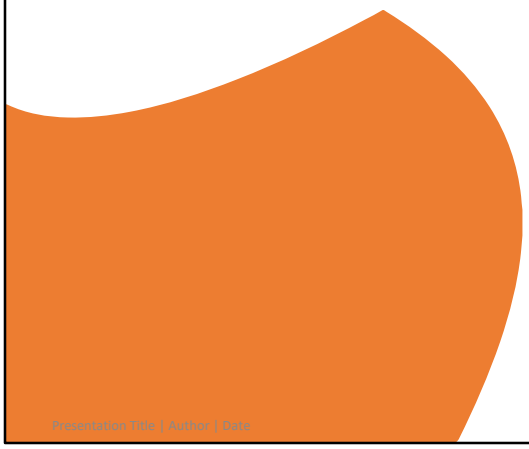
HANA DB Overview

Basic architecture and overview of HANA DB

Capgemini

Agenda



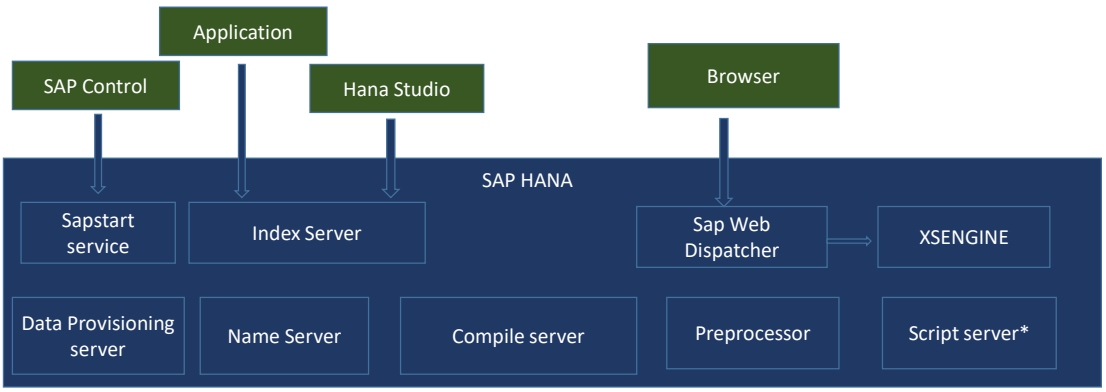
- What is SAP HANA
- HANA DB Architecture
- Overview of HANA DB
  - What is in-memory computing
  - What is persistent layer
  - HANA DB Services
- Using HANA Studio
  - Monitoring
  - Troubleshooting
  - Configuration
  - Traces
  - Backup and recovery

What is SAP HANA

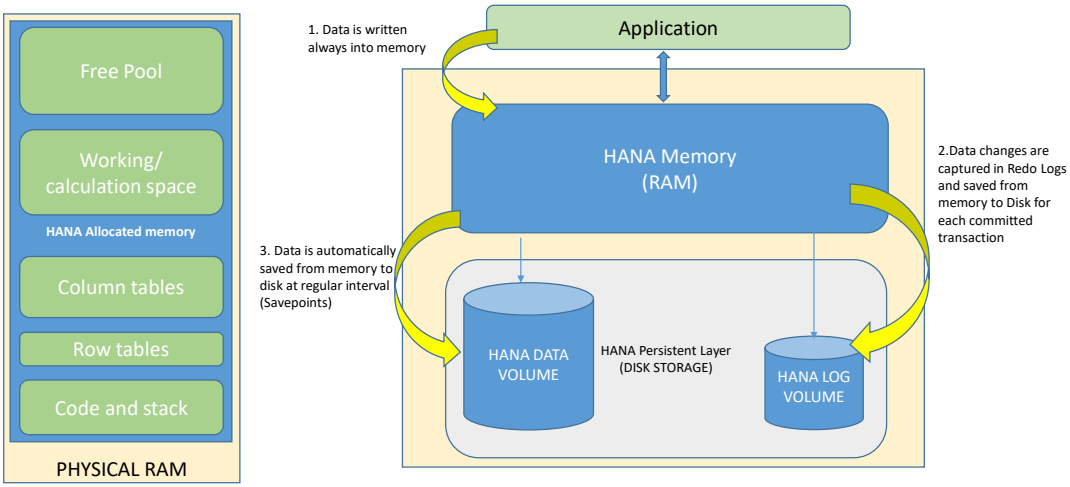
- **SAP HANA (H**igh-performance **AN**alytic **A**ppliance) is an in-memory, column-oriented, relational database management system developed and marketed by SAP.
- Its primary function as a database server is to store and retrieve data as requested by the applications.
- As it uses in-memory database technology which allows the processing of massive amounts of real-time data in a short time.
- In addition, it performs advanced analytics (predictive analytics, spatial data processing, text analytics, text search, streaming analytics, graph data processing)
- It is deployable as an on-premise appliance, or in the cloud.

HANA DB architecture

SAP HANA is made up of many processes called “Services”

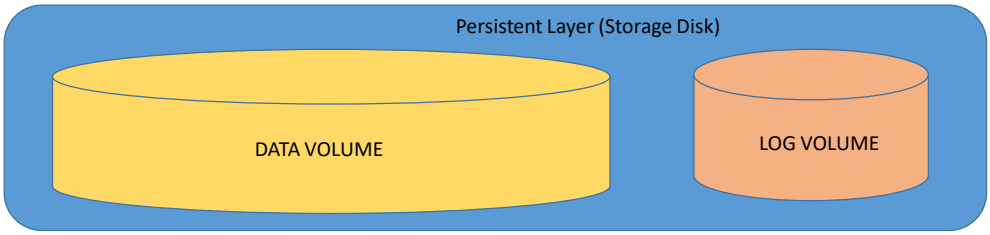


HANA DB in Memory Computing



HANA DB persistent layer

- SAP **HANA's persistence layer** is nothing but a disk based storage of Data which is stored under DATA And LOG Volumes.
- It manages logging of all the transactions in order to provide standard backup and restore functions.
- It offers regular savepoints, and also logging of all database transaction since the last savepoint.
- The **persistence layer** is responsible for the durability and atomicity of transactions.



Servers and Services Details

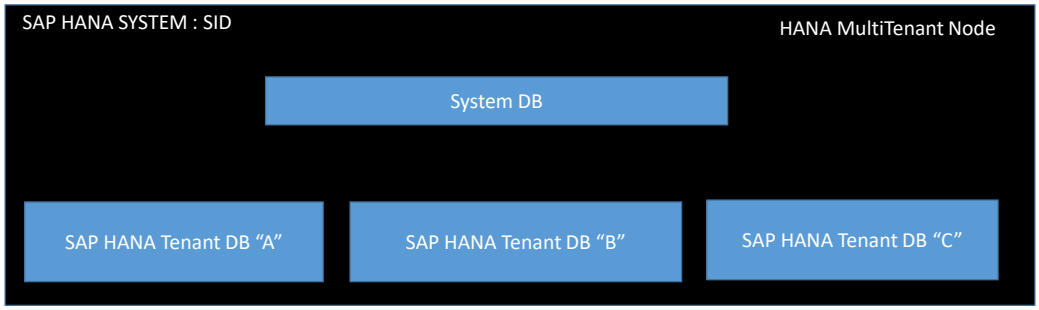
Server Component	OS Process	Service name	Description
Name server	hdbnameserver	nameserver	The name server, which runs in the system database, owns the information about the topology of the SAP HANA system, including knowledge of the tenant databases that exist in the system.
Index server	hdbindexserver	indexserver	The index server, which runs in every tenant database, contains the actual data stores and the engines for processing the data.
XS Classic Server	hdbxsengine	xsengine	It is installed with the SAP HANA database and allows developers to write and run SAP HANA-based applications without the need to run an additional application server. SAP HANA XS is also used to run web-based tools that come with SAP HANA, for instance for administration, lifecycle management and development. AP HANA XS, classic and the SAP HANA repository are deprecated as of SAP HANA 2.0 SPS 02. For more information, see SAP Note 2465027

Server Component	OS Process	Service name	Description
XS advanced runtime	•hdbxscontroller •hdbxsexeagent •hdixsuaaserver	•xscontroller •xsexeagent •hdixsuaaserver	SAP HANA includes a run-time environment for application development: **SAP HANA extended application services, advanced model** (XS advanced). The SAP HANA XS advanced model represents an evolution of the application server architecture within SAP HANA by building upon the strengths (and expanding the scope) of previous SAP HANA extended application services, classic model (XS classic).The SAP HANA XS advanced runtime consists of several processes for platform services and for executing applications. The SAP HANA XS advanced runtime runs either on dedicated hosts or together with other SAP HANA components on the same host.
Script server	hdbscriptserver	scriptserver	The script server is used to execute application function libraries written in C++. The script server is optional and must be started manually in the database that requires it. For more information, see SAP Note 1650957.

Server Component	OS Process	Service name	Description
Preprocessor server	hdbpreprocessor	preprocessor	The preprocessor server is used by the index server to analyze text data and extract the information on which the text search capabilities are based. It runs in the system database and serves all tenant databases.
Compile server	hdbcompileserver	compileserver	The compile server performs the compilation of stored procedures and programs, for example, SQLScript procedures. It runs on every host and does not persist data. It runs in the system database and serves all tenant databases.
SAP Web Dispatcher	hdbwebdispatcher	webdispatcher	The Web Dispatcher processes inbound HTTP and HTTPS connections to XS classic services.
SAP start service	sapstartsrv	sapstartsrv	The SAP start service is responsible for starting and stopping the other services in the correct order. It also performs other functions, such as monitoring their runtime state.
Data Provisioning Server	dpserver	hdbdpserver	To provide SAP HANA smart data access function.

SAP HANA : MultiTenant Database Containers (MDC)

- Prior to SPS09, SAP HANA supported multiple schemas in one SAP HANA system and multiple SAP HANA systems on single SAP HANA virtualized hardware.
- With SPS09, SAP HANA added support for multiple tenant databases in one SAP HANA system for production use. We call this feature, “Multitenant database containers”.
- As of SAP HANA 2.0 Support Package Stack (SPS) 01, the SAP HANA system can only be installed or configured to be a tenant database system.



SAP HANA system with multitenant database containers feature can contain multiple tenant databases. All tenant databases in the same system share the same system resources (memory and CPU Cores). However, each tenant database is fully isolated with its own database users, catalog, repository, persistence (data files and log files) and database services.

With multitenant database containers, you can assign system resource limits (memory and CPU cores) to each tenant database so that higher workload on one tenant database cannot impact other tenant databases. You can also change the allocated resources at any time, based on changing needs of each tenant database. You also get the flexibility to backup and recover all tenant databases at once or single tenant database at a time. This means, by running multiple tenant databases in one SAP HANA system and managing them as one, you can lower capital expenditure with better utilization of system resources and operating expenditure with simplified database maintenance.

Information on Tenant Database

A MDC always has exactly one 'SYSTEM' database, used for central system administration, and any number of tenant databases (including zero).

An SAP HANA system is identified by a single system ID (SID).

Databases are identified by a SID and a **database name**.

From the administration perspective, there is a distinction between tasks performed at system level and those performed at database level.

Database clients, such as the SAP HANA studio, connect to specific databases.

All the databases share the same installation of database system software, the same computing resources, and the same system administration.

However, each database is self-contained and fully isolated with its own:

- Set of database users
- Database catalog
- Repository
- Persistence
- Backups
- Traces and logs

Although database objects such as schemas, tables, views, procedures, and so on are local to the database, cross-database SELECT queries are possible

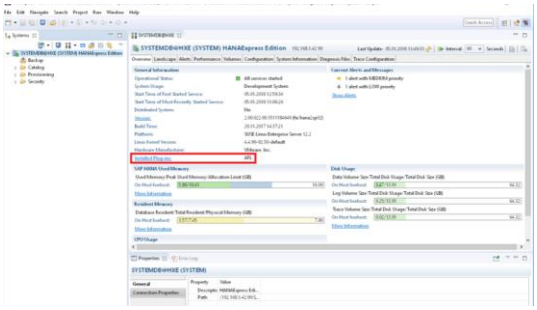
HANA STUDIO

SAP HANA Studio is an Eclipse-based tool.
SAP HANA Studio is both, the central development environment and the main administration tool for HANA system.
Additional features are −

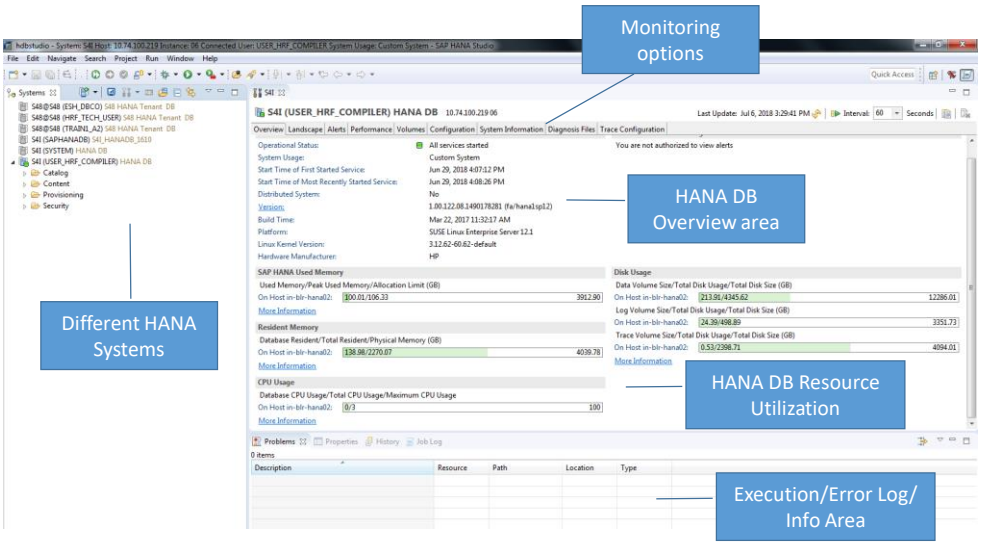
- It is a client tool, which can be used to access local or remote HANA system.
- It provides an environment for HANA Administration, HANA Information Modeling, and Data Provisioning in HANA database.

There are various administration tasks that can be performed using SAP HANA Studio −

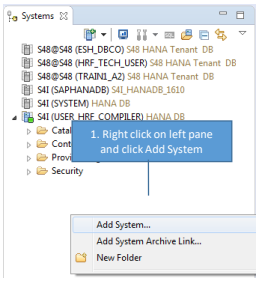
- To start and stop service
- To perform monitoring of SAP HANA system
- To perform user management and authorization
- To perform backup and recovery
- To perform Audit policy and Security configuration
- To perform license management
- To perform other configurations in HANA system
- To perform SQL development tasks - SQL Stored Procedures

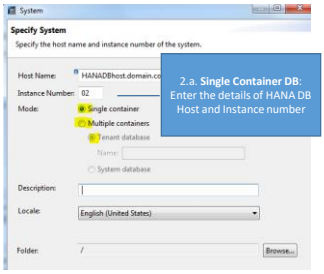


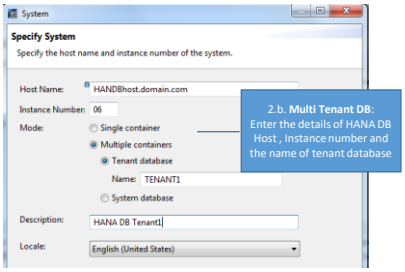
HANA Studio overview

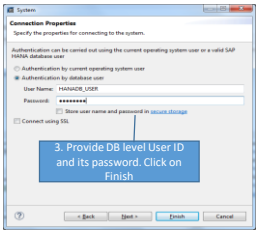


Adding a HANA Database into Studio:





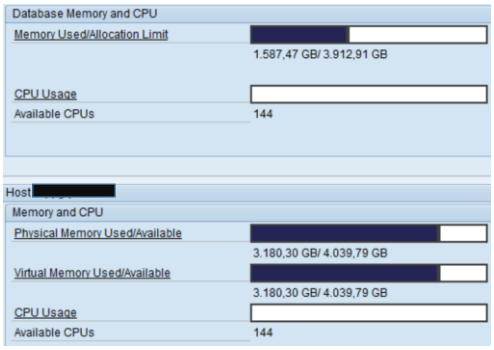




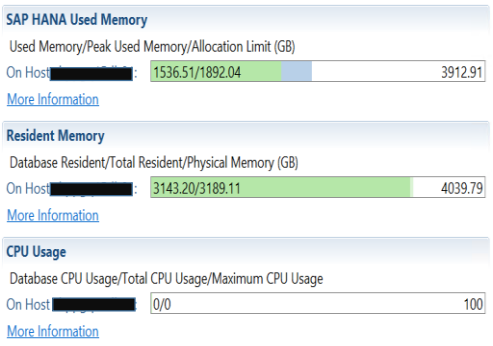
HANA DB Monitoring – Memory Consumption

(SAP System on HANA Vs HANA Studio)

From SAP system (DB02)



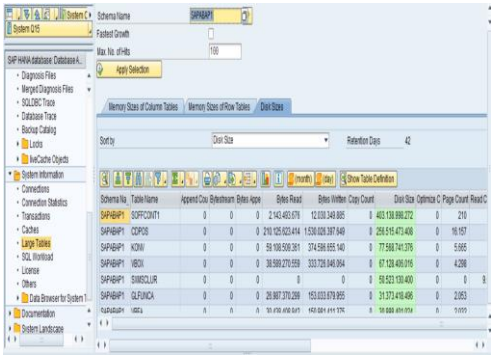
From HANA Studio



HANA DB Monitoring – Table Sizes

(SAP System on HANA Vs HANA Studio)

From SAP system (DB02)



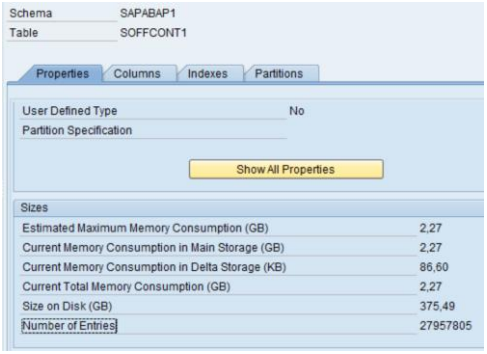
From HANA Studio

SCHEMA_NAME	TABLE_NAME	DISK_SIZE
SAPABAP1	SOFFCONT1	403,179,290,624
SAPABAP1	CDPOS	256,515,473,408
SAPABAP1	KONV	77,731,442,688
SAPABAP1	VBOX	67,128,410,112
SAPABAP1	SXMSCLUR	50,523,130,400
SAPABAP1	GLFUNCA	31,422,763,008
SAPABAP1	VBFA	30,880,206,848
SAPABAP1	BSEG	29,655,298,048
SAPABAP1	BALDAT	29,586,964,480
SAPABAP1	YCB_BAGATTRIB...	27,624,243,200
SAPABAP1	SCR_ABAP_SYMB	26,719,625,216
SAPABAP1	SXMSCLUP	26,551,993,872

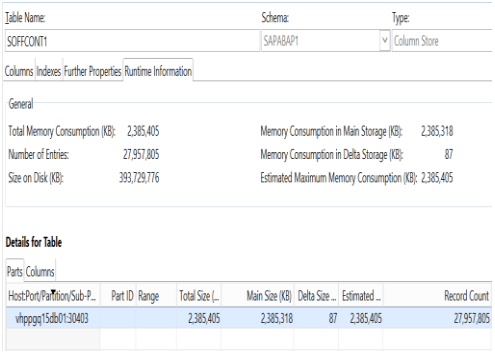
HANA DB Monitoring – Table Details

(SAP System on HANA Vs HANA Studio)

From SAP system (DB02)

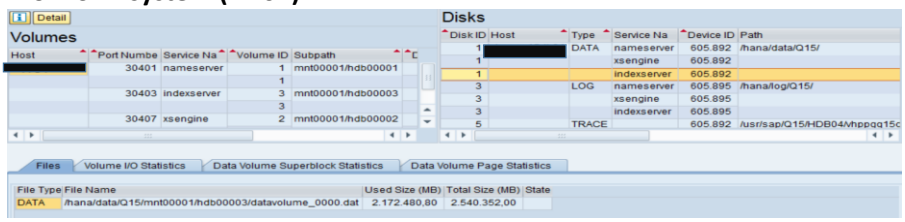


From HANA Studio

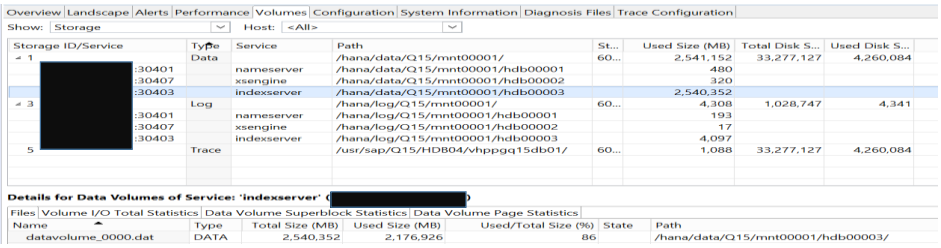


HANA DB Monitoring – Storage Volumes

From SAP system (DB02)



From HANA Studio



Monitoring on HANA

System Monitor in HANA Studio provides an overview of all your HANA system at a glance. From System Monitor, you can drill down into the details of an individual system in the Administration Editor. It tells about Data disk, Log disk, Trace disk, Alerts on resource usage with priority.

Following Information is available in the system monitor :-

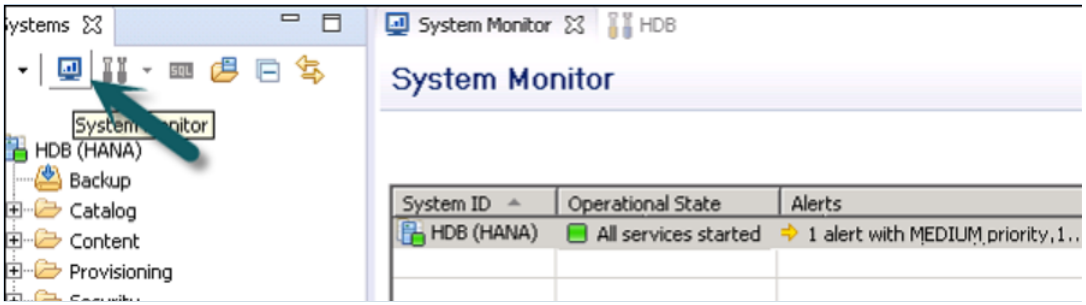
Column	Description
System ID	ID Assigned to a system when added.
Operational state	Overall system status.
Alerts	The systems generates alerts when resource usage and statistical threshold are violated. These alerts are categorized as low, medium and high priority.
Data Disk (GB)	Size of data volume on disk.
Log Disk (GB)	Size of log volume on disk.
Database Resident Memory	Size of resident memory at operating system level owing to SAP HANA db process.
System resident memory	Total size of resident memory.

Monitoring on HANA

Column	Description
Used Memory	Amount of Physical memory used by SAP Database.
CPU %	Percentage of CPU used by SAP HANA Database.
Hostname	Name of server hosting the SAP HANA Database.
Instance number	Instance number is the administrative unit that comprises the server software components.
System Data Disk	Total Disk space occupied on disk(s) containing data
System Log Disk	Total Disk space occupied on disk(s) containing Log files.
System Trace Disk	Total Disk space occupied on disk(s) containing trace files.
System CPU %	Overall CPU usage
Version	Software Version number of Hana Studio
Platform	Operating system on which SAP HANA studio is running.
Number of Crash dump files	The number of crash dump files in the trace directory of the system.

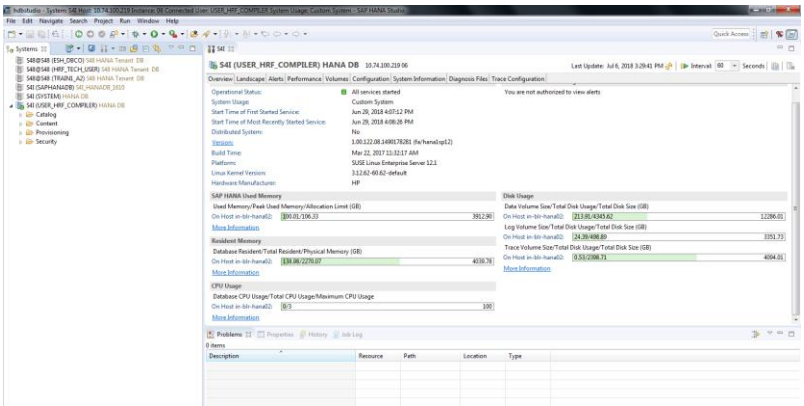
Monitoring on HANA

SAP HANA alert monitoring is used to monitor the status of system resources and services that are running in the HANA system. Alert monitoring is used to handle critical alerts like CPU usage, disk full, FS reaching threshold, etc. It raises an alert when any of the component breaches the set threshold value. The System Monitor is the most common way to monitor HANA system and to verify the availability of all your SAP HANA system components.
All your HANA Database of your system landscape can be integrated.
Working with a Database with different user is possible.



Monitoring on HANA

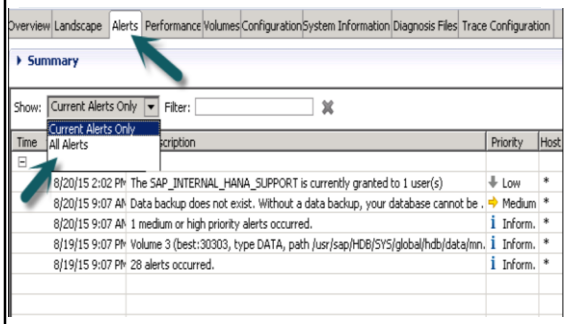
Provides most important information about one database at a glance. You can also drill down the details of an individual system in Administration Editor. It tells about Database and general system information, Memory usage, CPU Usage ,Data disk, Log disk, Trace disk, alerts on resource usage with priority.



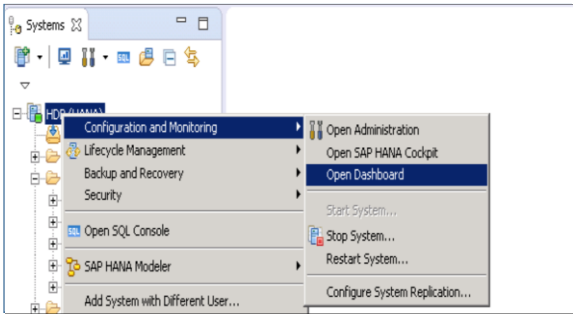
Monitoring on HANA

Alert tab in Administrator editor is used to check the current and all other alerts in HANA system.
It also shows the time when an alert is raised, the description of the alert, the priority of the alert, etc.
SAP HANA monitoring dashboard shows the key aspects of system health and configuration.

Alert TAB :-

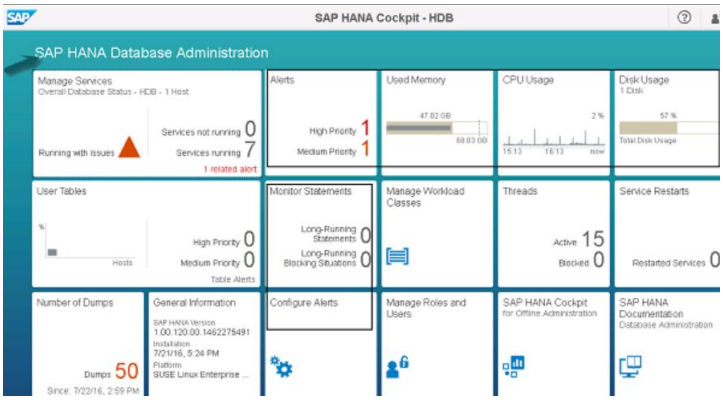


Monitoring Dashboard

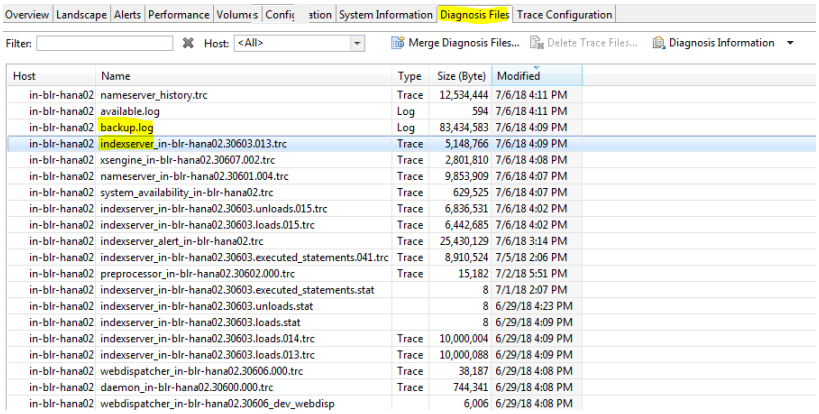


Monitoring on HANA Administrator Editor

You can also use SAP HANA Cockpit for system monitoring and alerts. SAP HANA Cockpit can be opened directly from HANA Studio or you can also open it via web browser. You should have sap.hana.admin.roles::Monitoring or sap.hana.admin.roles::Administrator role assigned to access SAP HANA Database Administrator catalog access.

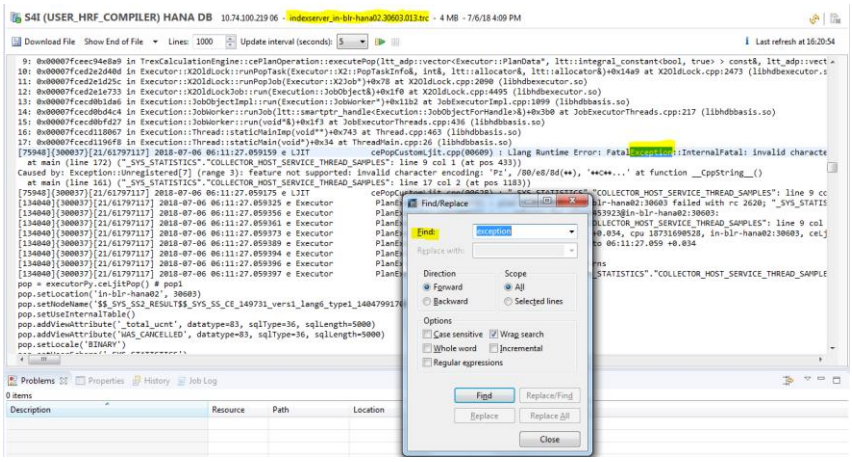


Basic Troubleshooting

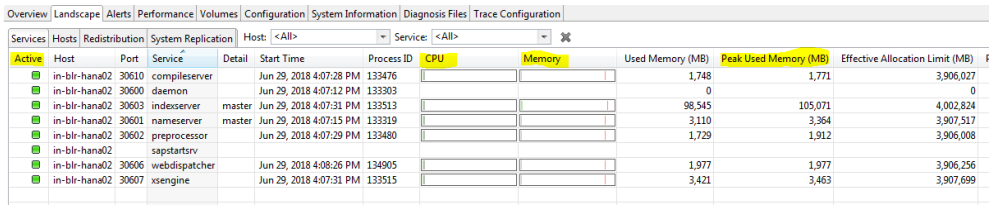


Host	Name	Type	Size (Byte)	Modified
in-blr-hana02	nameserver_history.trc	Trace	12,534,444	7/6/18 4:11 PM
in-blr-hana02	available.log	Log	594	7/6/18 4:11 PM
in-blr-hana02	backup.log	Log	83,434,583	7/6/18 4:09 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.013.trc	Trace	5,148,766	7/6/18 4:09 PM
in-blr-hana02	xsengine_in-blr-hana02.30607.002.trc	Trace	2,801,810	7/6/18 4:08 PM
in-blr-hana02	nameserver_in-blr-hana02.30601.004.trc	Trace	9,853,909	7/6/18 4:07 PM
in-blr-hana02	system_availability_in-blr-hana02.trc	Trace	629,525	7/6/18 4:07 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.unloads.015.trc	Trace	6,836,531	7/6/18 4:02 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.loads.015.trc	Trace	6,442,685	7/6/18 4:02 PM
in-blr-hana02	indexserver_alert_in-blr-hana02.trc	Trace	25,430,129	7/6/18 3:14 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.executed_statements.041.trc	Trace	8,910,524	7/5/18 2:06 PM
in-blr-hana02	preprocessor_in-blr-hana02.30602.000.trc	Trace	15,182	7/2/18 5:51 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.executed_statements.stat		8	7/1/18 2:07 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.unloads.stat		8	6/29/18 4:23 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.loads.stat		8	6/29/18 4:09 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.loads.014.trc	Trace	10,000,004	6/29/18 4:09 PM
in-blr-hana02	indexserver_in-blr-hana02.30603.loads.013.trc	Trace	10,000,088	6/29/18 4:09 PM
in-blr-hana02	webdispatcher_in-blr-hana02.30606.000.trc	Trace	38,187	6/29/18 4:08 PM
in-blr-hana02	daemon_in-blr-hana02.30600.000.trc	Trace	744,341	6/29/18 4:08 PM
in-blr-hana02	webdispatcher_in-blr-hana02.30606_dev_webdisp		6,006	6/29/18 4:08 PM

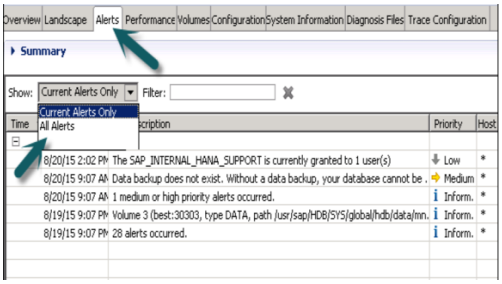
Basic Troubleshooting



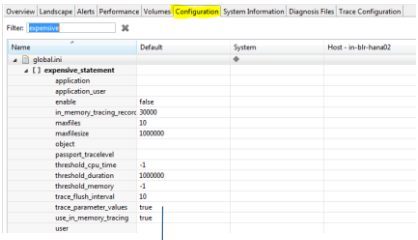
Basic Troubleshooting



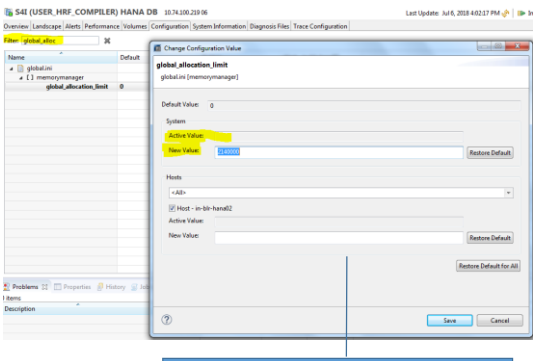
Active	Host	Port	Service	Detail	Start Time	Process ID	CPU	Memory	Used Memory (MB)	Peak Used Memory (MB)	Effective Allocation Limit (MB)
	in-blr-hana02	30610	compileserver		Jun 29, 2018 4:07:28 PM	133476			1,748	1,771	3,906,027
	in-blr-hana02	30600	daemon		Jun 29, 2018 4:07:12 PM	133303			0		0
	in-blr-hana02	30603	indexserver	master	Jun 29, 2018 4:07:31 PM	133513			98,545	105,071	4,002,824
	in-blr-hana02	30601	nameserver	master	Jun 29, 2018 4:07:15 PM	133319			3,110	3,364	3,907,517
	in-blr-hana02	30602	preprocessor		Jun 29, 2018 4:07:29 PM	133480			1,729	1,912	3,906,008
	in-blr-hana02		sapstartsrv								
	in-blr-hana02	30606	webdispatcher		Jun 29, 2018 4:08:26 PM	134905			1,977	1,977	3,906,256
	in-blr-hana02	30607	xsengine		Jun 29, 2018 4:07:31 PM	133515			3,421	3,463	3,907,699



DB Parameters configuration

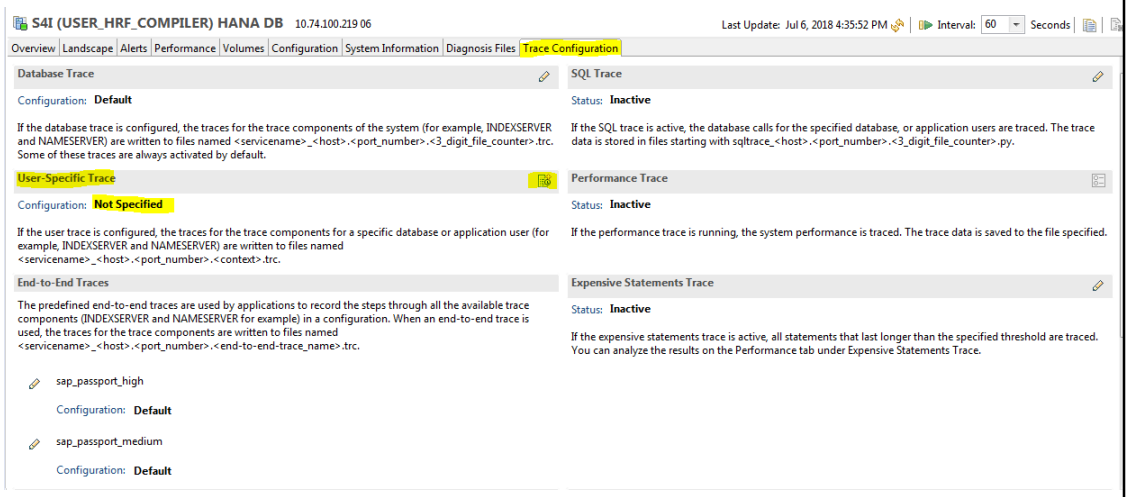


We can search the necessary parameter

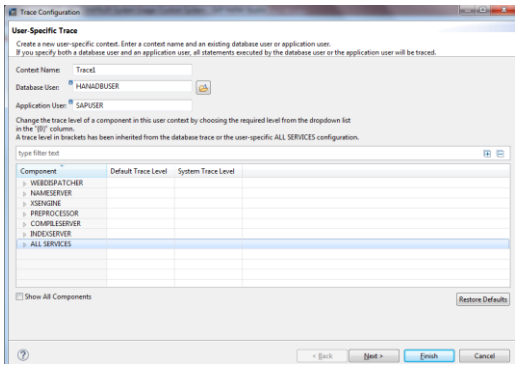


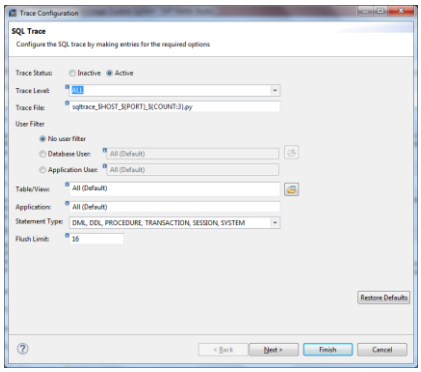
We can edit the parameter as per the recommended value.
Some parameters need DB restart.

HANA DB Traces



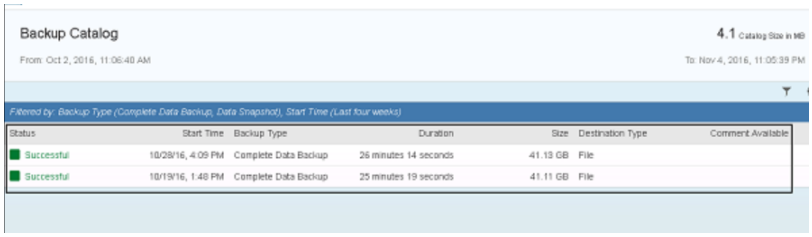
HANA DB Trace configuration





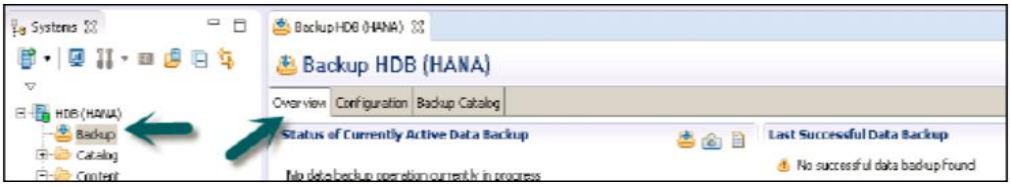
HANA DB Backup and Recovery

SAP HANA backup and recovery is used to perform HANA system backups and recovery of system in case of any database failure.
To view backup details, you can navigate to SAP HANA Backup app in HANA Cockpit. You can see the last backup status on the main screen.
You can also see the last backup status, time, duration, size and destination type details under Backup Catalog details.



HANA DB Backup and Recovery

You can also perform SAP HANA Backup using HANA Studio. Navigate to Backup Folder in System view.



Overview Tab	This tab specifies the status of the currently running data backup and last successful data backup.
Configuration Tab	**This tab specifies the Backup interval settings, file-based data backup settings, and log based data backup setting.**
Backup interval setting	**Backint settings provides an option to use third party tool for data and log backup with configuration of a backing agent.** **Configure the connection to a third-party backup tool by specifying a parameter file for the Backint agent.**

HANA DB Backup and Recovery

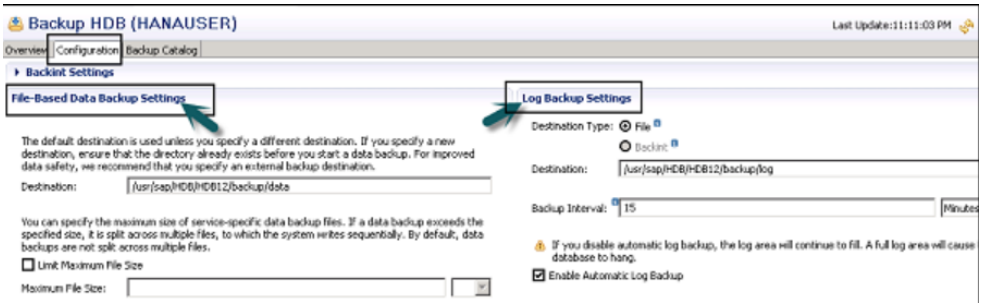
There are three options for SAP HANA backup -- file system, Backint and snapshot. You can also mix backup methods. These backup methods can be used to create full ,incremental or differential backups.

- File system backups protect only the current data, as opposed to the entire data area, and perform block-level consistency checks. However, file system backups place a load on the network, and it is necessary to monitor the file system fill level.
- The Backint method is an API-based method, and it usually refers to SAP HANA backup using a third-party utility. Like a file system backup, this method also performs block-level consistency checks and only backs up the current data rather than the entire data area. Because this method enables integration with third-party backup utilities, it fits neatly into an organization's existing backup infrastructure, and it enables features such as backup encryption and data reduction.
- The third option is to create a snapshot. Snapshots can be created or applied very quickly, and snapshots do not create the network load that file system and Backint backups do. However, snapshots do not perform block-level consistency checks, nor do they enable you to use third-party backup tools.

HANA DB Backup and Recovery

File and Log based Database Data Backup Settings :-

- File-based data backup setting specifies the folder where you want to save the data backup on HANA system. You can change your backup folder. You can also limit the size of data backup files. If the system data backup exceeds this set file size, it will split across the multiple files.
- Log backup settings specify the destination folder where you want to save log backup on the external server. You can choose a destination type for log backup.

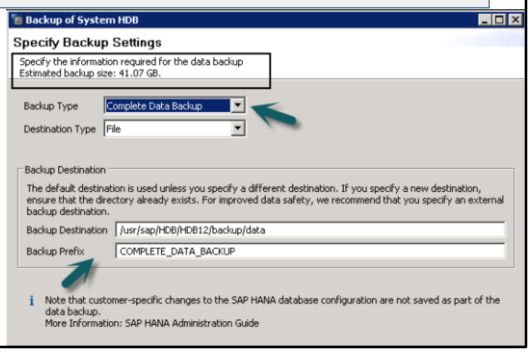


HANA DB Backup and Recovery

Full, Incremental and differential backup :-

- **Full Data Backup** :- A full data backup saves all current data that is contained in the data area.
- I**ncremental** :- Incremental backup saves the data changed since the last data backup.
- **Differential** :- Differential backups save all the data changed since the last full data backup.

Backup wizard is used to specify backup settings.
It specifies the Backup type, Destination type, Backup Destination folder, Backup prefix, the size of backup, etc.
Click Next → Review Backup settings → Finish. It runs the system backups and shows the time of complete backup for each server.



HANA DB Backup and Recovery

Recovery of SAP HANA database is required in the following situations –

- A disk in the data area is unusable or a disk in the log area is unusable.
- As a consequence of a logical error, the database needs to be reset to its state at a particular point in time.
- You want to create a copy of the database.

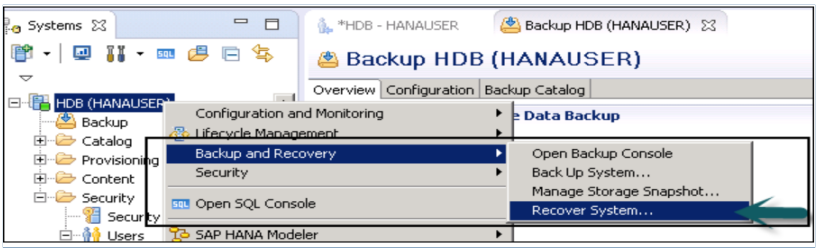
Most Recent State – Used for recovering the database to the time as close as possible to the current time. For this recovery, the data backup and log backup have to be available since the last data backup and the log area is required to perform the above type recovery.
Point in Time – Used for recovering the database to the specific point in time. For this recovery, the data backup and log backup have to be available, since last data backup and the log area are required to perform the above type of recovery.
Specific Data Backup – Used for recovering the database to a specified data backup. Specific data backup is required for the above type of recovery option.
Specific Log Position – This recovery type is an advanced option that can be used in exceptional cases where a previous recovery failed.

NOTE: To recover SAP HANA database, the database needs to shut down. Hence, during recovery, the end users or SAP applications cannot access the database.

HANA DB Backup and Recovery

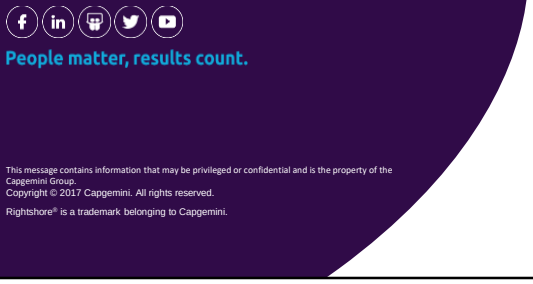
Points to Remember during Recovery

- To perform a recovery, an SAP HANA database needs to be shut down.
- To recover a database, at least one full backup (data backup or data snapshot) must be available.
- To recover a complete SAP HANA system, the system database needs to be recovered first, and then all the tenant databases are recovered individually.
- The system database only needs to be recovered if it is corrupted
- To recover a database to a point in time, a full backup (data backup or a data snapshot) must be available, together with all the relevant delta backups and log backups.
- At the beginning of a recovery, the data backup and all the log backups to be used must be either accessible in the file system or available through a third-party backup tool.
- An SAP HANA database cannot be recovered to an SAP HANA database with a lower software version.
- SAP HANA cockpit 2.0 can be used to recover SAP HANA using backups created with SAP HANA 1.0.



NOTE: To recover SAP HANA database, the database needs to shut down. Hence, during recovery, the end users or SAP applications cannot access the database.


THANK YOU



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