0


Statement 'backup data for JL0 using FILE('COMPLETE_DATA_BACKUP')'
successfully executed in 13.865 seconds  (server processing time: 13.863 seconds) - Rows Affected: 0
Duration of 2 statements: 26.393 seconds
```

Configuring SAP HANA System Replication on primary node

a) Log onto the primary node with: su - <sid>adm;
[sidadm] should be replaced by your SAP HANA database SID. In our example it is su - jl0adm;
b) Stop HANA with: HDB stop;
c) Change following file content as user root:
/hana/shared/<SID>/global/hdb/custom/config/global.ini>/global/hdb/custom/config/global.ini`
Add following content:

```

[system_replication_hostname_resolution]
<IP> = <HOSTNAME>
```

[IP]] should be address of the ENI (heartbeat IP address for HANA system replication) attached to the Secondary node;
[HOSTNAME] should be hostname of the Secondary node;

In this example, we have following configuration:
[system_replication_hostname_resolution]
192.168.1.246 = hana1

Configuring SAP HANA System Replication on secondary node

Same as above for primary, but use IP and hostname of primary node

In this example, we have following configuration:
[system_replication_hostname_resolution]
192.168.0.83 = hana0

Enable SAP HANA System Replication on primary node

a) Log onto the primary node with: su - <sid>adm;
b) Start HANA with: HDB start;
c) Enable System Replication with:
hdbnsutil -sr_enable --name= [primary location name]
[primary location name] should be replaced by location of your primary HANA node.
In this example, we use following command:
hdbnsutil -sr_enable --name=hana0
CAUTION: all above operations are done on primary node.

Register the Secondary node to the Primary HANA node

a) Log onto the secondary node with: su - <sid>adm;
b) Stop HANA with: HDB stop;
c) Register the Secondary HANA node to the Primary HANA node by running following command:
hdbnsutil -sr_register --remoteHost=[location of primary Node] --remoteInstance=[instance number of primary node] --replicationMode=sync --name=[location of the secondary node] --

operationMode=logreplay

In this example, we use following command:

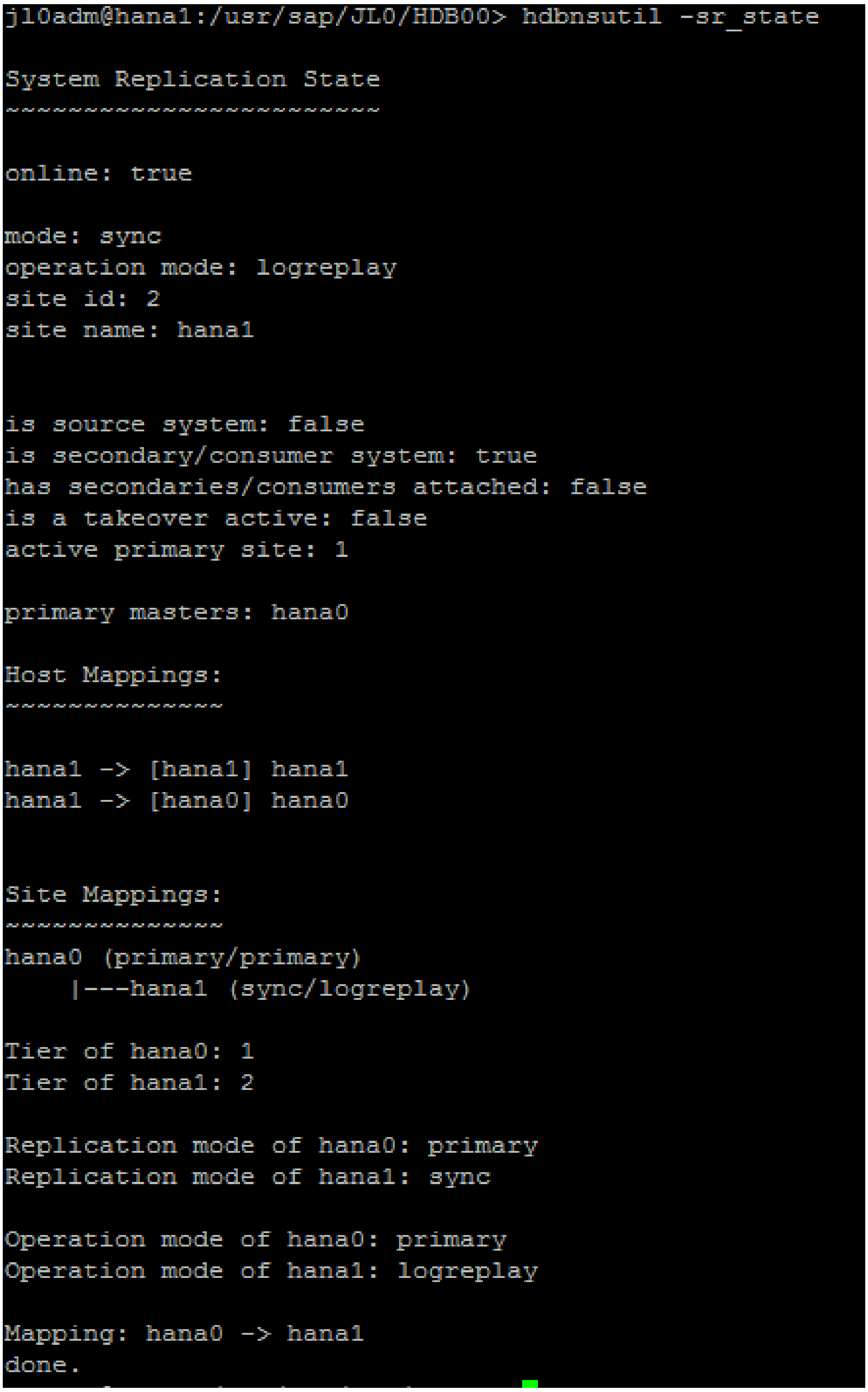
```
hdbnsutil -sr_register --name=hana1 --remoteHost=hana0 --remoteInstance=00 --
replicationMode=sync --operationMode=logreplay
```

d) Start HANA with: HDB start;

e) Verify the System Replication Status with:

```
hdbnsutil -sr_state
```

In this example, we have following status on secondary HANA node hana1:



```
jl0adm@hana1:/usr/sap/JL0/HDB00> hdbnsutil -sr_state

System Replication State
~~~~~~~~~~~~~~~~~~~~~~~~

online: true

mode: sync
operation mode: logreplay
site id: 2
site name: hana1


is source system: false
is secondary/consumer system: true
has secondaries/consumers attached: false
is a takeover active: false
active primary site: 1

primary masters: hana0

Host Mappings:
~~~~~~~~~~~~~~

hana1 -> [hana1] hana1
hana1 -> [hana0] hana0


Site Mappings:
~~~~~~~~~~~~~~
hana0 (primary/primary)
    |---hana1 (sync/logreplay)

Tier of hana0: 1
Tier of hana1: 2

Replication mode of hana0: primary
Replication mode of hana1: sync

Operation mode of hana0: primary
Operation mode of hana1: logreplay

Mapping: hana0 -> hana1
done.
```

CAUTION: all above operations are done on secondary node.

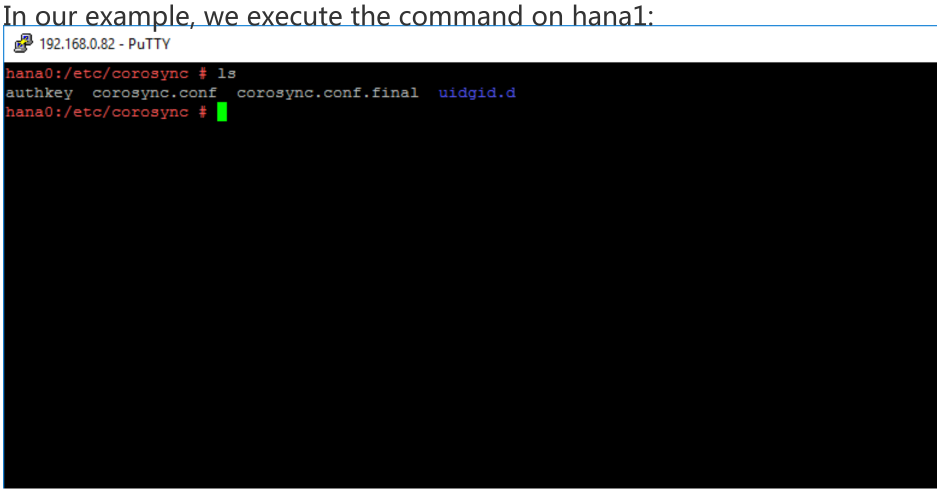
Configuring High Availability Extension for SAP HANA

Configuration of Corosync

It is recommended that you add more redundancy for messaging (Heartbeat) by using separate ENIs attached to the ECS instances with a separate network range.

On Alibaba Cloud, it is strongly suggested to only use Unicast for the transport setting in Corosync.Follow the following steps to configure Corosync:

Create Keys
Run corosync-keygen on primary HANA node. The generated key will be located in the file: /etc/corosync/authkey.
In our example, we execute the command on hana1:



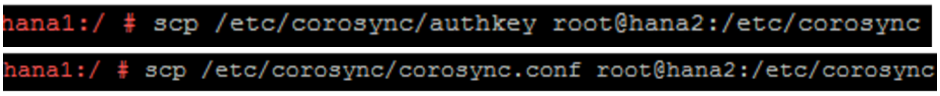
```
hana0:/etc/corosync # ls
authkey  corosync.conf  corosync.conf.final  uidgid.d
hana0:/etc/corosync #
```

Configure /etc/corosync/corosync.conf with following content as root on primary HANA node:

```
totem {
version: 2
token: 5000
token_retransmits_before_loss_const: 6
secauth: on
crypto_hash: sha1
crypto_cipher: aes256
clear_node_high_bit: yes
interface {
ringnumber: 0
bindnetaddr: **IP-address-for-heart-beating-for-the-current-server**
mcastport: 5405
ttl: 1
}
# On Alibaba Cloud, transport should be set to udpu, means: unicast
transport: udpu
}
logging {
fileline: off
to_logfile: yes
to_syslog: yes
logfile: /var/log/cluster/corosync.log
debug: off
timestamp: on
logger_subsys {
subsys: QUORUM
debug: off
}
}
nodelist {
node {
ring0_addr: **ip-node-1**
nodeid: 1
}
node {
ring0_addr: **ip-node-2**
nodeid: 2
}
}
quorum {
# Enable and configure quorum subsystem (default: off)
# see also corosync.conf.5 and votequorum.5
provider: corosync_votequorum
expected_votes: 2
two_node: 1
}
```

IP-address-for-heart-beating-for-the-current-server should be replaced by the IP address of the current server, used for messaging (heartbeat) or HANA System Replication. In our example, we use IP address of ENI of the current node (192.168.0.83 for hana0 and 192.168.1.246 for hana1); **Caution**: this value will be different on primary and secondary node.nodelist directive is used to list all nodes in the cluster.
ip-node-1 and **ip-node-2** should be replaced by the IP addresses of the ENIs attached to ECS instances for Heartbeat Purpose or HANA System Replication Purpose (in this example it should be 192.168.0.83 for hana0 and 192.168.1.246 for hana1).

After completing edit of /etc/corosync/corosync.conf on primary HANA node, copy the /etc/corosync/authkey and /etc/corosync/corosync.conf to /etc/corosync on the secondary HANA node with following command:
scp /etc/corosync/authkey root@**hostnameOfSecondaryNode**:/etc/corosync
scp /etc/corosync/corosync.conf root@**hostnameOfSecondaryNode**:/etc/corosync
In our example, we execute following command:



```
hana1:/ # scp /etc/corosync/authkey root@hana2:/etc/corosync
hana1:/ # scp /etc/corosync/corosync.conf root@hana2:/etc/corosync
```

After copy the corosync.conf to the secondary node, please kindly configure the bindnetaddr as above to the local heart beating IP address.

Configuration of pacemaker

For SAP HANA HA solution, we need to configure 7 Resource Agents and corresponding constraints

in Pacemaker.
CAUTION the following pacemaker configuration only need to be done on one node (normally primary node).

1. Cluster bootstrap and more
   Add configuration of bootstrap and default setting of resource and operations to the cluster; Save following scripts in a file: crm-bs.txt

   ```
   property $id='cib-bootstrap-options' \
   stonith-enabled="true" \
   stonith-action="off" \
   stonith-timeout="150s"
   rsc_defaults $id="rsc-options" \
   resource-stickness="1000" \
   migration-threshold="5000"
   op_defaults $id="op-options" \
   timeout="600"
   ```

   Execute command to add setting to the cluster:
   crm configure load update crm-bs.txt
2. STONITH device
   This part defines Aliyun STONITH devices in the cluster;
   Save following scripts in a file: crm-stonith.txt

   ```
   primitive res_ALIYUN_STONITH_1 stonith:fence_aliyun \
   op monitor interval=120 timeout=60 \
   params pcmk_host_list=<primary node hostname> port=<primary node instance id> \
   access_key=<access key> secret_key=<secret key> \
   region=<region> \
   meta target-role=Started
   primitive res_ALIYUN_STONITH_2 stonith:fence_aliyun \
   op monitor interval=120 timeout=60 \
   params pcmk_host_list=<secondary node hostname> port=<secondary node instance id> \
   access_key=<access key> secret_key=<secret key> \
   region=<region> \
   meta target-role=Started
   location loc_<primary node hostname>_stonith_not_on_<primary node hostname>
   res_ALIYUN_STONITH_1 -inf: <primary node hostname>
   #Stonith 1 should not run on primary node because it is controling primary node
   location loc_<secondary node hostname>_stonith_not_on_<secondary node hostname>
   res_ALIYUN_STONITH_2 -inf: <secondary node hostname>
   #Stonith 2 should not run on secondary node because it is controling secondary node
   ```

   [secondary node hostname] / **[primary node hostname]** should be replaced by the real hostname of your secondary node;
   [secondary node instance id] / **[secondary node instance id]** should be replaced by the real instance-id of your secondary node; you can get this from the console;
   [access key] should be replaced with real access key;

[secret key] should be replaced with real secret key;
[region] should be replaced with real region name where the node locates;
Execute command to add the resource to the cluster:
crm configure load update crm-stonith.txt

3. SAPHanaTopology
   This part defines a SAPHanaTopology RA, and a clone of SAPHanaTopology on both nodes in the cluster. Save following scripts in a file: crm-saphanatop.txt

```
primitive rsc_SAPHanaTopology_<SID>_HDB<instance number> ocf:suse:SAPHanaTopology \
operations $id="rsc_SAPHanaTopology_<SID>_HDB<instance number>-operations" \
op monitor interval="10" timeout="600" \
op start interval="0" timeout="600" \
op stop interval="0" timeout="300" \
params SID="<SID>" InstanceNumber="<instance number>"
clone cln_SAPHanaTopology_<SID>_HDB<instance number>
rsc_SAPHanaTopology_<SID>_HDB<instance number> \
meta clone-node-max="1" interleave="true"
```

   [SID] should be replaced by the real SAP HANA SID;
   [instance number] should be replaced by the real SAP HANA Instance Number;
   Execute command to add resources to the cluster:
   crm configure load update crm-saphanatop.txt

4. SAPHana
   This part defines a SAPHana RA, and a Multi-state resource of SAPHana on both nodes in the cluster. Save following scripts in a file: crm-saphana.txt

```
primitive rsc_SAPHana_<SID>_HDB<instance number> ocf:suse:SAPHana \
operatoins $id="rsc_sap_<SID>_HDB<instance number>-operations" \
op start interval="0" timeout="3600" \
op stop interval="0" timeout="3600" \
op promote interval="0" timeout="3600" \
op monitor interval="60" role="Master" timeout="700" \
op monitor interval="61" role="Slave" timeout="700" \
params SID="<SID>" InstanceNumber="<instance number>" PREFER_SITE_TAKEOVER="true" \
DUPLICATE_PRIMARY_TIMEOUT="7200" AUTOMATED_REGISTER="false"
ms msl_SAPHana_<SID>_HDB<instance number> rsc_SAPHana_<SID>_HDB<instance number> \
meta clone-max="2" clone-node-max="1" interleave="true"
```

   [SID] should be replaced by the real SAP HANA SID;
   [instance number] should be replaced by the real SAP HANA Instance Number;
   Execute command to add resources to the cluster:
   crm configure load update crm-saphana.txt

5. Virtual IP
   This part defines a Virtual IP RA in the cluster. Save following scripts in a file: crm-vip.txt.

```
primitive res_vip_<SID>_HDB<instance number> ocf:aliyun:vpc-move-ip \
op monitor interval=60 \
meta target-role=Started \
params address=<virtual_IPv4_address> routing_table=<route_table_ID> interface=eth0
```

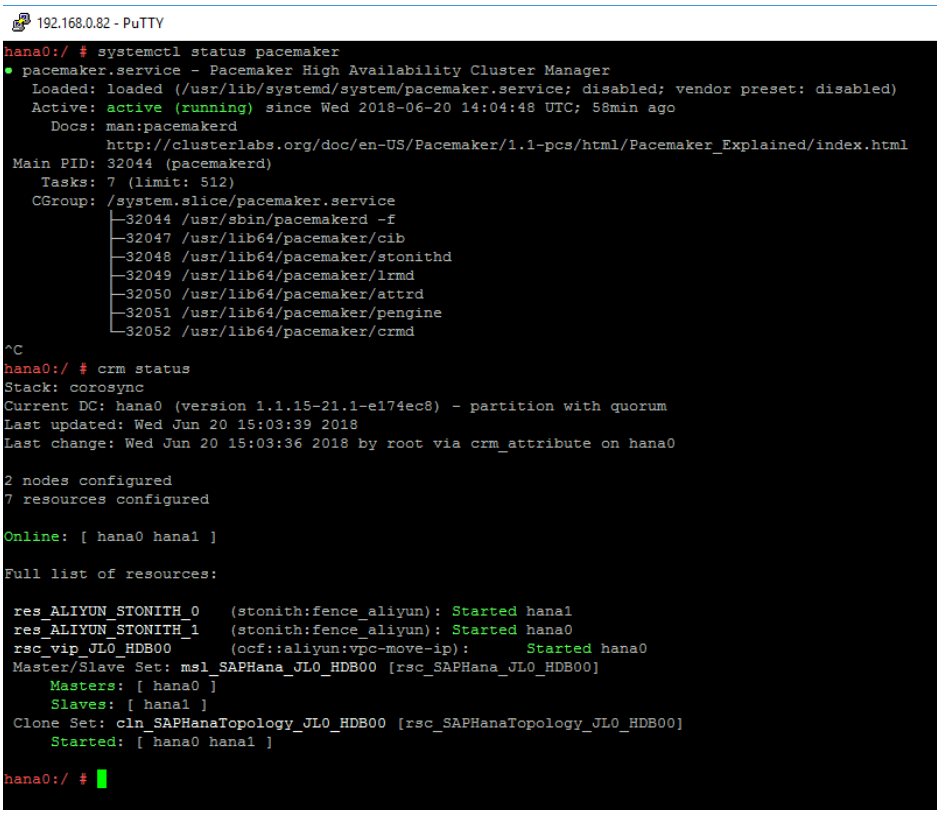
[virtual_IP4_address] should be replaced by the real IP address you prefer to provide service;
[route_table_ID] should be replaced by the route table ID of your VPC;
[SID] should be replaced by the real SAP HANA SID;
[instance number] should be replaced by the real SAP HANA Instance Number;
Execute command to add the resource to the cluster:
crm configure load update crm-vip.txt

6. Constraints
   Two constraints are organizing the correct placement of the virtual IP address for the client database access and the start order between the two resource agents SAPHana and SAPHanaTopology. Save following scripts in a file: crm-constraint.txt

```
colocation col_SAPHana_vip_<SID>_HDB<instance number> 2000: rsc_vip_<SID>_HDB<instance
number>:started \
msl_SAPHana_<SID>_HDB<instance number>:Master
order ord_SAPHana_<SID>_HDB<instance number> Optional:
cln_SAPHanaTopology_<SID>_HDB<instance number> \
msl_SAPHana_<SID>_HDB<instance number>
```

   [SID] should be replaced by the real SAP HANA SID;
   [instance number] should be replaced by the real SAP HANA Instance Number;
   Execute command to add the resource to the cluster:
   crm configure load update crm-constraint.txt

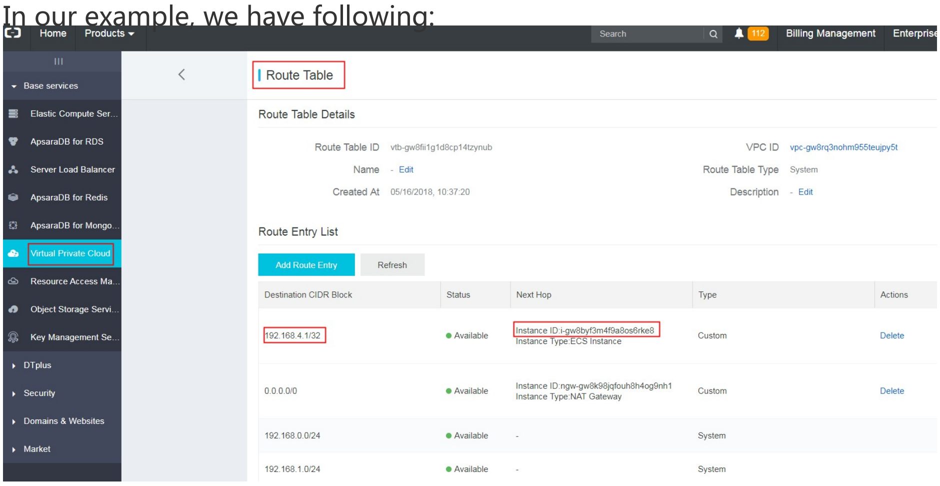
7. check cluster status
   a) Start HANA HA Cluster on both nodes
   Execute command: systemctl start pacemaker
   b) Monitor the HANA HA Cluster
   Execute command: systemctl status pacemaker
   Execute command: crm_mon –r
   In our example we have following result:



```
hana0:/ # systemctl status pacemaker
● pacemaker.service - Pacemaker High Availability Cluster Manager
   Loaded: loaded (/usr/lib/systemd/system/pacemaker.service; disabled; vendor preset: disabled)
   Active: active (running) since Wed 2018-06-20 14:04:48 UTC; 58min ago
     Docs: man:pacemakerd
           http://clusterlabs.org/doc/en-US/Pacemaker/1.1-pcs/html/Pacemaker_Explained/index.html
 Main PID: 32044 (pacemakerd)
    Tasks: 7 (limit: 512)
   CGroup: /system.slice/pacemaker.service
           ├─32044 /usr/sbin/pacemakerd -f
           ├─32047 /usr/lib64/pacemaker/cib
           ├─32048 /usr/lib64/pacemaker/stonithd
           ├─32049 /usr/lib64/pacemaker/lrmd
           ├─32050 /usr/lib64/pacemaker/attrd
           ├─32051 /usr/lib64/pacemaker/pengine
           └─32052 /usr/lib64/pacemaker/crmd
^C
hana0:/ # crm status
Stack: corosync
Current DC: hana0 (version 1.1.15-21.1-e174ec8) - partition with quorum
Last updated: Wed Jun 20 15:03:39 2018
Last change: Wed Jun 20 15:03:36 2018 by root via crm_attribute on hana0

2 nodes configured
7 resources configured

Online: [ hana0 hana1 ]

Full list of resources:

 res_ALIYUN_STONITH_0   (stonith:fence_aliyun): Started hana1
 res_ALIYUN_STONITH_1   (stonith:fence_aliyun): Started hana0
 rsc_vip_JL0_HDB00      (ocf::aliyun:vpc-move-ip):       Started hana0
 Master/Slave Set: msl_SAPHana_JL0_HDB00 [rsc_SAPHana_JL0_HDB00]
     Masters: [ hana0 ]
     Slaves: [ hana1 ]
 Clone Set: cln_SAPHanaTopology_JL0_HDB00 [rsc_SAPHanaTopology_JL0_HDB00]
     Started: [ hana0 hana1 ]

hana0:/ #
```

Meanwhile, please kindly check, if a new entry **[virtual_IP4_address]** is added into the route table of VPC.

In our example, we have following:



Route Table

Route Table Details

Route Table ID vtb-gw8fii1g1d8cp14tzynub
Name - Edit
Created At 05/16/2018, 10:37:20
VPC ID vpc-gw8rq3nohm955teujpy5t
Route Table Type System
Description - Edit

Route Entry List

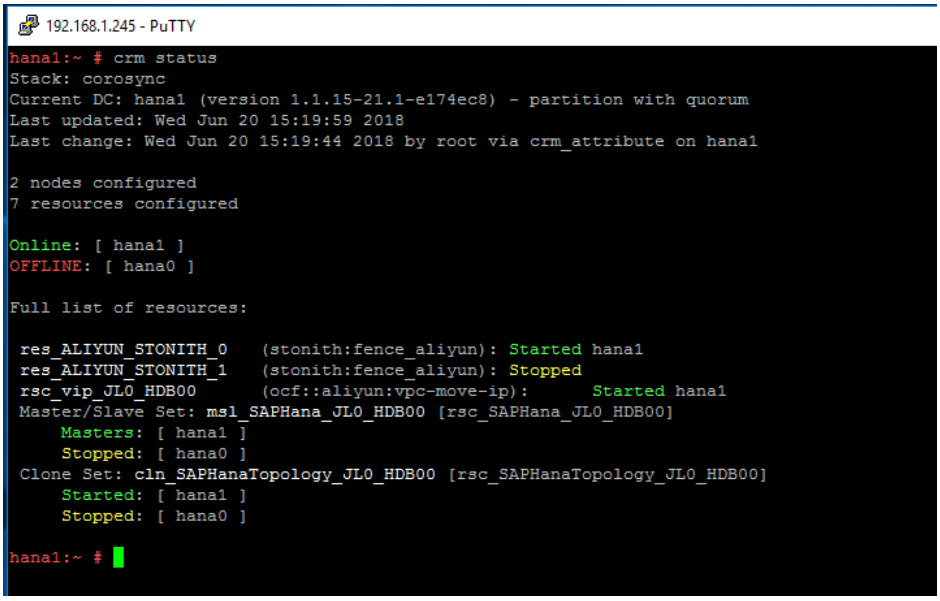
Add Route Entry Refresh

Destination CIDR Block	Status	Next Hop	Type	Actions
192.168.4.1/32	● Available	Instance ID:i-gw8byf3m4f9a8os6rke8 Instance Type:ECS Instance	Custom	Delete
0.0.0.0/0	● Available	Instance ID:ngw-gw8k98jqfouh8h4og9nh1 Instance Type:NAT Gateway	Custom	Delete
192.168.0.0/24	● Available	-	System	
192.168.1.0/24	● Available	-	System	

Verify the HA takeover

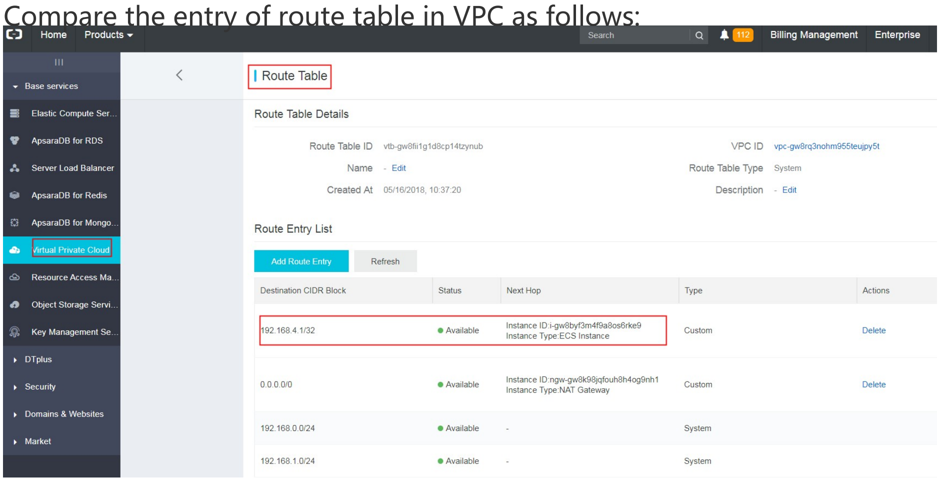
- Shutdown the primary node;

Check the status of Pacemaker as follows:



```
hana1:~ # crm status
Stack: corosync
Current DC: hana1 (version 1.1.15-21.1-e174ec8) - partition with quorum
Last updated: Wed Jun 20 15:19:59 2018
Last change: Wed Jun 20 15:19:44 2018 by root via crm_attribute on hana1

2 nodes configured
7 resources configured

Online: [ hana1 ]
OFFLINE: [ hana0 ]

Full list of resources:

 res_ALIYUN_STONITH_0   (stonith:fence_aliyun): Started hana1
 res_ALIYUN_STONITH_1   (stonith:fence_aliyun): Stopped
 rsc_vip_JL0_HDB00      (ocf::aliyun:vpc-move-ip):      Started hana1
 Master/Slave Set: msl_SAPHana_JL0_HDB00 [rsc_SAPHana_JL0_HDB00]
     Masters: [ hana1 ]
     Stopped: [ hana0 ]
 Clone Set: cln_SAPHanaTopology_JL0_HDB00 [rsc_SAPHanaTopology_JL0_HDB00]
     Started: [ hana1 ]
     Stopped: [ hana0 ]

hana1:~ #
```

Compare the entry of route table in VPC as follows:



Route Table

Route Table Details

Route Table ID vtb-gw8fii1g1d8cp14tzynub
VPC ID vpc-gw8rq3nohm955teujpy5t
Name - Edit
Route Table Type System
Created At 05/16/2018, 10:37:20
Description - Edit

Route Entry List

Add Route Entry | Refresh

Destination CIDR Block	Status	Next Hop	Type	Actions
192.168.4.1/32	● Available	Instance ID:i-gw8byf3m4f9a8os6rke9 Instance Type:ECS Instance	Custom	Delete
0.0.0.0/0	● Available	Instance ID:ngw-gw8k98jqfouh8h4og9nh1 Instance Type:NAT Gateway	Custom	Delete
192.168.0.0/24	● Available	-	System	
192.168.1.0/24	● Available	-	System	

Example

Example Cluster Configuration

In our example, the cluster configuration (you can check it via command “crm configure show”) should have content as below:

```
node 1: hana0 \
attributes hana_jl0_vhost=hana0 hana_jl0_srmode=sync hana_jl0_remoteHost=hana1 hana_jl0_site=hana0
lpa_jl0_lpt=10 hana_jl0_op_mode=logreplay
node 2: hana1 \
attributes lpa_jl0_lpt=1529509236 hana_jl0_op_mode=logreplay hana_jl0_vhost=hana1 hana_jl0_site=hana1
hana_jl0_srmode=sync hana_jl0_remoteHost=hana0
primitive res_ALIYUN_STONITH_0 stonith:fence_aliyun \
op monitor interval=120 timeout=60 \
params pcmk_host_list=hana0 port=i-gw8byf3m4f9a8os6rke8 access_key=<access key> secret_key=<secret key>
region=eu-central-1 \
meta target-role=Started
primitive res_ALIYUN_STONITH_1 stonith:fence_aliyun \
op monitor interval=120 timeout=60 \
params pcmk_host_list=hana1 port=i-gw8byf3m4f9a8os6rke9 access_key=<access key> secret_key=<secret key>
region=eu-central-1 \
meta target-role=Started
primitive rsc_SAPHanaTopology_JL0_HDB00 ocf:suse:SAPHanaTopology \
operations $id=rsc_SAPHanaTopology_JL0_HDB00-operations \
op monitor interval=10 timeout=600 \
op start interval=0 timeout=600 \
op stop interval=0 timeout=300 \
params SID=JL0 InstanceNumber=00
primitive rsc_SAPHana_JL0_HDB00 ocf:suse:SAPHana \
operations $id=rsc_SAPHana_JL0_HDB00-operations \
op start interval=0 timeout=3600 \
op stop interval=0 timeout=3600 \
op promote interval=0 timeout=3600 \
op monitor interval=60 role=Master timeout=700 \
op monitor interval=61 role=Slave timeout=700 \
params SID=JL0 InstanceNumber=00 PREFER_SITE_TAKEOVER=true DUPLICATE_PRIMARY_TIMEOUT=7200
AUTOMATED_REGISTER=false
primitive rsc_vip_JL0_HDB00 ocf:aliyun:vpc-move-ip \
op monitor interval=60 \
meta target-role=Started \
params address=192.168.4.1 routing_table=vtb-gw8fii1g1d8cp14tzynub interface=eth0
ms msl_SAPHana_JL0_HDB00 rsc_SAPHana_JL0_HDB00 \
meta clone-max=2 clone-node-max=1 interleave=true target-role=Started
clone cln_SAPHanaTopology_JL0_HDB00 rsc_SAPHanaTopology_JL0_HDB00 \
meta clone-node-max=1 interleave=true
colocation col_SAPHana_vip_JL0_HDB00 2000: rsc_vip_JL0_HDB00:Started msl_SAPHana_JL0_HDB00:Master
location loc_hana0_stonith_not_on_hana0 res_ALIYUN_STONITH_0 -inf: hana0
location loc_hana1_stonith_not_on_hana1 res_ALIYUN_STONITH_1 -inf: hana1
order ord_SAPHana_JL0_HDB00 Optional: cln_SAPHanaTopology_JL0_HDB00 msl_SAPHana_JL0_HDB00
property cib-bootstrap-options: \
have-watchdog=false \
dc-version=1.1.15-21.1-e174ec8 \
cluster-infrastructure=corosync \
stonith-action=off \
stonith-enabled=true \
stonith-timeout=150s \
last-lrm-refresh=1529503606 \
maintenance-mode=false
rsc_defaults rsc-options: \
resource-stickness=1000 \
migration-threshold=5000
op_defaults op-options: \
timeout=600
```

Example for /etc/corosync/corosync.conf

In our example, the corosync.conf should on hana1 should have content as below:

```
totem{
version: 2
token: 5000
token_retransmits_before_loss_const: 6
secauth: on
crypto_hash: sha1
crypto_cipher: aes256
clear_node_high_bit: yes
interface {
ringnumber: 0
bindnetaddr: 192.168.0.83
mcastport: 5405
ttl: 1
}
# On Alibaba Cloud, transport should be set to udpu, means: unicast
transport: udpu
}
logging {
fileline: off
to_logfile: yes
to_syslog: yes
logfile: /var/log/cluster/corosync.log
debug: off
timestamp: on
logger_subsys {
subsys: QUORUM
debug: off
}
}
nodelist {
node {
ring0_addr: 192.168.0.83
nodeid: 1
}
node {
ring0_addr: 192.168.1.246
nodeid: 2
}
}
quorum {
# Enable and configure quorum subsystem (default: off)
# see also corosync.conf.5 and votequorum.5
provider: corosync_votequorum
expected_votes: 2
two_node: 1
}
```

Reference

- Pacemaker 1.1 Configuration Explained
- SAP HANA SR Performance Optimized Scenario
- SAP HANA system replication - SAP Help Portal

Microsoft SQL Server on Alibaba Cloud

Microsoft SQL Server on Alibaba Cloud

Getting Started

Make use of Alibaba Cloud reliable and flexible cloud computing infrastructure and platform services can help you to run Microsoft SQL Server more stably and smoothly. Microsoft SQL server on Alibaba cloud Elastic Compute Service(ECS) just like when you installed on-premises, you are responsible for installation, administering the database, including backups and recovery, patching the operating system and the database, tuning of the operating system and database parameters, managing security, and configuring high availability or replication. It gives you complete control over every setting. To learn what is ECS, please refer to the detail .This article provides you with the best practice for Microsoft SQL Server instance running on ECS instance. Please be aware this article used **SQL server 2016 Enterprise Edition** as the example, so not every option is appropriate for every version. It also presents a simplistic procedure to guide you for running your Microsoft SQL server. If you want to choose Alibaba RDS for SQL server, please refer to Quick Start for SQL Server.

Prerequisites

Alibaba Cloud account and RAM

You must have registered to an Alibaba Cloud account. We recommend you to enable RAM to manage your account. Resource Access Management (RAM) is a cloud service that helps you manage user identities and control resources access. Using RAM, you can create and manage user accounts, and control the operation permissions that these user accounts possess for resources under your account, for example, employees, systems, and applications. For the detail information please refer to Quick Start and RAM best practices.

SQL Server Images and Version

Alibaba cloud support Bring Your Own License (BYOL) and Images.SQL Server Enterprise, Standard, and Express Editions are licensed for production use. For Enterprise and Standard Editions, contact your software vendor for the installation media. You can find purchasing information and a directory of Microsoft partners on Microsoft official purchasing website.Free editions you can find at Microsoft official website: SQL Server Downloads.

ECS instance

Elastic Compute Service (ECS) is a type of computing service that features elastic processing capabilities. ECS has a simpler and more efficient management mode than physical servers. You can create instances, change the operating system, and add or release any number of ECS instances at any time to fit your business needs.An ECS instance is a virtual computing environment that includes CPU, memory, and other basic computing components. An instance is the core component of ECS and is the actual operating entity offered by Alibaba Cloud. Other resources, such as disks, images, and snapshots, can only be used in conjunction with an ECS instance.Before create SQL server instances you have to create ECS instances first using the ECS console, about the detail information, please refer to Create ECS instances.

VPC

Virtual Private Cloud (VPC) creates an isolated network environment for you SQL Server environment. You can select an IP address range, divide networks, and configure the routing list and gateway. The interflow of VPC intranet and between VPC and physical IDC machine rooms can be realized among regions or users. About how to create VPC please refer to the detail.

Cloud Disk

Ultra Cloud Disk: When you create ECS instance, Ultra Cloud Disk as the system disk provides a high-performance location for operating system and windows page file.
SSD Cloud Disk: When you create ECS instance we recommend you choose SSD cloud disk store the database files, tempdb,log file separately. Separate SSD cloud disks provide high performance and high reliability.

- High performance: A single SSD cloud disk provides a maximum of 20,000 random reading/writing IOPS and 300 MBps throughput of storage performance.
- IOPS=min{1200+30*disk_size, 20000}. The base is 1200 IOPS, and each GB provides 30 random IOPS up to a maximum of 20,000.
- Throughput=min{80+0.5*disk_size, 300} MBps. The base is 80 MBps, and each GB adds an additional 0.5 MBps up to a maximum of 300 MBps throughput performance.
- Reliability: SSD cloud disks use Alibaba Cloud’ s Apsara distributed storage technology, based on three distributed copies, which can guarantee 99.9999999% data reliability.

For how to create a cloud disk, please refer to create a cloud disk.

OSS

Alibaba Cloud Object Storage Service (OSS) is a network-based data access service. OSS enables you to store and retrieve unstructured data including text files, images, audios, and videos. We recommend you backup your SQL Server database into OSS. For how to use OSS please see Get started with Object Storage Service

Shared block storage

Shared Block Storage is designed for the high availability architecture of enterprise-class applications and provide shared access to block storage devices in a Share-everything architecture, such as the SQL Server always on with WSFC node architecture, which is common among government departments, enterprises, and financial customers, and the high availability server cluster architecture. For about shared block storage detail, please see Shared block storage FAQ

Installation

This section provides general information about how to create a SQL server instance on Elastic Compute Service (ECS). The tutorial includes the following tasks：

Create SQL Server instance

We recommend you to close the windows update setting before you create your SQL Server instance as below:

1.Click “run” button and input gpedit.msc
2.You will open the “Local Computer Policy” :

- Select “Administrative template”
- Select ” Windows Components”
- Select ” Windows Update”

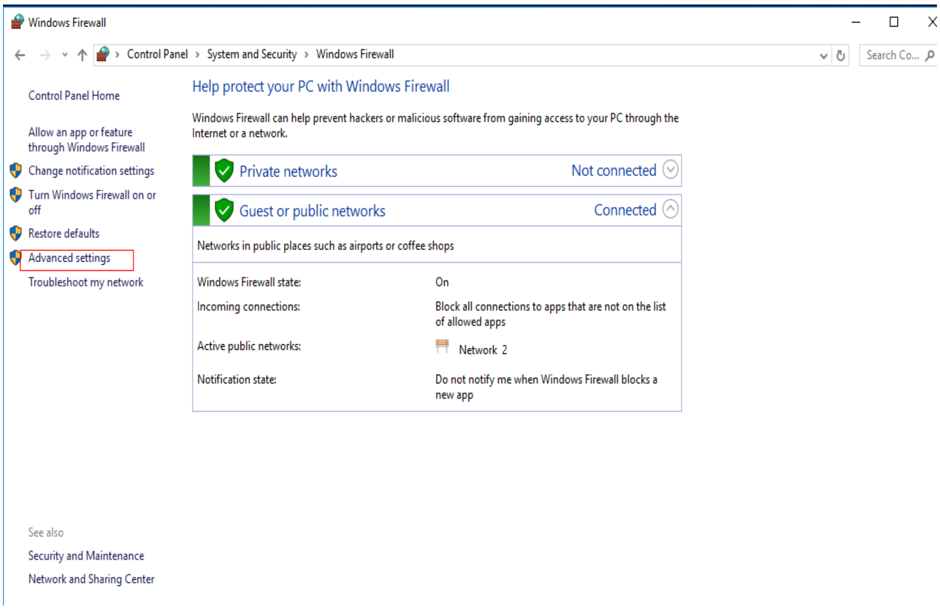
3.Change the “Configure Automatic Updates” option todisablestatus.

After the SQL server instance creating you can decide whether need to enable the update setting. It is the same method with on premise to create your SQL Server instance on ECS instance. You can choose installation wizard, command-line or using a configuration file. For how to create or install please refer to Microsoft website.

Windows Settings

This section provides you the settings about how to configure windows settings to better optimize your SQL Server instance. We recommend you to setting the windows server firewall rule to specify the IP addresses for your client computer. It is very important security policy when you create your SQL Server instance to be able to connect to the database from other client machines. Configure the firewall to allow incoming traffic:

- Open your windows firewall with advanced security.


Windows Firewall
Control Panel › System and Security › Windows Firewall
Search Co...
Control Panel Home
Allow an app or feature through Windows Firewall
Change notification settings
Turn Windows Firewall on or off
Restore defaults
Advanced settings
Troubleshoot my network
See also
Security and Maintenance
Network and Sharing Center

Help protect your PC with Windows Firewall

Windows Firewall can help prevent hackers or malicious software from gaining access to your PC through the Internet or a network.

Private networks Not connected

Guest or public networks Connected

Networks in public places such as airports or coffee shops

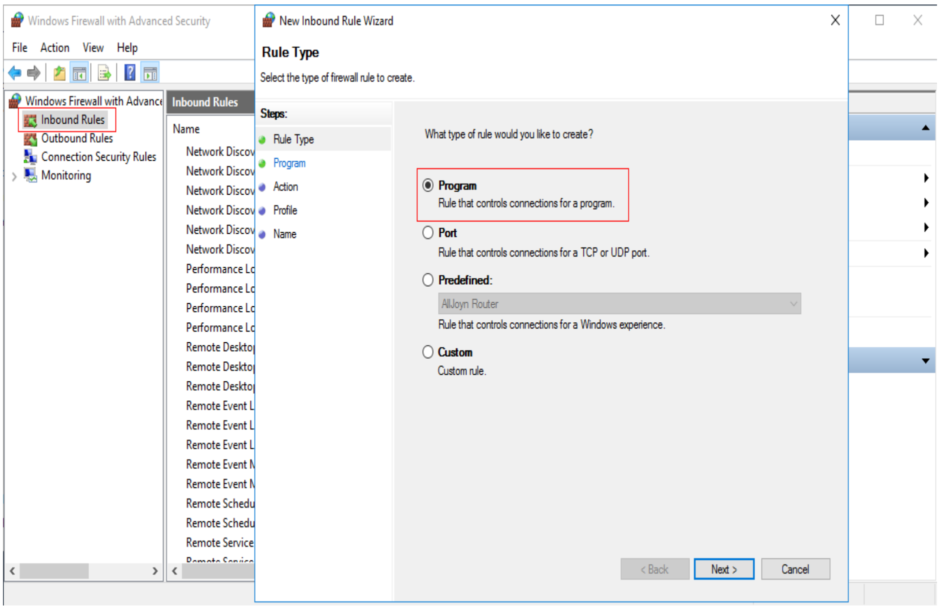
Windows Firewall state: On

Incoming connections: Block all connections to apps that are not on the list of allowed apps

Active public networks: Network 2

Notification state: Do not notify me when Windows Firewall blocks a new app

- Click right button to create a new inbound rule.



New Inbound Rule Wizard

Rule Type

Select the type of firewall rule to create.

What type of rule would you like to create?

● **Program**
Rule that controls connections for a program.

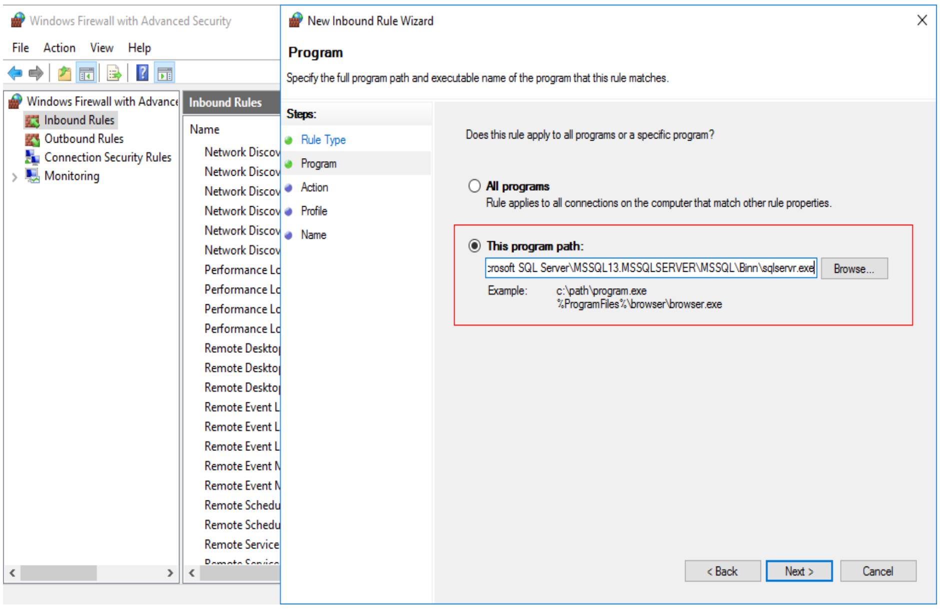
○ **Port**
Rule that controls connections for a TCP or UDP port.

○ **Predefined:**
AllJoyn Router
Rule that controls connections for a Windows experience.

○ **Custom**
Custom rule.

- Select your program path.

Input:%ProgramFiles%\Microsoft SQL Server\MSSQL13.MSSQLSERVER\MSSQL\Binn\sqlservr.exe



New Inbound Rule Wizard

Program

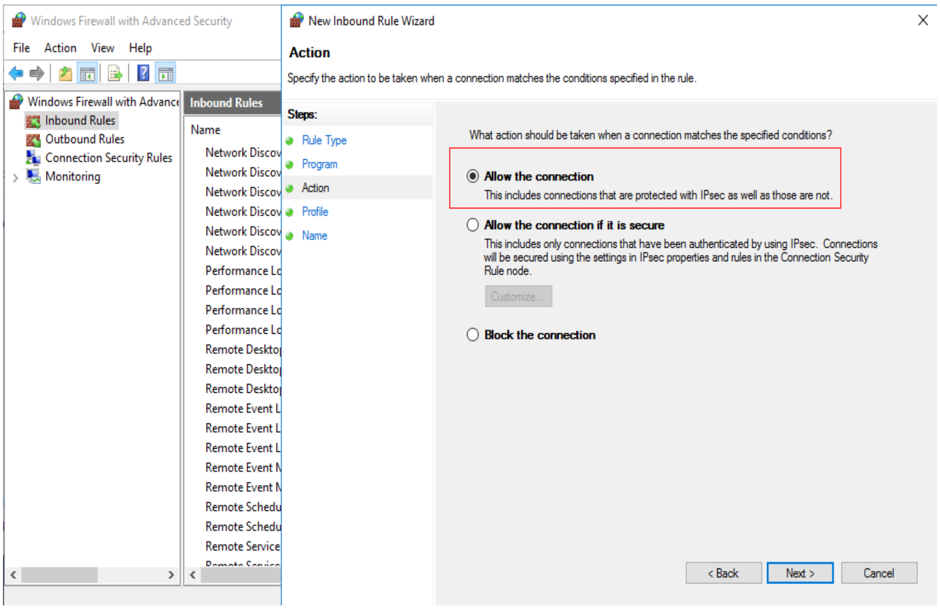
Specify the full program path and executable name of the program that this rule matches.

Does this rule apply to all programs or a specific program?

○ **All programs**
Rule applies to all connections on the computer that match other rule properties.

● **This program path:**
crosoft SQL Server\MSSQL13.MSSQLSERVER\MSSQL\Binn\sqlservr.exe
Example: c:\path\program.exe
%ProgramFiles%\browser\browser.exe

- Allow the connection.



New Inbound Rule Wizard

Action

Specify the action to be taken when a connection matches the conditions specified in the rule.

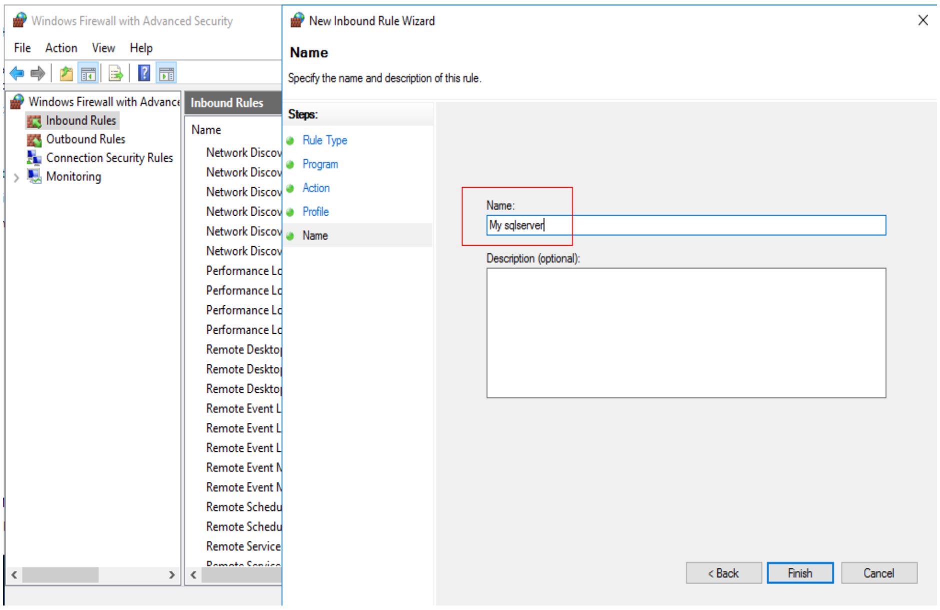
What action should be taken when a connection matches the specified conditions?

● **Allow the connection**
This includes connections that are protected with IPsec as well as those are not.

○ **Allow the connection if it is secure**
This includes only connections that have been authenticated by using IPsec. Connections will be secured using the settings in IPsec properties and rules in the Connection Security Rule node.

○ **Block the connection**

- Name your rule,for example:mysqlserver.



New Inbound Rule Wizard

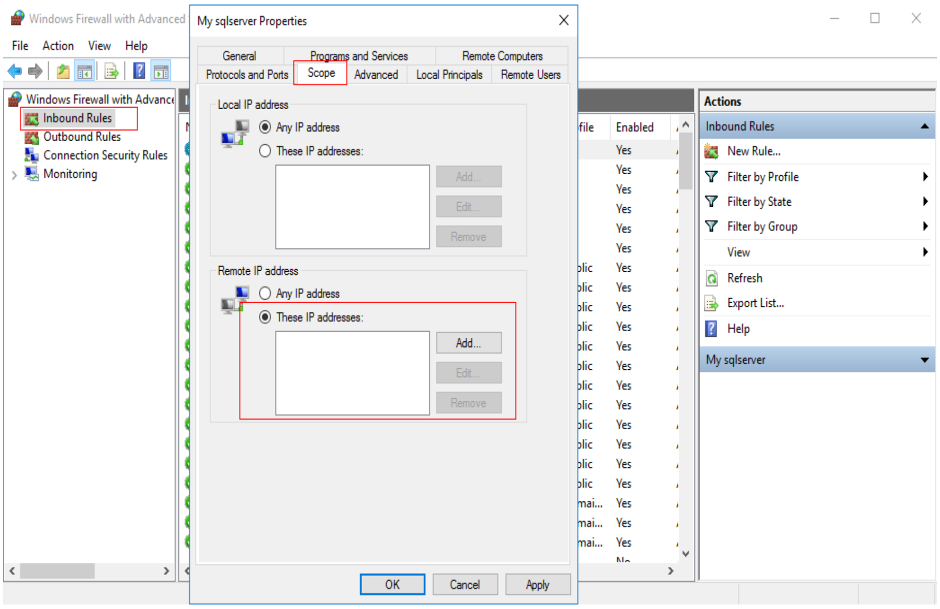
Name

Specify the name and description of this rule.

Name: My sqlserver

Description (optional):

- Set your remote policy.



Local IP address

● Any IP address

○ These IP addresses:

Remote IP address

○ Any IP address

● These IP addresses:

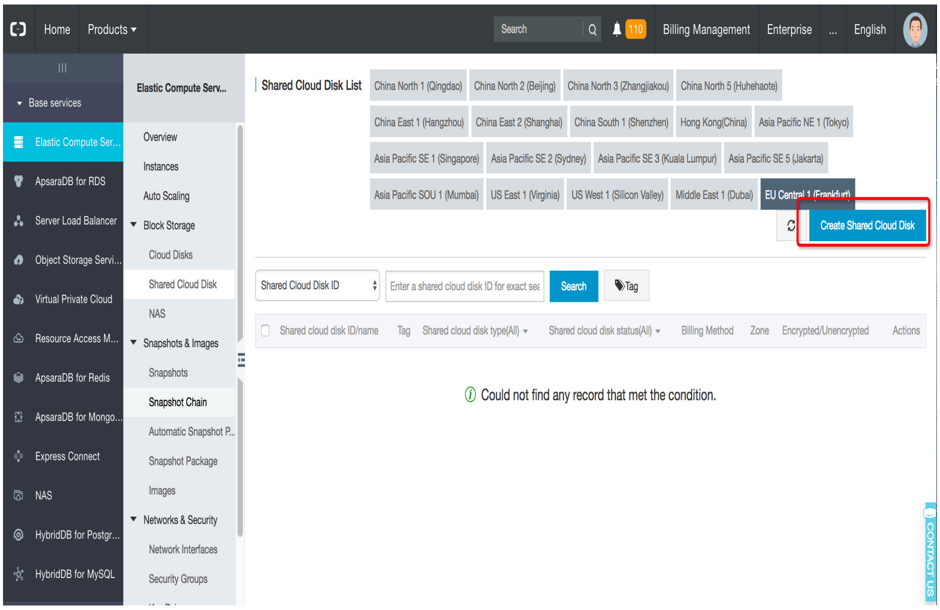
The system default network settings are usually sufficient. Alibaba cloud offers you the high capacity and performance network. When you create ECS instances you can choose the network bandwidth from 1M up to 100M,about the bandwidth, Please refer to ECS Bandwidth FAQs.Windows requires anti-virus software to be installed. Install enterprise level anti-virus software and enable virus library updating and real-time protection, however, if the antivirus software is not configured correctly, it can negatively impact your database performance. Microsoft provides advice about how to choose antivirus software.

High Availability

We recommend you to use Windows Server Failover Clustering and SQL Server AlwaysOn Availability Groups as your SQL Server high availability solution on ECS instances.
The Always On feature must be enabled for the server instance 'sqlserver' before you can create an availability group on this instance. To enable Always On:

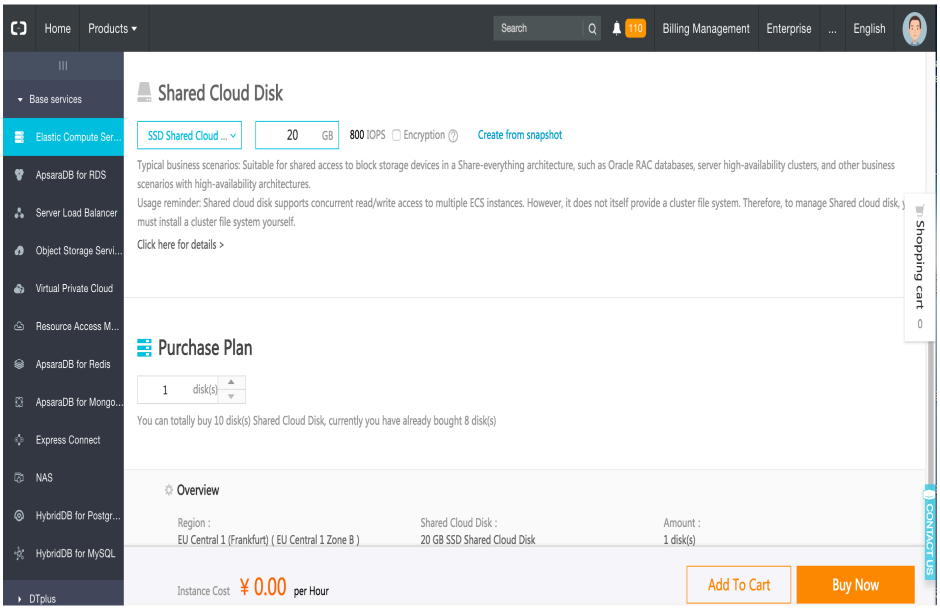
- Open the SQL Server Configuration Manager.
- Select SQL Server Services.
- Right-click the SQL Server instance name.
- Select Properties,and use the Always On High Availability tab of the SQL Server Properties dialog. (ObjectExplorer).

You should create 3 ECS instances, one is for the DC(domain controller)and DNS, the other two are the cluster nodes. You need to create a shared cloud disk as the shared block storage as below:



Could not find any record that met the condition.

and then choose the region and size, please pay attention you can only buy 20GB at least as the shared block storage.



Shared Cloud Disk

SSD Shared Cloud ... 20 GB 800 IOPS □ Encryption

Typical business scenarios: Suitable for shared access to block storage devices in a Share-everything architecture, such as Oracle RAC databases, server high-availability clusters, and other business scenarios with high-availability architectures.

Usage reminder: Shared cloud disk supports concurrent read/write access to multiple ECS instances. However, it does not itself provide a cluster file system. Therefore, to manage Shared cloud disk, y must install a cluster file system yourself.

Purchase Plan

1 disk(s)

You can totally buy 10 disk(s) Shared Cloud Disk, currently you have already bought 8 disk(s)

Overview

Region : EU Central 1 (Frankfurt) (EU Central 1 Zone B)

Shared Cloud Disk : 20 GB SSD Shared Cloud Disk

Amount : 1 disk(s)

Instance Cost ¥ 0.00 per Hour

For how to plan, configure your WSFC and Always on group please see Microsoft official website.

Backup

The SQL Server backup and restore component provides an essential safeguard for protecting critical data stored in your SQL Server databases. We strongly recommend place the databases, logs, backups on separate SSD Cloud disk. Placing the data and backups on SSD Cloud disk also enhances the I/O performance for both writing backups and the production use of the database. A backup and restore strategy contains a backup portion and a restore portion. Designing an effective backup and restore strategy requires careful planning, implementation, and testing. There is no difference between doing SQL Server database backup and restore from Alibaba cloud and on premise version. Backing Up and Restoring How-to Topics (SQL Server Management Studio)and Backing Up and Restoring How-to Topics (Transact-SQL)

provides best practice for how to implement a solid backup and maintenance action.
Use the Cloud SSD disk to store your backups and then copy them into OSS bucket or you can use the windows task scheduler copy them as the regular task.

Performance

This section provides you with how to tuning your SQL server instance performance on ECS instances. Running SQL Server on ECS environment we recommend you continue using the same database performance tuning options that are applicable to SQL Server in on-premises server environment SQL Server Enterprise Edition has a long list of added capabilities over Standard Edition. If you are migrating an existing license to ECS, there are some performance options that you might consider implementing.

Separate Cloud Disk

We recommend you to place the databases, logs, backups on separate SSD Cloud disk during you create your SQL Server instances

Table Compression

Generally, data compression reduces the space occupied by the data. It can help improve performance of I/O intensive workloads because the data is stored in fewer pages and queries need to read fewer pages from disk. Data compression can be performed for a table, clustered index, non-clustered index. We recommend you to enable table and index compression. It might seem counter-intuitive that compressing tables could make your system perform faster, but in most cases, that’ s what happens. The tradeoff is using a small amount of CPU cycles to compress the data and eliminate the extra disk IO required to read and write the bigger blocks. Generally, the less disk IO your system uses, the better its performance will be. Instructions for estimating and enabling table and index compression please refer to Micosoft website

Enable buffer pool extension (BPE)

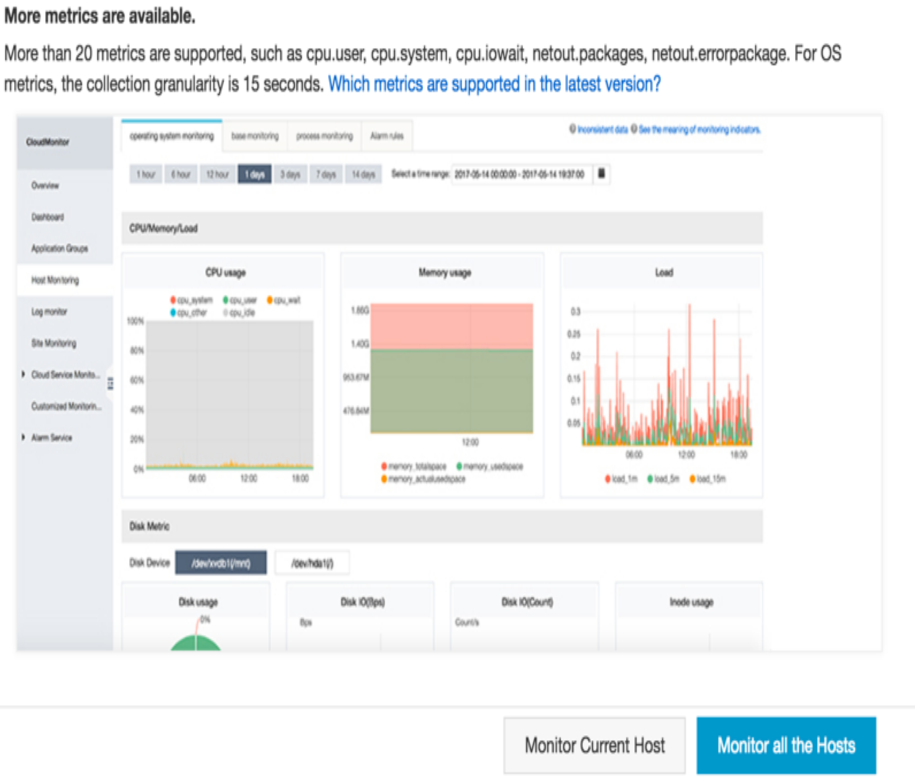
We recommend you to use the buffer pool extension to speed data access. The buffer pool extension feature enables you to push clean pages to the SSD Cloud disk, instead of dropping them. This works along the same lines as virtual memory, which is to say by swapping, and gives you access to the clean pages on the SSD Cloud disk, which is faster than you would get by going to the regular disk to fetch the data. This technique is not nearly as fast as having enough memory, but it can give you a modest increase in throughput when your available memory is low. For how to enable BPE and the technology detail please refer to Microsoft website

Max degree of parallelism setting

We recommend you to configure the max degree of parallelism option to 8. When your SQL Server instance runs on ECS that has more than one processor, it detects the best degree of parallelism, that is, the number of processors employed to run a single statement, for each parallel plan execution. You can use the max degree of parallelism option to limit the number of processors to use in parallel plan execution.
This value is set using sp_configure system procedure or you use SQL Server Management Studio. The default value is 0 which means there is no upper limit and SQL Server can use all available processors. If you set Max Degree of Parallelism to 1 then all queries will execute serially. This setting is ignored on servers with a single processor. Occasionally you might find that parallelism actually hinders performance of some queries. In this case the cost of initializing and synchronizing parallel plans might exceed the benefit of running portions of the query on multiple threads. If you feel that serial execution of a particular query can provide better performance you can override this setting using MAXDOP option within an individual query. For how to configure please refer to Microsoft website

Monitor

We recommend you to use CloudMonitor to monitor your ECS instances. Make sure that your ECS monitoring agents are functional to collect metric data. Otherwise, you must install the agent manually. For more information, see How to install CloudMonitor agent.



More metrics are available.

More than 20 metrics are supported, such as cpu.user, cpu.system, cpu.iowait, netout.packages, netout.errorpackage. For OS metrics, the collection granularity is 15 seconds. Which metrics are supported in the latest version?

Select a time range: 2017-05-14 00:00:00 - 2017-05-14 19:37:00

Disk Device: /dev/xvdb1(/mnt)

Monitoring capability

CloudMonitor allows more than 30 metrics covering CPU, memory, disk, and network to meet the basic monitoring and O&M requirements of the servers. Click here to view the full list of metrics the switch.

Alarm capability

CloudMonitor provides alarm service for all metrics, allowing you to set alarm rules for individual servers, application groups, and all the other resources. You can use the alarm service as per your business requirements. CloudMonitor provides Host monitoring metrics to set alarm rules for individual servers, application groups, and all the other resources. You can use the alarm services as per your business requirements. You can use the alarm service directly in the host monitoring list, or use it in your application group once you add servers to the group. You can add the alarm rules directly in the host monitoring list, or use it in your application group once you add servers to the group. For how to create an alarm service, please see here

Management Studio

You can use SQL Server Management Studio to perform most administrative tasks. This section provides you with how to manage your SQL server instance on ECS instances.

Remote SQL Server Management Studio

Microsoft offered SQL Server Management Studio to configure SQL Server databases. You can download and installed it on your desktop, connect to database remotely.

Default SQL Server Management Studio

You also can use the default SQL Server Management Studio which running on the instance itself. With this method you should connect to your SQL Server instance through RDP.SQL Server 2012 and SQL Server 2014 both include the SQL Server Management Studio by default. For SQL Server 2016, you must download the SQL Server Management Studio from the Microsoft website and install it on the instance.By default, SQL Server uses Windows Authentication mode to control remote access to SQL Server itself. If you need to use SQL Server Authentication mode, change the authentication mode.

ECS Metrics Collector for SAP Deployment Guide

Version Control

Version	Revision Date	Types Of Changes	Effective Date
1.0			2018/5/31
1.1	2018/6/11	Description of installation preparations is updated.	2018/6/12
1.2	2019/1/7	1. Update Frequently Asked Questions 2. Update RAM2.0 Operating Instructions	2019/1/7

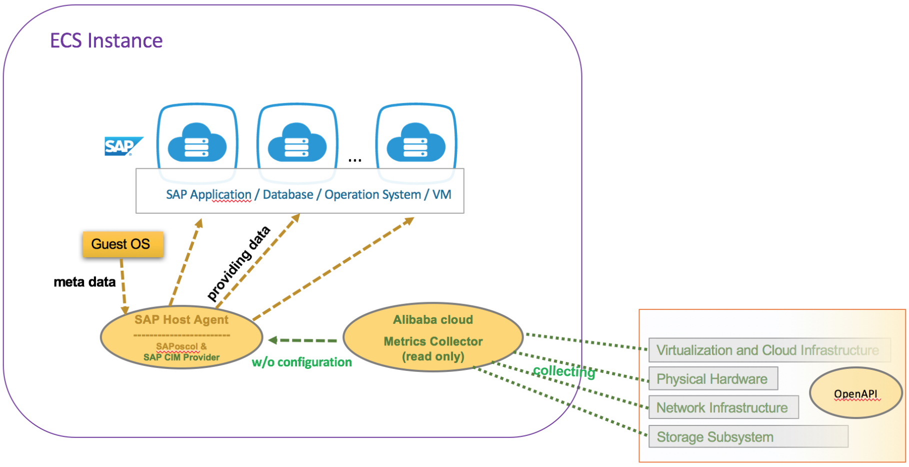
Overview

The ECS Metrics Collector is a monitor agent that used by the SAP system on the cloud platform to collect required VM configurations and physical resource usage information.

When the SAP system runs on ECS, the SAP host agent obtains SAP system monitoring information (such as operating system, network, storage, and SAP architecture information) through the metadata service and open APIs, and provides the information to SAP application for event analysis and system performance analysis.

You need to install Metrics Collector for SAP for each ECS instance (database or application) running the SAP system.

> The following figure is the overall architecture of Metrics Collector.



Configure the RAM role

To monitor the ECS Metrics Collector, you need to configure the certain RAM role and access rights.

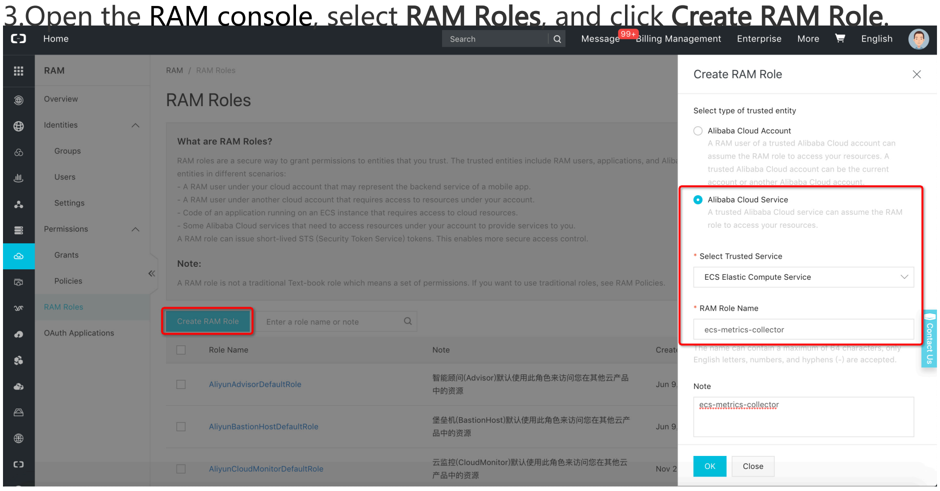
> Note: The configuration of RAM role is permanently valid for your account.

For more information about RAM role configuration, see Use the instance RAM role on the console.

1. Log on to the ECS console.
2. Click **Resource Access Management** in the left navigation bar.

> You need to activate the RAM function if you use this function first time.

3.Open the **RAM console**, select **RAM Roles**, and click **Create RAM Role.**



RAM Roles

What are RAM Roles?

RAM roles are a secure way to grant permissions to entities that you trust. The trusted entities include RAM users, applications, and Aliba entities in different scenarios:
- A RAM user under your cloud account that may represent the backend service of a mobile app.
- A RAM user under another cloud account that requires access to resources under your account.
- Code of an application running on an ECS instance that requires access to cloud resources.
- Some Alibaba Cloud services that need to access resources under your account to provide services to you.
A RAM role can issue short-lived STS (Security Token Service) tokens. This enables more secure access control.

Note:

A RAM role is not a traditional Text-book role which means a set of permissions. If you want to use traditional roles, see RAM Policies.

□	Role Name	Note	Creat
□	AliyunAdvisorDefaultRole	智能顾问(Advisor)默认使用此角色来访问您在其他云产品中的资源	Jun 9
□	AliyunBastionHostDefaultRole	堡垒机(BastionHost)默认使用此角色来访问您在其他云产品中的资源	Jun 9
□	AliyunCloudMonitorDefaultRole	云监控(CloudMonitor)默认使用此角色来访问您在其他云产品中的资源	Nov 2

Create RAM Role

Select type of trusted entity

○ Alibaba Cloud Account
A RAM user of a trusted Alibaba Cloud account can assume the RAM role to access your resources. A trusted Alibaba Cloud account can be the current account or another Alibaba Cloud account.

● Alibaba Cloud Service
A trusted Alibaba Cloud service can assume the RAM role to access your resources.

* Select Trusted Service

ECS Elastic Compute Service

* RAM Role Name

ecs-metrics-collector

The name can contain a maximum of 64 characters, only English letters, numbers, and hyphens (-) are accepted.

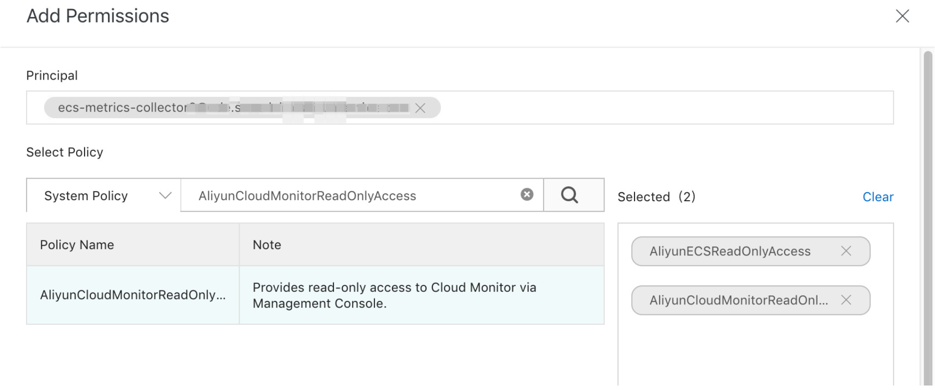
Note

ecs-metrics-collector

OK Close

Please note: The following is an example based on the RAM version 2.0. The description of the old version may be different

7.After the role is created, click **Add permissions** to assign necessary policies to your RAM role. Select the policy names **AliyunECSReadOnlyAccess** and **AliyunCloudMonitorReadOnlyAccess**



Add Permissions

Principal

ecs-metrics-collector[redacted]

Select Policy

System Policy | AliyunCloudMonitorReadOnlyAccess

Selected (2) Clear

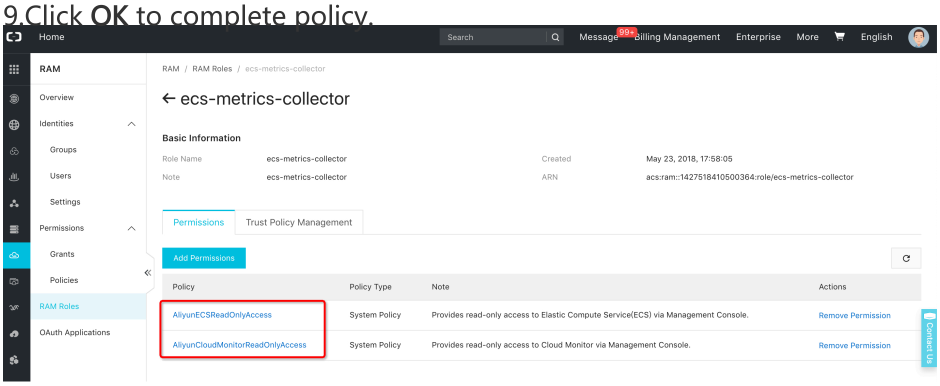
Policy Name	Note
AliyunCloudMonitorReadOnly...	Provides read-only access to Cloud Monitor via Management Console.

AliyunECSReadOnlyAccess

AliyunCloudMonitorReadOnl...

The two policies authorize the Metrics Collector to only read ECS information and only read CloudMonitor resources.

9.Click **OK** to complete policy.



RAM / RAM Roles / ecs-metrics-collector

← ecs-metrics-collector

Basic Information

Role Name ecs-metrics-collector

Note ecs-metrics-collector

Created May 23, 2018, 17:58:05

ARN acs:ram::1427518410500364:role/ecs-metrics-collector

Permissions | Trust Policy Management

Add Permissions

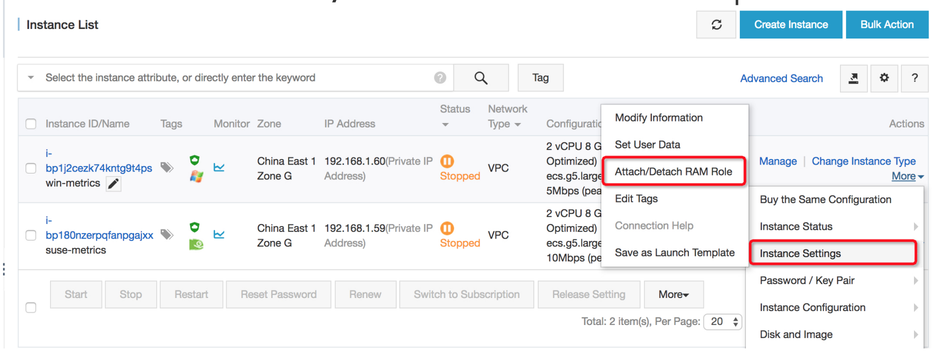
Policy	Policy Type	Note	Actions
AliyunECSReadOnlyAccess	System Policy	Provides read-only access to Elastic Compute Service(ECS) via Management Console.	Remove Permission
AliyunCloudMonitorReadOnlyAccess	System Policy	Provides read-only access to Cloud Monitor via Management Console.	Remove Permission

Configure RAM role

Attach the created RAM role to your SAP ECS instance.

Open the ECS console and click **Instance** to find out your ECS instance.

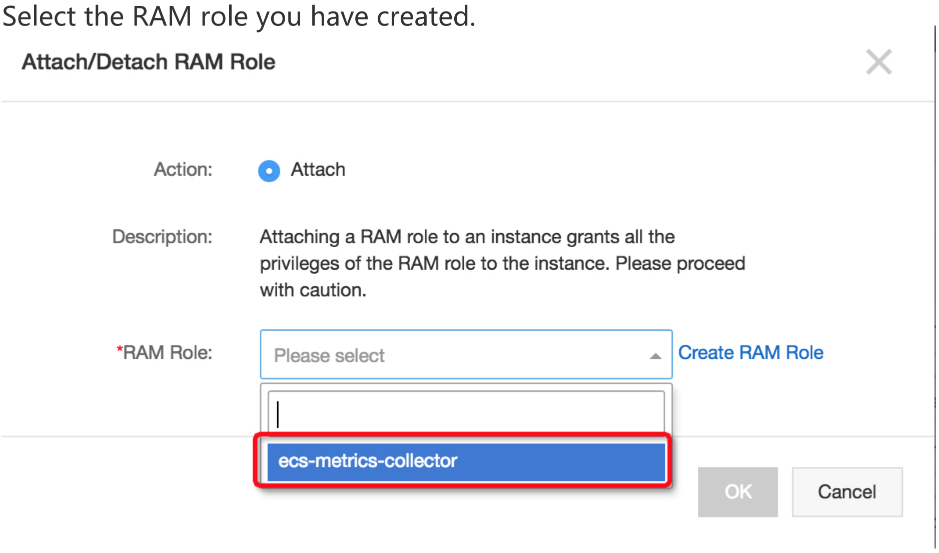
Click **More** and select **Bind/Unbind RAM Role** from the drop-down list.



Instance ID/Name	Tags	Monitor	Zone	IP Address	Status	Network Type	Configuratic	Actions
i-bp1j2cezk74kntg9t4ps win-metrics			China East 1 Zone G	192.168.1.60(Private IP Address)	Stopped	VPC	2 vCPU 8 G Optimized) ecs.g5.large 5Mbps (pea	Manage | Change Instance Type More
i-bp180nzerpqfanpgajxx suse-metrics			China East 1 Zone G	192.168.1.59(Private IP Address)	Stopped	VPC	2 vCPU 8 G Optimized) ecs.g5.large 10Mbps (pe	

Total: 2 item(s), Per Page: 20

Select the RAM role you have created.



Attach/Detach RAM Role

Action: ● Attach

Description: Attaching a RAM role to an instance grants all the privileges of the RAM role to the instance. Please proceed with caution.

*RAM Role: Please select

Click OK to attach the role.

For more information about RAM binding and unbinding, see Use the instance RAM role on the console

Install the SAP Host Agent

You need an SAP market place account for logon.

For the suggested version of SAP Host Agent, see 1031096 - Installing Package SAPHOSTAGENT

Install and uninstall the ECS Metrics Collector

The installation of ECS Metrics Collector and the data reading from open APIs require a connection to the Internet. External network access needs to be combined with cloud security products to protect data and network security. For details, please refer to Cloud Security Solution

Based on Linux

Install the ECS Metrics Collector

1.Log on to the SAP ECS instance as a root user.

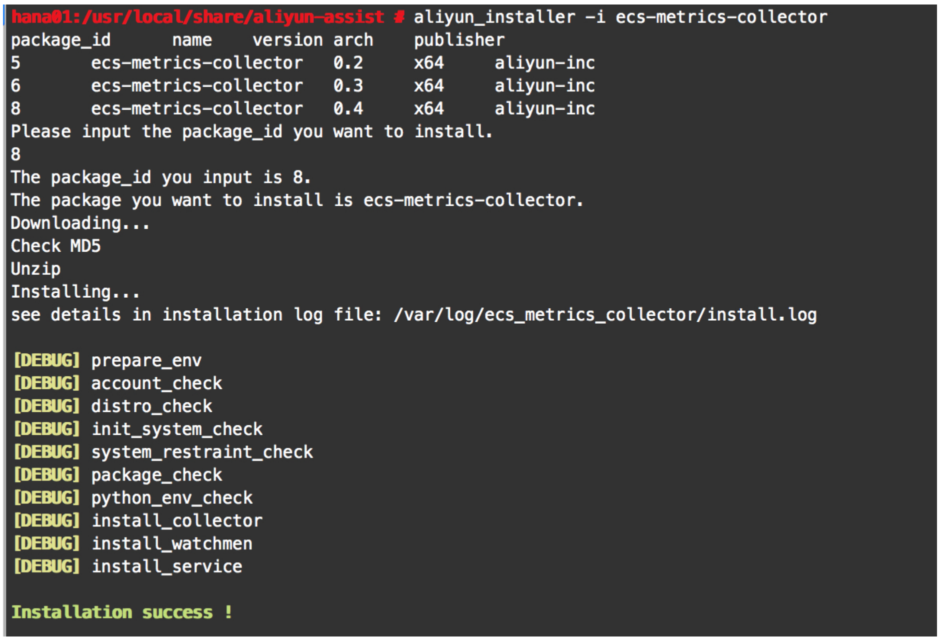
To use the root rights, you need sudo, so you must belong to the sudo group.

2.Install the ECS Metrics Collector by using the Cloud Assistant as follows:

> The Metrics Collector needs the support of python. If you have not installed pip for the ECS instance, install it first.

```
wget https://bootstrap.pypa.io/get-pip.py
python get-pip.py
pip -V #Check the pip version



aliyun_installer -i ecs-metrics-collector
```

Enter the ID of the latest version for package_id. In this example, the latest version 8 is used.

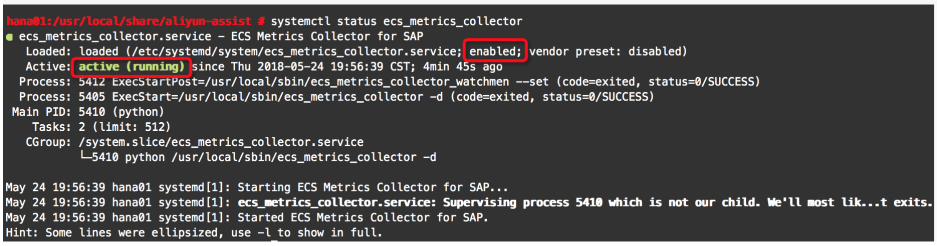


```
hana01:/usr/local/share/aliyun-assist # aliyun_installer -i ecs-metrics-collector
package_id      name     version arch     publisher
5       ecs-metrics-collector   0.2     x64     aliyun-inc
6       ecs-metrics-collector   0.3     x64     aliyun-inc
8       ecs-metrics-collector   0.4     x64     aliyun-inc
Please input the package_id you want to install.
8
The package_id you input is 8.
The package you want to install is ecs-metrics-collector.
Downloading...
Check MD5
Unzip
Installing...
see details in installation log file: /var/log/ecs_metrics_collector/install.log

[DEBUG] prepare_env
[DEBUG] account_check
[DEBUG] distro_check
[DEBUG] init_system_check
[DEBUG] system_restraint_check
[DEBUG] package_check
[DEBUG] python_env_check
[DEBUG] install_collector
[DEBUG] install_watchmen
[DEBUG] install_service

Installation success !
```

Verify the installation of Metrics Collector

3.Verify the ECS Metrics Collector service.

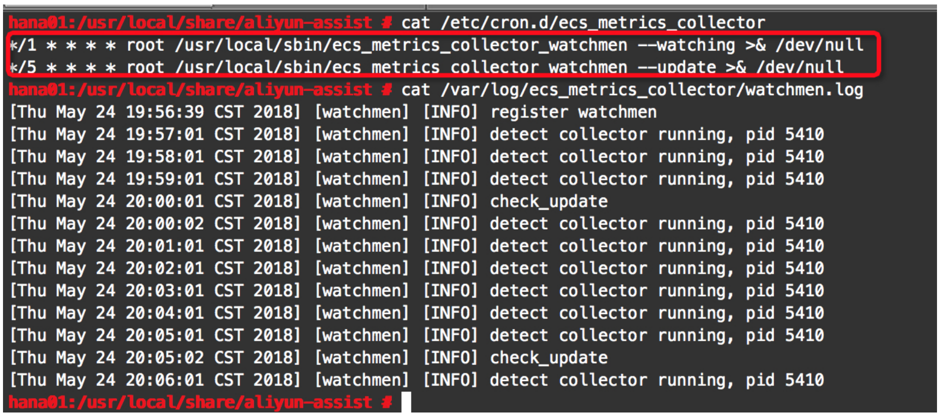
```
systemctl status ecs_metrics_collector
```



```
hana01:/usr/local/share/aliyun-assist # systemctl status ecs_metrics_collector
● ecs_metrics_collector.service - ECS Metrics Collector for SAP
   Loaded: loaded (/etc/systemd/system/ecs_metrics_collector.service; enabled; vendor preset: disabled)
   Active: active (running) since Thu 2018-05-24 19:56:39 CST; 4min 45s ago
  Process: 5412 ExecStartPost=/usr/local/sbin/ecs_metrics_collector_watchmen --set (code=exited, status=0/SUCCESS)
  Process: 5405 ExecStart=/usr/local/sbin/ecs_metrics_collector -d (code=exited, status=0/SUCCESS)
 Main PID: 5410 (python)
    Tasks: 2 (limit: 512)
   CGroup: /system.slice/ecs_metrics_collector.service
           └─5410 python /usr/local/sbin/ecs_metrics_collector -d

May 24 19:56:39 hana01 systemd[1]: Starting ECS Metrics Collector for SAP...
May 24 19:56:39 hana01 systemd[1]: ecs_metrics_collector.service: Supervising process 5410 which is not our child. We'll most lik...t exits.
May 24 19:56:39 hana01 systemd[1]: Started ECS Metrics Collector for SAP.
Hint: Some lines were ellipsized, use -l to show in full.
```

4.Check whether the watching task and automatic update task are configured in crontab and whether the running log is recorded.

```
cat /etc/cron.d/ecs_metrics_collector
cat /var/log/ecs_metrics_collector/watchmen.log
```



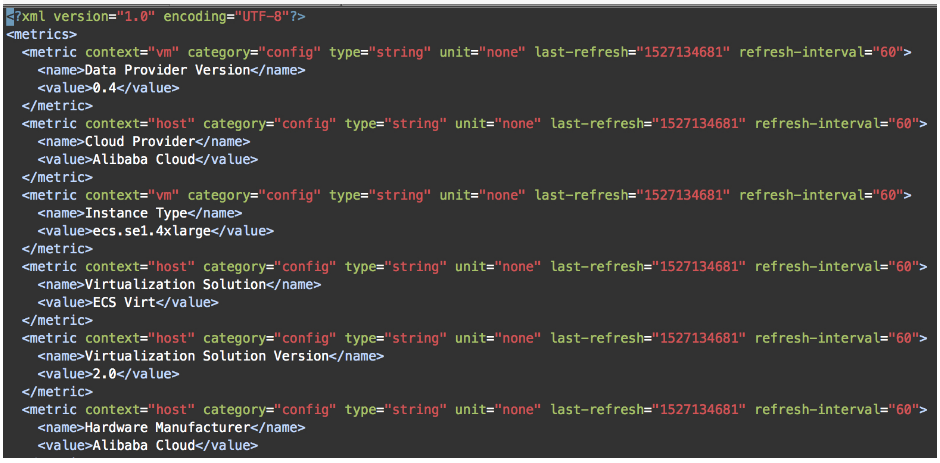
```
hana01:/usr/local/share/aliyun-assist # cat /etc/cron.d/ecs_metrics_collector
*/1 * * * * root /usr/local/sbin/ecs_metrics_collector_watchmen --watching >& /dev/null
*/5 * * * * root /usr/local/sbin/ecs_metrics_collector_watchmen --update >& /dev/null
hana01:/usr/local/share/aliyun-assist # cat /var/log/ecs_metrics_collector/watchmen.log
[Thu May 24 19:56:39 CST 2018] [watchmen] [INFO] register watchmen
[Thu May 24 19:57:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 19:58:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 19:59:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:00:01 CST 2018] [watchmen] [INFO] check_update
[Thu May 24 20:00:02 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:01:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:02:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:03:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:04:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:05:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
[Thu May 24 20:05:02 CST 2018] [watchmen] [INFO] check_update
[Thu May 24 20:06:01 CST 2018] [watchmen] [INFO] detect collector running, pid 5410
hana01:/usr/local/share/aliyun-assist #
```

The two tasks are automatically added to crontab during the installation of ECS Metrics Collector. The automatic update task checks for available updates of ECS Metrics Collector on the Cloud Assistant server every hour. If an update of the latest version is detected, an automatic upgrade is performed.

Check the collected metric data

5.Verify the collected data.

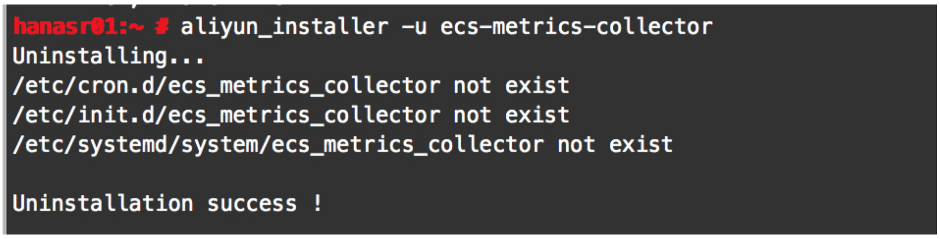
```
curl localhost:8888 | vim -
```



```
<?xml version="1.0" encoding="UTF-8"?>
<metrics>
  <metric context="vm" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Data Provider Version</name>
    <value>0.4</value>
  </metric>
  <metric context="host" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Cloud Provider</name>
    <value>Alibaba Cloud</value>
  </metric>
  <metric context="vm" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Instance Type</name>
    <value>ecs.se1.4xlarge</value>
  </metric>
  <metric context="host" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Virtualization Solution</name>
    <value>ECS Virt</value>
  </metric>
  <metric context="host" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Virtualization Solution Version</name>
    <value>2.0</value>
  </metric>
  <metric context="host" category="config" type="string" unit="none" last-refresh="1527134681" refresh-interval="60">
    <name>Hardware Manufacturer</name>
    <value>Alibaba Cloud</value>
```

Uninstall the ECS Metrics Collector

Log on to your SAP ECS instance as a root user.
Run the
aliyun_installer -u ecs-metrics-collector command to uninstall the ECS Metrics Collector.

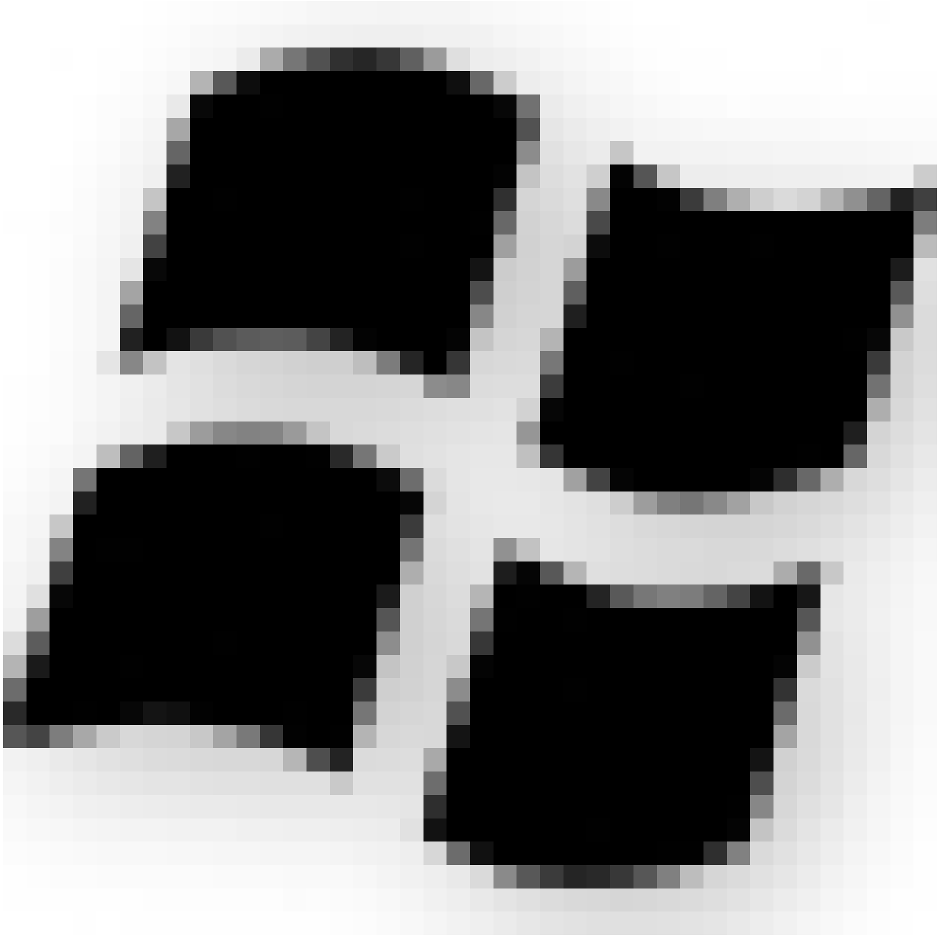


```
hanasr01:~ # aliyun_installer -u ecs-metrics-collector
Uninstalling...
/etc/cron.d/ecs_metrics_collector not exist
/etc/init.d/ecs_metrics_collector not exist
/etc/systemd/system/ecs_metrics_collector not exist

Uninstallation success !
```

More commands

For more commands related to Metrics Collector, run the aliyun_installer --h command.

Based on Windows



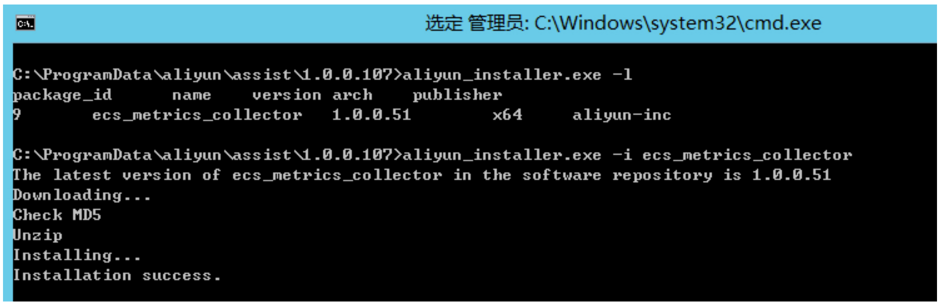
1.Log on to your SAP ECS instance as an administrator.

2.Install the ECS Metrics Collector by using the Cloud Assistant. Right-click the Start menu, right-click CMD, and choose Run as Administrator to open the CMD window.Switch to the directory of Cloud Assistant to perform the installation.

> The latest version of Cloud Assistant is 1.0.0.107. Modify the directory name according to the latest version.

```
cd "C:\ProgramData\aliyun\assist\[1.0.0.107]"
aliyun_installer.exe -l
aliyun_installer.exe -i ecs_metrics_collector
```

> Select the ID of the latest version for package_id.

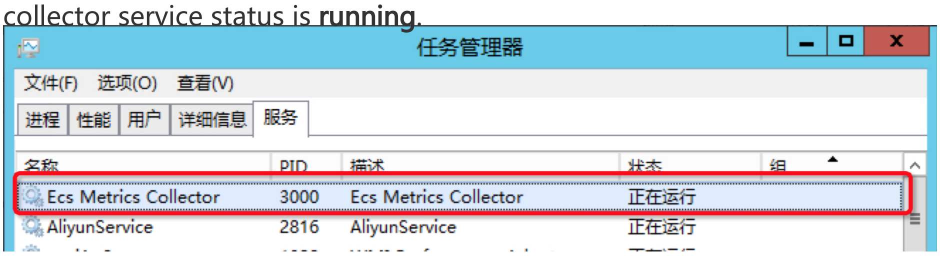


```
C:\ProgramData\aliyun\assist\1.0.0.107>aliyun_installer.exe -l
package_id      name    version arch    publisher
9       ecs_metrics_collector   1.0.0.51        x64     aliyun-inc

C:\ProgramData\aliyun\assist\1.0.0.107>aliyun_installer.exe -i ecs_metrics_collector
The latest version of ecs_metrics_collector in the software repository is 1.0.0.51
Downloading...
Check MD5
Unzip
Installing...
Installation success.
```

Verify the installation of ECS Metrics Collector

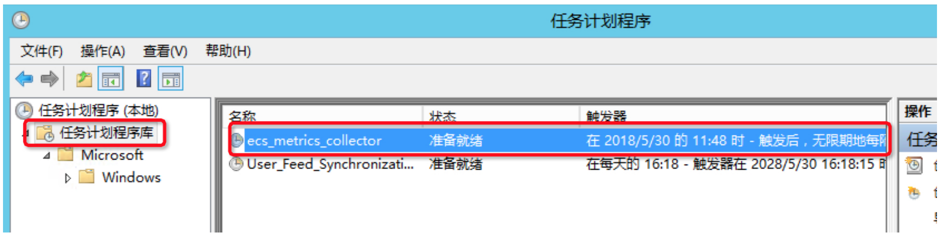
3.Verify the ECS Metrics Collector service.

Right-click the taskbar and choose Task Manager > Service. Check and ensure that the Ecs metrics collector service status is **running**.



名称	PID	描述	状态	组
Ecs Metrics Collector	3000	Ecs Metrics Collector	正在运行	
AliyunService	2816	AliyunService	正在运行	

4.Right-click the Start menu, choose Run, enter taskschd.msc, and press Enter. Open the task schedule program and click Task Scheduler Library to check that the update detection task has been scheduled.



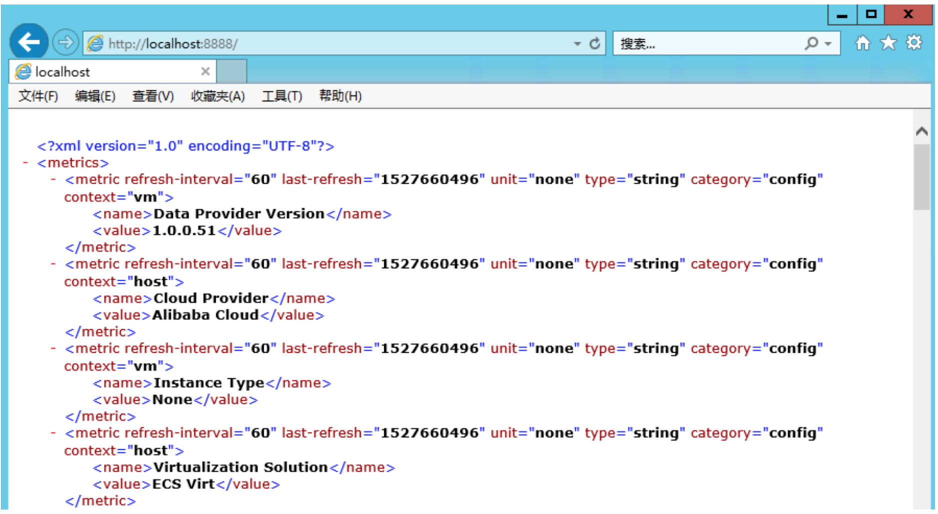
名称	状态	触发器
ecs_metrics_collector	准备就绪	在 2018/5/30 的 11:48 时 - 触发后，无限期地每隔
User_Feed_Synchronizati...	准备就绪	在每天的 16:18 - 触发器在 2028/5/30 16:18:15 时

A task is created during the installation of ECS Metrics Collector to check for version updates of ECS Metrics Collector on the Cloud Assistant server every hour. If an update of the latest version is detected, an automatic upgrade is performed.

Check the collected metric data

5.Verify the collected data.

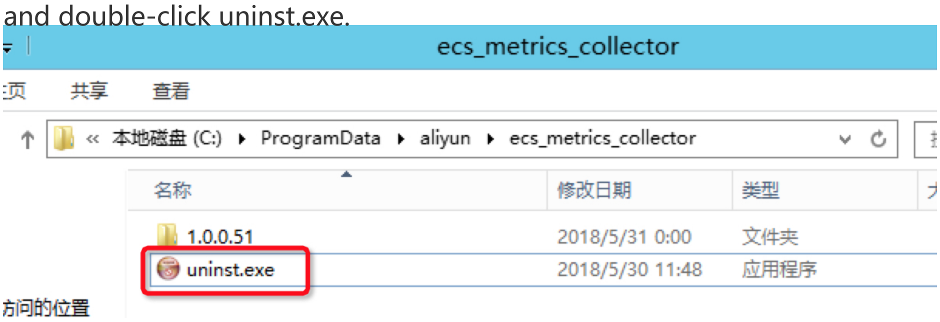
Open the browser and enter http://localhost:8888A page similar to the following is displayed. If all parameters have values, the configuration is successful. If a value is abnormal, check the RAM role configuration.



```
<?xml version="1.0" encoding="UTF-8"?>
- <metrics>
  - <metric refresh-interval="60" last-refresh="1527660496" unit="none" type="string" category="config"
    context="vm">
        <name>Data Provider Version</name>
        <value>1.0.0.51</value>
    </metric>
  - <metric refresh-interval="60" last-refresh="1527660496" unit="none" type="string" category="config"
    context="host">
        <name>Cloud Provider</name>
        <value>Alibaba Cloud</value>
    </metric>
  - <metric refresh-interval="60" last-refresh="1527660496" unit="none" type="string" category="config"
    context="vm">
        <name>Instance Type</name>
        <value>None</value>
    </metric>
  - <metric refresh-interval="60" last-refresh="1527660496" unit="none" type="string" category="config"
    context="host">
        <name>Virtualization Solution</name>
        <value>ECS Virt</value>
    </metric>
```

Uninstall the ECS Metrics Collector

1. Log on to your SAP ECS instance as an administrator. Switch to the installation directory and double-click uninst.exe.



« 本地磁盘 (C:) ▸ ProgramData ▸ aliyun ▸ ecs_metrics_collector

名称	修改日期	类型
1.0.0.51	2018/5/31 0:00	文件夹
uninst.exe	2018/5/30 11:48	应用程序

More commands

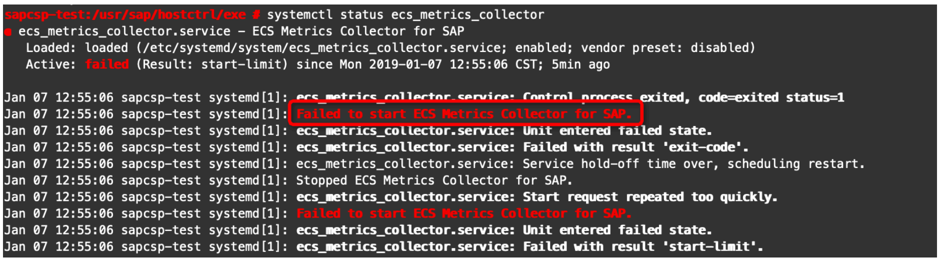
For more commands related to Metrics Collector, run the aliyun_installer.exe --h command.

FAQ

Failed to start ECS Metrics Collector for SAP

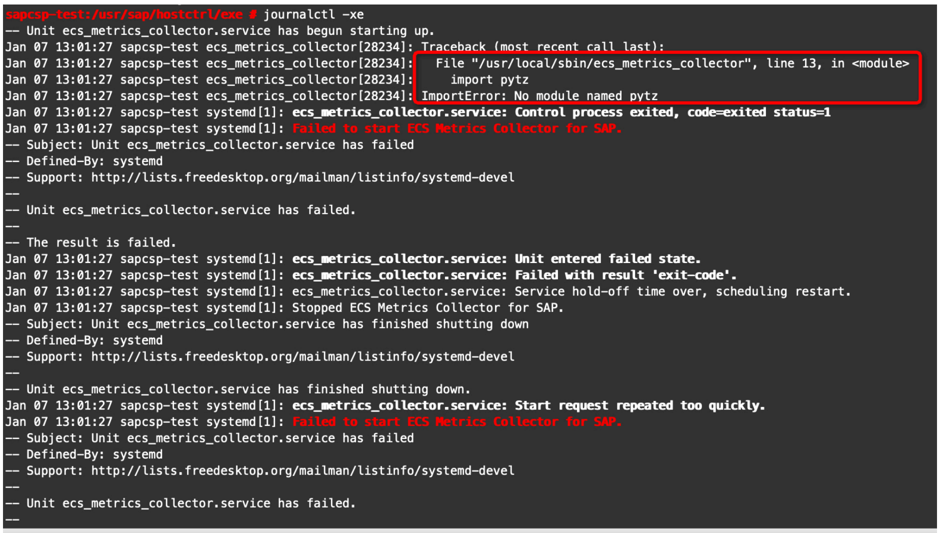
Symptom

- An error occurred while checking the status of the service ecs_metrics_collector



```
sapcsp-test:/usr/sap/hostctrl/exe # systemctl status ecs_metrics_collector
● ecs_metrics_collector.service - ECS Metrics Collector for SAP
   Loaded: loaded (/etc/systemd/system/ecs_metrics_collector.service; enabled; vendor preset: disabled)
   Active: failed (Result: start-limit) since Mon 2019-01-07 12:55:06 CST; 5min ago

Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Control process exited, code=exited status=1
Jan 07 12:55:06 sapcsp-test systemd[1]: Failed to start ECS Metrics Collector for SAP.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Unit entered failed state.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Failed with result 'exit-code'.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Service hold-off time over, scheduling restart.
Jan 07 12:55:06 sapcsp-test systemd[1]: Stopped ECS Metrics Collector for SAP.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Start request repeated too quickly.
Jan 07 12:55:06 sapcsp-test systemd[1]: Failed to start ECS Metrics Collector for SAP.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Unit entered failed state.
Jan 07 12:55:06 sapcsp-test systemd[1]: ecs_metrics_collector.service: Failed with result 'start-limit'.
```

- Use the command **journalctl -xe** to view the system log. The following message appears: **ImportError: No module named pytz**

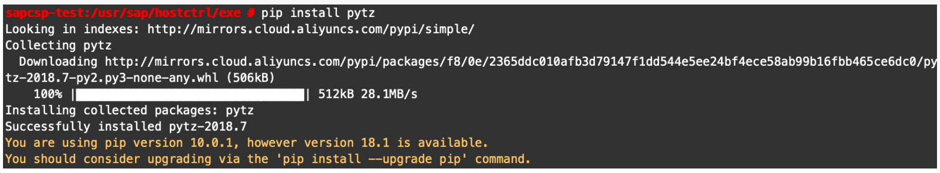


```
sapcsp-test:/usr/sap/hostctrl/exe # journalctl -xe
-- Unit ecs_metrics_collector.service has begun starting up.
Jan 07 13:01:27 sapcsp-test ecs_metrics_collector[28234]: Traceback (most recent call last):
Jan 07 13:01:27 sapcsp-test ecs_metrics_collector[28234]:   File "/usr/local/sbin/ecs_metrics_collector", line 13, in <module>
Jan 07 13:01:27 sapcsp-test ecs_metrics_collector[28234]:     import pytz
Jan 07 13:01:27 sapcsp-test ecs_metrics_collector[28234]: ImportError: No module named pytz
Jan 07 13:01:27 sapcsp-test systemd[1]: ecs_metrics_collector.service: Control process exited, code=exited status=1
Jan 07 13:01:27 sapcsp-test systemd[1]: Failed to start ECS Metrics Collector for SAP.
-- Subject: Unit ecs_metrics_collector.service has failed
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit ecs_metrics_collector.service has failed.
--
-- The result is failed.
Jan 07 13:01:27 sapcsp-test systemd[1]: ecs_metrics_collector.service: Unit entered failed state.
Jan 07 13:01:27 sapcsp-test systemd[1]: ecs_metrics_collector.service: Failed with result 'exit-code'.
Jan 07 13:01:27 sapcsp-test systemd[1]: ecs_metrics_collector.service: Service hold-off time over, scheduling restart.
Jan 07 13:01:27 sapcsp-test systemd[1]: Stopped ECS Metrics Collector for SAP.
-- Subject: Unit ecs_metrics_collector.service has finished shutting down
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit ecs_metrics_collector.service has finished shutting down.
Jan 07 13:01:27 sapcsp-test systemd[1]: ecs_metrics_collector.service: Start request repeated too quickly.
Jan 07 13:01:27 sapcsp-test systemd[1]: Failed to start ECS Metrics Collector for SAP.
-- Subject: Unit ecs_metrics_collector.service has failed
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit ecs_metrics_collector.service has failed.
--
```

Resolution

- Manual installing the **pytz** module

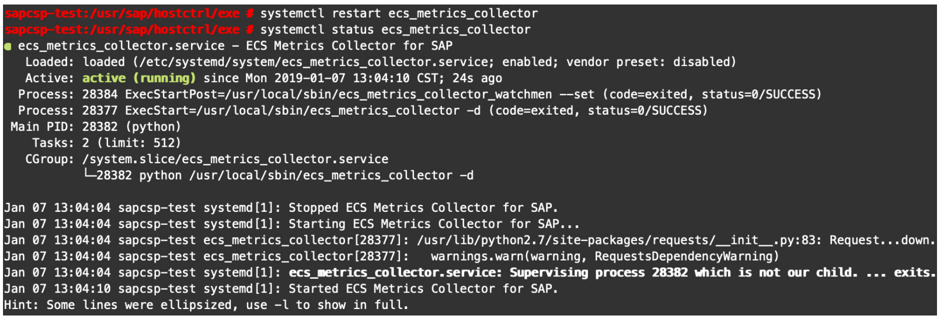
```
pip installing pytz
```



```
sapcsp-test:/usr/sap/hostctrl/exe # pip install pytz
Looking in indexes: http://mirrors.cloud.aliyuncs.com/pypi/simple/
Collecting pytz
  Downloading http://mirrors.cloud.aliyuncs.com/pypi/packages/f8/0e/2365ddc010afb3d79147f1dd544e5ee24bf4ece58ab99b16fbb465ce6dc0/py
tz-2018.7-py2.py3-none-any.whl (506kB)
    100% |████████████████████████████████| 512kB 28.1MB/s
Installing collected packages: pytz
Successfully installed pytz-2018.7
You are using pip version 10.0.1, however version 18.1 is available.
You should consider upgrading via the 'pip install --upgrade pip' command.
```

- Restart and verify the service status of ecs_metrics_collector

```
systemctl restart ecs_metrics_collector
systemctl status ecs_metrics_collector
```



```
sapcsp-test:/usr/sap/hostctrl/exe # systemctl restart ecs_metrics_collector
sapcsp-test:/usr/sap/hostctrl/exe # systemctl status ecs_metrics_collector
● ecs_metrics_collector.service - ECS Metrics Collector for SAP
   Loaded: loaded (/etc/systemd/system/ecs_metrics_collector.service; enabled; vendor preset: disabled)
   Active: active (running) since Mon 2019-01-07 13:04:10 CST; 24s ago
  Process: 28384 ExecStartPost=/usr/local/sbin/ecs_metrics_collector_watchmen --set (code=exited, status=0/SUCCESS)
  Process: 28377 ExecStart=/usr/local/sbin/ecs_metrics_collector -d (code=exited, status=0/SUCCESS)
 Main PID: 28382 (python)
    Tasks: 2 (limit: 512)
   CGroup: /system.slice/ecs_metrics_collector.service
           └─28382 python /usr/local/sbin/ecs_metrics_collector -d

Jan 07 13:04:04 sapcsp-test systemd[1]: Stopped ECS Metrics Collector for SAP.
Jan 07 13:04:04 sapcsp-test systemd[1]: Starting ECS Metrics Collector for SAP...
Jan 07 13:04:04 sapcsp-test ecs_metrics_collector[28377]: /usr/lib/python2.7/site-packages/requests/__init__.py:83: Request...down.
Jan 07 13:04:04 sapcsp-test ecs_metrics_collector[28377]:   warnings.warn(warning, RequestsDependencyWarning)
Jan 07 13:04:04 sapcsp-test systemd[1]: ecs_metrics_collector.service: Supervising process 28382 which is not our child. ... exits.
Jan 07 13:04:10 sapcsp-test systemd[1]: Started ECS Metrics Collector for SAP.
Hint: Some lines were ellipsized, use -l to show in full.
```