Best Practices for SAP MaxDB Backup and Recovery using IBM Tivoli Storage Manager

White Paper

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# Best Practices for SAP MaxDB Backup and Recovery using IBM Tivoli Storage Manager

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Abstract

This document is intended to help SAP MaxDB administrators to implement database backup, restore and recover scenarios using IBM Tivoli Storage Manager. The instrument which enables SAP MaxDB for transferring data from or to IBM Tivoli Storage Manager is the interface program IBM ADINT/TSM. With that utility the management of backup storage, e.g. tapes is separated from SAP MaxDB related backup and restore functions which facilitates the administration of SAP MaxDB backup and recover work flows significantly.

Part of this document is a basic introduction of IBM ADINT/TSM. It will be shown some architectural insides as well as guidelines and samples for setting up IBM ADINT/TSM in a SAP MaxDB environment.

Furthermore, SAP MaxDB backup and recover scenarios in combination with IBM ADINT/TSM will be discussed by means of different SAP MaxDB backup and recover work flows.

Finally, this document will bring up administrators in the position to isolate problem scenarios which might occur during SAP MaxDB backup or recover processes. Here, the SAP MaxDB side as well as the IBM Tivoli Storage Manager side including IBM ADINT/TSM will be discussed.
1. Introduction

This chapter gives basic introductions to IBM Tivoli Storage Manager (TSM) as well as to IBM ADINT/TSM (ADINT/TSM), the interface between SAP MaxDB (MaxDB) and TSM. Further, important guidelines will be given for setting up a MaxDB database environment to be backed up with TSM. That includes the MaxDB configuration as well as the TSM and the interface program ADINT/TSM.

1.1 IBM Tivoli Storage Manager

IBM Tivoli Storage Manager (TSM) is the core product of the Tivoli Storage Management product portfolio. It automates data protection (data backup and restore) and centralizes storage resource management operations in an enterprise network environment.

The base function provided by TSM includes:

Data Protection
1. Operational Backup and Restoration of Data
   The backup process creates a copy of the data which protects against operational loss or destruction of file or application information.
2. Disaster Recovery
   This involves all activities for organizing, managing and automating of the recovery process after a major loss of IT infrastructure and data across the enterprise.

Storage Resource Management
1. Vital Record Retention Archive and Retrieval
   The archival process creates a copy of a file or a set of files for long term storage. The retrieval process locates the copies within the archival storage and places them back into a designated system.
2. Hierarchical Space Management
   This process provides automatic and transparent movement of operational data from dedicated disk space to a central storage repository.

The focus of this document is the data protection part of TSM. See Appendix A: IBM Tivoli Storage Manager documentation for further details.
1.2 IBM ADINT/TSM

IBM ADINT/TSM (ADINT/TSM), a client/server program running on the MaxDB database server, is designed for backing up and restoring MaxDB databases and their associated logs using TSM.

The data between MaxDB and TSM will be moved transparently, whereas no intermediate storage, e.g. file systems for the data to be send to TSM is necessary. With ADINT/TSM the management of backup storage is separated from database related backup/restore functions.

ADINT/TSM is embedded in the MaxDB backup and recovery work flow using TSM through implementing the pipe interface provided by MaxDB and the TSM Application Programming Interface (API) client provided by the TSM client package as shown in Figure 1.

![ADINT/TSM internals](image)

**Figure 1** ADINT/TSM internals
ADINT/TSM combines two executables – *ADINT2* and *ADINTAGENT*. ADINT2 is the operator process, which is called by MaxDB if a TSM backup or restore was requested. The purpose of the ADINT/TSM operator process is to:

- control the backup and restore work flow (spawns a number of configured ADINTAGENTs)
- inquire TSM for available backup images
- delete backup images from TSM
- handle errors
- generate status information, e.g. calculation of transfer rates.

The way ADINT/TSM works can be customized in a *profile*, e.g. which TSM server or which storage path (disk storage, tape storage) to be used.

MaxDB database or log data to be backed up or restored will be transferred exclusively by an ADINTAGENT process, whereas one or multiple agents can be spawned by ADINT2, depending on the MaxDB configuration.

In case of a MaxDB backup (the restore work flow behaves accordingly), each ADINTAGENT process starts to read data from its assigned pipe, which will be created by MaxDB as part of the backup work flow. The multi-threaded ADINTAGENT engine (one thread for pipe operations, one thread for TSM API operations) sends the data via TSM API calls to the specified TSM server, which will typically be done via TCP/IP communication (here, ADINT/TSM supports LAN as well as SAN network topologies).

Further details about ADINT/TSM see references listed in *Appendix A: IBM ADINT/TSM – The backup interface for MaxDB and TSM*.

### 2. General setup considerations

To be able to backup or recover MaxDB databases in combination with TSM all participating entities have to be installed and setup according to the requirements and prerequisites. The core installation steps of the involved components will not be part of this document. Furthermore, special hints and dedicated samples will be given to overcome most of the common setup problems.

As a base for the following discussion it is assumed the components listed in Figure 2 are installed and the basic setup steps are successfully accomplished.
<table>
<thead>
<tr>
<th>Components</th>
<th>Version</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaxDB</td>
<td>7.6 or higher</td>
<td><strong>Linux/Unix:</strong> During the installation, the database software must be assigned to a <code>&lt;sdb_user&gt;</code> special operating system user as owner of the software, and to the group <code>&lt;sdba_group&gt;</code>. For SAP systems, one <strong>must</strong> use the <code>sdb</code> and <code>sdba</code> names for the <code>&lt;sdb_user&gt;</code> owner and the <code>&lt;sdba_group&gt;</code> group.</td>
</tr>
<tr>
<td>TSM Server</td>
<td>5.3 or higher</td>
<td>Typically, a dedicated machine will be selected for hosting that service (optional).</td>
</tr>
<tr>
<td>TSM API</td>
<td>5.4 or higher</td>
<td>It has to be installed on the machine where the MaxDB database is running.</td>
</tr>
<tr>
<td>ADINT/TSM</td>
<td>2.3.1 or higher</td>
<td>It has to be installed on the machine where the MaxDB database is running. During the installation a path for the configuration files (e.g. profile and others) has to be specified. It is highly recommended <strong>not</strong> to use the installation directory for that purpose. A dedicated location under the home directory of the database owner is the preferable solution.</td>
</tr>
</tbody>
</table>

**Figure 2** Software requirements

### 2.1 MaxDB setup for TSM support

Prior using TSM for backup and recover operations some additional configuration tasks have to be done. This comprises updates of the database manager configuration as well as
the definition of dedicated backup media (or backup templates) supporting backup and recover operations using TSM.

### 2.1.1 Setup database manager configuration

ADINT/TSM has to be declared for a database instance in the MaxDB environment which intents for using it. That involves information about the location where the ADINT/TSM executables can be found and the name of the profile ADINT/TSM has to evaluate for its configuration. Figure 3 illustrates a sample setup of those required configuration parameters using the MaxDB Database Manager Command Line Interface (DBMCLI):

![Figure 3 Configuration of MaxDB database instance for ADINT/TSM](image)

Thereby, the semantics of the configuration parameter is as follows:
- ADA_OPT (specifies the fully qualified name of the ADINT/TSM profile)
- ADINT (specifies the location of the ADINT/TSM executables)

A verification of the ADINT/TSM relevant configuration parameter for a database instance can be done as shown in Figure 4:

![Figure 4 Verification of MaxDB – ADINT/TSM configuration](image)
2.1.2 Definition of Backup Media (Backup Template) for TSM usage

Backups require so called Backup Media or Backup Templates which describes or defines the way how data is to be sent to (external) backup storage. Backup Media enable to define backup methods of different properties.

These methods are characterized mainly through the type of a backup (e.g. DATA, LOG), the device type (e.g. File, Pipe) and the tool to be used to handle backup or restore requests (e.g. TSM).

Typically, two base Backup Media will be created: one for database data, another for database logs. Figure 5 provides a media configuration example for usage with TSM. The sample uses the MaxDB DBMCLI. Backup Media can also be defined using the MaxDB Database Manager GUI (DBMGUI).

![Command Line](image)

After that, two Backup Media
- ADINT_FULL (database backups)
- ADINT_LOG (log archives)

were configured and registered in the MaxDB database instance.

**Note:**

The device specification of Backup Media on Windows systems must meet the following specification: `\\\pipe\<pipe name>`

Due to ADINT/TSM is able to support multiple backup sessions for improving the overall backup performance, a dedicated Backup Medium has to be configured to enable so called parallel backups. Thus, a Backup Medium consisting of a media group – a set of Backup Media supporting a single backup session – has to be configured as shown in Figure 6 by means of appropriate DBMCLI commands.
The name of the configured parallel Backup Medium registered in the MaxDB database instance is **ADINT_PARA**.

**Note:**
The degree of backup parallelism (upper bound of how many sessions can be opened for transferring data to backup storage) is marked by the MaxDB configuration parameter `MAXBACKUPDEVS` (MaxDB version 7.6) or `MAXBACKUPMEDIA` (MaxDB version 7.7 and higher). The default is 2.

### 2.2 TSM setup
The setup of the TSM components is divided into two parts. One part has to be done on the TSM server side, the other on the TSM API client.

#### 2.2.1 TSM server
ADINT/TSM requires some dedicated settings of the TSM server infrastructure. Details of how to setup and configure the TSM server can be found in *Appendix A: IBM Tivoli Storage Manager*.

Figure 7 lists a set of components, which can or have to be customized properly depending on the ADINT/TSM specification.
### 2.2.2 TSM API client

To enable ADINT/TSM to connect to a dedicated TSM server, the TSM API client has to be customized accordingly. Figure 8 gives an overview about the involved items and what the recommendations and guidelines are.

<table>
<thead>
<tr>
<th>Components</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment variables</td>
<td>These variables come with default values, which can be used in most cases except for DSMI_LOG. It contains the path for the TSM API error log file (dsierror.log). It is recommended to set this variable for the database owner explicitly. A good location would be a directory under the home directory of the database owner.</td>
</tr>
<tr>
<td>- DSMI_DIR</td>
<td></td>
</tr>
<tr>
<td>- DSMI_CONFIG</td>
<td></td>
</tr>
<tr>
<td>- DSMI_LOG</td>
<td></td>
</tr>
<tr>
<td>Client system options file (exists only on Linux/Unix systems)</td>
<td>Linux/Unix:</td>
</tr>
<tr>
<td>- dsm.sys</td>
<td>This file contains one or multiple so called server stanzas, each of them contain appropriate connection information for a dedicated TSM server. A minimum server stanza record has to contain the following parameters:</td>
</tr>
<tr>
<td></td>
<td>servername &lt;logical server name&gt;</td>
</tr>
<tr>
<td></td>
<td>commmethod tcpip</td>
</tr>
<tr>
<td></td>
<td>tcpport 1500</td>
</tr>
<tr>
<td></td>
<td>tcpserveraddress &lt;TCP/IP address&gt;</td>
</tr>
<tr>
<td></td>
<td>The TSM server address can be specified as TCP/IP domain name or as dot address.</td>
</tr>
</tbody>
</table>
### Client user options file - dsm.opt

**Linux/Unix:**
This file might contain additional options for the TSM server configured in dsm.sys. If no additional options required, the dsm.opt can also be empty.

---

**Windows:**
This file contains one so called server stanza, which contains appropriate connection information for a dedicated TSM server. A minimum server stanza record has to contain the following parameters:

- `servername` <logical server name>
- `commmethod` tcpip
- `tcpport` 1500
- `tcpserveraddress` <TCP/IP address>

The TSM server address can be specified as TCP/IP domain name or as dot address.

---

**Figure 8** TSM API client settings

### 2.3 ADINT/TSM setup
If not already done by the ADINT/TSM installation procedure, the ADINT/TSM profile has to be adapted to reflect the environment, e.g. TSM server to be used. See Figure 9 will give a sample overview.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjust profile</td>
<td>The profile, named <code>init&lt;SID&gt;.utl</code> is located in the configuration file directory specified during the installation procedure. The following parts of the profile were already adjusted during the installation or can be adjusted at a later point in time manually:</td>
</tr>
<tr>
<td></td>
<td><code>LOGFILE &lt;full qualified name of ADINT/TSM log&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>SERVER &lt;logical server name as in dsm.opt/dsm.sys&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>NODENAME &lt;node name defined on TSM server&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>FULLMANAGEMENTCLASS &lt;Mgmt class for data backups&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>NCFULLMANAGEMENTCLASS &lt;Mgmt class for data backups&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>UPDATEMANAGEMENTCLASS &lt;Mgmt class for incr. backups&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>NCUPDATEMANAGEMENTCLASS &lt;Mgmt class for incr. backups&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>LOGMANAGEMENTCLASS &lt;Mgmt class for log archives&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>LOGSEGMANAGEMENTCLASS &lt;Mgmt class for log archives&gt;</code></td>
</tr>
</tbody>
</table>
Verify TSM password | Prior starting the first backup or restore, the TSM password has to be verified and stored persistently in a special internal parameter file in encrypted format. That ensures the password has only to be entered once.

Further ADINT/TSM sessions connecting to TSM will read the password from that file.

**Figure 9** ADINT/TSM settings

### 3. Using ADINT/TSM

This chapter describes how ADINT/TSM can be used to fulfill basic tasks. In general, there are several ways how operations like a backup can be executed:

- using the MaxDB Database Manager GUI (DBMGUI)
- using the MaxDB DBM Command Line Interface (DBMCLI)
- using the MaxDB Database Studio (coming with MaxDB 7.7).

The method to choose depends on personal preference. No solution is superior to the other. Using the DBMGUI might be more comfortable in some cases, while using the DBMCLI can be faster in others. Furthermore, automating tasks is done using the DBMCLI.

In this chapter triggering ADINT/TSM in both variations will be shown: using the DBMGUI and using the DBMCLI. Most DBMCLI commands shown are specific to the used demo environment, where the database instance was called P01. More detailed information about the general syntax and usage of the MaxDB commands can be found in the MaxDB Library (see Appendix A: SAP MaxDB - The SAP Database System).

#### 3.1 Backup

This section shows with the assistance of examples how a MaxDB database backup can be executed.

#### 3.1.1 Backup via DBMCLI

Making a backup using the DBMCLI is simple. The DBMCLI is started using the following command, where **P01** is the name of the database to connect to:

```
dbmcli -d P01 -u <user>,<password>
```
Best Practices for SAP MaxDB Backup and Recovery using IBM Tivoli Storage Manager

Then, an administrative session must be opened on the database instance using the `db_connect` command. Afterwards, the backup is started with the `backup_start` command, as shown in Figure 10:

```
Command Line

tdben1:P01> db_connect DBM, DBM
OK

tdben1:P01> backup_start ADINT_FULL
OK
```

![Figure 10](image)

**Figure 10** Database backup using DBMCLI

The `backup_start` command is given the name of the medium defined earlier. When the call is executed, MaxDB is starting the backup and ADINT/TSM is called internally. After the execution of the command, detailed information about the backup process is displayed, as shown in Figure 10.

The command sequence for backing up the database using ADINT/TSM described above can also be started with the following single DBMCLI command:

```
dbmcli -d P01 -u <user>,<password> -uUTL backup_start ADINT_FULL
```
3.1.2 Backup via DBMGUI

Using the GUI to create a backup requires a few more steps than using the CLI. First, locate the DB instance that should be backed up and select it, then locate and click the Backup pane in the lower right of the DBMGUI screen. Start the Backup Wizard.

Execute the following steps to start a backup:
- Click Next on the first panel on the Backup Wizard.
- Chose the desired Backup Type.

![Backup Type Selection](image)

*Figure 11* Choosing the backup type
• Select the **Backup Medium** that should be used. For an ADINT/TSM backup, choose the corresponding medium.

![Figure 12 Selecting a backup medium](image)

• Review the selected options in the **Start Backup** pane. Then, click **Start** to trigger the backup process.

![Figure 13 Starting a database backup](image)
• In the final pane, a progress bar indicates the advancement of the backup process. When the backup is finished, the Close button exits the Backup Wizard.

![Backup Database Instance](image)

**Figure 14** Database backup finished successfully

### 3.2 Parallel database backup

For a parallel database backup, everything that needs to be done is the definition of a parallel backup medium (see Chapter 2.1.2 Definition of Backup Media (Backup Template) for TSM usage). The procedure to execute a backup doesn’t change at all, neither in CLI nor in GUI mode (other than the name of the medium being different).

### 3.3 Log backup using staged archiving

MaxDB provides support for automated log backups. It can be enabled to make a log backup after a certain time interval or to backup when the log area has reached a certain filling degree or both.

This feature can be configured with the backup wizard or using the DBMCLI commands `autolog_on` and `autolog_off`:

Today, MaxDB can use the automatic log backup feature only with a Backup Medium of type “FILE”. This means that no external backup program (here ADINT/TSM) can be
used. However, there is the possibility to use staged archiving: MaxDB will automatically backup log files to a certain file medium, and then the `archive_stage` command can be used to move the files from the file medium to an external backup medium. See Figure 15 below for an example of the `archive_stage` call.

MaxDB keeps track of the location where the log files have been saved using the LOGBACKUP medium, which has to be a FILE medium. When `archive_stage` is called, the database reads the log files from the LOGBACKUP medium and hands them over to the ADINT_LOG medium.

### 3.4 Recovery

Database recovery is needed when an unforeseen accident occurs. Usually these accidents can be divided into physical errors and logical error. A physical error would be a hardware failure, like a crashed disk. A logical error might be a user who accidentally deleted the contents of a table. In case of a physical error, typically one would like to recover the database to the latest point possible. In case of a logical error, the database might be recovered to a point in time slightly before the error occurred. Hence, this is known as Point In Time (PIT) Recovery, which will be discussed later.

Generally, a recovery process is divided into two phases: Restore of the data area, and application of logs. In the restore phase, MaxDB uses ADINT/TSM to read the needed backups from the TSM server. These might be full and incremental database backups, as well as log backups. In the second phase, the changes recorded in the logs will be applied. Here comes the distinction between PIT recovery and recovery to end of logs into play. The latter applies all changes that can be found, while the PIT recovery only applies changes until a given point in time.

In the chapter, both recovery scenarios will be shown.
3.4.1 Recovery using the DBMCLI

To recover the database using the DBMCLI, an administrative session on the database instance must be opened (like in the backup procedure). Following, the decision has to be made which backup shall be restored. Using the `backup_ext_ids_get` and `backup_ext_ids_list` commands, one can display which backups are available for recovery. Internally, the `backup_ext_ids_get` command calls ADINT/TSM which in turn queries the TSM server for available backup images.

When it is clear which backup ID should be used for the restore, the `recover_start` command initiates the recovery process, as illustrated in Figure 16.

![Command Line](image)

**Figure 16** Recovering a full backup using the CLI
After the recovery has finished, detailed information about the process is displayed. If all information for restarting the database are available (log area contains all necessary information), the database can be restarted using the `db_restart` command as shown in Figure 17. If the log area doesn’t provide all data needed for the database restart, the corresponding log backups have to be restored previously. Detailed information about it can be found in chapter 3.4.3 Point in time recovery.

Figure 17  Restarting the DB in the CLI

3.4.2 Recovery using the DBMGUI
When recovering the database using the DBMGUI, execute the following steps:

- Locate the database instance that should be recovered and select it, then locate and click the Recovery pane in the lower right of the DBMGUI screen. Start the Recovery Wizard.
- There might be a warning that the database is not in Admin state. If so, the database can be set to the requested state by clicking the yellow symbol at the left bottom of the warning panel
• Select the **Type of Recovery** to be performed. (‘‘Restore database until a specific time’’ will be discussed later)

![Figure 18 Choosing the Type of Recovery](image)

• Chose the complete backup that should be recovered (normally, there will be only one backup displayed, since we chose ‘‘Restore last backup’’). Click **Start** to execute the recovery process. (See Figure 19)

![Figure 19 Chose backup to be recovered](image)

• After the restore process has finished successfully, the wizard indicates that the DB can be restarted, if the log area contains all necessary information. Clicking **Restart** will do so.
3.4.3 Point in time recovery
To recover the DB to a certain state, point in time recovery (PIT) is used. In almost every case (the log area doesn’t contain necessary log information), this involves restoring specific log backups. This makes the whole process more complex than the recovery to end of logs.

3.4.3.1 PIT recovery using the DBMCLI
To recover the DB via the Command Line Interface, the db_admin and db_connect commands need to be executed. Furthermore, the IDs of the backups located on the TSM server must be fetched using backup_ext_ids_get. After displaying the list of IDs and choosing the complete backup that shall be restored, the recover_start command triggers the recovery process.

![Figure 20 Recovery with 2 sessions](image-url)
In the example above (see Figure 20), the backup to be restored was done with two sessions. Therefore, the `recover_start` is called with two backup ids (one for each session).

After the recover process has finished successfully, `db_restartinfo` provides information about the current state of the database (Figure 21).

The database is consistent and can be restarted. However, there are some logs to be restored. The information needed to decide which log file is the one that fits to the current state of the database is provided by the `backup_history_list` command.

The backup history contains detailed information about the start- and end-time of a backup, the medium which performed the backup and which log pages were active during the backup (or in case of a LOG backup: which log pages are contained in the log file).

The log pages are the important part for a PIT recovery: the `db_restartinfo` shows which page is used currently by the database (in the example, that would be 539333 [see Figure 21]). Now this log page should be used to find the log backup that shall be restored (see Figure 22):

As it can be seen in Figure 22, LOG_000000250 starts at LOG page 538282 and ends at 540545. This would be the log file that matches the restored backup, since the backup
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currently uses LOG page 539333. This backup was done using staged archiving (see 3.3 Log backup using staged archiving), therefore information about the ADINT/TSM backup ID is needed to execute a restore of the object.

To find out the backup ID, backup_history_list provides a detailed mode, as shown in Figure 23:

Figure 23 Showing details of the backup history

The –k switch receives the ID of the backup history entry (displayed at the beginning of a backup history line). The –e switch displays information about the external backup ID (tdben1_P01_2008.03.27_18.27.25_SAVELOG_ADINT_LOG in the example).

With this external backup ID, the restore of the log file can be started (shown in Figure 24):

Figure 24 Retrieving a log file
After the recovery has finished, the DB can be restarted (using `db_restart`), or further logs could be restored using the `recover_replace` command.

### 3.4.3.2 PIT recovery using the DBMGUI

A point in time recovery via the DBMGUI is less complex than using the DBMCLI, since all the log file handling and the retrieval of the external backup IDs is being handled by the DBMGUI.

In the following example, recovery with initialization was used. However, the process is exactly the same for recovery without initialization. The following steps should be executed to perform a PIT Recovery:

- Locate the database instance that should be recovered and select it, then locate and click the **Recovery** pane in the lower right of the DBMGUI screen. Start the **Recovery Wizard**.
- There might be a warning that the database is not in **Admin** state. If so, the database can be set to the requested state by clicking the yellow symbol at the left bottom of the warning panel.
- Select the **Type of Recovery** to be performed. Activate the checkbox and provide the necessary date and time information for the recovery.

![Selecting type of recovering and point in time](Figure 25 Selecting type of recovering and point in time)
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- When there are log files that were backed up using staged archiving, the wizard will provide the option to restore them either from the stage medium (if they are still located there) or from the external medium, as shown in Figure 26.

![Figure 26 Selecting which medium should be used for log restore](image)

- Now the wizard has collected all necessary information to start the recovery, which will be triggered using the **Start** button. Detailed information is provided about which backup will be restored from which location (see Figure 27).

![Figure 27 Starting the PIT recovery](image)
After the full backup has been restored, the wizard prompts whether the database should be restarted or if the log files should be recovered as well. Normally, one would recover the logs as well, which is started by clicking **Continue** as shown in Figure 28.

![Figure 28 Recovering logs during PIT recovery](image1)

After the successful log recovery, the database instance will be automatically restarted. The point in time that was provided for the wizard has been restored (see Figure 29).

![Figure 29 Restarting the database after PIT recovery](image2)
4. Troubleshooting

Mostly, failure situations require more detailed information to be able to isolate the root cause of the issue. This chapter gives information and guidelines on how to resolve errors that might occur during MaxDB database backup or recovery operations using TSM.

4.1. General problem resolution

During MaxDB database backup or recovery operations one may run into problems, whereby it is not always obvious which component causes the problem. Thus, Figure 30 below will give a road map to bring MaxDB database administrators in the position to isolate the issue causes the overall work flow to fail.

![Flow of problem isolation](image)

Figure 30 Flow of problem isolation
In case of a backup or recovery failure whereby it is not obvious what causes the failure, it is recommended to choose as the entry point of investigations the MaxDB External Backup Log and if required the Database Error Log. If it is not possible to isolate the error already in the MaxDB logs, the logs of the participating units (ADINT/TSM, TSM API and TSM server) have to be investigated step by step. Details and specifics about the different logs can be found in the following chapters.

If no problem solution could be developed, the appropriate support facility should be involved to help finding a solution for the issue. Thereby, problems related to MaxDB need to be addressed to SAP directly via opening a so called Online Service System request, shortly OSS. A pure MaxDB problem exists if either ADINT/TSM was not started during the backup or recovery work flow or if for some reason the pipe, transferring the data, was closed unexpectedly.

**Note:**

The administration of the pipe (create, drop) used for transferring the data is under control of the MaxDB.

Problems related to either ADINT/TSM or one of the TSM components (API, server) need to be addressed to IBM directly, more precisely to the ADINT/TSM support organization. For details concerning ADINT/TSM support refer to Appendix A: IBM ADINT/TSM – Service & Support.

### 4.2 MaxDB logs

Each database instance owns a set of logs, also called Diagnosis Files necessary for either reporting purposes or to bring database administrators in the position to isolate and resolve different kind of problems. These logs can be found in the database instance run directory.

With MaxDB 7.6 the logs one can either be opened using native command line utilities or the DBMGUI for navigating through the logs. Against it, introduced with MaxDB 7.7 some logs will be written in XML style, which requires MaxDB tools for displaying them accordingly. By choosing the Check pane of a selected database instance as illustrated in Figure 31 all existing diagnostic logs will be listed.
The content of a file can be displayed by just a double click on the candidate. The two highlighted entries

- Database Errors (filename in run directory: knldiag.err)
- External Backup Log (filename in run directory: dbm.ebl)

are the entry points regarding problems during MaxDB backup or recovery. The External Backup Log also contains the output ADINT/TSM generates during a backup or recovery operation. Thus, in most cases ADINT/TSM relevant errors will be manifested and visible in the External Backup Log too.

### 4.3. ADINT/TSM log

In addition to the output ADINT/TSM writes to STDOUT as part of a backup or recovery operation a log will be written containing information regarding every function ADINT/TSM executes.

The full qualified name of the log can be setup in the ADINT/TSM profile using the keyword **LOGFILE**. Further, the profile keyword **TRACE** can be specified to setup the granularity of the messages to be logged. The default is ‘15’, which is sufficient for most scenarios. To prevent a flooding of the log higher values should only be specified if advised from IBM support.
4.4. **TSM logs**

This chapter discusses the logging facilities coming with the TSM API client as well as with the TSM server. Usually, the TSM API client log gives all necessary information needed for error detection. Nevertheless, in rare cases gathering information from the TSM server log as well could help solving an issue.

4.4.1 **TSM API client log**

The TSM API client log (default name is `dsierror.log`) is generated by the TSM API. It is used for logging consecutively all TSM API client relevant issues.

The directory where the TSM API client log will be stored is determined by the environment variable `DSMI_LOG`.

4.4.2 **TSM server log**

The TSM server log, called *activity log*, contains all messages (information, warnings, and errors) that are sent to the server console. Besides logging of TSM server internal processes, e.g. tape mounts, also connection (session) information regarding clients using the TSM server for sending or retrieving data can be reviewed.

For querying the activity log a so called administrative client session has to be established. The command for displaying the activity log is `query actlog`. The query result can be refined through various filtering options. Refer to *Appendix A: IBM Tivoli Storage Manager documentation* for further details on that topic.
Appendix A: References

SAP MaxDB

SAP MaxDB - The SAP Database System
http://www.sdn.sap.com/irj/sdn/maxdb

IBM Tivoli Storage Manager

IBM Tivoli Storage Manager

IBM Tivoli Storage Manager documentation
http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp

Redbook “IBM Tivoli Storage Manager Concepts”
http://www.redbooks.ibm.com/abstracts.sg244877.html

IBM ADINT/TSM

IBM ADINT/TSM – The backup interface for MaxDB and TSM
http://www.ibm.com/de/entwicklung/adint_tsm

IBM ADINT/TSM – User’s guide

IBM ADINT/TSM – Service & Support
http://www.ibm.com/de/entwicklung/adint_tsm/support.html