Backup and Recovery of SAP Systems on Amazon Web Services

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Document History

Before proceeding, make sure you have the latest version of this document. You can find the latest version on the AWS website:

http://aws.amazon.com/sap

The latest errata to this document can be found in SAP note 1588667.

<table>
<thead>
<tr>
<th>Version</th>
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<tr>
<td>1.0</td>
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<td>2.0</td>
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<td>Sybase ASE Database additions</td>
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About this Guide

This guide provides an overview of how to backup SAP systems on Amazon Web Services (AWS). This guide is not intended to replace any of the standard SAP or RDBMS documentation. This guide focuses on the essential differences in backing up SAP systems on AWS as compared to traditional infrastructure.

Different backup options and methods are provided for non-production (sandbox, training, demo, POC, etc.) and production systems.

What is not included in this guide...
Apart from some examples, this guide does not include detailed instructions how to execute database backups using either native RDBMS backup/recovery features or 3rd party backup tools. Please refer the standard OS, SAP and RDBMS documentation or the documentation provided by the backup software vendor.

Backup schedules, frequency, and retention periods, are primarily based on your system type and business requirements. Please refer to the standard SAP documentation for guidance on these topics.

Prerequisite Documentation

This guide does not provide detailed instructions on how to execute SAP system and database backups or provide recommendations for backup frequencies or retention. For this information please refer to the standard SAP and database vendor documentation mentioned in the following sections.

SAP on Amazon Web Services

This document assumes that you are already familiar with implementing and operating SAP solutions on Amazon Web Services infrastructure. If you have not already read the SAP on AWS Implementation Guide and the SAP on AWS Operations Guide, please read these guides before continuing. All AWS guides for SAP can be found at http://aws.amazon.com.sap.

Table 1 below list the available SAP notes for deploying SAP on AWS infrastructure; the latest errata to this guide can be found in SAP note 1677381.

<table>
<thead>
<tr>
<th>SAP Note #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1588667</td>
<td>SAP on AWS: Overview of related SAP Notes and Web-Links</td>
</tr>
<tr>
<td>1656099</td>
<td>SAP on AWS: Supported SAP, DB/OS and AWS EC2 products</td>
</tr>
<tr>
<td>1656250</td>
<td>SAP on AWS: Support prerequisites</td>
</tr>
<tr>
<td>1656249</td>
<td>SAP on AWS: Initial implementation guidelines</td>
</tr>
</tbody>
</table>

General SAP Backup and Restore recommendations can be found at:

**SAP on SQL Server**

- [SAP with SQL Server Best Practices Guide](#)
- [SAP Library (help.sap.com) – Backup with MS SQL Server](#)
- [Backup and Recovery Overview for Windows Server 2008 R2](#)
- [SQL Server 2008 - Backing Up and Restoring How-to Topics (SQL Server Management Studio)](#)

<table>
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<tr>
<th>SAP Note #</th>
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<tbody>
<tr>
<td>44449</td>
<td>Backup strategies with the SQL Server</td>
</tr>
<tr>
<td>1297986</td>
<td>Backup and Restore strategy for MS SQL Server</td>
</tr>
</tbody>
</table>

**SAP on DB2 LUW**

- [Database Administration Guide "SAP on IBM DB2 for Linux, Unix and Windows"](#)
- [IBM DB2 Universal Database for UNIX and Windows - New Log File Management](#)
- [A Practical Guide to Backup and Recovery of IBM DB2 for Linux, UNIX and Windows in SAP Environments](#)

**SAP on MaxDB**

- [SAP SCN Page on MaxDB Backup and Restore](#)
- [SAP Library (help.sap.com) – Database Studio – Backing up Databases: Overview](#)

<table>
<thead>
<tr>
<th>SAP Note #</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1377148</td>
<td>FAQ: SAP MaxDB Backup and Recovery</td>
</tr>
<tr>
<td>767598</td>
<td>Available SAP MaxDB documentation</td>
</tr>
</tbody>
</table>

**SAP on Sybase ASE**

- [Sybase Infocenter – Systems Administration Guide, Volume 2](#)
- [Getting Started with the Sybase Database and the SAP System](#)
- [SAP DBA Guide: Sybase Adaptive Server Enterprise](#)

<table>
<thead>
<tr>
<th>SAP Note #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1585981</td>
<td>SYB: Ensuring Recoverability for Sybase ASE</td>
</tr>
<tr>
<td>1611715</td>
<td>SYB: How to restore a Sybase ASE database server (Windows)</td>
</tr>
<tr>
<td>1618817</td>
<td>SYB: How to restore a Sybase ASE database server (UNIX)</td>
</tr>
<tr>
<td>1588316</td>
<td>SYB: Configure automatic database and log backups</td>
</tr>
</tbody>
</table>
Overview of AWS Services for Backup and Recovery

This section provides an overview of the different AWS services that are required for the backup and recovery of SAP systems running on AWS. For a more detailed description of each service please refer to the links provided.

Simple Storage Service (S3) – http://aws.amazon.com/s3
Amazon S3 provides a highly durable storage infrastructure designed for mission-critical and primary data storage. Amazon S3 is designed to provide 99.999999999% durability and 99.99% availability over a given year.

⚠️ Amazon S3 in the center of any SAP backup and recovery solution on AWS. All backups methods described in this document rely on backup data being stored directly or indirectly in Amazon S3.

Elastic Compute Cloud (EC2) – http://aws.amazon.com/ec2
The Amazon Elastic Compute Cloud (EC2) is an IT infrastructure platform that provides on-demand access to virtual Linux and Windows servers, storage, networking, and other infrastructure services.

Components of AWS EC2

Amazon Machine Image (AMI)
An AMI is the server template that is used to launch a new instance (virtual server). The AMI contains the base operating system (e.g., Linux or Microsoft Windows) that you can then install SAP software on top of. A large selection of public AMIs is available from Amazon and the Amazon EC2 community and it is possible to create your own AMIs.

Instance
After an AMI is launched, the resulting running system is called an instance.

Regions and Availability Zones
Amazon EC2 locations are composed of Regions and Availability Zones. Availability Zones are distinct locations that are engineered to be insulated from failures in other Availability Zones and provide inexpensive, low latency network connectivity to other Availability Zones in the same Region. Regions consist of one or more Availability Zones, are geographically dispersed, and will be in separate geographic areas or countries. Amazon EC2 is currently available in seven regions: US East (Northern Virginia), US West 1 (Northern California), US West 2 (Oregon), EU (Ireland), Asia Pacific (Singapore), and Asia Pacific (Tokyo) and AWS GovCloud.

Elastic Block Store (EBS) – http://aws.amazon.com/ebs
AWS Elastic Block Store (EBS) provides persistent block level storage volumes for use with EC2 instances. EBS volumes are off-instance storage that persists independently from the life of an instance. Elastic Block Store provides highly available, highly reliable storage volumes that can be attached to an Amazon EC2 instance and exposed as a device within the instance’s guest operating system.
EBS Snapshot
EBS provides the ability to create point-in-time snapshots of volumes, which are persisted to Amazon S3.Snapshots can be used as the starting point for new Amazon EBS volumes as well as to protect data for long-term durability. If you make periodic snapshots of a volume, the snapshots are incremental so that only the blocks on the device that have changed since your last snapshot are incrementally saved in the new snapshot. Even though snapshots are saved incrementally, the snapshot deletion process is designed so that you need to retain only the most recent snapshot in order to restore the volume.

AWS Import/Export accelerates moving large amounts of data into and out of AWS using portable storage devices for transport. AWS transfers your data directly onto and off of storage devices using Amazon’s high-speed internal network and bypassing the Internet. For significant data sets, AWS Import/Export is often faster than Internet transfer and more cost effective than upgrading your connectivity.

Amazon Glacier – http://aws.amazon.com/glacier
Amazon Glacier is an extremely low-cost storage service that provides secure and durable storage for data archiving and backup. In order to keep costs low, Amazon Glacier is optimized for data that is infrequently accessed and for which retrieval times of several hours are suitable. With Amazon Glacier, customers can reliably store large or small amounts of data for as little as $0.01 per gigabyte per month, a significant savings compared to on-premises solutions.

Backup Destination on AWS
The primary difference between backing up SAP systems on Amazon Web Services compared to traditional on-premises infrastructure is the backup destination. The typical backup destination used with on-premises infrastructure is tape. On AWS, instead of storing backups on tape, backups are stored in Amazon S3. There are many benefits to storing backups in Amazon S3 vs. tape. Backups stored in Amazon S3 are automatically stored “offsite” from the source system since data in Amazon S3 is replicated across multiple facilities within the AWS region.

There are primarily two different methods to store backups in Amazon S3. The first method is to backup data directly into Amazon S3, the second method involves backing up your data to a locally attached EBS volume and then subsequently copying this data into Amazon S3. Details how to copy backup data from an EBS volume into Amazon S3 are provided later in this document.

Backup and Recovery of non-Production Systems
This section provides backup options for non-production systems. Examples of non-production systems are:

- Demo systems
- Training systems
- Sandbox systems
- Proof-of-Concept systems
- Trial systems

Systems of this type share the following backup requirements:
- Infrequent backups (1-2 times per week)
- Do not require point-in-time recovery
- Can tolerate downtime to complete a backup
- Simple low cost backup solutions

**Create Image Backup Method**

The EC2 Create Image function can be used to create full (OS, application, and database file systems) offline backups of a complete SAP system. Executing a Create Image creates and registers a new Amazon Machine Image (AMI) of the running instance and creates snapshots of all EBS volumes attached to the instance. Create Image can also be used to copy complete SAP systems with very little effort. The AMI created during the Create Image process can then be used to launch additional EC2 instances that are identical to the source SAP system.

Please note that in order to provide a consistent backup, the EC2 Instance is stopped at the beginning of the create image process to confirm all I/O to the EBS volumes is quiesced. The EC2 Instance is only stopped for a short period of time and is restarted while EBS snapshot synchronization is continued in the background.

The following graphic illustrates the Create Image process (Figure 1).

**How to execute an ad-hoc backup using Create Image**

You can execute a create image from within the AWS Management Console by simply right clicking on the instance you would like to backup and selecting Create Image (EBS AMI).

For detailed documentation of the Create Image process please read the *Creating Amazon EBS-Backed AMIs* section of the AWS EC2 User Guide:
Creating an EC2 Image will shut down and restart the EC2 Instance (VM and Operating System) to create consistent snapshots. You need to make sure that SAP application(s) and database(s) are cleanly shut down before using this command. After EC2 Instance restart, database(s) and SAP application(s) need to be restarted again to resume SAP operation.

**How to schedule a backup using Create Image**

You can schedule backups using the Create Image method using the EC2 API command line tools. The EC2 API command line tools allow you to manage AWS EC2 resources from Windows or Linux command shell. Included in the EC2 API tools is the `ec2-create-image` command that it used to create an AMI from and existing EC2 instance.

Below is the syntax and an example how to create a new AMI using the `ec2-create-image` command:

**Syntax:** `ec2-create-image`

```bash
ec2-create-image -n <your_image_name> <instance_id>
```

**Example:** `ec2-create-image`

```
<stopsap on EC2 instance i-eo9483uj>
ec2-create-image -n ECC_Demo_20120401 i-eo9483uj
<startsap on EC2 instance i-eo9483uj>
```

**How to schedule the Create Image process:**

1. Install and configure the EC2 API command line tools on a server on your corporate network or on another EC2 Windows instance (this can be a dedicated administration system used for tasks like this).
2. Create a shell or batch script that contains the `ec2-create-image` command with the necessary parameters to create an image of the instance you wish to backup.
3. Schedule the batch script to run when you would like the Create Image process to take place using cron on Linux or the Task Scheduler built into Windows.

Detailed information on the `ec2-create-image` and other EC2 API command line tools, including download information, are provided below.

**Amazon EC2 Command Line Reference – ec2-create-image**


**Download - Amazon EC2 API command line tools**


**Getting Started with the Command Line Tools**
How to restore a system that was backed up using Create Image

Restoring a system that was backed up using the Create Image method is very simple. Since the Create Image process creates a complete image (AMI) of the instance being backed by creating snapshots of all attached EBS volumes, all that is needed to restore a system is to launch a new instance from the latest AMI version.

For detailed instruction how to launch and instance from an AMI please refer to the AWS EC2 Users Guide: [http://docs.amazonwebservices.com/AWSEC2/latest/UserGuide/LaunchingAndUsingInstances.html](http://docs.amazonwebservices.com/AWSEC2/latest/UserGuide/LaunchingAndUsingInstances.html)

After the complete system has been restored from an AMI, the SAP database(s) can be rolled forward as described in the next chapter.

Snapshot backups of individual primary EBS Volumes

Instead of creating a complete AMI system backup as described in the previous section, snapshots of individual EBS Volumes can also be leveraged to create more fine-grained snapshot backups. The Create Snapshot process of individual EBS Volumes is illustrated in Figure 2 below.

![Figure 2: Snapshots of individual primary EBS Volumes](image)

You can create a consistent snapshot of individual EBS Volumes on a running system as long as you can make sure that no I/O is taking place on the EBS Volumes, and all (file system) cache is flushed properly to the underlying EBS Volumes. The easiest and safest way to assure EBS Volume consistency is to stop processes that access the EBS Volumes, like stopping the SAP application and its database, and dismount their file systems properly before creating snapshots of underlying EBS Volumes.

Alternatively, combinations of DBMS and file system techniques can be used to temporarily freeze file system I/O for a short period of time to create snapshots of the underlying EBS Volumes, and to resume I/O after consistent snapshot creation has finalized.
As direct primary EBS Volume snapshot techniques of SAP systems and their databases are complex to set up correctly, they are not within the scope of these general backup and restore guidelines.

Backup and Recovery of Production Systems

The backup options covered in this section address the following backup requirements that are common for production systems:

- Frequent backups via a scheduled backup
- Online database data backup
- Database transaction log backup
- Point-in-time database recovery
- Closely synchronized file system and database backups

For production systems, a regular restore of their backups to a separate system is strongly recommended, so that:

- Restore and recovery procedures, and Service Level Agreement (SLA) objectives can be validated
- Restored data can be checked for consistency using the DBMS tools listed in Table 2 below

### Table 2: Overview of DBMS tools for checking data consistency and integrity

<table>
<thead>
<tr>
<th>DBMS</th>
<th>Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Server</td>
<td>DBCC CHECKDB</td>
</tr>
<tr>
<td>DB2</td>
<td>DB2DART</td>
</tr>
<tr>
<td>MaxDB</td>
<td>CHECK DATA</td>
</tr>
<tr>
<td>Sybase ASE</td>
<td>DBCC CHECKDB</td>
</tr>
</tbody>
</table>

Database Backup to secondary EBS Volumes

The backup options covered in this section involve first writing the backup data to a local “backup” EBS volume and then copying the backup data to Amazon S3 so that the data is protected in case of failure of the backup EBS volume.

The following graphic shows how backups are first created on a local EBS volume and then the backup data is copied to S3:
SAP File System Backup on Windows
Backup and recovery of the operating system and critical SAP file systems is accomplished using the Windows Server Backup feature built into Windows Server 2008 R2. The Windows Server Backup feature is not installed by default on the standard Windows Server 2008 R2 AMI but can be easily added by following the steps provided below:

1) Click on the **Start** button and then right click on **Computer**
2) Select **Manage**
3) On the left select **Server Manager**
4) On the right scroll down to **Features Summary** and click on **Add Features**
5) Select **Windows Server Backup Features** and then click on **Install**

Once the Windows Server Backup Feature installed, you can then schedule backups of the drives and/or directories that need to be backed up using the Windows Server Backup wizard.

While scheduling a backup in the Windows Server Backup wizard you will be asked to choose a **Destination Type**, choose **Local Drives** and then select the drive that is the backup EBS volume (Windows Drive) and folder you wish to back up to.

For detailed instructions how to schedule a backup using the Windows Server Backup feature, please refer to:
**Backup and Recovery Overview for Windows Server 2008 R2**
SAP File System Backup on Linux
Open source tools for backing up data on Linux include `tar`, `cpio`, and `rsync`; a detailed example is given in “Appendix 1: Linux System Backup using TAR”.

For SAP instruction how to create a full SAP system backup on Linux with TAR, please refer to:
- SAP Library (help.sap.com) – Backing Up and Restoring your SAP System on UNIX
  (use the file system example herein, with a file location on a backup EBS volume)

Microsoft SQL Server 2008 R2 on Windows
Table 3 below shows a sample database layout for SQL Server, where each Windows Drive is backed by a single EBS Volume. For additional information on recommended drive/EBS configuration for SAP systems on AWS, please refer to the SAP on AWS Implementation Guide referenced at the beginning of this guide.

Drives X:\, Y:\ and Z:\ are the secondary drives that will hold file system, DB Data and DB Log backups to disc. After a backup to one of these drives has finished, it can be sent to S3 by creating a snapshot of the underlying EBS Volume, or by copying the individual backup files directly to S3, as described in the subsequent section “Backup and Recovery without 3rd party backup software”.

<table>
<thead>
<tr>
<th>Windows Drive</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>C:\</td>
<td>Root volume (included with EC2 instance)</td>
</tr>
<tr>
<td>D:\</td>
<td>SAP / MS SQL software</td>
</tr>
<tr>
<td>S:\</td>
<td>Swap</td>
</tr>
<tr>
<td>E:\</td>
<td>DB Log file</td>
</tr>
<tr>
<td>F:\ G:\ H:\ I:\</td>
<td>DB Data file 1-4</td>
</tr>
<tr>
<td>X:\</td>
<td>File System backups</td>
</tr>
<tr>
<td>Y:\</td>
<td>DB Log backups</td>
</tr>
<tr>
<td>Z:\</td>
<td>DB Data backups</td>
</tr>
</tbody>
</table>

Backup and Recovery of the SAP database and transaction log are accomplished using the native SQL Server backup functionality that can either be scheduled and executed interactively from the SQL Server Management Studio or via a script using Transact-SQL commands.

Just as with the file system backup described earlier, the only special consideration when scheduling and executing SQL Server backups on AWS is the backup destination. Instead of choosing the backup destination `Tape` you need to select `Disk` and point to the drive that is the “backup” EBS volume that you have designated for backups, Y:\ for Log- and Z:\ for Data-backups in our example.

If case of database Restore and Recovery:
- First check if all required Data and Transaction Log backups are still available on the designated “backup” EBS volumes, Y:\ and Z:\ our example.
- If the available backups are not usable or incomplete, retrieve the missing Data and Transaction Log backups from Amazon S3 as described in the section “Copying backup data to, and retrieving them again from Amazon S3”.

---

Backup and Recovery of SAP Systems on Amazon Web Services

• Perform SQL Server Restore and Recovery, using the Data and Transaction Log backups that are available on the EBS Volumes

For detailed instructions how to schedule database and transaction log backups, and perform restore and recovery by using either the SQL Server Management Studio or via a script using Transact-SQL commands please refer to:

**SQL Server 2008 - Backing Up and Restoring How-to Topics (SQL Server Management Studio)**

**IBM DB2 LUW on Linux or Windows**

Table 4 below shows an example database layout for DB2. For additional information on recommended drive/EBS configuration for SAP systems on AWS, please refer to the *SAP on AWS Implementation Guide* referenced at the beginning of this guide.

The secondary file systems /os_exe_backups (Windows Drive X:\) and /db_data_backups (Windows Drive Z:\) will hold System and DB Data and backups to disc. The file system /db2/<SID>/log_archive (Windows Drive Y:\) is used to let DB2 automatically archive its DB transaction logs, a process managed by the DB2 RDBMS itself.

After a backup to one of /os_exe_backups or /db_data_backups has finished, or a transaction log has been archived to /db2/<SID>/log_archive by the DB2 RDBMS, it can be sent to S3 by creating a snapshot of the underlying EBS Volume, or by copying the individual files directly to S3, as described in the subsequent section “Backup and Recovery without 3rd party backup software”.

**Table 4: Sample DB2 file system layout with backup EBS volumes on Linux or Windows**

<table>
<thead>
<tr>
<th>Linux file system</th>
<th>Windows Drive(s)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>C:</td>
<td>Root volume (included with EC2 instance)</td>
</tr>
<tr>
<td>/sapmnt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/usr/sap</td>
<td>D:\</td>
<td>SAP and DB2 software</td>
</tr>
<tr>
<td>/db2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;swap&gt;</td>
<td>S:\</td>
<td>Swap</td>
</tr>
<tr>
<td>/db2/&lt;SID&gt;/log_dir</td>
<td>E:\</td>
<td>Active DB Transaction Logs</td>
</tr>
<tr>
<td>/db2/&lt;SID&gt;/sapdata1-4</td>
<td>F:\ G:\ H:\ I:\</td>
<td>DB Data File System 1-4</td>
</tr>
<tr>
<td>/os_exe_backups</td>
<td>X:\</td>
<td>File System backups</td>
</tr>
<tr>
<td>/db2/&lt;SID&gt;/log_archive</td>
<td>Y:\</td>
<td>Archived DB Transaction Logs</td>
</tr>
<tr>
<td>/db2_data_backups</td>
<td>Z:\</td>
<td>DB Data backups</td>
</tr>
</tbody>
</table>

An example of how to create DB2 database backups to /db_data_backups is given in “Appendix 2: IBM DB2 Database Backup”.

For detailed instructions on DB2 database and transaction log backups, and DB2 restore and recovery in SAP environments, please refer to:

**Database Administration Guide "SAP on IBM DB2 for Linux, Unix and Windows"**
SAP MaxDB on Linux or Windows
Table 4 below shows an example database layout for MaxDB. For additional information on recommended drive/EBS configuration for SAP systems on AWS, please refer to the SAP on AWS Implementation Guide referenced at the beginning of this guide in “Prerequisite Documentation”.

The secondary file systems /os_exe_backups, /db_log_backups and /db_data_backups (Windows Drives X:\, Y:\ and Z:\) will hold System DB Log and DB Data and backups to disc.

After a backup to one of these file systems or Windows drives, it can be sent to S3 by creating a snapshot of the underlying EBS Volume, or by copying the individual files directly to S3, as described in the subsequent section “Backup and Recovery without 3rd party backup software”.

Table 5: Sample MaxDB file system layout with backup EBS volumes on Linux or Windows

<table>
<thead>
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<th>Use</th>
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<td>/</td>
<td>C:\</td>
<td>Root volume (included with EC2 instance)</td>
</tr>
<tr>
<td>/sapmnt</td>
<td>D:\</td>
<td>SAP and MaxDB software</td>
</tr>
<tr>
<td>/usr/sap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/sapdb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;swap&gt;</td>
<td>S:\</td>
<td>Swap</td>
</tr>
<tr>
<td>/sapdb/&lt;SID&gt;/saplog</td>
<td>E:\</td>
<td>DB Transaction Log</td>
</tr>
<tr>
<td>/sapdb/&lt;SID&gt;/sapdata1-4</td>
<td>F:, G:, H:, I:\</td>
<td>DB Data File System 1-4</td>
</tr>
<tr>
<td>/os_exe_backups</td>
<td>X:\</td>
<td>File System backups</td>
</tr>
<tr>
<td>/db_log_backups</td>
<td>Y:\</td>
<td>DB Log backups</td>
</tr>
<tr>
<td>/db_data_backups</td>
<td>Z:\</td>
<td>DB Data backups</td>
</tr>
</tbody>
</table>

An example of how to create MaxDB database backups to /db_data_backups and MaxDB Log backups to /db_log_backups is given in “Appendix 4: SAP MaxDB Database Backup to a Local File System”. An example of how to restore and recover a MaxDB database from “backup” EBS Volume Snapshots is given in “Appendix 5: SAP MaxDB Database Restore and Recovery”.

SAP Sybase ASE on Linux or Windows
Table 4 below shows an example database layout for SAP Sybase ASE. For additional information on recommended drive/EBS configuration for SAP systems on AWS, please refer to the SAP on AWS Implementation Guide referenced at the beginning of this guide in “Prerequisite Documentation”.

The secondary file systems /os_exe_backups, /db_log_backups and /db_data_backups (Windows Drives X:\, Y:\ and Z:\) will hold System, DB Log and DB Data and backups to disk.

After a backup to one of these file systems or Windows drives, it can be sent to S3 by creating a snapshot of the underlying EBS Volume, or by copying the individual files directly to S3, as described in the subsequent section “Backup and Recovery without 3rd party backup software”.

16
Table 6: Sample Sybase ASE file system layout with backup EBS volumes on Linux or Windows

<table>
<thead>
<tr>
<th>Linux file system</th>
<th>Windows Drive</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>C:\</td>
<td>Root volume (included with EC2 instance)</td>
</tr>
<tr>
<td>/sapmnt</td>
<td>D:\</td>
<td>SAP and Sybase ASE software</td>
</tr>
<tr>
<td>/usr/sap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/sybase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;swap&gt;</td>
<td>S:\</td>
<td>Swap</td>
</tr>
<tr>
<td>/sapdb/&lt;SID&gt;/sap_log_1</td>
<td>E:\</td>
<td>DB Transaction Log</td>
</tr>
<tr>
<td>/sapdb/&lt;SID&gt;/sapdata_1-N</td>
<td>F:\ G:\ H:\ I:\</td>
<td>DB Data File System 1-4</td>
</tr>
<tr>
<td>/os_exe_backups</td>
<td>X:\</td>
<td>File System backups</td>
</tr>
<tr>
<td>/db_log_backups</td>
<td>Y:\</td>
<td>DB Log backups</td>
</tr>
<tr>
<td>/db_data_backups</td>
<td>Z:\</td>
<td>DB Data backups</td>
</tr>
</tbody>
</table>

Backup and Recovery of the Sybase ASE database and transaction log are accomplished using the native Sybase ASE backup functionality that can be executed interactively or via a script using Transact-SQL commands.

Just as with the file system backup described earlier, the only special consideration when scheduling and executing Sybase ASE backups on AWS is choosing the correct backup destination. You need to save the Sybase ASE dumps to the file system or drive that is on the “backup” EBS volume that you have designated for backups, /db_log_backups (drive Y:\) for Log- and /db_data_backups (drive Z:\) for Data-dumps in our example.

The /db_data_backups file system (drive Z:\) will hold the dump images of the following databases:
- <DBSID> database (SAP database)
- master database
- sybsystemprocs database
- sybmgmtdb database
- saptools database

You can use the DUMP DATABASE command to create these database dump images.

The /db_log_backups file system (drive Z:\) will hold dump images of the transaction log. You can use the DUMP TRANSACTION command to create these transaction log dump images.

⚠ Ensure that a complete sequence of transaction log archives is available at all times! SAP notes 1585981 and 1588316 provide details on how this can be achieved and automated.

In case of database Restore and Recovery:
- First check if all required Data and Transaction Log dumps are still available on the designated “backup” EBS volumes; /db_data_backups (drive Z:\) and /db_log_backups (drive Y:\) in our example.
- If the available backups are not usable or incomplete, retrieve the missing Data and Transaction Log dumps from Amazon S3 as described in the section “Copying backup data to, and retrieving them again from Amazon S3”.
Perform Sybase ASE Restore and Recovery, using the Data and Transaction Log dumps that are available on the EBS Volumes

For detailed instructions how to create Sybase ASE database and transaction log dump images, and perform restore and recovery by using the Sybase ASE Transact-SQL commands please refer to the SAP DBA Guide: Sybase Adaptive Server Enterprise and the SAP notes referred to in “Prerequisite Documentation”.

**Backup and Recovery without 3rd party backup software**

Once you have created a backup on an EBS volume, you need to copy the backup data to Amazon S3 to protect the data against EBS volume failure.

**Copying backup data to, and retrieving them again from Amazon S3**

Amazon S3 stores data as objects within buckets. An object is comprised of a file and optimally and metadata that describes that file. It is recommended that you create a dedicated Amazon S3 bucket to store your backups. You can use one bucket to store backups from multiple systems. To help organize backups from different systems and different backup types (i.e. file system, DB, transaction log, etc.) you can create multiple folders within a bucket.

For detailed instructions how to create an Amazon S3 bucket please refer to the Amazon S3 Getting Started Guide: [http://docs.amazonwebservices.com/AmazonS3/latest/gsg/CreatingABucket.html](http://docs.amazonwebservices.com/AmazonS3/latest/gsg/CreatingABucket.html)

AWS provides three methods to copy data directly to Amazon S3:

- AWS Management Console
- AWS SDK API
- S3 REST API

Fortunately you do not need to develop your own command line interface to copy data to Amazon S3. Various command line interfaces exist that you can incorporate into a script to copy data to or retrieve data from Amazon S3. A few of these Amazon S3 command line interfaces are listed below:

- **CloudBerry Labs – S3 backup command line interface (Windows only)**

- **s3cmd (Linux and Windows)**
  [http://s3tools.org/s3cmd](http://s3tools.org/s3cmd)

- **s3.exe (Windows only)**
  [http://s3.codeplex.com](http://s3.codeplex.com)

Below are sample commands using `s3cmd`, called from either a Linux shell or windows command prompt.

Copy a backup stored on an EBS volume to Amazon S3:

```
s3cmd put <backup_file> <s3://bucket_name/folder_name>
```
Retrieve a backup from Amazon S3 to an EBS volume to be used for a restore:

```
s3cmd get <s3://bucket_name/folder_name/backup_file>
```

Creating a Snapshot of a backup EBS Volume

Instead of copying and retrieving single files to Amazon S3, you can also create a snapshot of the complete EBS Volume. The snapshot will automatically be stored in Amazon S3 and can subsequently be used to create new EBS Volumes that contain the same data as stored in the snapshot.

Below are sample commands, using the EC2 Command Line Tools, called from either a Linux shell or windows command prompt.

Create a snapshot of an EBS volume that is automatically stored in Amazon S3:

```
ec2-create-snapshot -d <DESCRIPTION> <VOLUME>
```

Create a new EBS Volume from an EBS snapshot stored in Amazon S3:

```
ec2-create-volume --snapshot <SNAPSHOT> [-s <SIZE>] -z <AVAIL_ZONE>
```

Attach an EBS Volume to an Amazon EC2 instance:

```
ec2-attach-volume <VOLUME> -i <INSTANCE> -d <DEVICE>
```

Backup and Recovery using 3rd party backup software

This section discusses using 3rd party backup solutions to backup SAP systems running on AWS. Many of the same reasons why you would choose to use a 3rd party enterprise backup solutions for managing the backup and recovery of SAP systems running on traditional on-premise infrastructure also apply to backing up SAP systems on AWS:

- Centralized backup schedule management
- Automated Data Retention and Disposition Policy
- Clients and agents for various operating systems and databases
- Reporting

Using 3rd party backup software on AWS

Using an enterprise backup solution on AWS is similar to how you would operate it in a traditional on-premises infrastructure. The only special consideration, as discussed early in this guide, is the backup destination. Most existing enterprise backup solutions do not yet support backup directly to Amazon S3. For enterprise backup solutions that do not support backup directly to S3 you can first backup to a local EBS volume attached to the instance and then copy the backup data to Amazon S3. Most all enterprise backup solutions allow you to run pre and post scripts before and after the backup is run. One of the post scripts you would run would be a script to copy the backup data to Amazon S3 as described earlier in this section.
3rd party backup software that supports direct backup to Amazon S3
Below is a list of 3rd party backup products that support direct backup to Amazon S3.

**Zmanda – Amanda Enterprise Backup**

Zmanda’s – *Amanda Enterprise* backup suite supports direct backup to Amazon S3. *Amanda Enterprise* has backup clients and agents for different operating systems and databases. For additional information on the *Amazon Enterprise* backup suite please visit Zmanda’s website:

http://www.zmanda.com/amanda-agent-overview.html

**CloudBerry Lab**

CloudBerry Lab offers a suite of products designed to work with Amazon S3. Two products offered by CloudBerry Lab that can be used to backup Windows Server and MS SQL are listed below:

- Online Backup for Winders Server
- Online Backup for MS SQL Server

For additional information on the visit CloudBerry Lab’s website:

http://www.cloudberrylab.com/

The following graphic shows a direct backup to Amazon S3:

**Figure 4: Backup directly to S3**
Appendix 1: Linux System Backup using TAR

This appendix provides an example for creating a Linux file system backup that can be used in case of a full system loss.

**NOTE:** THIS OS BACKUP CANNOT BE USED TO RESTORE THE DATABASE, AS DATABASE DATA AND TRANSACTION LOGS ARE SPECIFICALLY EXCLUDED FROM THE BACKUP. AFTER RESTORING THIS BACKUP, RESTORE AND RECOVERY OF THE DATABASE SHOULD FOLLOW.

The example procedure is as follows:

1) Ensure you have enough space on the backup EBS Volume file system /os_exe_backups
   **NOTE:** DATABASE DATA, TRANSACTION LOGS AND MOUNTED BACKUP FILE SYSTEMS WILL BE EXCLUDED FROM THIS BACKUP

2) Start the OS, SAP and DBMS binaries and profiles backup
   a. Logon into the OS start a tar backup on the /os_exe_backups file system
      **NOTE:** THE USE OF COMPRESSION AFFECTS THE CPU UTILIZATION AND BACKUP TIME. CHOOSE TO USE COMPRESSION OR NOT BY ADDING OR REMOVING THE "--GZIP" PARAMETER OF THE TAR COMMAND

   **For database type of MaxDB use this script as an example:**

   ```
   export exclusion_file=/os_exe_backups/backup-exclude-dirs.txt
   export backup_file=/os_exe_backups/backup.tar.gz
   export log_file=/os_exe_backups/backup.stdout
   export error_log_file=/os_exe_backups/backup.stderr
   #Create the exclusion file
   #Exclude OS directories
   >$exclusion_file
   echo "/tmp" >>$exclusion_file
   echo "/proc" >>$exclusion_file
   echo "/sys" >>$exclusion_file
   echo "/dev" >>$exclusion_file
   #Exclude database files
   echo "/sapdb/<SID>/sapdata1" >>$exclusion_file
   echo "/sapdb/<SID>/saplog" >>$exclusion_file
   #Exclude the backup directories
   echo "/os_exe_backups" >>$exclusion_file
   echo "/db_data_backups" >>$exclusion_file
   echo "/db_log_backups" >>$exclusion_file
   #Run the backup
   cd /os_exe_backups
   tar -v --gzip -cf $backup_file / --exclude-from=$exclusion_file > $log_file 2> $error_log_file
   #to monitor
   #tail -f $log_file
   #tail -f $error_log_file
   **NOTE:** THE COMMAND HAS BEEN PROVIDED AS AN EXAMPLE, PLEASE TEST AND CHANGE AS REQUIRED.
For database type of DB2 use this script as an example:

```bash
export exclusion_file=/os-exe-backups/exclude-dirs.txt
export backup_file=/os-exe-backups/backup.tar.gz
export log_file=/os-exe-backups/backup.stdout
export error_log_file=/os-exe-backups/backup.stderr

# Create the exclusion file
# Exclude OS directories
>$exclusion_file
echo "/tmp" >>$exclusion_file
echo "/proc" >>$exclusion_file
echo "/sys" >>$exclusion_file
echo "/dev" >>$exclusion_file

# Exclude database-related filesystems
echo "/db2/<SID>/sapdata1" >>$exclusion_file
echo "/db2/<SID>/sapdata<n>" >>$exclusion_file
echo "/db2/<SID>/log_dir" >>$exclusion_file
echo "/db2/<SID>/log_archive" >>$exclusion_file

# Exclude the backup directories
echo "/os-exe-backups" >>$exclusion_file
echo "/db2-data-backups" >>$exclusion_file

# Run the backup
cd /os-exe-backups
.tar -v --gzip --cf $backup_file / --exclude-from=$exclusion_file > $log_file 2> $error_log_file

# To monitor
# tail -f $log_file
# tail -f $error_log_file
```

**NOTE:** The commands have been provided as an example, please test and change as required.

To send the backup to S3, create an EBS snapshot of the backup EBS volume that holds the /os_exe_backups file system.

It is recommended to tag the snapshot with a description like

"<EC2-INSTANCE-ID>_OS_EXE_BACKUPS_<YYYY-MM-DD> ",

where <EC2-INSTANCE-ID> can be retrieved from the EC2 metadata web service through


Linux tools like `curl` or `wget` can be used to issue the above HTTP command from a local shell on the EC2 instance.

Appendix 2: IBM DB2 Database Backup to a local File System

DB2 rollforward recovery
Make sure that you have enabled your DB2 database for rollforward recovery. Rollforward recovery mode enables you to recover from a database backup to the most recent point in time using archived database log files and is a prerequisite for taking DB2 online backups. If you have not configured your DB2 database for rollforward recovery mode, you cannot take online backups. Instead you will need to shutdown the SAP system and DB2 to take offline backups. For production systems, your database must be in rollforward recovery mode. For more details refer to the „Database Administration Guide SAP on IBM DB2 for Linux, UNIX, and Windows“.

The file system names listed in Table 4 will be used for the following examples.

Steps to enable rollforward recovery and set up DB2 logfile management
1) Stop SAP and DB2
2) Enable rollforward recovery by updating the database configuration parameter LOGARCHMETH1:
   ```bash
   su - db2<sid>
db2 update db cfg for <SID> using logarchmeth1
   DISK:/db2/<SID>/log_archive
   ```
   The database will now be placed in backup pending state. A full database backup must be taken.
   From this point onwards DB2 will automatically archive log files from the /db2/<SID>/log_dir filesystem to the /db2/<SID>/log_archive filesystem.
3) Take a full database offline backup
   ```bash
   db2 backup database <sid> to "/db_data_backups" compress
   ```
4) Configure a retention period for your database backups and the corresponding database log files. For example if you want to keep at least 4 database backups and you want to remove surplus backups older than 30 days and all corresponding database log files, configure DB2 in the following way:
   ```bash
   db2 update db cfg for <sid> using NUM_DB_BACKUP 4
   db2 update db cfg for <sid> using REC_HIS_RETENTN 30
   db2 update db cfg for <sid> using AUTO_DEL_REC_OBJ ON
   ```
5) Start SAP
Example: DB2 LUW full online data and log backup

Make sure the /db_data_backups file system (as from Table 4) has enough storage space, and proper read/write permissions.

Please remember to use the references mentioned in section “Prerequisite Documentation” as primary documentation. In addition the SAP on DB2 LUW for Unix and Windows (DB6) forum on the SAP Community Network (SCN) can be consulted for other questions. The following sections merely provide examples, and should not be used as a general reference.

Two options to back up the DB2 LUW database will be shown in the following sections:

- Option 1: back up the database directly from the SAP system
- Option 2: back up the database using the CLI

Option 1: back up the database directly from the SAP system

1) Log in to the SAP system with an admin user
2) Execute the transaction /nDBACOCKPIT
3) On the left screen panel, navigate to Jobs/DBA Planning Calendar
4) In the calendar area, select any cell representing time older than current time and click on ‘Add’ button.
5) On the pop-up window, select ‘Database Backup to Device’ action, choose ‘Online’ backup mode with ‘Include Logs’ option and enter /db2_data_backups in the ‘Device/Directory’ field
6) Click on ‘Execute Immediately’ button

Option 2: back up the database using the CLI

1) Log in to the EC2 instance
2) Execute the following commands:

```
su - db2<sid>
s#start online compressed backup including logs
db2 backup database <sid> online to "/db2_data_backups" compress \
include logs
```

3) Wait until the backup has completed.
   You will see the following message when the backup has completed:

```
Backup successful. The timestamp for this backup image is : 20111220221428
```

This message is shown in the following log file, located in the backup directory:

<SID>.0.db2<sid>.NODE0000.CATN0000.<datetime stamp>.001
4) Backup the database manager configuration required to rebuild the database:

```
su - db2<sid>
cd /db2_data_backups
db2cfexp <SID>_cfg_backup.txt BACKUP
```

5) Backup the DB2 recovery history file:

```
su - db2<sid>
cp /db2/<SID>/db2<sid>/NODE0000/SQL00001/db2rhist.asc \
/db2_data_backups
```

**DB2 transaction log file management**

It is recommended to configure the DB2 transaction log management as mentioned in the example above and described in “IBM DB2 Universal Database for UNIX and Windows - New Log File Management”, section 2.2.1.

As from DB2 LUW V9.5, automatic log file retention management can be configured in addition. This is described in the example above and in the Database Administration Guide "SAP on IBM DB2 for Linux, Unix and Windows", section “DB2 V9.5 and Higher Only: Automatic Log File and Backup Retention”.

The content of the /db2/<SID>/log_archive file system should be sent to S3 on a regular basis by creating a direct snapshot of the underlying EBS Volume, or by copying added files individually to S3, optimally each time after a transaction log was written into the DB2-LOG-ARCHIVE file system. The snapshot of the EBS Volume can be taken directly without dismounting the file system if this file system is the only one to reside on a single EBS Volume (no striping, etc.).

**Create a snapshot to send the backup to S3**

It is recommended to tag snapshots with a description like

- “<SID>_DB2_DATA_BACKUPS_<YYYY-MM-DD>” for the database data backups
- “<SID>_DB2_LOG_ARCHIVE_<YYYY-MM-DD-HH-MM-SS>” for the database archive log backups
Appendix 3: DB2 LUW Database Restore and Recovery

Restore and recovery of databases requires careful planning and preparation before execution. Take time for root-cause analysis to be better able to identify the most efficient recovery strategy before executing.

For example, data only need to be restored from S3 if recovery is not possible anymore from data and backups that are already available on the system. If a database needs to be recovered to the latest possible point in time, always make sure to not overwrite and destroy the latest database transaction logs. As these are typically not yet archived and/or backed up to S3, the latest transactions contained in these logs could then get lost forever!

This guide does not intend to replace the original backup and restore documentation of the database vendors that was referenced in section “Prerequisite Documentation”. As especially restore and recovery scenarios are most diverse and dependent on the environment and failure cause, it is strongly recommended to follow the original documentation in case of a real failure.

Example: DB2 Restore and Recovery from “backup” EBS Volume Snapshots

1) If this is an DR, make sure you have restored the OS
2) Mount the correct Database backup on the local EC2 instance

   NOTE: THIS STEP IS ONLY REQUIRED IF THE ALREADY MOUNTED DATABASE BACKUP IS NOT ADEQUATE FOR RECOVERY, OR IF THE LATEST DATABASE BACKUP IS NOT AVAILABLE ANYMORE ON THE EC2 INSTANCE

   a. Create an EBS volume based on an EBS snapshot
      1. On Volumes, click on Create Volumes
      2. Type the Size of the Volume
      3. Select the same Availability Zone as the Instance
      4. On Snapshot select the latest DB backup
      5. Click on Yes, Create

   b. Attach the volume to the EC2 Instance
   c. Mount the file system
      1. Logon to the EC2 instance using putty, or any other ssh client
      2. Mount the backup filesystem

         Example:

         ```
         vgscan
         vgimport vgbackup
         vgchange vgbackup -a y
         mkdir /db_data_backups
         mount /dev/vgbackup/backups /db_data_backups
         ```

3) Mount the required Database logs on the instance

   NOTE: THIS STEP ONLY REQUIRED IF THE AVAILABLE ARCHIVED LOGS ARE NOT SUFFICIENT FOR RECOVERY, OR IF THEY ARE NOT AVAILABLE ANYMORE
a. Create an EBS volume based on an S3 log backup snapshot
   1. On Volumes, click on Create Volumes
   2. Type the Size of the Volume
   3. Select the same Availability Zone as the Instance
   4. On Snapshot select the latest log backup
   5. Click on Yes, Create

b. Attach the volume to the Instance
c. Mount the FS
   
   **NOTE: FOR SAFETY REASONS, THE FILE SYSTEM WILL BE MOUNTED TO ANOTHER MOUNT POINT AS THE ARCHIVE LOG FILE SYSTEM ITSELF.**
   1. Logon to the instance using putty, or any other ssh client
   2. Mount the backup filesystem

   ```
   Example:
   vgscan
   vgimport vgbackuplog
   vgchange vgbackuplog -a y
   mkdir /mnt/backuplogs
   mount /dev/vgbackuplog/backuplogs /mnt/backuplogs
   ```

4) Restore and recover the database using CLI
   a. Logon into the instance as root
   b. Execute the following commands

   ```
   # Log on as db2<sid>
   su - db2<sid>
   
   # If required, copy additional DB logs to the default log archive location
   # For example:
   cp -rp /mnt/backuplogs/* /db2/<SID>/log_archive
   
   # Start database manager
   db2start
   
   # Start the db recovery
   db2 recover db <sid> using history file (/db_data_backups/db2rhist.asc)
   
   # Once DB recovery is done, restore configuration stored outside of DB
   cd /db_data_backups
   db2cfimp <SID> cfg_backup.txt
   ```

5) Start the SAP system

   ```
   su - <sidadm>
   startsap all
   ```
Appendix 4: SAP MaxDB Database Backup to a Local File System

Example: full online data and log backup for MaxDB
Make sure the DB-DATA-BACKUPS and DB-LOG-BACKUPS file systems have enough storage space, and ensure proper read/write permissions for these file systems. The file system names listed in Table 5 will be used in this example.

Apart from the general references mentioned in section “Prerequisite Documentation”, specific MaxDB Backup / Recovery examples can also be found at “SAP MaxDB HowTo” on the SAP Community Network (SCN).

Two options to back up the MaxDB database will be shown in the following sections:

- Option 1: database and log backup using MaxDB Database Studio
- Option 2: database and log backup using DBMCLI

Create MaxDB backup templates
a. Start the SAP MaxDB Database Studio
   If not installed, it can be downloaded from http://www.sdn.sap.com/irj/scn/maxdb-downloads and installed on any computer for remote management
b. Add the server and database into the landscape (if required)
   Go to: My Landscape / Servers / (right click) /Add/“Server/Database”
c. Type the server name or ip: on “Server Name:” and click next
d. Select the Databases and click on Finish
e. Log in to the database using the CONTROL user
   (My Landscape / Servers / <servername/ip>/<DB>/(right click) /Login)
f. (Right click) on the database and click on Administration
g. Go to the Backup Tab
h. Expand Templates
i. Create a Backup template for FULL Backup
j. Choose New...

<table>
<thead>
<tr>
<th>Name</th>
<th>&lt;Template Name&gt; can be FULL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup Type</td>
<td>COMPLETE DATA</td>
</tr>
<tr>
<td>Device Type</td>
<td>FILE</td>
</tr>
<tr>
<td>Backup Tool</td>
<td>NONE</td>
</tr>
<tr>
<td>Device/File</td>
<td>/db_data_backups/&lt;SID&gt;_FULL</td>
</tr>
<tr>
<td>Compressed</td>
<td>Unselect</td>
</tr>
</tbody>
</table>

k. Click Ok
l. Create a Backup template for LOG Backup
Backup and Recovery of SAP Systems on Amazon Web Services

<table>
<thead>
<tr>
<th>Name</th>
<th>&lt;Template Name&gt; can be LOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup Type</td>
<td>LOG</td>
</tr>
<tr>
<td>Device Type</td>
<td>FILE</td>
</tr>
<tr>
<td>Backup Tool</td>
<td>NONE</td>
</tr>
<tr>
<td>Device/File</td>
<td>/db_log_backups/&lt;SID&gt;_LOG</td>
</tr>
<tr>
<td>Compressed</td>
<td>Unselect</td>
</tr>
</tbody>
</table>

Option 1: Back up the database using Database Studio
1) Start the SAP MaxDB Database Studio
2) Log in to the database using the CONTROL user
   (My Landscape / Servers / <servername/ip>/<DB>/ (right click) /Login)
3) (Right click) on the database and click on Administration
4) Go to the Backup Tab
5) Expand Templates
6) Right click on the template “FULL” and click on Backup

Option 1: Back up the database transaction logs using Database Studio
1) Start the SAP MaxDB Database Studio
2) Log in to the database using the CONTROL user
   (My Landscape / Servers / <servername/ip>/<DB>/ (right click) /Login)
3) (Right click) on the database and click on Administration
4) Go to the Backup Tab
5) Expand Templates
6) Right click on the template “LOG” and click on Backup

Option 2: Back up the database using DBMCLI
1) Log in to the EC2 instance
2) Execute the following commands

   ```
su - <sid>adm
# start an utility session
dbmcli -d <SID> -U c -uUTL
# start backup using the template FULL
backup_start FULL
```

3) Wait until the backup has completed

Option 2: Back up the database log using DBMCLI
1) Log in to the EC2 instance
2) Execute the following commands

   ```
su - <sid>adm
# start an utility session
dbmcli -d <SID> -U c -uUTL
```
3) Wait until the backup has completed

**Schedule hourly automatic log backup using Database Studio**

1) Start the SAP MaxDB Database Studio
2) Log in to the database using the CONTROL user
   (My Landscape / Servers / <servername/ip>/{DB} / (right click) / Login)
3) (Right click) on the database and click on
   Administration Tasks/Automatic Log Backup
4) Select the template “LOG” from the list
5) Select “Create a log backup every <XX> minutes”
6) Type 60 on the <XX> field
7) Click on Activate

The EBS snapshot creation of the volume that holds the DB-LOG-BACKUPS file system can now be automated through a script, time-synchronized with the automatic log backup.

**Create a snapshot to send the backup to S3**

Please refer to the section “Creating a Snapshot of a backup EBS Volume” for the detailed steps.

It is recommended to tag snapshots with a description like

- “<SID>_MAXDB_DATA_BACKUPS_<YYYY-MM-DD>” for the database data backups
- “<SID>_MAXDB_LOG_BACKUPS_<YYYY-MM-DD-HH-MM-SS>” for the database log backups
Appendix 5: SAP MaxDB Database Restore and Recovery

Restore and recovery of databases requires careful planning and preparation before execution. Take time for root-cause analysis to be better able to identify the most efficient recovery strategy before executing.

For example, data only need to be restored from S3 if recovery is not possible anymore from data and backups that are already available on the system. If a database needs to be recovered to the latest possible point in time, always make sure to not overwrite and destroy the latest database transaction logs. As these are typically not yet archived and/or backed up to S3, the latest transactions contained in these logs could then get lost forever!

This guide does not intend to replace the original backup and restore documentation of the database vendors that was referenced in section “Prerequisite Documentation”. As especially restore and recovery scenarios are most diverse and dependent on the environment and failure cause, it is strongly recommended to follow the original documentation in case of a real failure.

Example: MaxDB Restore and Recovery from “backup” EBS Volume Snapshots

1) If this is a DR, make sure you have restored the OS and SAP System, either from an Image Backup (AMI) and/or from a backup as described in “Appendix 1: Linux System Backup using TAR”.

2) If required, mount the Database backup on the EC2 instance

   NOTE: NORMALLY, THE MOST RECENT BACKUP SHOULD ALREADY BE AVAILABLE ON THE EC2 INSTANCE

   a. Only if required, create a new EBS volume based on an S3 snapshot backup
      1. On Volumes, click on Create Volumes
      2. Type the Size of the Volume
      3. Select the same Availability Zone as the Instance
      4. On Snapshot select the latest OS backup
      5. Click on Yes, Create

   b. Attach the volume to the Instance
   c. Mount the file system
      1. Log in to the EC2 instance
      2. Mount the /db_data_backups file system

         Example if using LVM2:

         | Command |
         |----------|
         | vgscan   |
         | vgimport vgbackup |
         | vgchange vgbackup -a y |
         | mkdir /db_data_backups |
         | mount /dev/vgbackup/db_data /db_data_backups |

3) If required, repeat the previous step, but now for the /db_log_backups file system

   NOTE: NORMALLY THE MOST RECENT BACKUP SHOULD ALREADY BE AVAILABLE ON THE EC2 INSTANCE
Option 1: Database Restore and Recovery using MaxDB Database Studio

1) Restore the database using Database Studio
   a. Logon into the instance as root
   b. Start $server
   c. Logon into the database using the CONTROL user
      (My Landscape / Servers / <servername/ip>/<DB>/(right click) /Login)
   d. Set the database in admin mode: (Right click) on the database and click on Administration Tasks/Set State/Admin
   e. Start the recovery: (Right click) on the database and click on Administration Tasks/Recovery...
   f. On the Recovery of Database window, click on Recover a medium
   g. Select FULL from the template list and then Next
   h. Click on Start
   i. Click Ok on the in the Confirmation Initialization database window
   j. Wait until the restore has completed.

2) Apply transaction logs using Database Studio
   a. First restore the database using dbmcli or Database Studio without restarting the database
   b. Logon into the database using the CONTROL user (My Landscape / Servers / <servername/ip>/<DB>/(right click) /Login)
   c. Start the recovery: (Right click) on the database and click on “Administration Tasks/Recovery…”
   d. You can select if you want to restore until a specific time (Point in time recovery), in this example we will restore until the last available log, so do not select “Recover until a specific time.” Select Recover a medium and then Click Next
   NOTE: CREATE AN EBS VOLUME FROM AN S3 LOG BACKUP SNAPSHOT — FOLLOWING THE LOG SEQUENCE — AND MOUNT IT TO THE /DB_LOG_BACKUPS IF IT IS REQUIRED TO APPLY OLDER LOGS AS THE ONES AVAILABLE ON THE SYSTEM. HOWEVER, BEFORE DOING SO, MAKE SURE TO HAVE A SNAPSHOT AVAILABLE OF THE LATEST CONTENT OF /DB_LOG_BACKUPS FILE SYSTEM, AS THAT MIGHT BE REQUIRED LATER IN THE RECOVERY PROCESS.
   e. Select LOG from the template list and then Next
   f. Select the Log File Number and Then Next (In this case put the next log after the backup) and click Next
   g. Click Start
   h. The recovery session will try to recover all consecutive logs until it fails with a missing log. You can choose to restore more logs and continue...
   i. Choose Start Database and then Continue

Option 2: Database Restore and Recovery using MaxDB DBMCLI

1) Restore the database using DBMCLI
   a. Log in to the EC2 instance as root
   b. Execute the following example commands

```
#Fix permissions
chown sdb:sdba /sapdb/<SID>/sapdata
```
chown sdb:sdba /sapdb/<SID>/saplog

#logon as <sid>adm
su - <sid>adm

#start the db in ADMIN mode
dbmcli -U c db_admin

#Logon a recovery session
dbmcli -U c

#List the backup history, and last logs
#take notes of the next log number
backup_history_open
backup_history_list -r last -c
label,action,pages,firstlog,lastlog,media

#If possible, check if the backup is accessed as expected
recover_check FULL data

#Restore the database
db_connect
recover_start FULL data

c. Wait until the restore is completed
   To monitor the restore session, use the following command
   Example:

   #logon as <sid>adm
   su - <sid>adm
   
   #start restore session session
dbmcli -U c -uUTL -d <SID>
   recover_state

   Monitor the “Pages Transferred” and “Pages Left”

2) Restore the database logs using DBMCLI
   a. Before restoring logs, you should have had restored a database without restarting, (see step 1) or step 3)). The DB should be in ADMIN mode
   b. Logon into the instance as root
   c. Execute the following

   su - <sid>adm
   
   #Logon a recovery session
dbmcli -U c
   
   #List the backup history, and last logs
   #take notes of the next log number
backup_history_open
backup_history_list -r last -c
label,action,pages,firstlog,lastlog,media

service_connect

#Restore the Logs where <XXX> is the next log sequence.
db_connect
recover_start LOG log <XXX>

#If the recovery ends with -8020 error code and you still have logs to recover that are not listed in the backup history, you can continue with the following commands, where <YYY> is the next log to recover, recover log by log until you restore the latest available log.
recover_replace LOG /backuplog/<SID>_LOG.<YYY>

#Use the following command to review the status of the database after the restore
db_restartinfo

#If the consistent=1 the database can start
d
Use the following commands to start the recovery if you want to restore in point in time recovery

su - <sid>adm

#Logon a recovery session
dbmcli -U c

#List the backup history, and last logs
#take notes of the next log number
backup_history_open
backup_history_list -r last -c
label,action,pages,firstlog,lastlog,media

service_connect

#Restore the Logs where <XXX> is the next log sequence.
db_connect
recover_start LOG log <XXX> UNTIL <date> <time>

#If the recovery ends with -8020 error code and you still have logs to recover that are not listed in the backup history, you can continue with the following commands, where <YYY> is the next log to recover, recover log by log until you restore the latest available log.
recover_replace LOG /backuplog/<SID>_LOG.<YYY>
#Note: the database will be put on ONLINE automatically after the DB is recovered until the time specified

3) Start the SAP instance

```
su - <sidadm>
startssap all
```

At this point the SAP instance should be started with no issues

4) After restoring the database, you can remove the backup EBS Volume if required
   a. Logon into the EC2 instance
   b. dismount and remove the volume
      Example:
      ```
      umount /db_data_backups
      vgchange vgbackup -a n
      vgexport vgbackup
      ```
   c. Logon in to the AWS EC2 Management Console
      https://console.aws.amazon.com/ec2/
   d. Go to Volumes and select the volume to remove
   e. Click on Detach Volume
   f. Click on Yes, Detach on the popup window
   g. When detached, click on Delete Volume
Appendix 6: Sybase ASE Database Backup to a local File System

Sybase ASE provides two different methods for backup up databases.

1) Online database backups with the ‘DUMP DATABASE’ command
2) External backups while the database has been quiesced, i.e. ‘write’ access to the database has been suspended.

The sections below describe only option 1, for more information on external backups review Sybase ASE documentation.

Ensuring Recoverability of the Sybase ASE database server.
To ensure recoverability of the Sybase ASE server you need be able to restore a current backup of the master database, a current backup of the <DBSID> database and the complete sequence of the transaction log archives that have taken since the last database backup.

For production systems, you must archive the transaction log of the <DBSID> database. Following database options must be set for the <DBSID> database.

- 'trunc log on chkpt', 'false'
- 'full logging for all', 'true'
- 'enforce dump tran sequence', 'true'

For more information refer to SAP Note 1585981.

Preparation
When dumping a database or a transaction log to a disk device it is important to not overwrite existing dumps and to keep track of the sequence. It is highly recommended to generate devices names that include a timestamp. Ideally you call the ‘DUMP’ command from within a stored procedure that generates a device file name, which will include the current timestamp and database name. Then you schedule calls to these stored procedures in Sybase ASE Job Scheduler. Additionally we suggest defining a threshold that triggers a dump of the transaction log when the log fills. SAP note 1588316 provides instructions how to achieve this.

- Create a stored procedure ‘sp_dumpdb’ and ‘sp_dumptrans’ to call the dump command
  SAP note 1588316 provides templates for these procedures. Replace the path as appropriate, use /db_log_backups as directory for transaction log dumps. Use /db_data_backups as directory for database dumps.
- Create the stored procedure ‘sp_thresholdaction’ in the <DBSID> database (see SAP note 1588316)
Automating Database and Transaction Log Dumps
Sybase ASE provides an integrated job scheduler, which you may use to automate database and transaction log dumps. The Job Scheduler should be setup by default in your SAP system.

Create a job and a schedule for each database you want to back up. Open the Transaction DBACOCKPIT, switch to the tab ‘Jobs’ → ‘DBA Planning Calendar’.
Create a job to execute store procedure ‘sp_dumpdb’ for the databases ‘master’, ‘<DBSID>’, ‘saptools’, ‘sybmgmtdb’ (the latter two are optional). We recommend to schedule these jobs at least daily.

Create a job to call store procedure ‘sp_dumptrans’ for the <DBSID> database. In order to minimize the potential for transaction loss in the case of a disk error, we recommend that you schedule this job at least hourly in a production environment.
Appendix 7: Sybase ASE Server Recovery

A complete restore and recovery of an Sybase ASE server of an SAP System consists of these tasks

1) Recreation of the ASE Software Installation from a file system copy.
2) Recreation of the ASE Server
3) Load of the ‘master’ database
4) Load of the ‘sybmgmtdb’ database (optional)
5) Load of the ‘saptools’ database (optional)
6) Load of the ‘<DBSID>’ database
7) Load of the sequence of transaction log dumps of the ‘<DBSID>’ database

Detailed instructions can be found in SAP Note No. 1618817 (UNIX) and SAP Note No. 1611715 (Windows). We also refer to Sybase ASE documentation in Sybase Infocenter (http://infocenter.sybase.com/help/index.jsp).

Particularly for production systems, it is strongly recommended that you perform test restores at regular intervals to validate your restore process.