SAP HANA
Backup and Recovery (Overview, SPS09)

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Agenda

Backup

Recovery

Support for multitenant database containers

Dynamic tiering integration

Database copy

Tool support and certification

What‘s new?

Backup

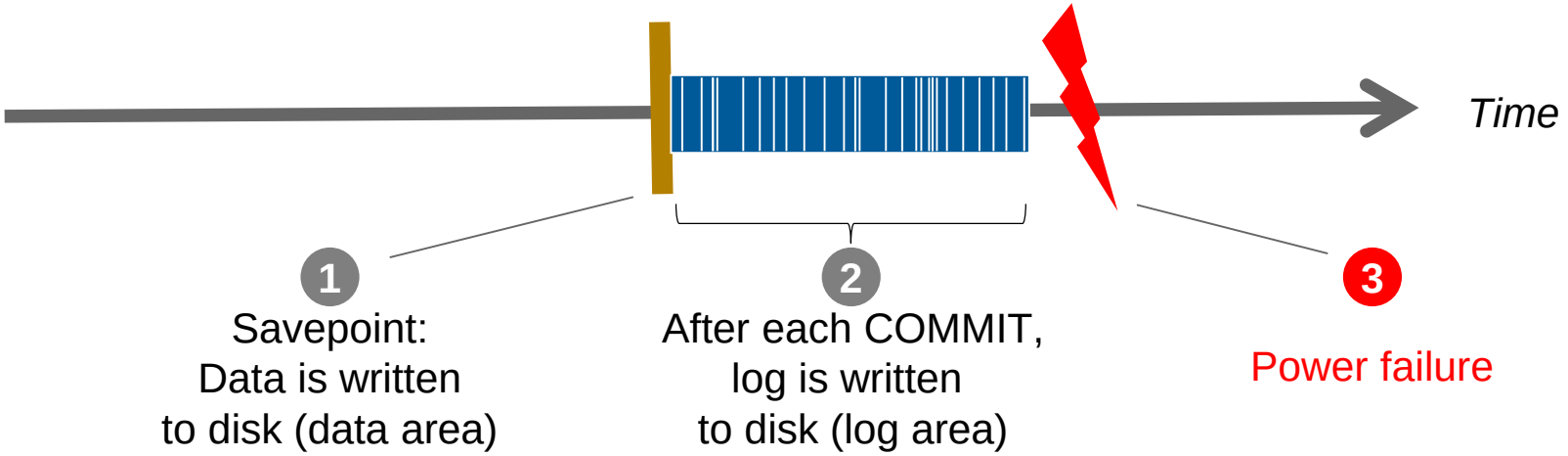
SAP HANA Backup and Recovery

In-memory data and persistent storage

In-memory computing is safe: The SAP HANA database holds the bulk of its data in memory for maximum performance, but still uses persistent storage to provide a fallback in case of failure.

During normal operation of the database, data is automatically saved from memory to disk at regular savepoints. Additionally, all data changes are captured in the log. The log is saved from memory to disk after each committed database transaction.

After a power failure, the database can be restarted like any disk-based database and returns to its last consistent state by replaying the log since the last savepoint.



SAP HANA Backup and Recovery

Why backups?

While savepoints and log writing protect your data against power failures, this does not help when the persistent storage itself is damaged or a logical error occurred.

Backups are required

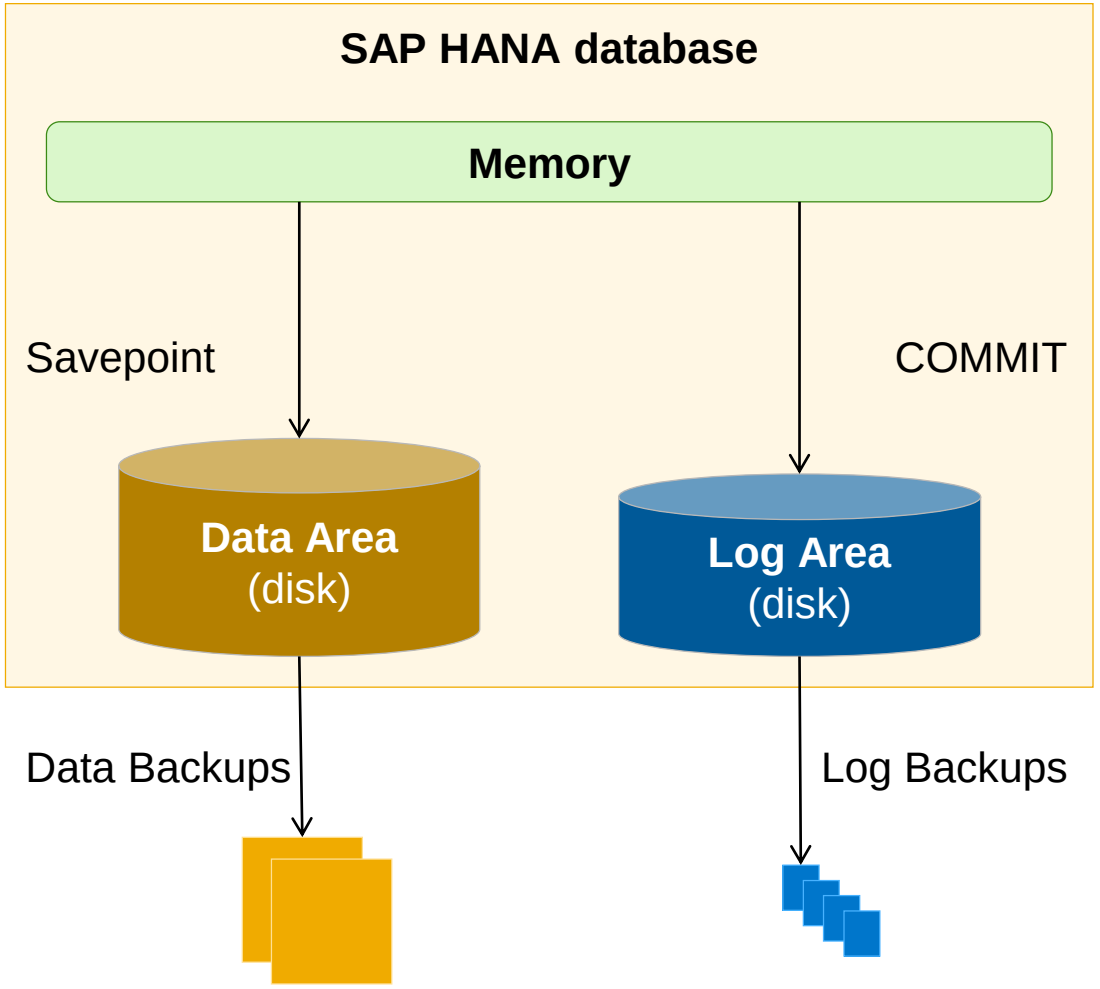
- **To protect against disk failures**
- **To make it possible to reset the database to an earlier point in time**

They are also useful for other scenarios such as database copy.

Backups are carried out while the database is running, users can continue to work normally.

SAP HANA Backup and Recovery

Memory ➔ disk ➔ backup



Data backups

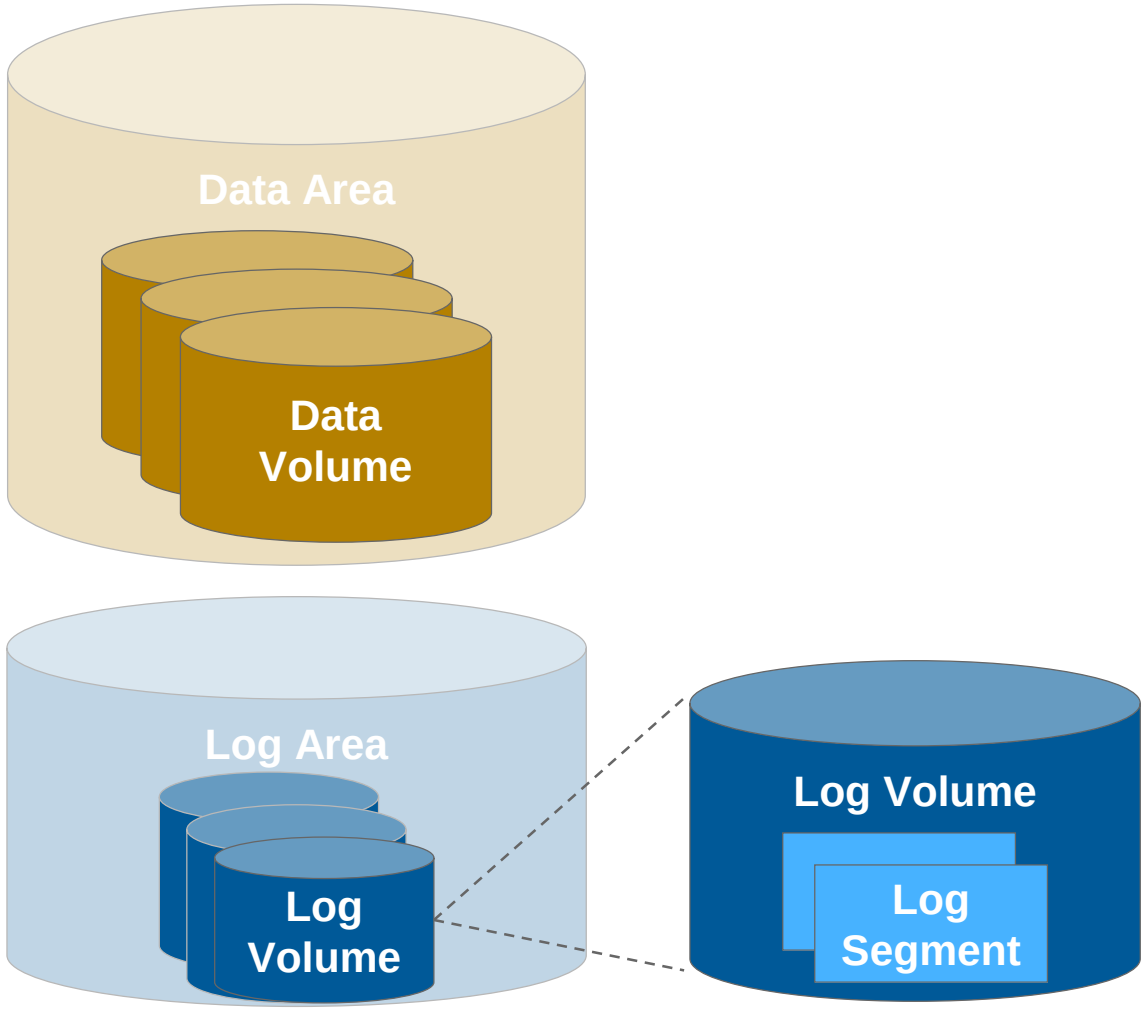
- Contain the current payload of the data volumes (data and undo information)
- Manual (SAP HANA studio, SQL commands), or scheduled (DBA Cockpit)

Log backups

- Contain the content of closed log segments; the backup catalog is also written as a log backup
- Automatic (asynchronous)

SAP HANA Backup and Recovery

Terminology



Data

- Data area = all data volumes
- 1 data volume per service with persisted data (per node)

Redo log

- Log area = all log volumes
- 1 log volume per service with persisted data (per node)
- Log volume contains log segments
  - Number of pre-formatted log segments is configurable
  - A log segment is closed and automatically backed up if
    - it is full; or
    - the log backup timeout (configuration parameter) has elapsed and the log segment contains a COMMIT entry
  - After a log segment has been successfully backed up, it is released for overwriting

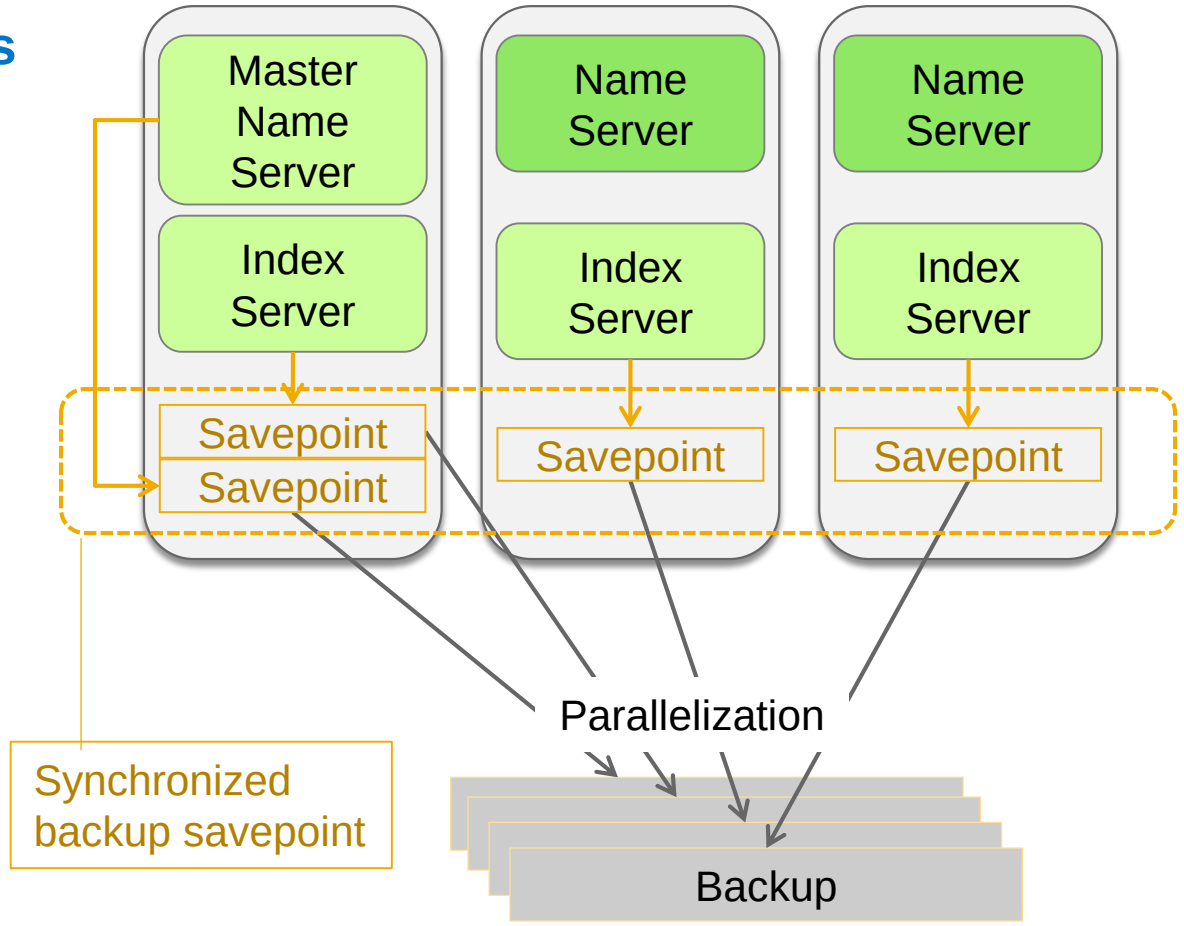
SAP HANA Backup and Recovery

Data backup: synchronization of multiple hosts

SAP HANA automatically handles the synchronization of the data backup across hosts

➔ no user interaction for synchronization required!

- **All services that persist data are backed up**
  - E.g. master name server, index servers
- **Global data backup savepoint** for these services
  - Synchronized across all hosts and services
  - Transactions are paused very briefly
  - Savepoint is kept until the backup is finished for all services. If a page is changed during the backup, it is written to a different location (**shadow page concept**)
- Data marked in the savepoint is read from the data volumes and written to the backups
  - **Parallelization:** one backup stream per service, double buffer technology for reading from the volumes and writing to the target

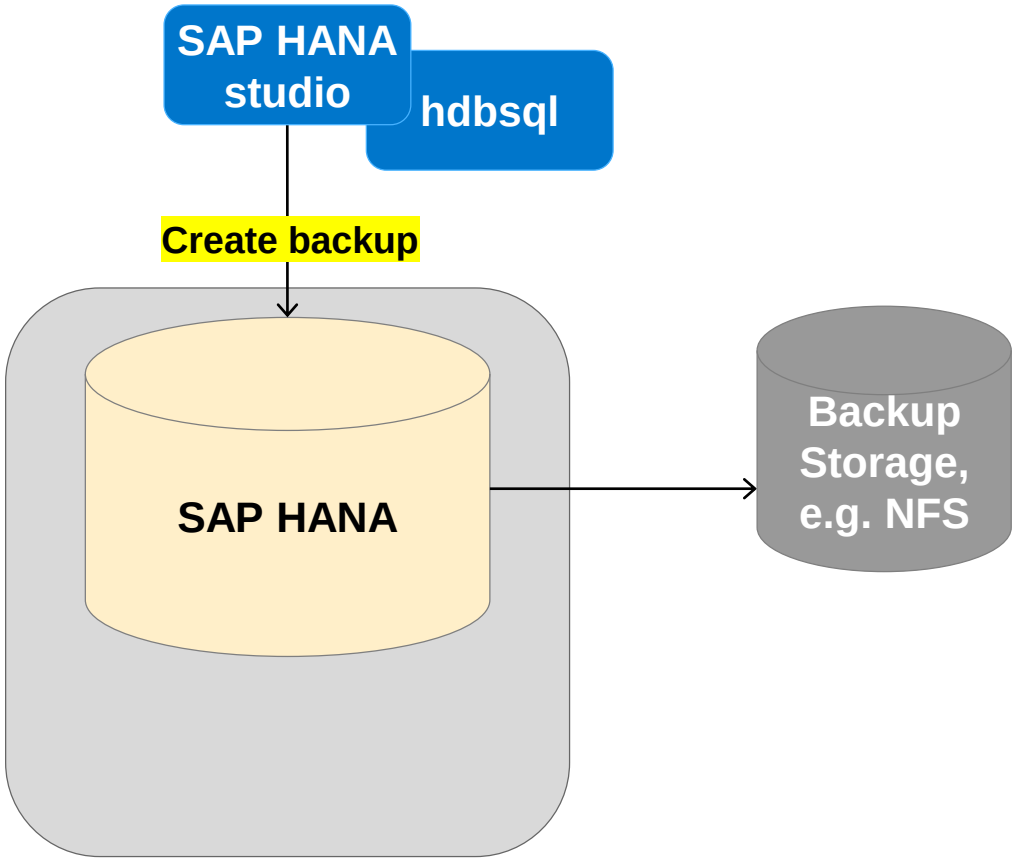


SAP HANA Backup and Recovery

Options for backups: File system

Backups to the file system

- For both data and log backups
- E.g. to an NFS share
- For information on file systems: SAP Note 1820529
- Data backups triggered/scheduled using SAP HANA studio, SQL commands, or DBA Cockpit, log backups written automatically (unless disabled)

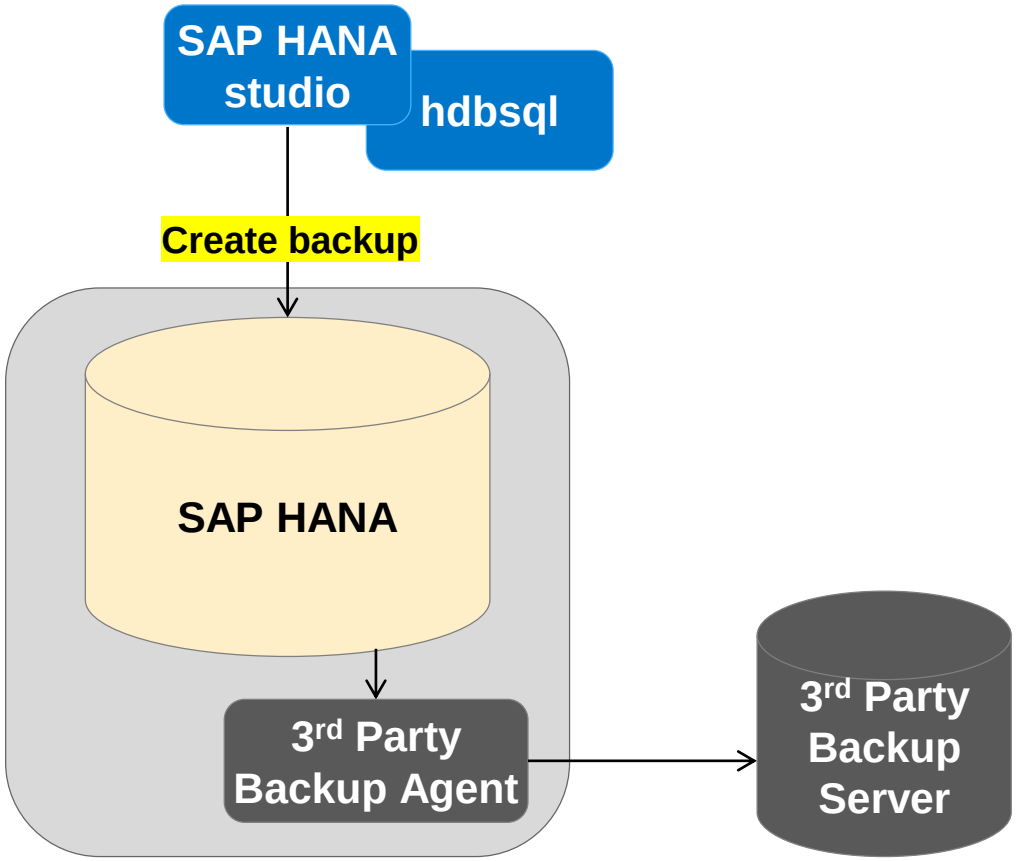


SAP HANA Backup and Recovery

Options for backups: Backint

Backups to 3rd party backup server

- For both data and log backups
- “Backint for SAP HANA” API can be implemented by a 3rd party backup agent (certification required)
- Provides functions for backup, recovery, query, delete
- 3rd party backup agent runs on the SAP HANA server, communicates with 3rd party backup server
- Backups are transferred via pipe
- Direct integration with SAP HANA:
  - Data backups to Backint can be triggered/scheduled using SAP HANA studio, SQL commands, or DBA Cockpit
  - Log backups are automatically written to Backint (if configured)



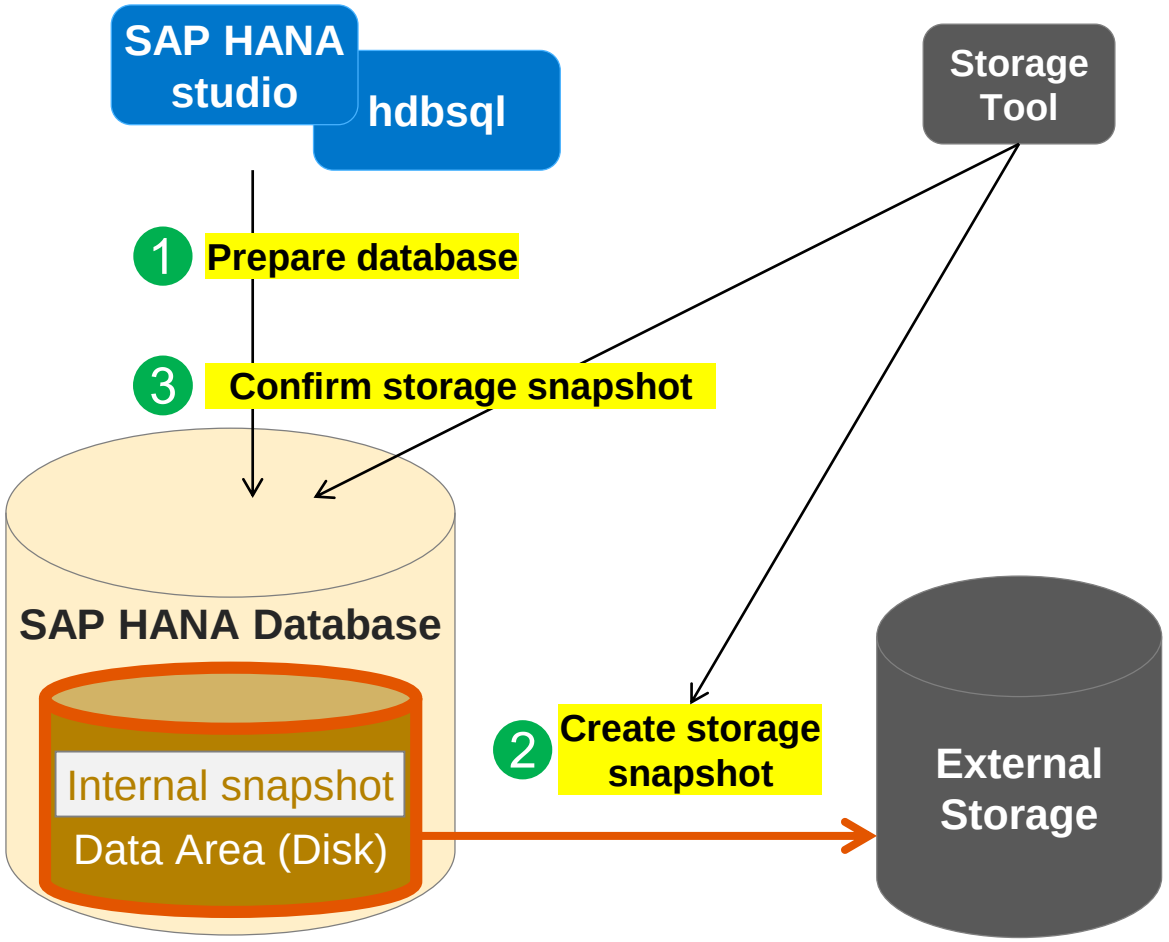
SAP HANA Backup and Recovery

Options for backups: Storage snapshot

Storage snapshots as backups

SAP HANA also supports the creation of storage snapshots, which can later be used for recovery

1. **Prepare the database** for the storage snapshot, using HANA Studio, SQL commands, or the storage tool (if implemented).
   Technically, this creates an internal backup snapshot (same as for a normal data backup)
2. Using the storage tool, **create a storage snapshot** of the SAP HANA data area
3. **Confirm the storage snapshot** as successful, using either HANA studio, SQL commands, or the storage tool (if implemented).
   An entry including the external backup ID is written to the backup catalog.



SAP HANA Backup and Recovery

Options for backup: Comparison

	File system	Backint	Storage snapshot
Advantages	• Consistency checks on block level	• Consistency checks on block level • Data center integration • Additional features, e.g. encryption or de-duplication • Backups immediately available for recovery	• Fast • Negligible network load
Disadvantages	• Additional storage required • File system fill level needs to be monitored • Additional time needed to make backups available for recovery • Network load	• Network load	• No consistency checks on block level
Size	• Payload only	• Payload only	• ~ Size data area, but usually compressed/de-duplicated by storage
Duration	• IO-bound (reading from data volume, writing to target) • Network-bound (writing to file system)	• IO-bound (reading from data volume) • Network-bound (writing to backup server)	• Negligible (logical pointers are replicated)

SAP HANA Backup and Recovery

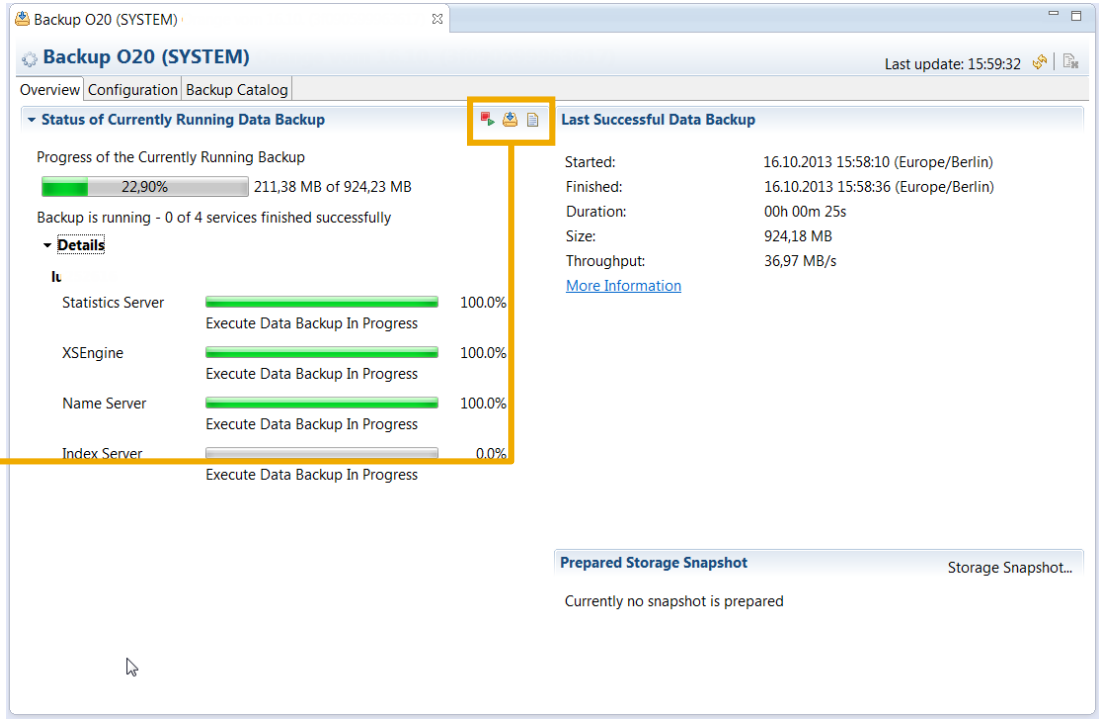
Backup information in SAP HANA Studio

You open the backup overview tab by double-clicking *Backup* in the *Systems* view in SAP HANA studio

- Progress information on currently running data backup, with information on the services included in the backup
- Last successful data backup
  - Start/end time, duration, size, and throughput
  - To display more detailed information on this data backup, click More Information
- Information on open snapshot

Buttons for

- Canceling running data backup
- Starting backup
- Displaying backup.log file



SAP HANA Backup and Recovery

Backup configuration in SAP HANA Studio

Backint

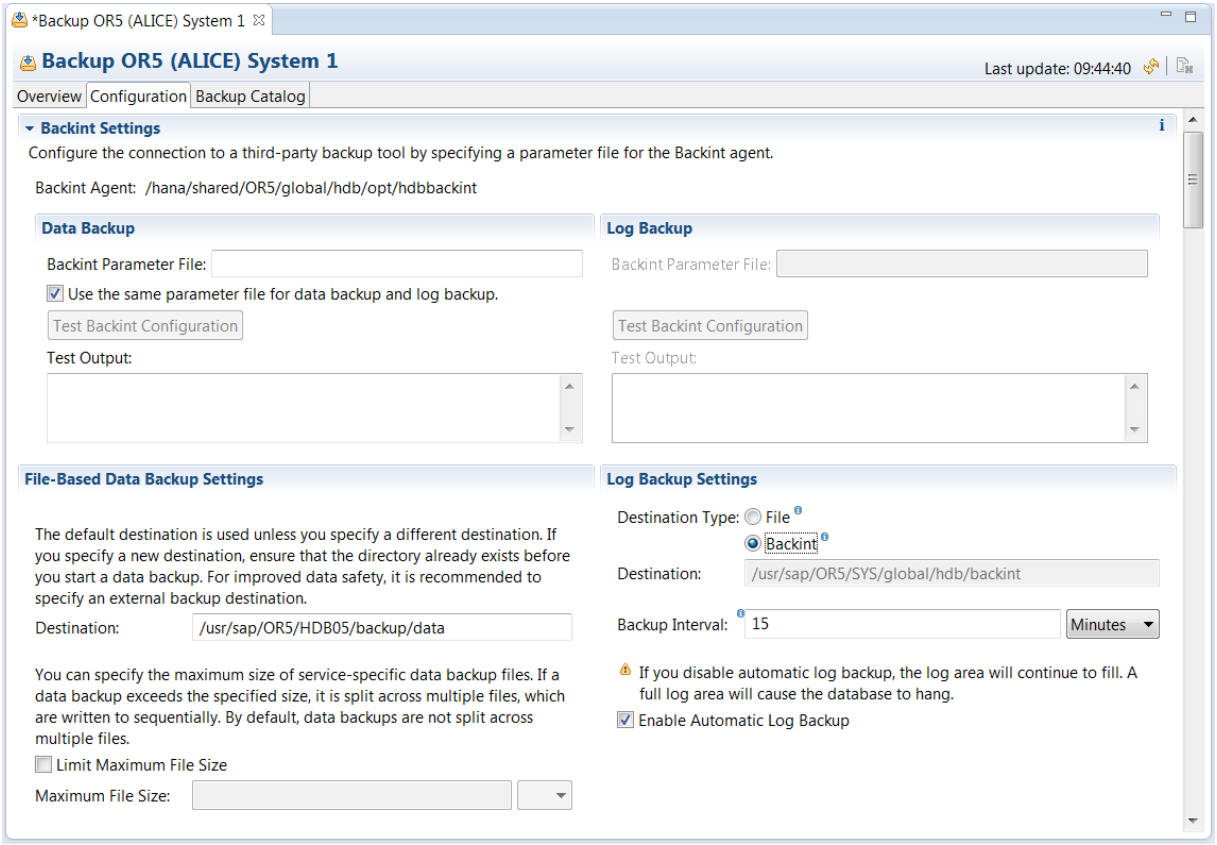
- If a 3rd party backup tool is installed, it is displayed automatically
- (optional) Specify vendor-specific parameter files

Data backup

- Default settings for data backups to the file system
- Destination, maximum file size
- You specify the destination type (file or Backint) when executing the data backup

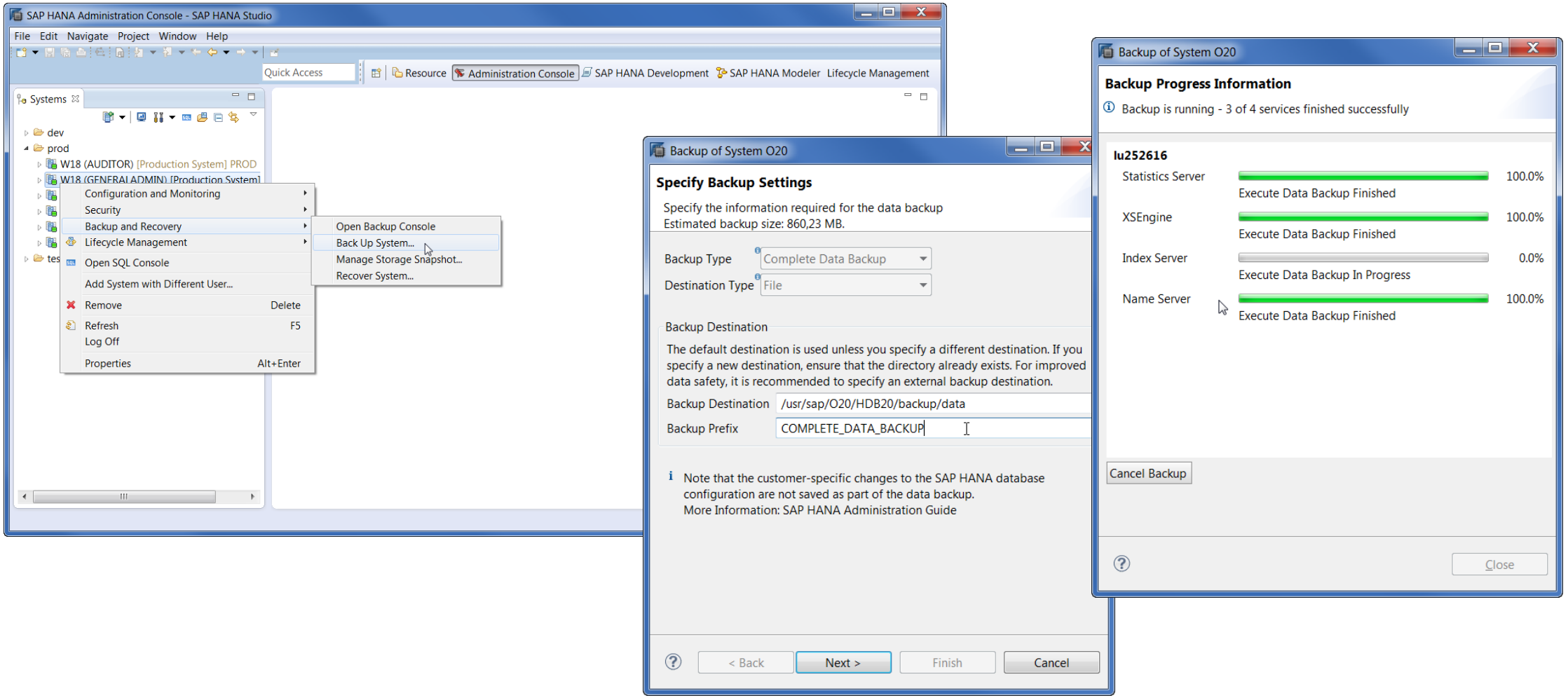
Log backup

- Default settings for log backups
- Destination type (file or Backint), destination, backup interval
- Log backups are carried out automatically unless disabled



SAP HANA Backup and Recovery

Creating a data backup



SAP HANA Backup and Recovery

Creating a storage snapshot

Creating a snapshot

1. In the *Systems* view in SAP HANA studio, right-click on the system and choose *Storage Snapshot...*
   Then choose the *Prepare* option.
   Alternatively, you can use the SQL command:
   ```
   BACKUP DATA CREATE SNAPSHOT COMMENT 'snapshot_test'
   ```
2. Using the storage tool, create a storage snapshot of the SAP HANA data area
3. In SAP HANA studio, confirm the successful storage snapshot and enter the external snapshot ID.
   Alternatively, you can use the SQL command:
   ```
   BACKUP DATA CLOSE SNAPSHOT BACKUP_ID 3456789 SUCCESSFUL 'storage_id_12345'
   ```

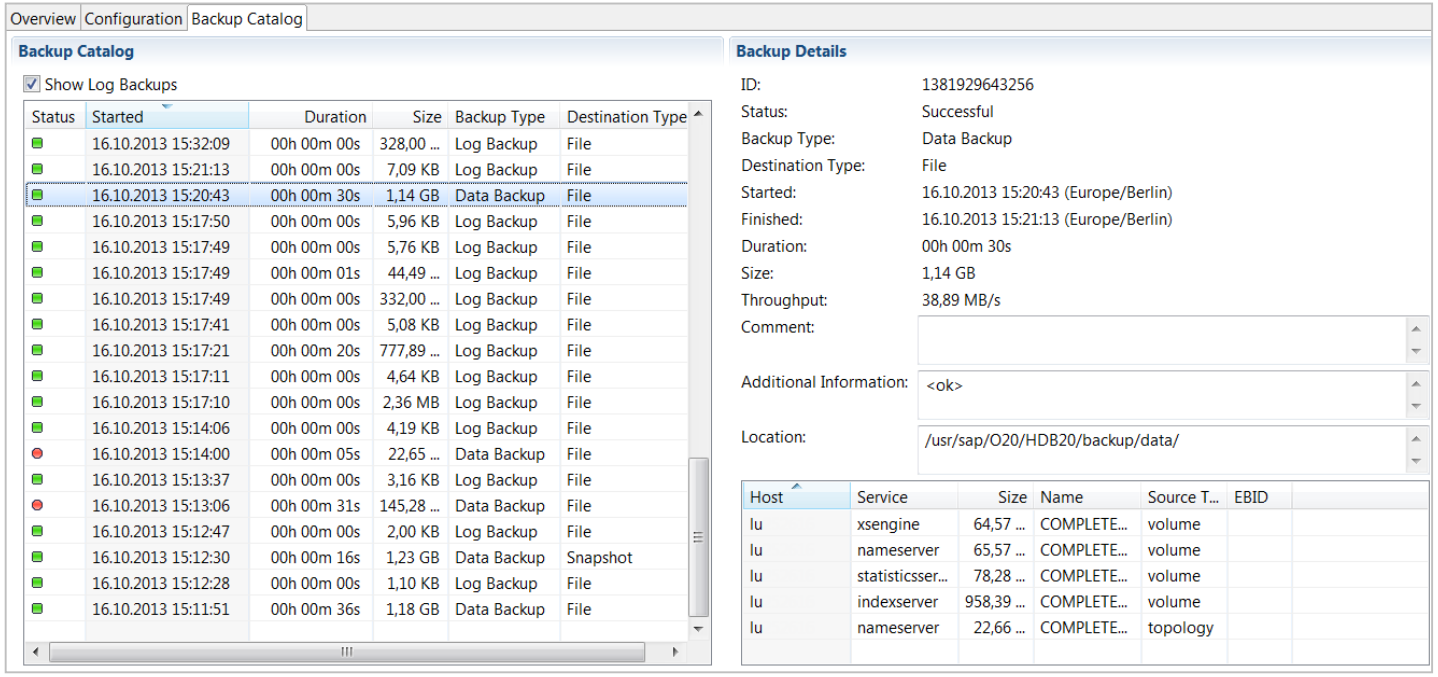
Storage snapshots are listed in the backup catalog. You can either display the backup catalog in SAP HANA studio, or query it using SQL (system view M_BACKUP_CATALOG).

SAP HANA Backup and Recovery

Backup catalog

The backup catalog provides detailed information on data backups, log backups and storage snapshots, for example start/end time, duration, size, and throughput

The backup catalog is stored within the SAP HANA database, and also backed up as part of the log backup (even in log mode OVERWRITE). This allows for offline access to the backup catalog during recovery.



Status	Started	Duration	Size	Backup Type	Destination Type
	16.10.2013 15:32:09	00h 00m 00s	328,00 ...	Log Backup	File
	16.10.2013 15:21:13	00h 00m 00s	7,09 KB	Log Backup	File
	16.10.2013 15:20:43	00h 00m 30s	1,14 GB	Data Backup	File
	16.10.2013 15:17:50	00h 00m 00s	5,96 KB	Log Backup	File
	16.10.2013 15:17:49	00h 00m 00s	5,76 KB	Log Backup	File
	16.10.2013 15:17:49	00h 00m 01s	44,49 ...	Log Backup	File
	16.10.2013 15:17:49	00h 00m 00s	332,00 ...	Log Backup	File
	16.10.2013 15:17:41	00h 00m 00s	5,08 KB	Log Backup	File
	16.10.2013 15:17:21	00h 00m 20s	777,89 ...	Log Backup	File
	16.10.2013 15:17:11	00h 00m 00s	4,64 KB	Log Backup	File
	16.10.2013 15:17:10	00h 00m 00s	2,36 MB	Log Backup	File
	16.10.2013 15:14:06	00h 00m 00s	4,19 KB	Log Backup	File
	16.10.2013 15:14:00	00h 00m 05s	22,65 ...	Data Backup	File
	16.10.2013 15:13:37	00h 00m 00s	3,16 KB	Log Backup	File
	16.10.2013 15:13:06	00h 00m 31s	145,28 ...	Data Backup	File
	16.10.2013 15:12:47	00h 00m 00s	2,00 KB	Log Backup	File
	16.10.2013 15:12:30	00h 00m 16s	1,23 GB	Data Backup	Snapshot
	16.10.2013 15:12:28	00h 00m 00s	1,10 KB	Log Backup	File
	16.10.2013 15:11:51	00h 00m 36s	1,18 GB	Data Backup	File

Host	Service	Size	Name	Source T...	EBID
lu	xsengine	64,57 ...	COMPLETE...	volume	
lu	nameserver	65,57 ...	COMPLETE...	volume	
lu	statisticsser...	78,28 ...	COMPLETE...	volume	
lu	indexserver	958,39 ...	COMPLETE...	volume	
lu	nameserver	22,66 ...	COMPLETE...	topology	

SAP HANA Backup and Recovery

Backup lifecycle management (I)

Deleting old backups may be required in order to manage your backup storage space or to fulfill regulatory deletion requirements

You can delete old backups

- From the backup catalog (logical view)
- Physically (from disk and/or from a 3rd party backup server via the Backint interface)

There is an audit event which you can enable to create an entry in the audit trail whenever a backup is deleted using this function.

The deletion functionality is available both in SAP HANA studio (see next slide) and on the command line (SQL commands)

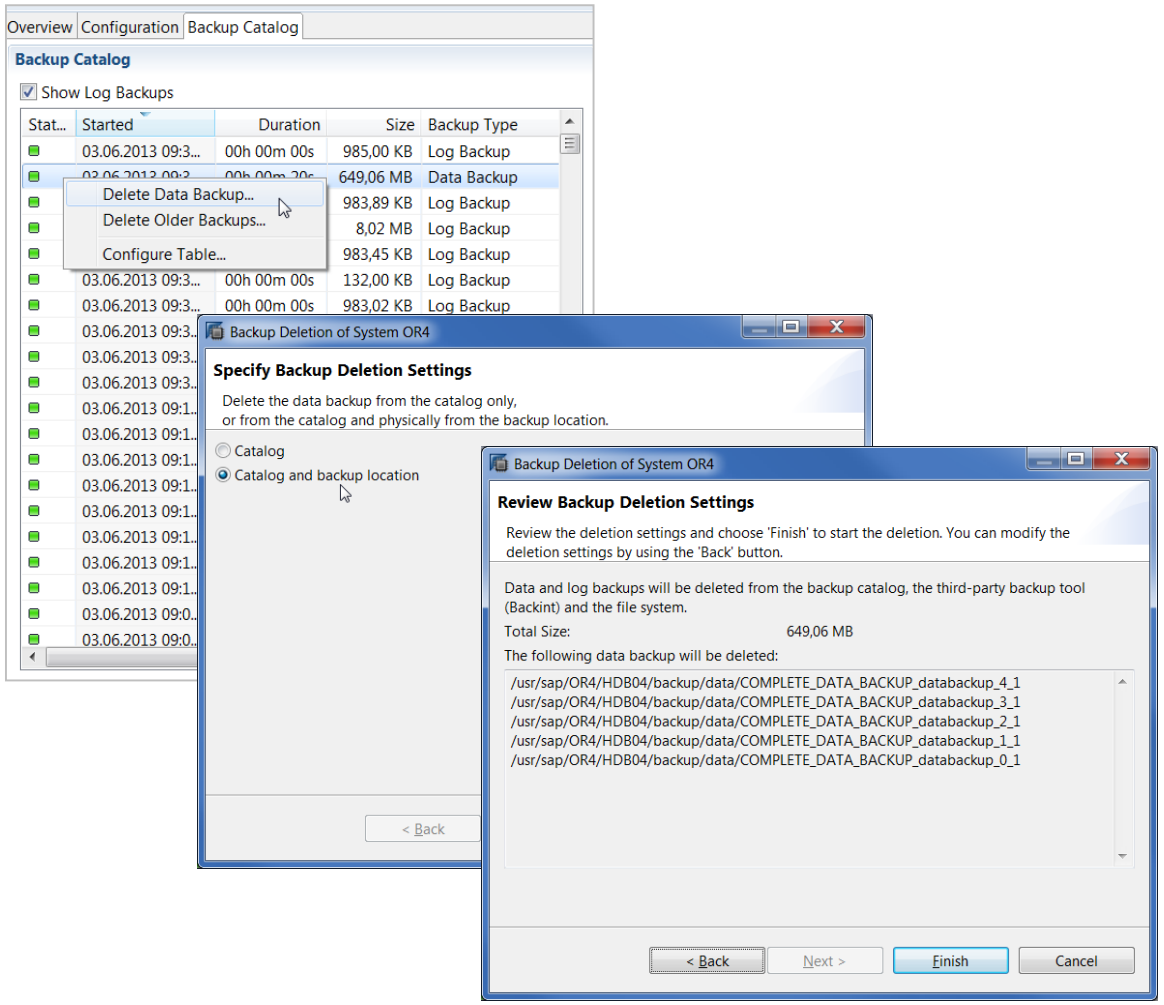
SAP HANA Backup and Recovery

Backup lifecycle management (II)

Prerequisite

- BACKUP ADMIN system privilege

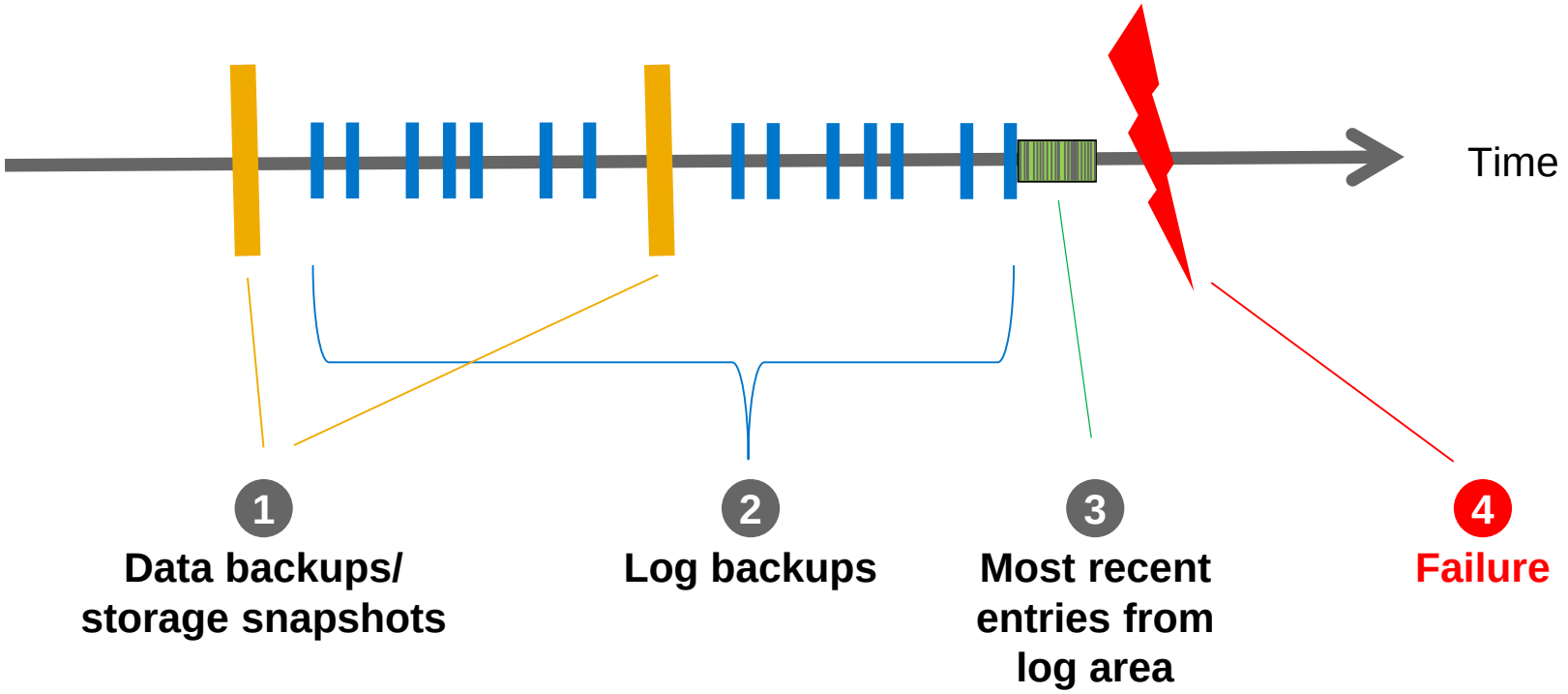
1. In the Systems view in SAP HANA studio, double-click *Backup* and open the *Backup Catalog* tab
2. Right-click on a data backup in the list and select an option:
   - Delete the selected data backup only
   - Delete backups (both data and log backups) that are older than the selected data backup
3. Choose whether you want to delete the entry in the backup catalog only, or whether you want to also physically delete the backup (from the file system or if available from the 3rd party backup tool)
4. Review your settings before starting the deletion by pressing *Finish*



Recovery

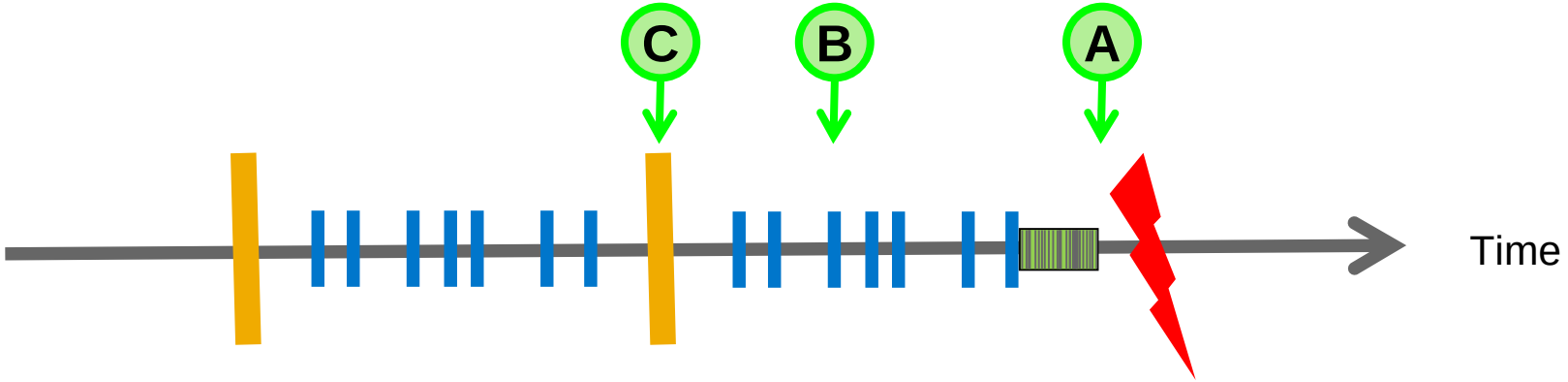
SAP HANA Backup and Recovery

Backups during normal database operation



SAP HANA Backup and Recovery

Recovery options



(A) To the most recent state

- Uses the specified data backup or storage snapshot
  + subsequent log backups
  + entries that are still available in the log area (if it was not destroyed by the failure)

(B) To a point in time in the past

- Uses the specified data backup or storage snapshot
  + subsequent log backups
  + entries that are still available in the log area (if it was not destroyed by the failure)

(C) Using a specified data backup or storage snapshot (without log replay)

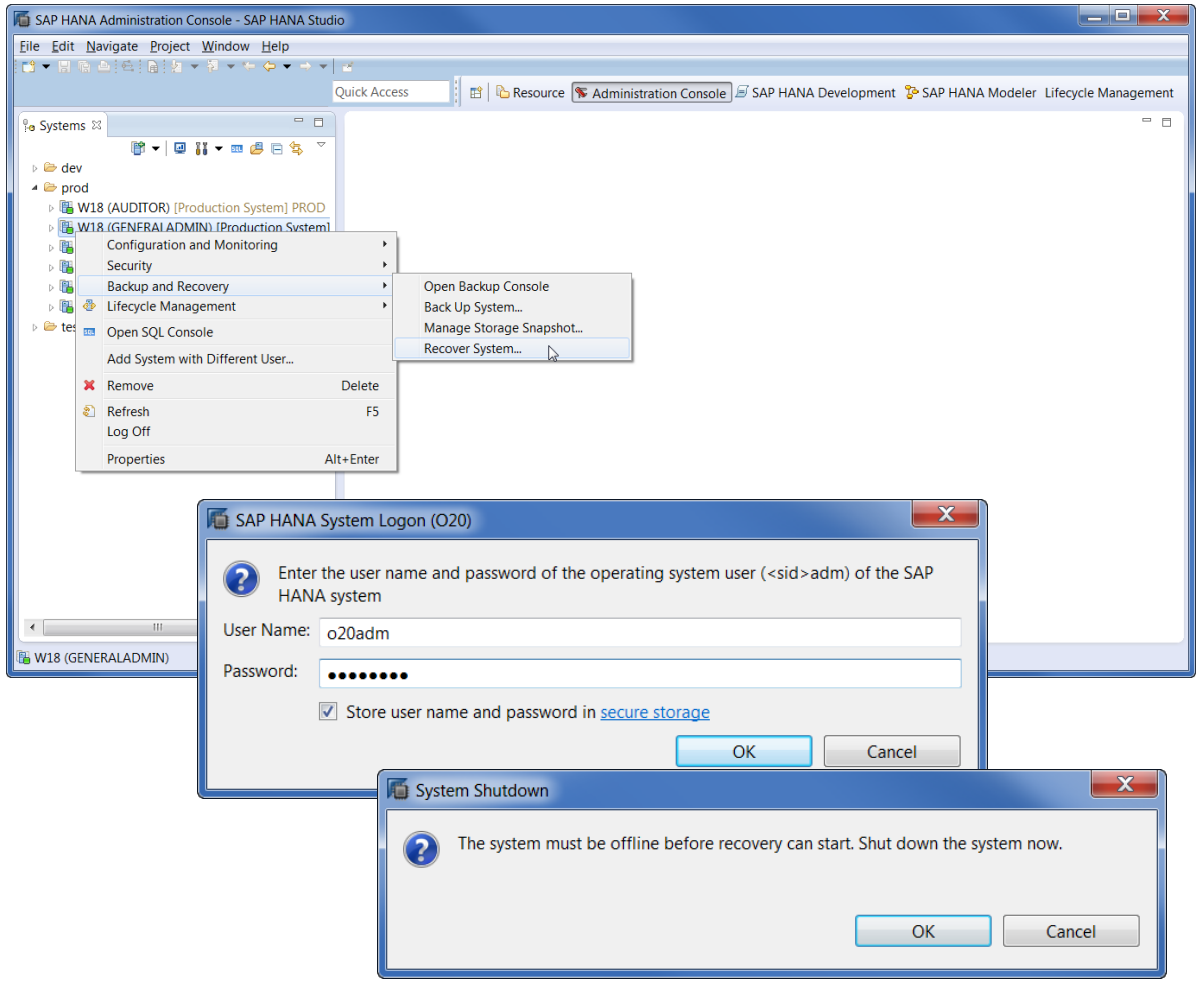
- Uses the specified data backup or storage snapshot, but no log backups
- All log entries that still exist in the log area are deleted, no log will be replayed

SAP HANA Backup and Recovery

Starting a recovery

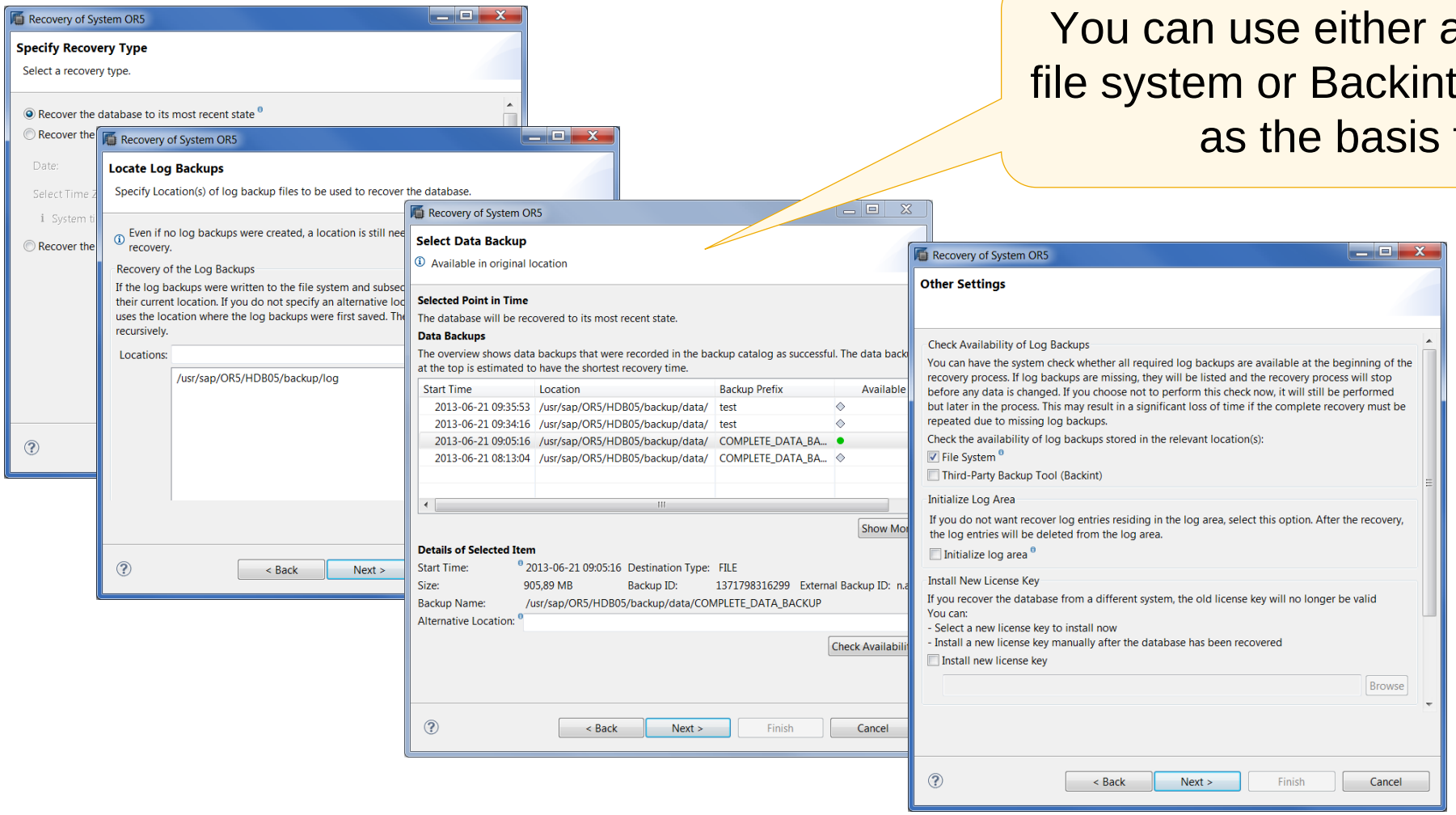
In the *Systems* view in SAP HANA studio, choose *Backup and Recovery → Recover System...* from the context menu of the database and enter the credentials of the SAP HANA operating system user <SID>adm

Caution: For a recovery, the SAP HANA database will be shut down



SAP HANA Backup and Recovery

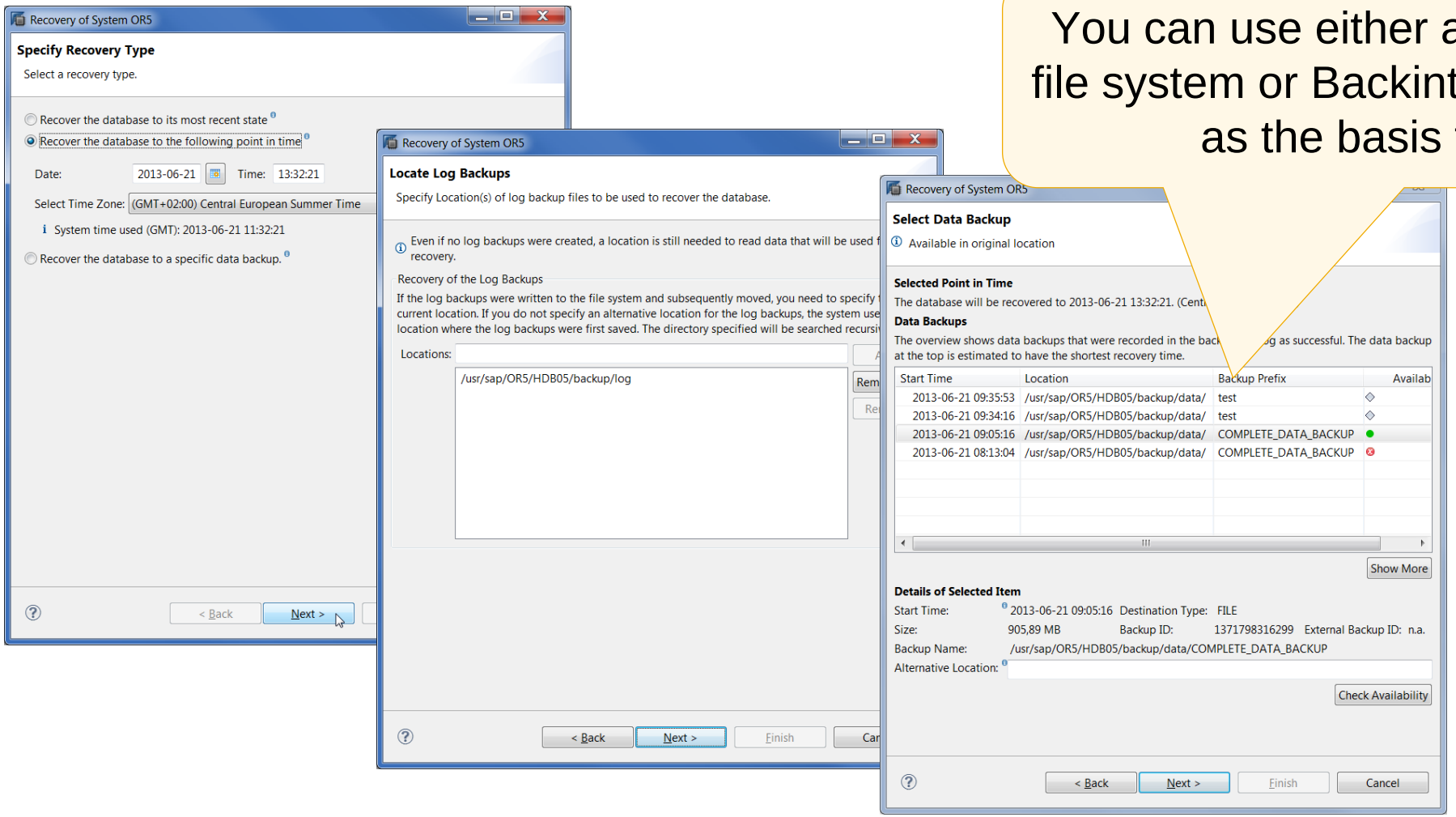
Recovery to the most recent state (option A)



You can use either a data backup (from the file system or Backint), or a storage snapshot as the basis for the recovery

SAP HANA Backup and Recovery

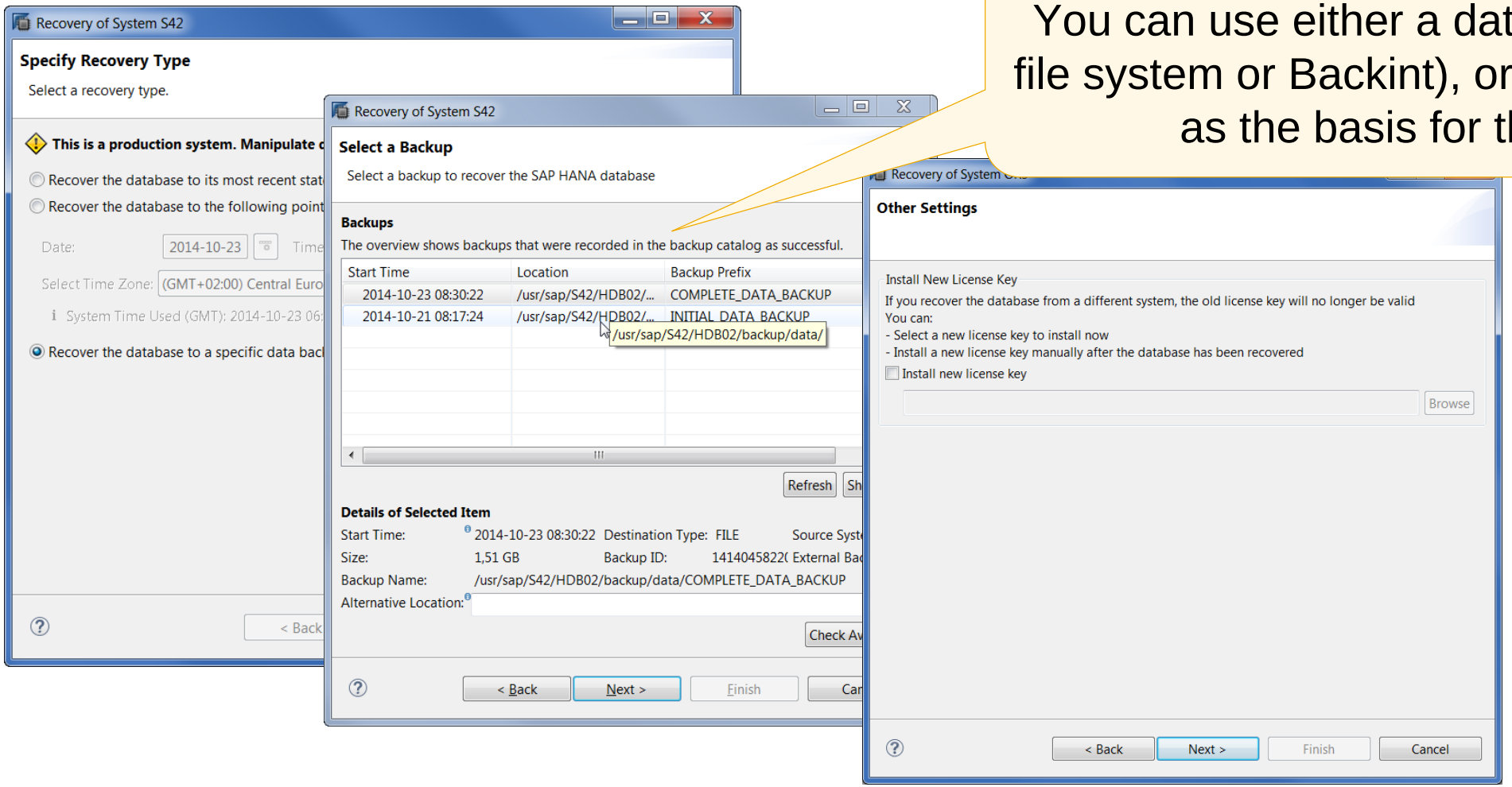
Recovery to a point in time in the past (option B)



You can use either a data backup (from the file system or Backint), or a storage snapshot as the basis for the recovery

SAP HANA Backup and Recovery

Recovery using a specified data backup or storage snapshot (option C)



You can use either a data backup (from the file system or Backint), or a storage snapshot as the basis for the recovery

SAP HANA Backup and Recovery

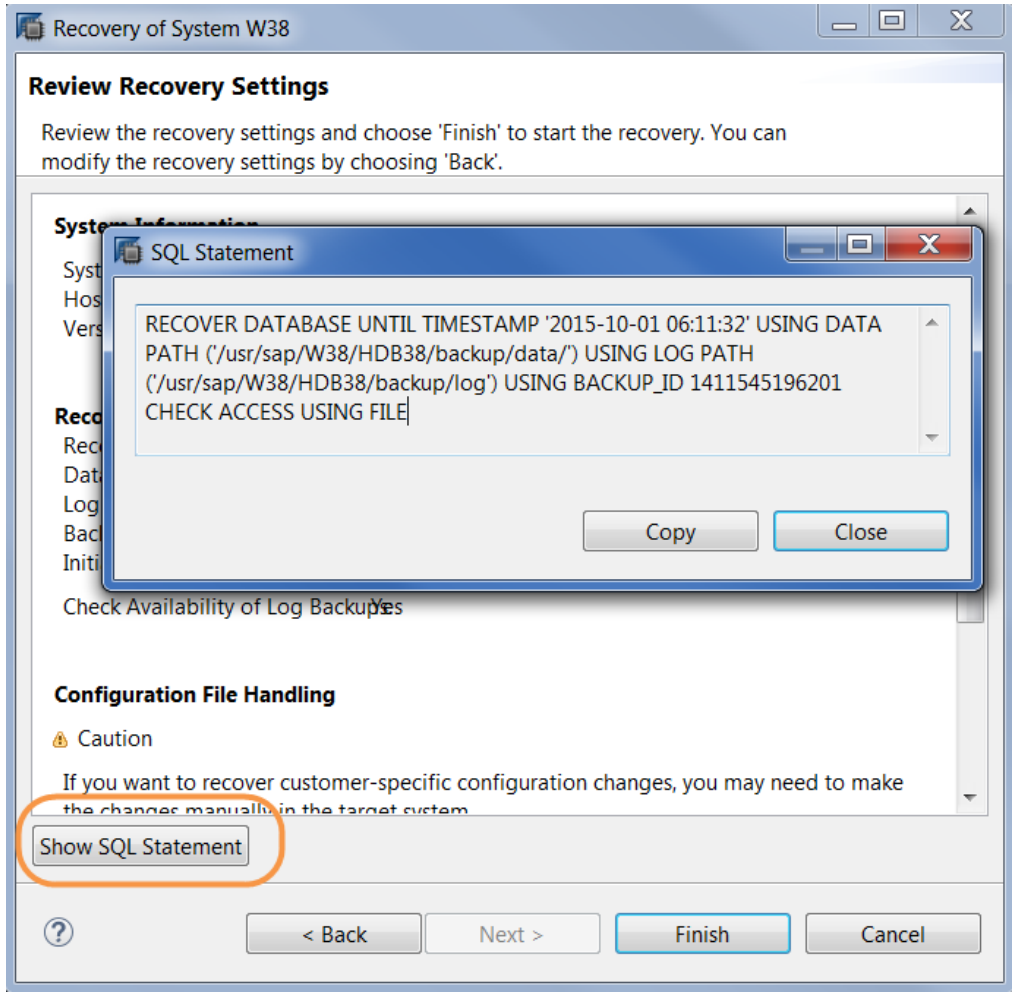
Recovery SQL statement displayed in the recovery wizard

You can now display the SQL statement for a specific recovery in SAP HANA Studio

Preparing a recovery

- Prerequisites: <sid>adm operating system user credentials

1. In the *Systems* view in SAP HANA Studio, right-click on the system to be recovered and choose *Recovery...*
2. Specify your recovery options in the recovery wizard
3. On the *Review Recover Settings* page, choose *Show SQL Statement*



SAP HANA Backup and Recovery

Recovery phases

After the initial collection of system information for the recovery, the recovery wizard shows the following phases:

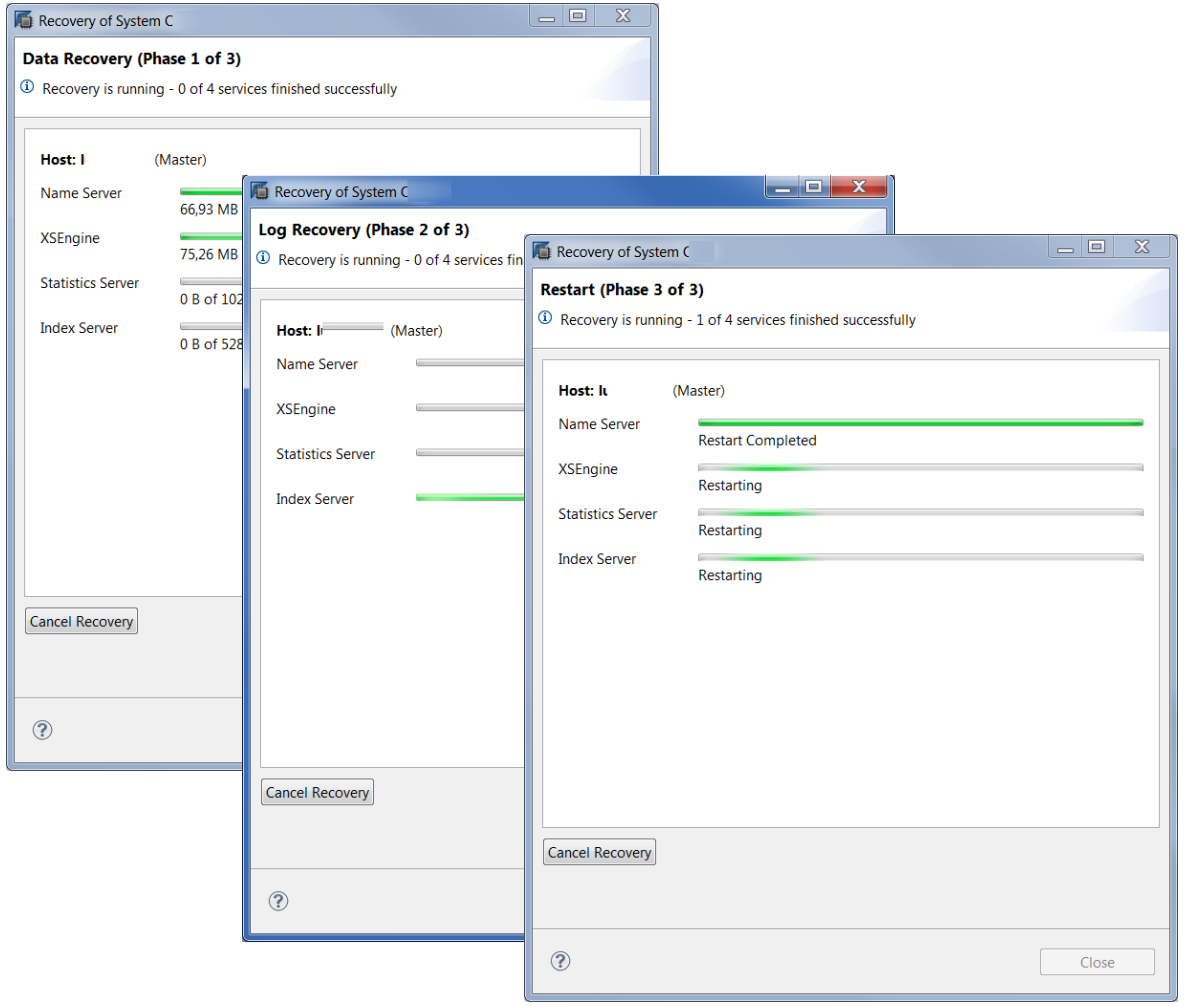
Phase 1: Data recovery

- using data backup or snapshot

Phase 2: Log recovery

- using log backups and/or log that is still available in the log area

Phase 3: Restart

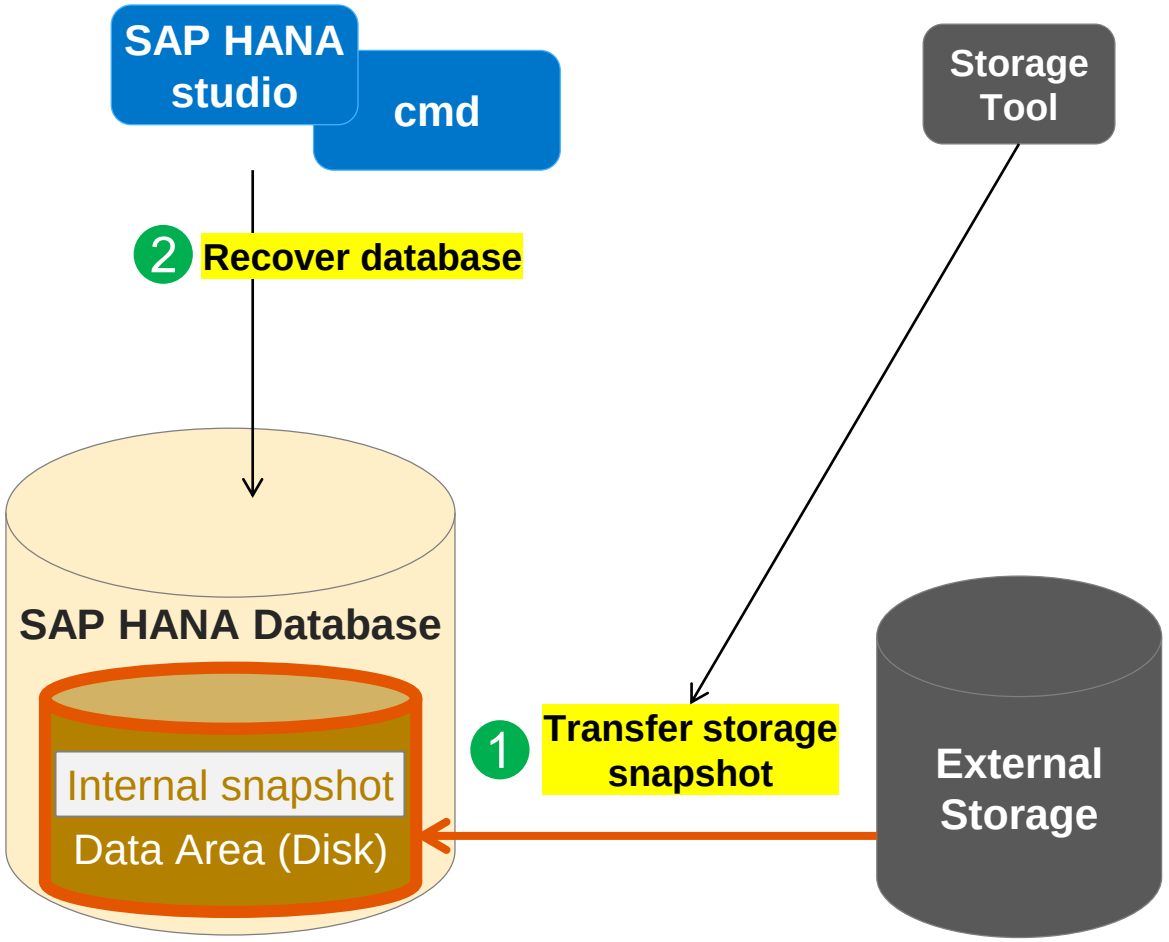


SAP HANA Backup and Recovery

Recovery steps when using a storage snapshot

1. Using the storage tool, **transfer the storage snapshot** to the data area of the SAP HANA database
2. Using SAP HANA studio or the command line, **recover the database** using the storage snapshot as basis (available in the recovery wizard)

Note: All recovery options are available, including point-in-time recovery using log backups/log from the log area



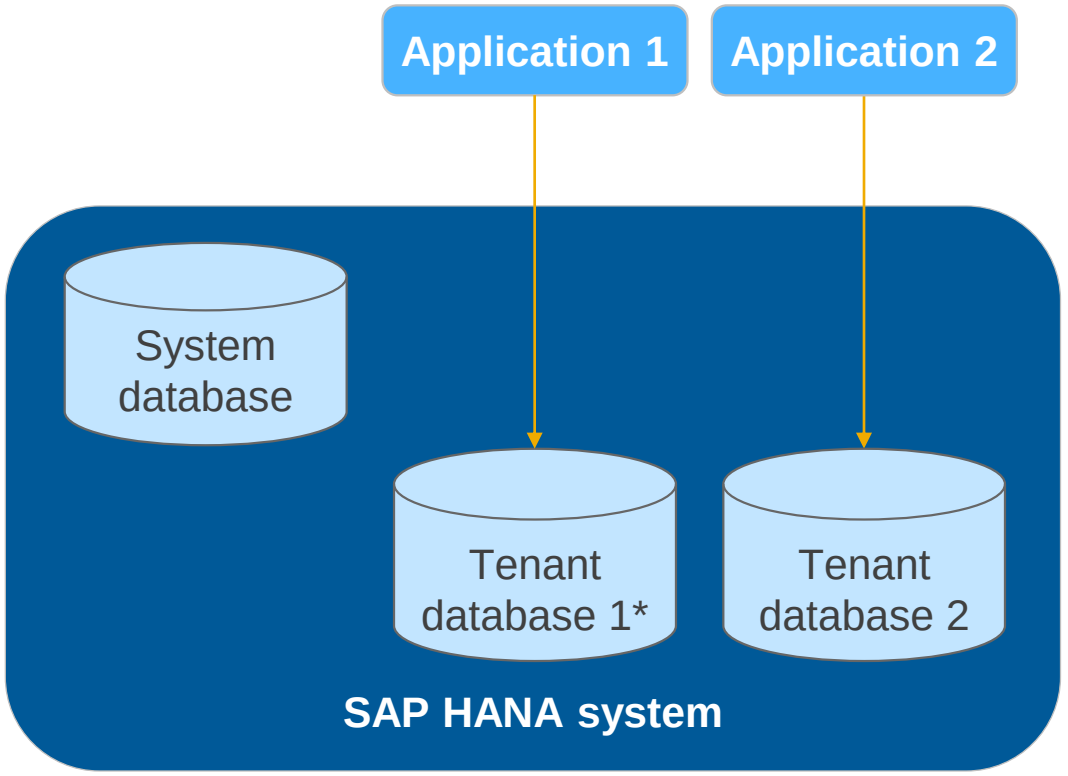
Support for multitenant database containers

SAP HANA Backup/Recovery

Multitenant database containers: Overview

Multitenant database containers are a new way to run multiple applications/scenarios on one SAP HANA system

- 1 system database and multiple tenant databases
- Shared installation of database system software
- Strong isolation features, the system database and each of the tenant databases have their own:
  - Database users, database catalog, repository, persistence, backups, traces and diagnosis files
- Distinction between tasks performed at system level and those performed at database level
- Integration with data center operation procedures
- More information:
  - SAP HANA documentation on the SAP Help Portal
  - SAP Note 2096000: SAP HANA multitenant database containers – additional information



**tenant database = multitenant database container*

SAP HANA Backup and Recovery

Multitenant database containers: Backup/recovery concept

An SAP HANA system installed in multiple-container mode follows the same SAP HANA backup/recovery principles as a single-container system

- Data backups are initiated manually or scheduled via scripts/tools such as DBA Cockpit
- Log backups are carried out automatically if the log mode is set to NORMAL (recommended for production)
- Backup information is stored in the backup catalog
- Different backup destinations are supported: backups to the file system, backups to 3rd party backup tools
- Database copies using backup/recovery are supported for individual databases
- Recovery options: point-in-time recovery, recovery to a specific data backup
- Tool support: SAP HANA Studio, DBA Cockpit, command line (SQL statements)

Specific properties of backup/recovery in a multiple-container system

- The system database plays a central role. It can initiate both backups of the system database itself and of individual tenant databases. Recoveries are always initiated by the system database
- Tenant databases can carry out their own backups unless this has been prohibited in the system configuration
- System database and tenant databases have their own backup catalogs.
- Snapshots are currently not supported

SAP HANA Backup and Recovery

Multitenant database containers: Backing up the system database

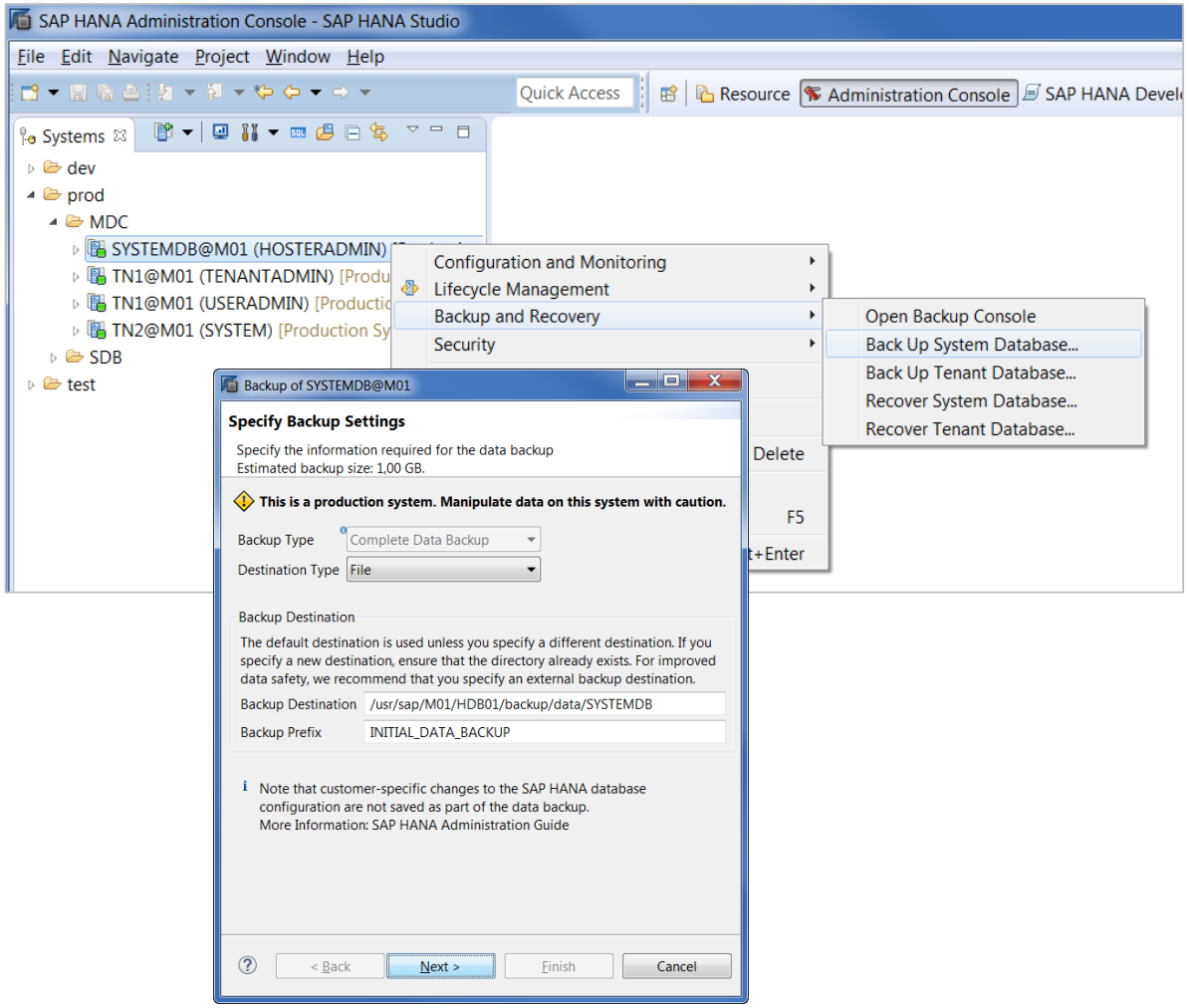
You regularly need to create data backups of the system database

The system database contains information about the system as a whole and all tenant databases and is used for central system administration.

Creating a data backup of the system database

- Prerequisites: User in the system database with BACKUP ADMIN or BACKUP OPERATOR and CATALOG READ system privileges

1. In the *Systems* view in SAP HANA studio, right-click on the system database and choose *Backup and Recovery → Backup Up System Database...*
2. Specify your backup settings and start the backup



SAP HANA Backup and Recovery

Multitenant database containers: Backing up a tenant database

You regularly need to create data backups of the tenant databases

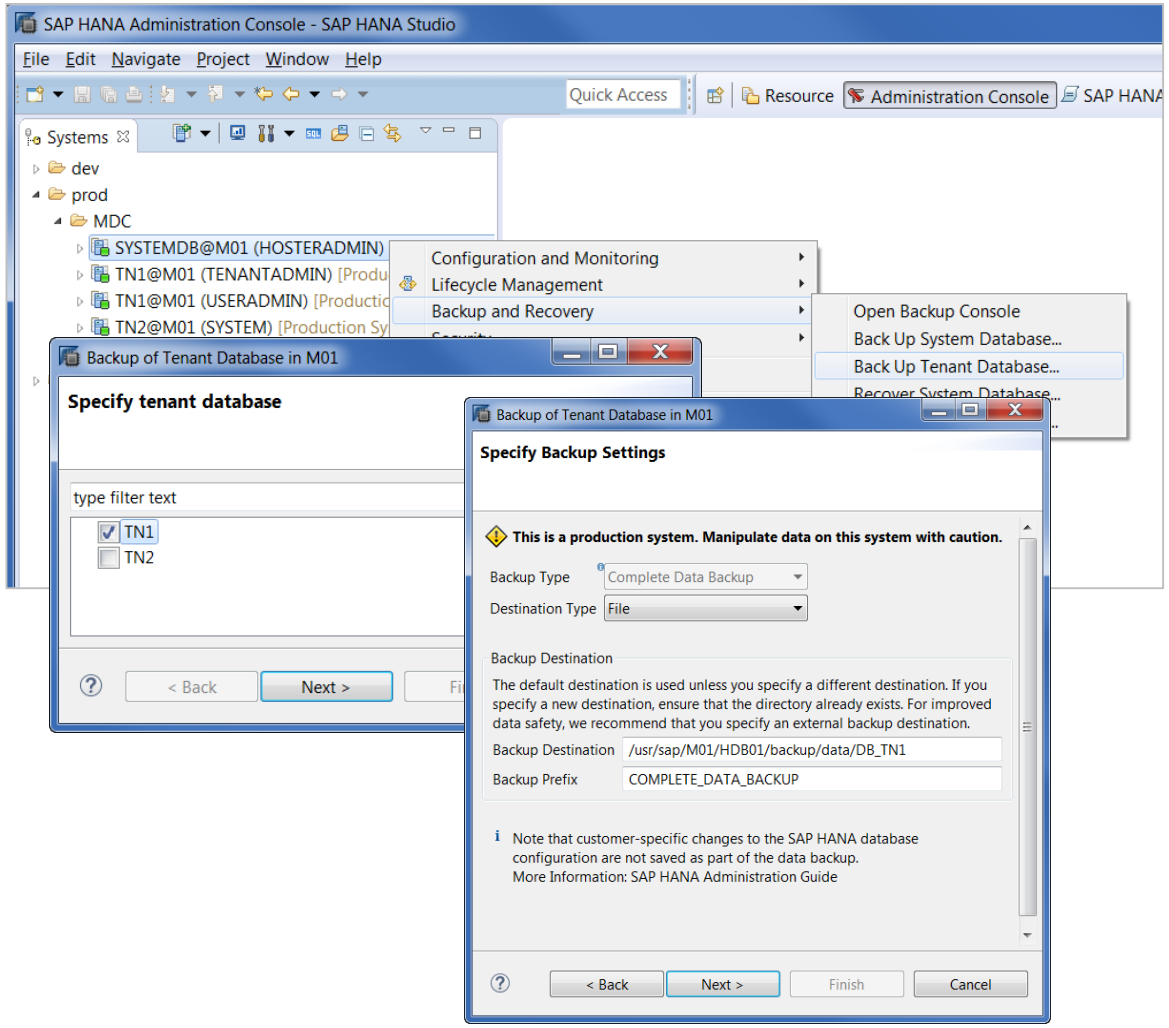
The tenant databases contain the business data. They have their own index servers.

Note: Depending on the system configuration, it may also be possible to initiate a data backup directly from a tenant database

Creating a data backup of a tenant database

- Prerequisites: User in the system database with DATABASE ADMIN system privilege

1. In the *Systems* view in SAP HANA studio, right-click on the system database and choose *Backup and Recovery → Backup Up Tenant Database...*
2. Select the tenant database to be backed up
3. Specify your backup settings and start the backup



SAP HANA Backup and Recovery

Multitenant database containers: Viewing backup information

Backup information is contained in the backup catalog

Viewing information for all databases

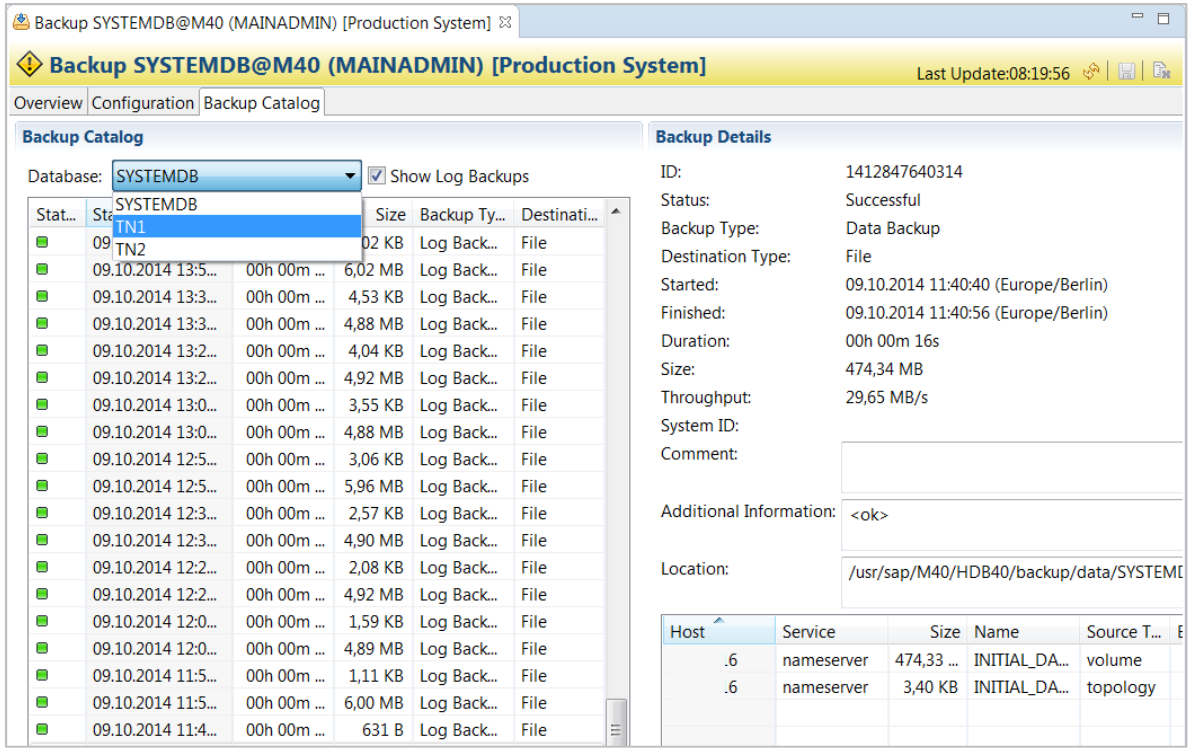
- Prerequisites: User in the system database with DATABASE ADMIN privilege; tenant database running

1. In the *Systems* view in SAP HANA studio, expand the system database and double-click on *Backup*
2. Open the *Backup Catalog* tab and select the database for which you want to view the information

Viewing information for a tenant database

- Prerequisites: User in the tenant database with BACKUP ADMIN and CATALOG READ privileges

1. In the *Systems* view in SAP HANA studio, expand the tenant database and double-click on *Backup*
2. Open the *Backup Catalog* tab



SAP HANA Backup and Recovery

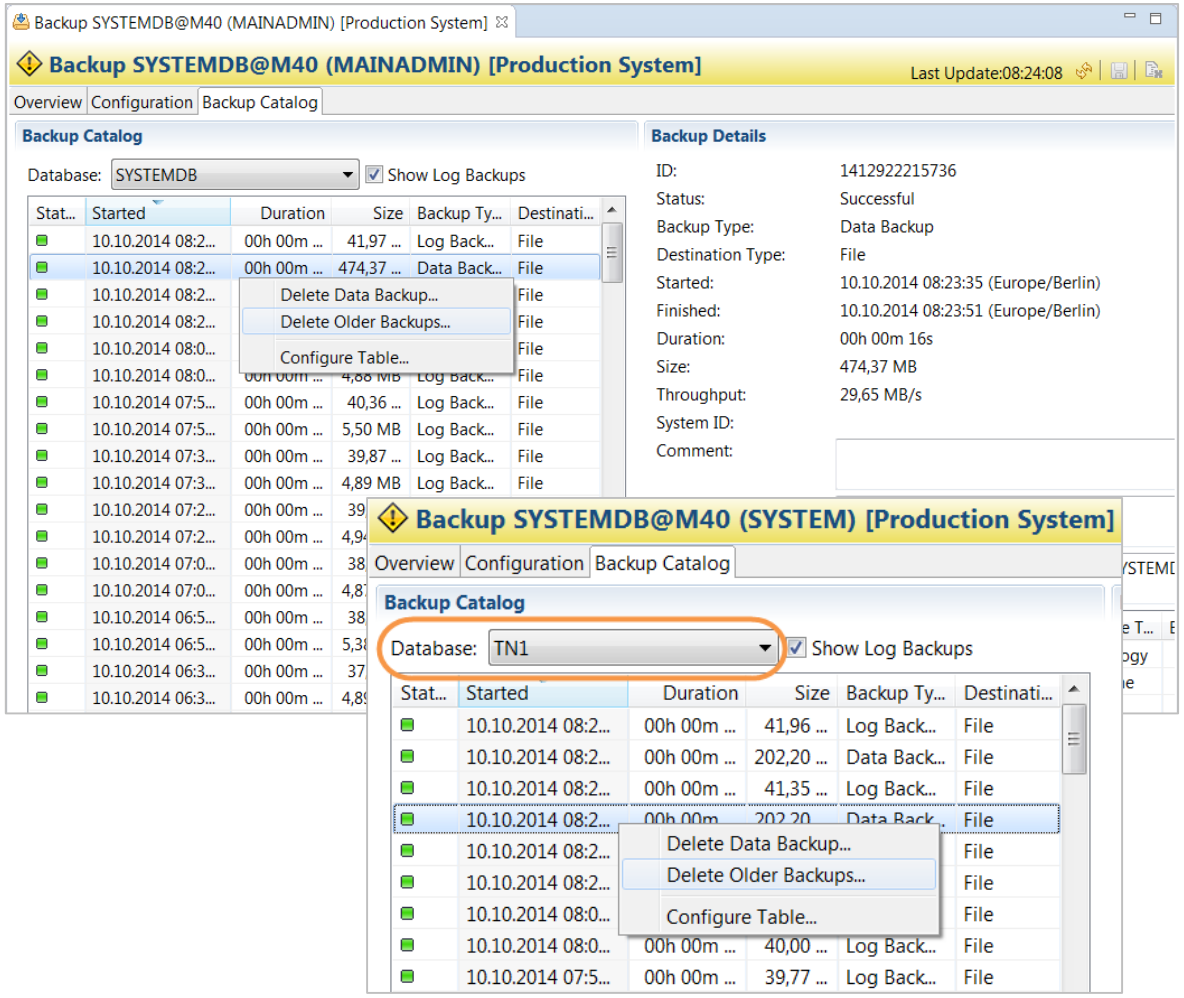
Multitenant database containers: Backup lifecycle management

You can delete backups that are not needed any longer

Deleting old backups

- Prerequisites:
  - To delete system database backups: User in the system database with BACKUP ADMIN system privilege
  - To delete tenant database backups: User in the system database with DATABASE ADMIN system privilege

1. In the *Systems* view in SAP HANA studio, expand the system database and double-click on *Backup*
2. Open the *Backup Catalog* tab and select the database for which you want to delete backups
3. From the context menu, choose which backups you want to delete. Specify whether the backups should be deleted from the backup catalog only, or also from from the file system/3rd party backup tool



SAP HANA Backup and Recovery

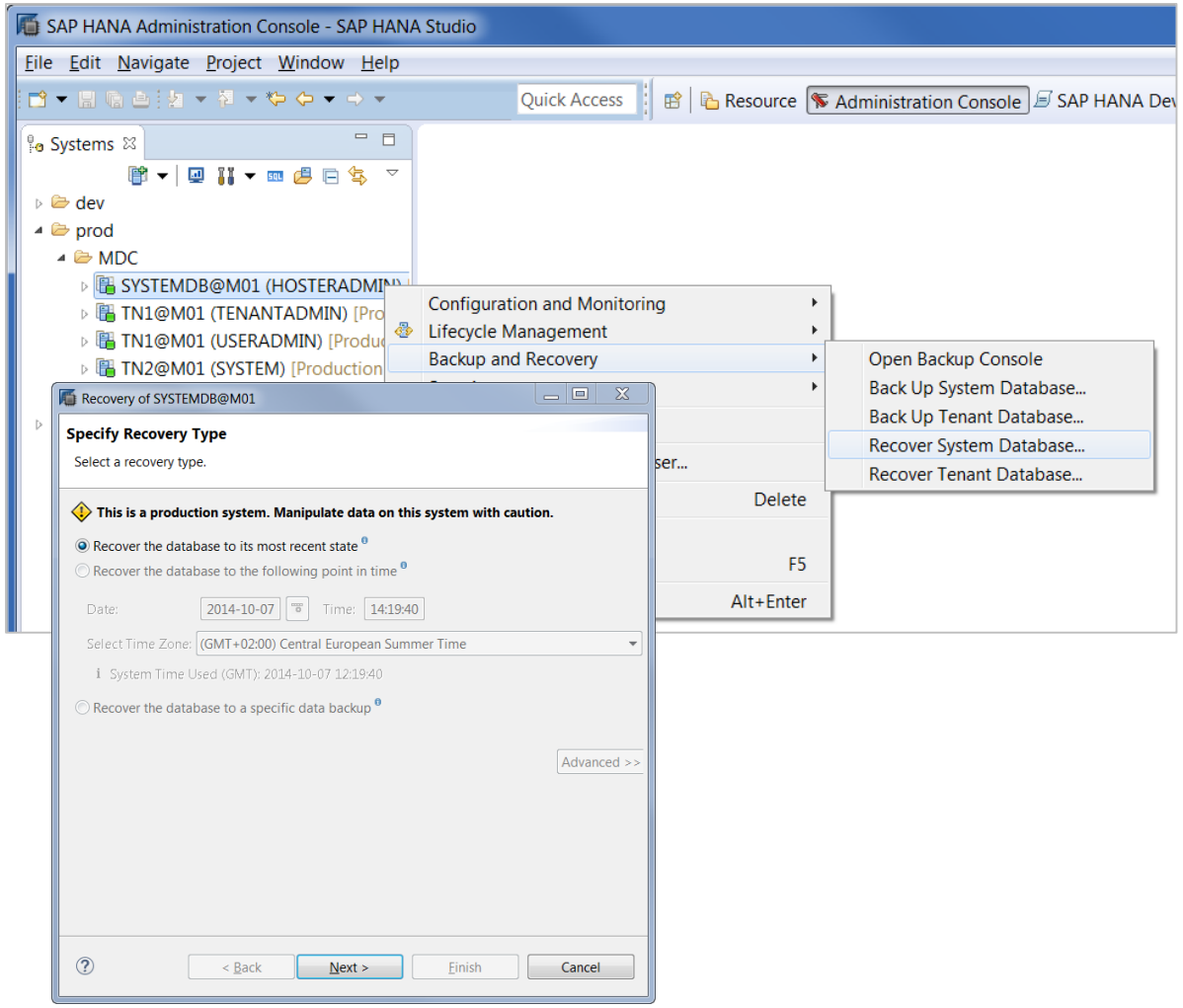
Multitenant database containers: Recovering the system database

A recovery of the system database may be be needed, for example, if there are physical errors in the system database's volumes

Recovering the system database

- Prerequisites: <sid>adm user credentials

1. In the *Systems* view in SAP HANA studio, right-click on the system database and choose *Backup and Recovery → Recover System Database...*
2. Enter the <sid>adm credentials. The whole system will be shut down, including all tenant databases.
3. Specify your recovery type and further recovery settings and start the recovery. The system database will be recovered and restarted.
4. Restart the tenant databases. The tenant databases' content is not affected by the system database recovery.



SAP HANA Backup and Recovery

Multitenant database containers: Recovering a tenant database

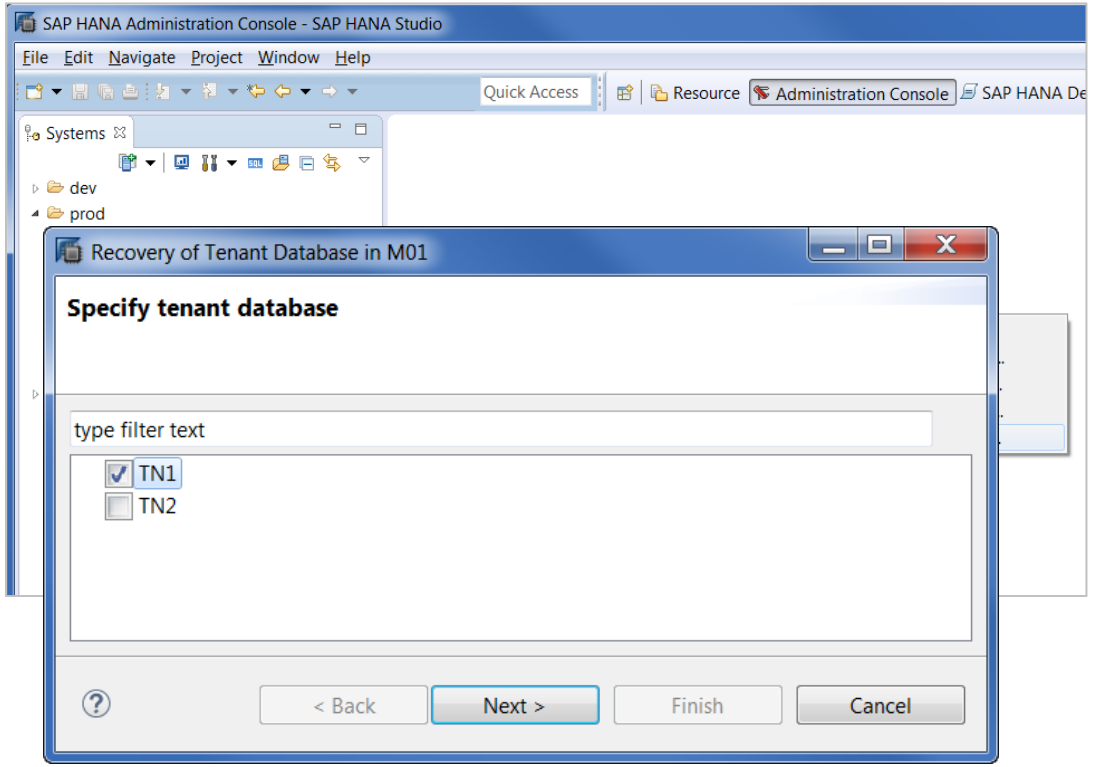
A recovery of a tenant database may be required, for example, if a logical error occurred in the tenant database

Recovery of tenant databases can only be initiated from the system database. The system database and other tenant databases are not affected.

Recovering a tenant database

- Prerequisites: User in the system database with DATABASE ADMIN system privilege

1. In the *Systems* view in SAP HANA studio, right-click on the system database and choose *Backup and Recovery → Recover Tenant Database...*
2. Select the tenant database to be recovered
3. Specify your recovery type and further recovery settings and start the recovery.

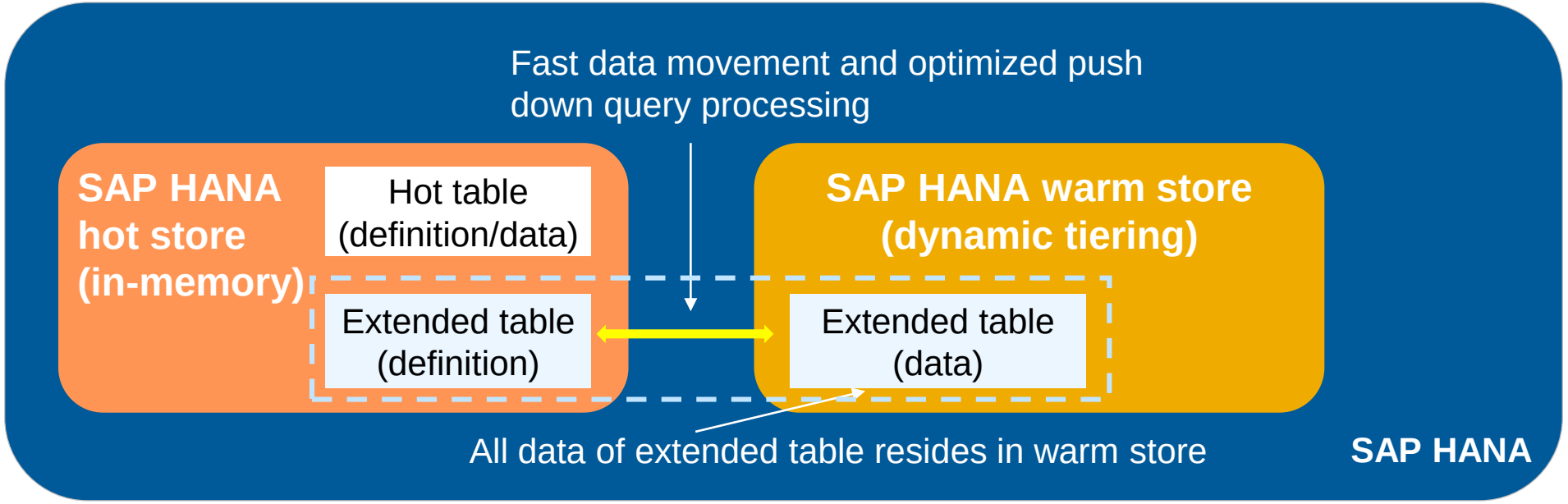


Integration with Dynamic Tiering

SAP HANA Backup and Recovery
Dynamic tiering

Dynamic tiering is an add-on product to SAP HANA for managing data of different temperatures

- Hot data (always in memory) – classical SAP HANA database tables
- Warm data (in extended table = disk-based columnar table) – dynamic tiering option



SAP HANA Backup and Recovery

Backup/recovery for systems with the dynamic tiering option (I)

Backup and recovery always apply to the whole database, both the HANA database and its extended store

Supported with SAP HANA SPS09:

- Data backup
- Log backup
- Database copy
- Point-in-time recovery
- Recovery to a specific data backup without log replay

Roadmap:

- Storage snapshots
- 3rd party backup tools

SAP HANA Backup and Recovery

Backup/recovery for systems with the dynamic tiering option (II)

Backup

- Backup paths for the extended store can be set in SAP HANA's `global.ini` file.
- Data backups are carried out as usual for the SAP HANA database; they will automatically include the extended store.
- Log backups are carried out automatically.
- The SAP HANA backup catalog also contains information about extended store backups.

Recovery

- Both the data and log backups for the SAP HANA database and the extended store are required. You cannot recover one without the other.
- Note: The number and type of services must be identical in both the source and target system.
- Recovery is carried out from SAP HANA studio (recovery wizard) or from the command line using the usual SAP HANA recovery commands.

Database copy

SAP HANA Backup and Recovery

Database copy (I)

You can carry out database copies using SAP HANA's standard backup/recovery functions

A typical use case would be to create a copy of your production system for tests on a smaller QA system. Note that if the target system has less resources, e.g. less CPU and RAM, performance cannot be expected to be the same as in the source system.

As a **basis for a database copy**, you can use a

- Data backup (file system or 3rd party backup tool)
- Storage snapshot

You can choose to also apply log backups.

Options for database copy

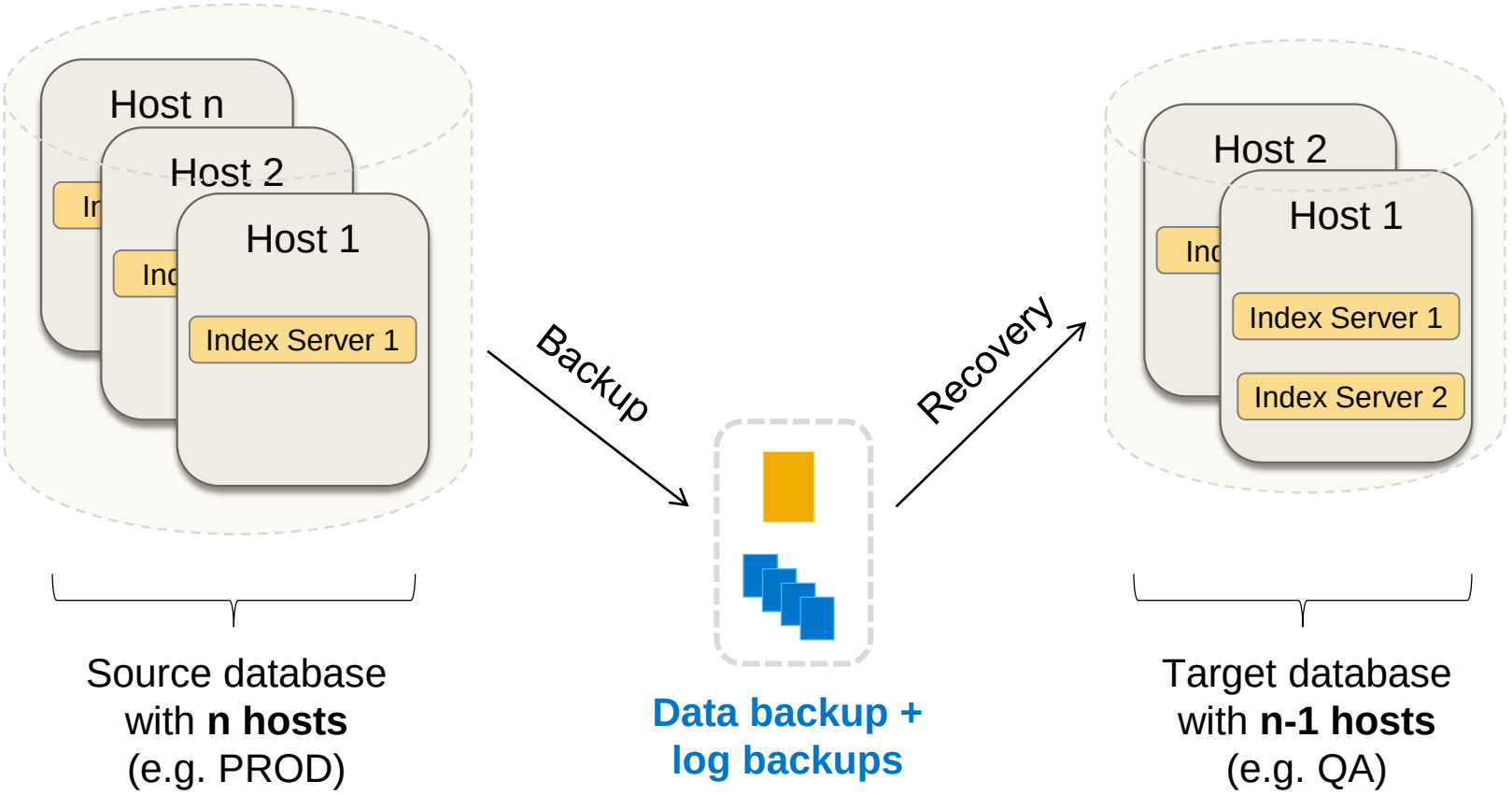
- **n → n** hosts
- **n → n+x** hosts (not supported for storage snapshots)
- **n → n-x** hosts (not supported for storage snapshots)

SAP HANA Backup and Recovery

Database copy (II)

Example: n → n-x database copy using data backup and log backups

Target system has fewer hosts and needs to have additional index servers configured

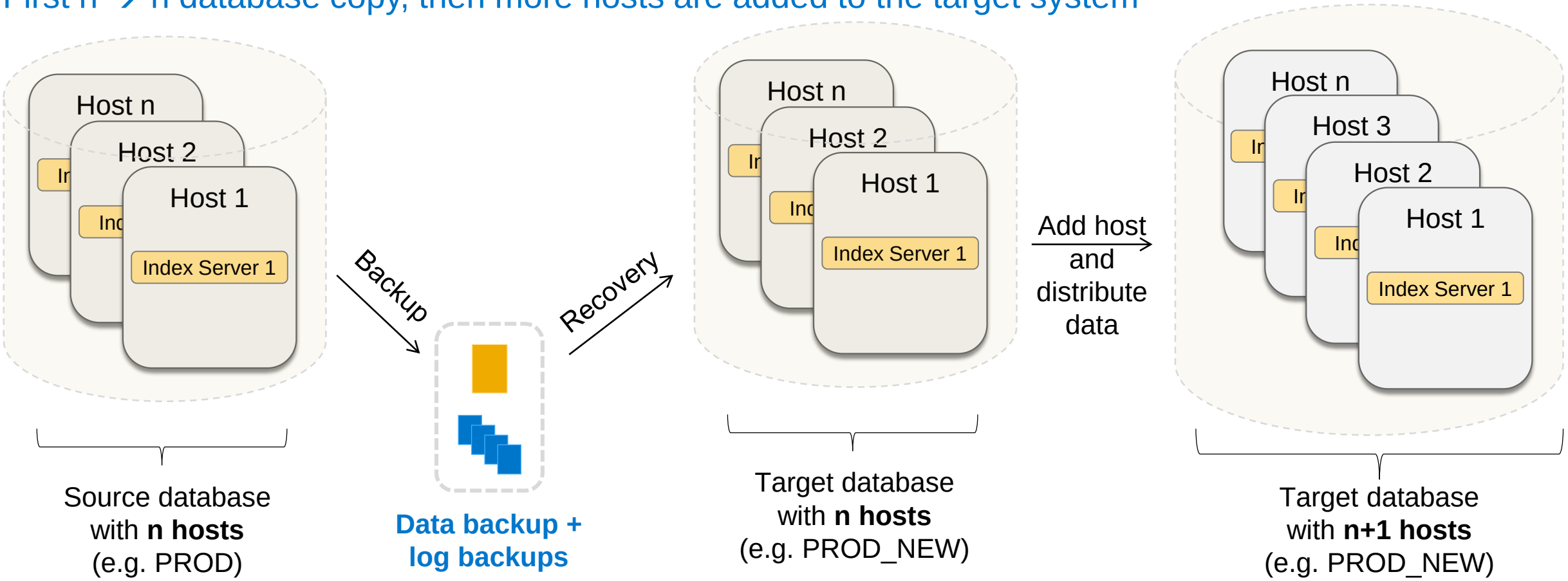


SAP HANA Backup and Recovery

Database copy (III)

Example: n → n+x database copy using data backup and log backups

First n → n database copy, then more hosts are added to the target system

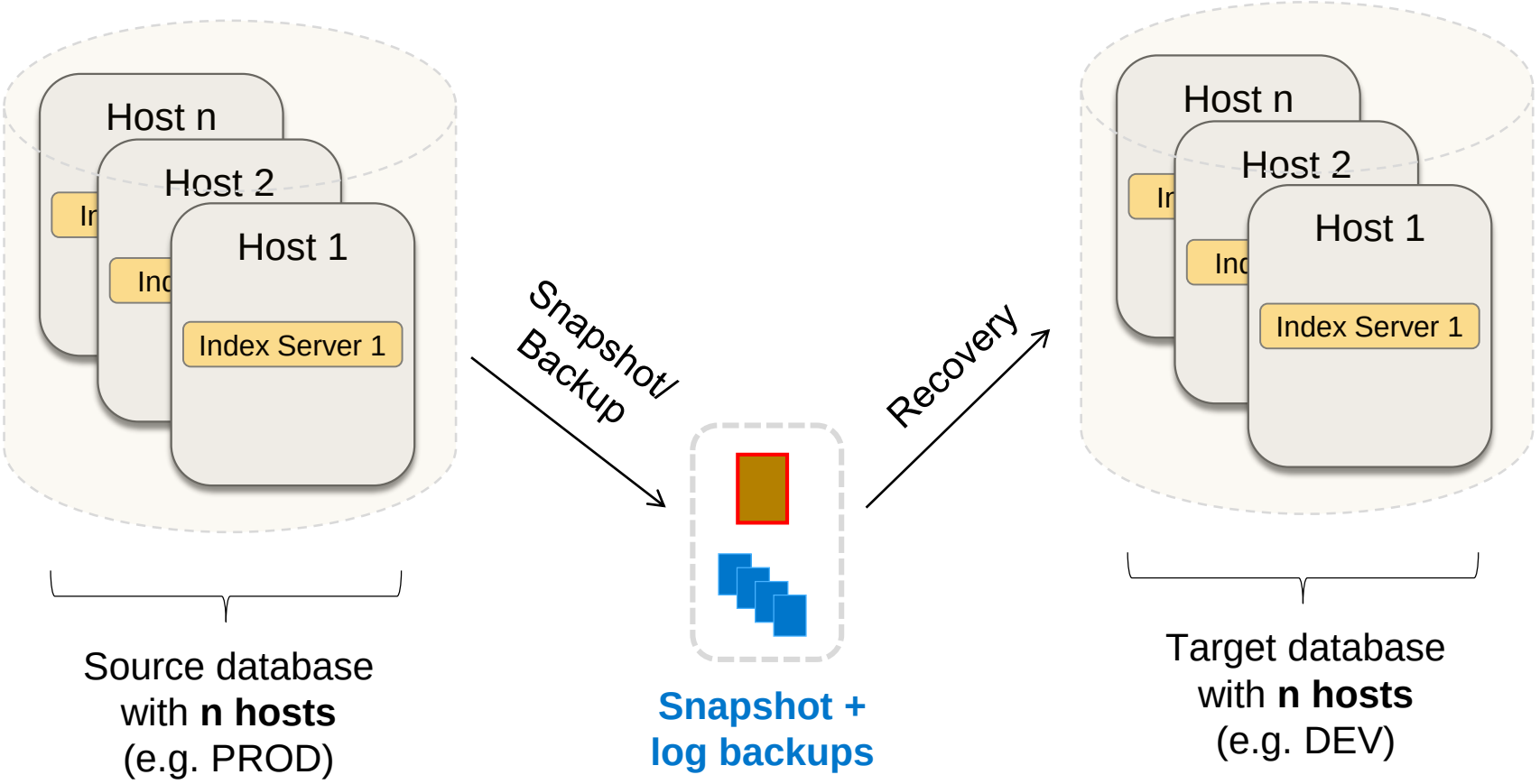


SAP HANA Backup and Recovery

Database copy (IV)

Example: n → n database copy using storage snapshot and log backups

Source and target systems must have same number of hosts

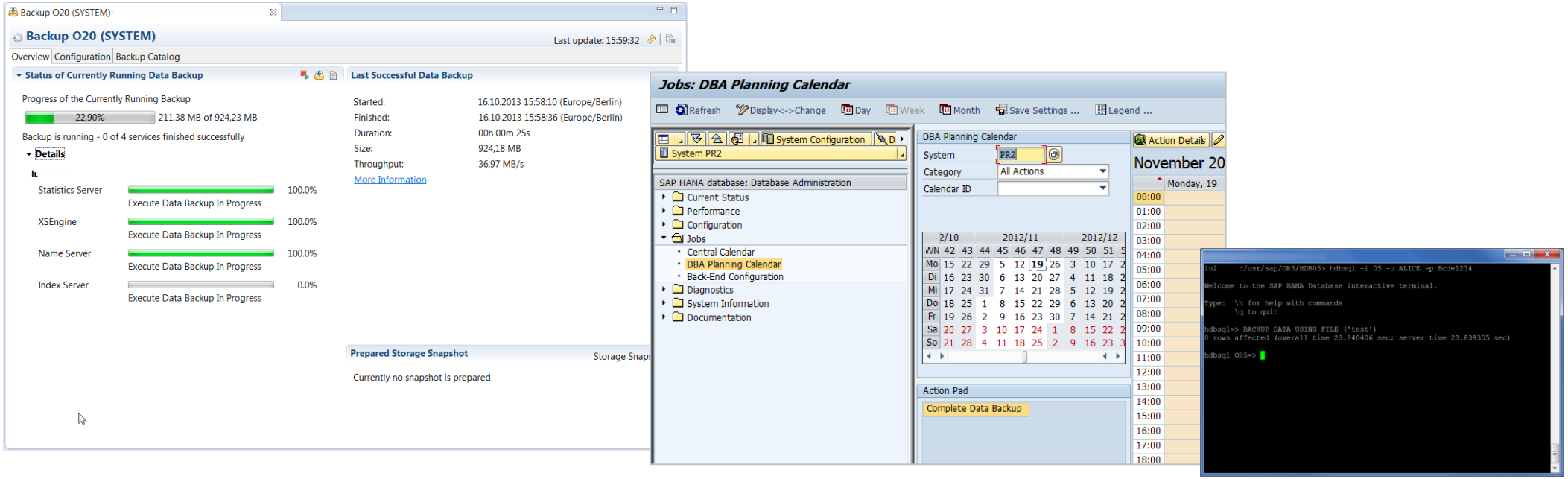


Tool support and certification

SAP HANA Backup and Recovery

SAP tool support for backup and recovery

	SAP HANA studio	DBA Cockpit	hdbsql/command Line
Backup	✓	✓	✓
Recovery	✓		✓



SAP HANA Backup and Recovery

Backint Certification

Certification is an installation prerequisite for backup tools using the “Backint for SAP HANA” interface.

- SAP Note 1730932 (Using backup tools with Backint)
- "Backint for SAP HANA" Certification

Certified tools (as of 2015-04-23)

Vendor	Backup Tool	Support Process (SAP Notes)
Commvault	Simpana 10.0, Hitachi Data Protection Suite 10 (via Simpana Backint interface)	1957450
EMC	Networker 8.2, Interface for Data Domain Boost 1.0	1999166, 1970559
HP	Data Protector 7.0, 8.1, 9.0	1970558
IBM	Tivoli Storage Manager for Enterprise 6.4	1913500
SEP	Sesam 4.4	2024234
Symantec	NetBackup 7.5	1913568

Online listing of certified tools: Application Development Partner Directory

- Enter the search term **HANA-BRINT** and click on a partner name → ”SAP Certified Solutions” for further details

What‘s new?

SAP HANA SPS09

SAP HANA Backup and Recovery

What's New in SAP HANA SPS09

3rd party backup tools (Backint)

- Database copy using 3rd party backup tools
- Improved handling of log backups
- Improved tape handling
- New certifications: EMC Networker 8.2, SEP Sesam 4.4, Hitachi Data Protection Suite 10 (integration via Commvault Simpana Backint interface)

Remove host/service

- No longer needs a manual data backup
- UI support in SAP HANA Studio for removing services

New alerts

- Log backup taking too long
- Automatic log backup disabled
- Storage snapshot prepared

Support for multitenant database containers

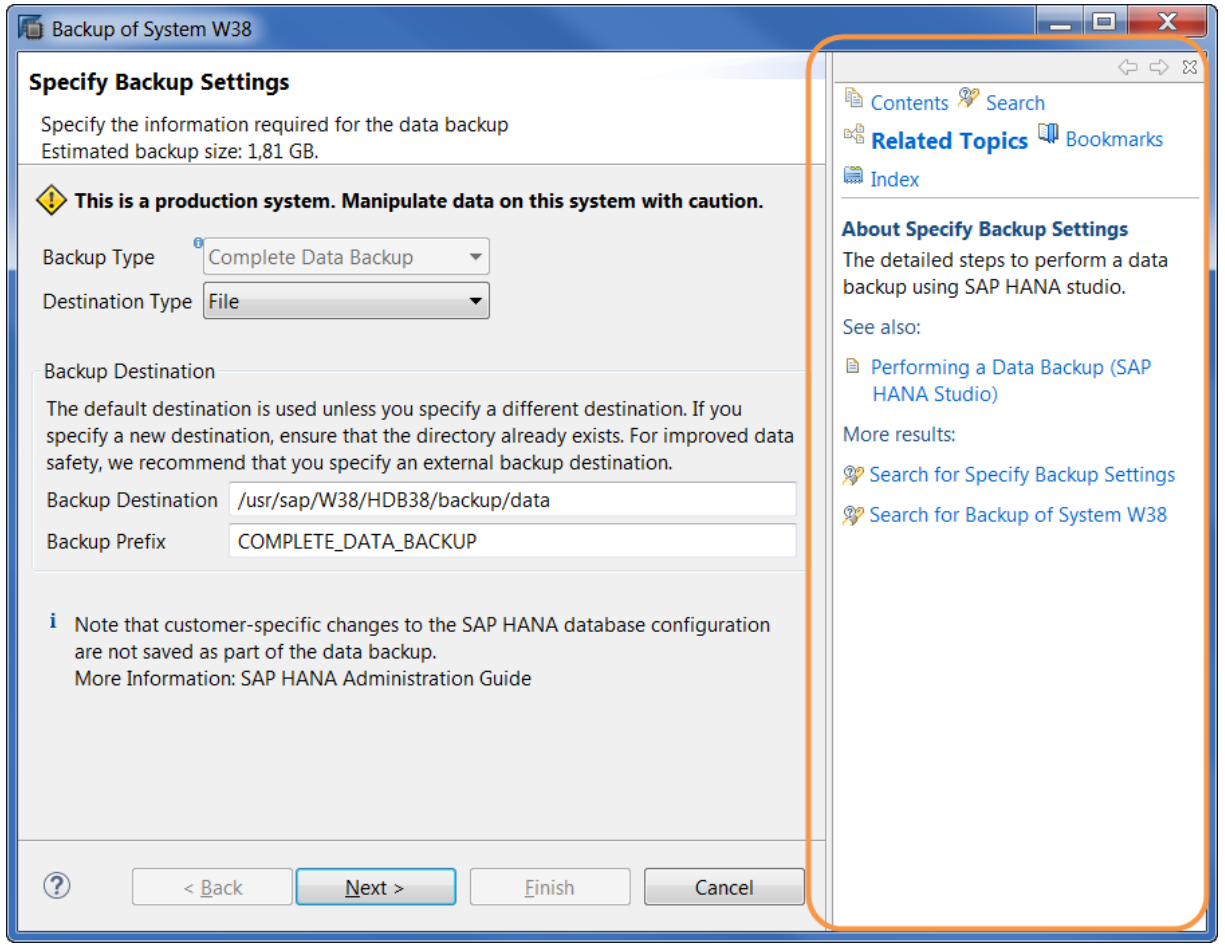
More information

SAP HANA Backup and Recovery

Context-sensitive help

SAP HANA studio provides context-sensitive help for backup/recovery

To open the context-sensitive help, press F1, or choose *Help -> Dynamic Help*

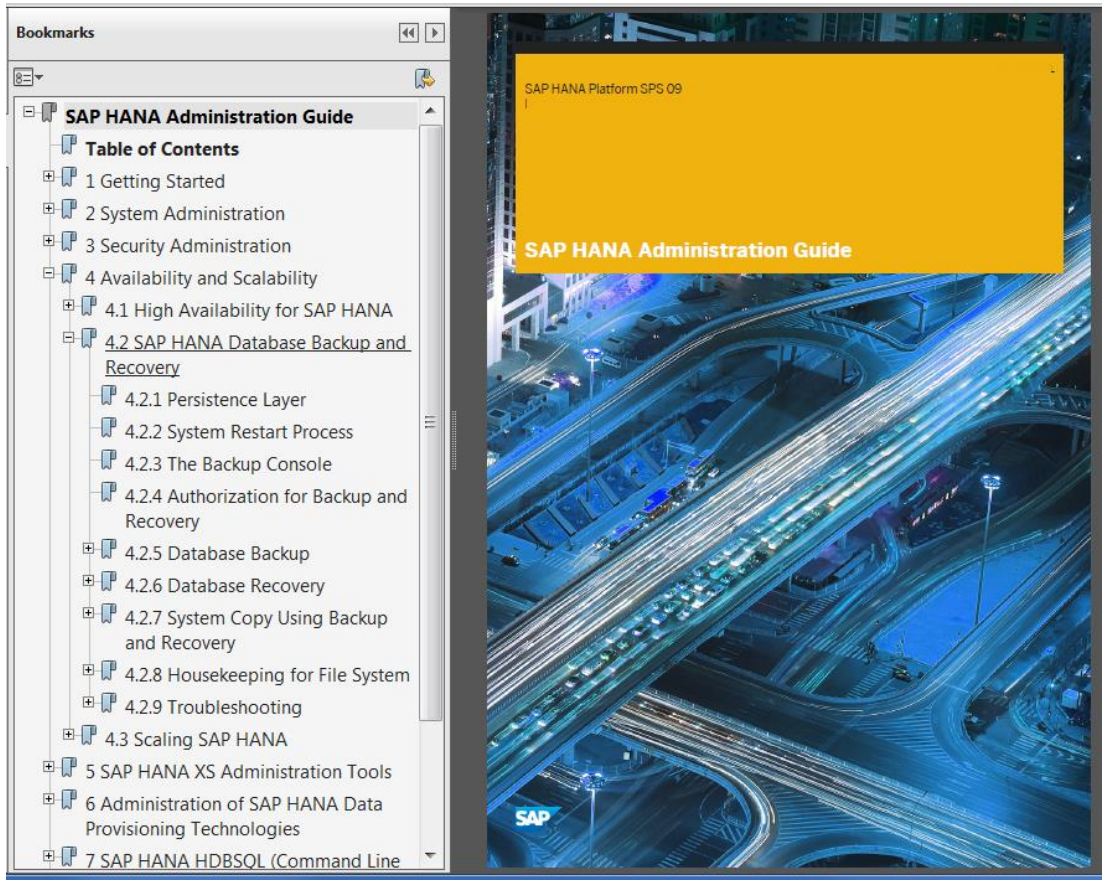


SAP HANA Backup and Recovery

More information

- **Documentation:** SAP Help Portal – Administration Guide, Technical Operations Manual, SQL Reference Guide
- **Overview presentation:** SAP HANA Backup/Recovery Overview
- **Certification:** "Backint for SAP HANA" Certification
- **Best practice:** SAP Note 2091951: SAP HANA Backup and Restore
- **Training:** HA200: SAP HANA - Operations & Administration

SAP Note	Title
1642148	FAQ: SAP HANA database backup and recovery
1730932	Using backup tools with Backint
1869119	Check backup integrity
2021789	SAP HANA revision and maintenance strategy
Further SAP notes are available on component **HAN-DB-BAC**	



Thank You!

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