Running an SAP System on IBM Db2 11.1 with the Db2 pureScale Feature
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Running an SAP System on IBM Db2 11.1 with the Db2 pureScale Feature

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PUBLIC
1 Introduction

Do you want to create an SAP system running on IBM Db2 for Linux, UNIX, and Windows with the Db2 pureScale Feature? Read on to learn how you can do the following:

- Convert the IBM Db2 11.1 database of an existing SAP system to an IBM Db2 11.1 database with the Db2 pureScale Feature.
- Install a new SAP system on IBM Db2 11.1 with the Db2 pureScale Feature.

For more information about installing an SAP system, see your relevant SAP NetWeaver installation guide to which this Db2 pureScale guide is a supplement.

If you want to upgrade an existing Db2 pureScale system, see Upgrading DPF, HADR, MSCS, SA MP, and pureScale Systems in our Db2 11.1 upgrade guide.

**i Note**

Before you start, please check SAP Note 2593454. This SAP Note might contain more information about the pureScale installation as well as corrections/additions to this document. Make sure that you always have the most recent version of this SAP Note.

What Is Db2 pureScale?

The Db2 pureScale Feature is a clustering technology for Db2 for Linux, UNIX, and Windows that can be enhanced by several features and capabilities regarding high availability, disaster recovery, and performance such as the geographically dispersed DB2 pureScale cluster (GDPC) or multiple communication adapter ports. Db2 pureScale requires an extensive environment setup in addition to installing the software.

This document is intended for implementing the start configuration with single communication adapter ports in a single-switch environment without additional disaster recovery capabilities. We concentrate on the software installation as well as the Db2 pureScale conversion itself, assuming that the environment setup, such as shared storage or cluster interconnect, is already done.

For more information about the environment setup, see the IBM Knowledge Center for AIX or Linux.

1.1 Document History

**i Note**

Before you start the implementation, make sure you have the latest version of this document. You can find it at http://help.sap.com/viewer/db6_purescale_11_1 on SAP Help Portal. On the webpage, there’s also a button to download the PDF version of this guide.
The following table provides an overview of the most important document changes:

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.01</td>
<td>2018-11-30</td>
<td>Information about upgrading a Db2 pureScale system was added in Introduction [page 4].</td>
</tr>
<tr>
<td>1.0</td>
<td>2018-04-03</td>
<td>Initial version</td>
</tr>
</tbody>
</table>

### 1.2 Naming Conventions

The following terminology and variables are used in this document:

#### SAP Terminology

- *SAP NetWeaver application server ABAP* is referred to as *AS ABAP*.
- *SAP NetWeaver application server Java* is referred to as *AS Java*.

#### IBM Terminology

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Db2 Version 11.1 for Linux, UNIX, and Windows</td>
<td>Db2 11.1</td>
</tr>
<tr>
<td>IBM Db2 Version 10.5 for Linux, UNIX, and Windows</td>
<td>Db2 10.5</td>
</tr>
<tr>
<td>IBM Db2 Version 10.1 for Linux, UNIX, and Windows</td>
<td>Db2 10.1</td>
</tr>
<tr>
<td>IBM Db2 pureScale Feature for Enterprise Server Edition</td>
<td>Db2 pureScale</td>
</tr>
<tr>
<td>IBM cluster caching facility</td>
<td>CF</td>
</tr>
<tr>
<td>IBM Tivoli System Automation for Multiplatforms</td>
<td>SA MP</td>
</tr>
<tr>
<td>IBM Spectrum Scale (also known as General Parallel File System)</td>
<td>GPFS</td>
</tr>
</tbody>
</table>

With Db2 11.1, IBM introduced the concept of Modification Packs. A Modification Pack (also referred to as Mod or MP) introduces new functions to the Db2 product. For the IBM Db2 Modification Packs and Fix Packs, we mostly use abbreviations such as Db2 11.1 Mod 2 Fix Pack 2, or even shorter, simply Db2 11.1 MP2 FP2.
Renaming: IBM DB2 for Linux, UNIX, and Windows is now IBM Db2

IBM has changed its database name from IBM DB2 for Linux, UNIX, and Windows to simply IBM Db2 (with a lowercase 'b' now in Db2). In older SAP publications, you will still find the old product name, but in future documentation, we will use the new term, sometimes extended by 'for Linux, UNIX, and Windows' to avoid confusion with other products of the Db2 family, such as Db2 for z/OS or Db2 for i.

### Variables

<table>
<thead>
<tr>
<th>Name of Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;SAPSID&gt;</td>
<td>SAP system ID in upper case</td>
</tr>
<tr>
<td>&lt;sapsid&gt;</td>
<td>SAP system ID in lower case</td>
</tr>
<tr>
<td>&lt;DBSID&gt;</td>
<td>Database name in upper case</td>
</tr>
<tr>
<td>&lt;dbsid&gt;</td>
<td>Database name in lower case</td>
</tr>
</tbody>
</table>

**i Note**

The database name is not necessarily the same name as the SAP system ID. For example, the database name is not necessarily the same as the SAP system ID in an environment with multiple components in one database (MCOD).

### 1.3 Architectural Overview of Db2 pureScale

The Db2 pureScale Feature is an extension to the existing Db2 for Linux, UNIX, and Windows product with the focus on scalability and high availability. You can use Db2 pureScale to create a database cluster using the shared disk approach.
The following figure provides an overview of the architecture of Db2 pureScale in an SAP environment:

**Members**

A node in a Db2 pureScale cluster is called member. Each member runs its own Db2 instance using the Db2 server software, and has access to the complete database.

**Cluster Caching Facility (CF)**

To assist in sharing data between the members and to particularly address the problems of concurrency control and cache coherency, Db2 pureScale introduces the cluster caching facility (CF). The CF typically runs on a dedicated physical or logical host and is connected to all members of the cluster using a high speed interconnect. This high speed interconnect is realized using an InfiniBand fabric or RDMA over Converged Ethernet (RoCE) network. Alternatively, the interconnect can be realized with a 10 Gigabit TCP/IP Ethernet (10GE) network infrastructure. When using a 10GE network, make sure that the workload requirements do not exceed the capabilities of the 10GE network and that you perform a proper sizing for the system running on Db2 pureScale.

Since one CF would constitute a single point of failure, two CFs can be installed in a Db2 pureScale cluster, that is, a primary and a secondary CF. The primary CF performs all CF workload for the cluster and the secondary
CF can take over if the primary CF fails. Through a process called duplexing, the secondary CF is kept up-to-date so that a fast takeover is ensured and no vital information from the primary CF is lost.

**Locks and Buffer Pools**

To ensure concurrency control in the cluster, Db2 pureScale introduced the global lock manager (GLM) running on the CF as well as a new type of database lock. The locks that are used in a regular, non-shared database environment to ensure transaction serialization are now called logical locks. To prevent conflicting accesses to the same data from different pureScale members, physical locks were introduced.

Physical locks are held by the Db2 members, not by transactions. The local lock manager (LLM), which is the lock manager of every member, requests a physical lock from the global lock manager before it grants the logical lock to the transaction. The GLM uses a global lock list to track the lock request made by the local lock managers.

Since physical locks work on pages, they can also be used to address the problem of cache coherency. The group buffer pool (GBP) in the CF is a single buffer pool that is used by all members. The members cache pages in their own local buffer pools (LBPs) and use the GBP to maintain page consistency between members.

A set of protocols is used to determine:

- Which copy of a particular page that exists in multiple local buffer pools and the global buffer pool is the latest
- How to make changes to this page
- How to propagate these changes to other members

Finally, the CF holds a memory area that contains cluster-wide metadata that needs to be accessed and updated by all Db2 pureScale members.

**Shared Disk Subsystem**

The disk subsystem is accessed by all members of the pureScale cluster and must therefore allow for concurrent read and write access while maintaining the integrity of the files. To achieve this, a clustered file system (also known as shared disk file system) is used. Db2 pureScale uses IBM Spectrum Scale, also known as IBM general parallel file system (GPFS). GPFS is a high-performance, scalable file management solution that provides fast and reliable access to a common set of files. Management and installation of GPFS are embedded in Db2 pureScale. To prevent data loss if a single disk array fails and to avoid another single point of failure, an appropriate RAID level like RAID10 is recommended. The disk subsystem is attached to the Db2 pureScale cluster using a storage area network (SAN), which again allows for fast communication with high-speed protocols, such as Fibre Channel.

Besides storing database data, the shared disk is also used to store the log files of the members. The log files of a member are called log stream, and every member writes its log stream into its own directory.
Cluster Manager

Another component that is required for Db2 pureScale is the cluster manager. The cluster manager is responsible for checking the availability of all cluster components. If it detects the failure of a component, it automatically performs all necessary actions so that the impact on the overall system is as minimal as possible. For example, if the primary CF fails, the cluster manager automatically assigns the primary role to the secondary CF and redirects all requests to it. Db2 pureScale uses IBM Tivoli System Automation for Multiplatforms (SA MP) as cluster manager.

The SAP application servers (AS ABAP or AS Java) act as clients of the Db2 pureScale cluster. Normally, they are connected to the cluster using a TCP/IP network connection. The database shared library (DBSL) of the AS ABAP kernel uses the IBM Data Server Driver for ODBC and CLI to connect to Db2 pureScale. The AS Java uses the type 4 JDBC driver for the same purpose. The clustering of the database is transparent to its client so that DB2 pureScale appears like a single database to the SAP system.

Enhancements

The architecture described above can be enhanced by the following features and capabilities regarding high availability, disaster recovery, and performance:

- Geographically dispersed Db2 pureScale cluster (GDPC)
- High availability disaster recovery (HADR) with Db2 pureScale
- Multiple communication adapter ports
- Two-switch configurations for the cluster interconnect fabric
- Storage or GPFS-based replication to a second cluster

These enhancements can also be combined, resulting in a variety of different possible pureScale implementations. This document is intended for implementing the start configuration using single communication adapter ports in a single-switch environment without additional disaster recovery capabilities. To enhance the standard installation by one or more of the above features, search the IBM Knowledge Center for concepts and details.

1.4 SAP Specifics

Various enhancements were made to SAP NetWeaver 7.0 SR3 and higher to deal with the following SAP-specific aspects in a Db2 pureScale cluster:

- Client affinity concept
- Availability of Other SAP NetWeaver Components
- Partitioning of update tables
- Monitoring enhancements in the DBA Cockpit
Client Affinity Concept

Experience from running SAP applications on Db2 z/OS Parallel Sysplex has shown that the overall performance of the Db2 pureScale cluster increases if a similar workload is processed on every member. To realize a similar workload on each member, you can do the following:

- On SAP application level, you can use logon groups to direct SAP users with similar tasks to a specified set of SAP application servers.
- On database level, you can by default assign every member to one or more SAP application servers. It is beneficial if you can define an affinity of each SAP application server to a specific Db2 pureScale member. Since every member can fail, you can enhance the concept of client affinity (keeping in mind that the SAP application servers act as clients of the Db2 pureScale cluster) by defining a list of members instead of a single member. If the first defined member in this list fails, the SAP application server connects to the second member, and so on. This concept does not imply that there is an equal number of SAP application servers and Db2 members available. Several SAP applications servers can, of course, connect to the same Db2 member.

An SAP system installation on Db2 pureScale uses the db2dsdriver.cfg configuration file of the Db2 client to define such an affinity. This file contains a list of all application servers as well as a client affinity list that controls to which Db2 member the respective SAP application server connects. The SAP installation tool creates an initial configuration in the db2dsdriver.cfg that you can later adapt to define certain affinities manually. For more information about configuration details regarding client affinity, see Adapting the Db2 Client Connectivity Setup [page 59].

Availability of Other SAP NetWeaver Components

Db2 11.1 with the pureScale feature delivers high availability for the database. To ensure that the whole SAP systems is highly available, you should apply high availability concepts for the central services as well. Unlike some implementations, where the database and the SAP central services are running within the same instance of a cluster manager, this is not supported with Db2 pureScale. You should install the SAP central services together with a cluster manager on dedicated servers.

Partitioning of Update Tables

The programming model in the AS ABAP defers updates to the database to the end of a business transaction. At that time, all updates to the database are performed asynchronously in update tasks. During a business transaction, all update requests are stored in the tables VBHDR, VBMOD, and VBDATA. These tables are critical for the overall performance of the system.

In a Db2 pureScale cluster, all members must access these tables frequently so that contention due to locking can occur. Contention can result in reduced system performance. To avoid contention and the resulting reduced system performance, you can partition the update tables VBHDR, VBMOD, and VBDATA so that the SAP application server operates on its own data partition for these tables.
Monitoring Enhancements in the DBA Cockpit

The DBA Cockpit (SAP transaction DBACOCKPIT) was enhanced with Db2 pureScale monitoring functions that let you monitor Db2 pureScale members and cluster caching facilities (CFs). These Db2 pureScale-specific enhancements provide the following information:

- An overview of the cluster topology and cluster alerts
- An overview of the Db2 member performance in the Db2 pureScale cluster
- Information about the group buffer pool and local buffer pool hit ratio
- The content of the (global) package cache
- Information about the memory configuration and consumption of the cluster caching facilities (CFs)
- Information about page contention in the DB2 pureScale cluster
- Information about connected clients and the client configuration (that is, the content of the db2dsdriver.cfg file)

Related Information

Implementation of SAP-Specific Enhancements [page 59]
2 Planning

Key factors for a successful implementation are conscientiously planning and execution as well as a clear understanding of all the prerequisites, limitations, and steps involved. Please read the following sections carefully.

Related Information

Conversion Steps for Db2 pureScale with SAP NetWeaver [page 12]
Pre-Installation Planning Rules and Best Practices [page 13]
Installation Requirements [page 14]
Installation Restrictions [page 16]

2.1 Conversion Steps for Db2 pureScale with SAP NetWeaver

With SAP NetWeaver, the process of installing the Db2 pureScale Feature consists of the following steps:

1. Preparing the Environment and Checking the Prerequisites [page 18]
2. Adding the Db2 pureScale Feature and Creating GPFS File Systems [page 29]
3. Converting the Db2 11.1 AESE Instance to a Db2 11.1 pureScale Instance [page 47]
4. Optional: Adding Additional Members and Cluster Caching Facilities (CFs) [page 54]
5. Optional: Implementation of SAP-Specific Enhancements [page 59]
6. Optional: Homogeneous System Copy Into an Existing Db2 pureScale Cluster [page 56] to refresh the database in a newly created cluster.

You can perform step 2, that is, move the database to a GPFS file system, in several ways:

- **In-place move of required Db2 files to GPFS on an existing Db2 database**
  You can use this procedure to get the database up and running on GPFS file systems; it’s optimized for minimal downtime. Use this option if you are converting a Db2 database to Db2 pureScale within an existing server. The procedure of moving the data form the current file system type to GPFS file systems is not automated with the SAP installer (SWPM). The detailed procedure depends on the tablespace layout of the current database. Use this procedure if you want to do an in-place conversion of an existing database.

- **Installation of a new or copy of an existing SAP system**
  Here you have the following options:
  - **Installation of a new SAP NetWeaver System with the Db2 pureScale Feature**
    You install the Db2 pureScale software component and create a new database on a GPFS file system. This procedure is supported by the SAP installer. Only use it if you want to install a new system.
- **Homogeneous system copy with the Db2 pureScale Feature installed**
  You install the DB2 pureScale software component and restore an existing database to a set of GPFS file systems. Use this procedure if you want to convert an existing Db2 database on a new server or an existing server where you restore the database to GPFS file systems after you have removed the source database and Db2 instance. This procedure is supported by the SAP installer.

- **Heterogeneous system copy**
  You install the Db2 pureScale software component and load a Db2 database on a set of GPFS file systems. Use this option if you want to convert an existing Db2 database on a new server together with implementing optimizations like data and index compression, or if you want to move from a different database product to Db2 with the pureScale Feature. This procedure is supported by the SAP installer.

**i Note**
It’s not possible to directly install or make a heterogeneous system copy of an SAP NetWeaver system into a newly created or existing Db2 pureScale instance or database.

### 2.2 Pre-Installation Planning Rules and Best Practices

Installing a Db2 pureScale cluster is a complex procedure because it requires an extensive environment setup that ensures all components of Db2 pureScale work together. The complexity can be easily managed if you stick to the following essential rules and best practices:

- Setting up Db2 pureScale is typically a team effort as the process requires storage hardware, networking, operating system, Db2, and SAP knowledge and skills. Make sure you have all these skills available for a pureScale conversion for both planning and implementation.
- Read the installation prerequisites for Db2 pureScale in the IBM Knowledge Center and follow all continuing links to further details.
- Write down a plan with all the tasks and details.
- Compile a checklist with all the prerequisites and tasks for every participating host in the cluster and follow up precisely on that checklist (see also the Pre-Installation Checklist [page 74] in the appendix).
- For additional members and CFs, start with servers or virtual machines with a fresh operating system installation. If you reuse already existing operating system images, make sure they are properly cleaned up from any Db2 or SAP installation.
- Perform a test installation and rehearse the installation procedure as well as the operational aspects like simulated outages in various components.

### Related Information

- Installation Requirements [page 14]
- Installation Restrictions [page 16]
2.3 Installation Requirements

Make sure that the following requirements are met when you plan the installation of or the upgrade to Db2 pureScale:

Hardware and Operating System Requirements

For hardware and software requirements and restrictions, see the following sections and also check the IBM Db2 11.1 Knowledge Center:

<table>
<thead>
<tr>
<th>Document</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-installation checklist for Db2 pureScale Feature (Linux)</td>
<td><a href="https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/r0057204.html">https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/r0057204.html</a></td>
</tr>
</tbody>
</table>

Database Requirements

Your Db2 11.1 installation must run with an Advanced Enterprise Server Edition (AESE) license. In Db2 11.1, all Db2 editions come with one installation image. It depends on the installed license which Db2 edition is used. To be able to install the Db2 pureScale Feature, you must use the Db2 Advanced Enterprise Server Edition (AESE).

SAP System Requirements

To use Db2 11.1 with SAP NetWeaver Application Server ABAP, you need a minimum SAP_BASIS support package level. For the minimum SAP Basis release levels, see SAP Note 2303763.

In addition to the support packages mentioned above, you must implement the following SAP Notes:

1835822: DB6: Compatibility Patches for IBM DB2 10.5 for LUW
1954802: DB6: pureScale Features for DBA Cockpit
This SAP Note is only relevant if you’re using the DBA Cockpit on SAP NetWeaver up to and including 7.02 SP 15, 7.3 SP 11, 7.31 SP 12, and 7.4 SP 7. For higher Support Packages, you don’t need the transport attached to SAP Note 1954802 to use Db2 pureScale monitoring functions in the DBA Cockpit.

The following SAP tools for Db2 require certain patch levels to be able to work with Db2 pureScale:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Patch Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>db6pmudf</td>
<td>21</td>
</tr>
<tr>
<td>brdb6btr</td>
<td>30</td>
</tr>
</tbody>
</table>

For more information about how to download and apply the latest patch for these tools, see SAP Note 19466 🚀. The dmdb6bkp tool is not relevant for Db2 pureScale.

## Space and GPFS Requirements

Disk space on the local file system of each participating host is required as follows:

<table>
<thead>
<tr>
<th>Local File System or Directory</th>
<th>Description</th>
<th>Recommended Minimum Disk Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>Required to temporarily extract software in the root file system</td>
<td>10 GB</td>
</tr>
<tr>
<td>/tmp</td>
<td>Required for installation log and trace files</td>
<td>5 GB</td>
</tr>
<tr>
<td>/var</td>
<td>Used for various configuration information, for example, the Db2 global registry</td>
<td>5 GB</td>
</tr>
<tr>
<td>/db2/db2&lt;dbsid&gt;</td>
<td>Local Instance home directory</td>
<td>10 GB</td>
</tr>
<tr>
<td>/db2/db2&lt;dbsid&gt;/db2_software</td>
<td>Disk space for the Db2 software</td>
<td>6 GB</td>
</tr>
<tr>
<td>/db2/&lt;DBSID&gt;</td>
<td>Database directory containing configuration files, history file, and so on</td>
<td>1 GB</td>
</tr>
</tbody>
</table>

Disk space on the shared GPFS file systems is required as follows:

<table>
<thead>
<tr>
<th>General Parallel File System (GPFS)</th>
<th>Description</th>
<th>Recommended Minimum Disk Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>/db2/instance_shared</td>
<td>Instance-shared directory containing files that are relevant to all installed instances. It also serves as a tiebreaker for the GPFS cluster.</td>
<td>10 GB</td>
</tr>
</tbody>
</table>
### General Parallel File System (GPFS)

<table>
<thead>
<tr>
<th>Directory Path</th>
<th>Description</th>
<th>Recommended Minimum Disk Space</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>/db2/&lt;DBSID&gt;/sapdata&lt;n&gt;</code> or <code>/db2/&lt;DBSID&gt;/sapdata/sapdata&lt;n&gt;</code></td>
<td>Database file systems containing the SAP database data.</td>
<td>See SAP Note 1707361.</td>
</tr>
<tr>
<td><code>/db2/&lt;DBSID&gt;/saptmp&lt;n&gt;</code> or <code>/db2/&lt;DBSID&gt;/saptmp/saptmp&lt;n&gt;</code></td>
<td>Database file systems containing the SAP database temporary data.</td>
<td>See SAP Note 1707361.</td>
</tr>
<tr>
<td><code>/db2/&lt;DBSID&gt;/log_dir</code></td>
<td>Db2 log directory containing the log streams of the Db2 members.</td>
<td>1.4 GB for each Db2 member</td>
</tr>
<tr>
<td><code>/db2/&lt;DBSID&gt;/db2dump</code></td>
<td>Db2 dump directory containing the diagnostic data.</td>
<td>1 GB for each Db2 member or cluster caching facility (CF)</td>
</tr>
<tr>
<td><code>/db2/&lt;DBSID&gt;/db2&lt;dbsid&gt;</code></td>
<td>Database directory containing configuration files, history file, and so on.</td>
<td>1 GB</td>
</tr>
</tbody>
</table>

**iNote**

The default tablespace layout is changed to separate regular data and indexes from the temporary objects.

### Other Requirements

For the latest additions and corrections to this document, see SAP Note 2593454.

### 2.4 Installation Restrictions

#### Operating System-Specific Restrictions

The installation of Db2 pureScale is **only** supported on AIX and Linux. Db2 pureScale **cannot** run across AIX workload partitions (WPARs).
Database-Specific Restrictions

- You can have one Db2 pureScale instance on a server or virtual server. This means that you can only have one instance running. Without Db2 pureScale, you can run multiple Db2 instances on a server.
- Db2 pureScale supports only single-node databases. You cannot use the Db2 database partitioning feature (DPF).
- Multidimensional clustering (MDC) tables, insert time clustering (ITC) tables, range-clustered tables, and column-organized tables cannot be used.
- Concurrent write access is not allowed during index creation.
- Multiple HADR stand-by databases are not supported.
- You cannot configure infinite active log space.
- Various clauses for the alter tablespace statement like BEGIN NEW STRIPE SET, LOWER HIGH WATER MARK, RESIZE, ADD or DROP container are not supported.

SAP System-Specific Restrictions

- Db2 pureScale is only supported for SAP systems based on at least SAP NetWeaver 7.0 SR3 and higher.
- The host names of all SAP application servers must be different within the first 8 characters. This is a requirement for the partitioning of the update tables, which is described later in this guide.
- The installation of multiple components in one database (MCOD) is not supported with Db2 pureScale.
- The installation of multiple databases within one Db2 instance is not supported.
- For the Db2 client connectivity, the AS ABAP of the SAP system must use the IBM Data Server Driver for CLI and ODBC (CLI Driver) as Db2 client software. (The Db2 Runtime Client is not supported.)
3 Preparing the Environment and Checking the Prerequisites

Prepare your environment as described in the following sections. To assist you with the prerequisite checking, you can use our Pre-Installation Checklist [page 74] in the appendix.

Related Information

Preparing the Basic Infrastructure for Db2 pureScale [page 18]
Setting Up Identical Users on All Nodes [page 19]
Manually Setting Up Passwordless Access for User Root [page 19]
Preparing Disks for the General Parallel File System (GPFS) [page 20]
Checking the Prerequisites for the Conversion to Db2 pureScale [page 27]
Identifying the Cluster Interconnect Netname [page 28]
Pre-Installation Checklist [page 74]

3.1 Preparing the Basic Infrastructure for Db2 pureScale

Read the following information from the IBM Knowledge Center and configure your environment accordingly:

- Shared storage support for Db2 pureScale environments (Linux and AIX) at https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/c0059360.html
3.2 Setting Up Identical Users on All Nodes

The following users must be available on all cluster nodes:

- Database administration user `db2<dbsid>`
- DB2 connect user `sap<sapsid>` (AS ABAP) and `sap<sapsid>db` (AS Java)
- SAP system administration user `<sapsid>adm`

These users must belong to the same groups, the user and group IDs must match, and they must use the same shell and the same path to the home directory.

You can use a central user management for user authorization and authentication, for example, by using the Lightweight Directory Access Protocol (LDAP) or the Network Information Service (NIS). Alternatively, you can also use local user authentication and authorization. In this case, the SAP installer makes sure that all users are created with the correct properties on all members and CFs.

3.3 Manually Setting Up Passwordless Access for User Root

In a Db2 pureScale cluster, the user `root` must be able to execute commands on all cluster nodes without providing a password.

This can be achieved by either setting up passwordless access via OpenSSH or by using the `db2ssh` command.

**Note**

The SAP software provisioning manager (SWPM) requires passwordless root access using OpenSSH during the installation. Therefore, if you decide to use `db2locssh`, you temporarily need to enable OpenSSH whenever you use SWPM.

For more information about `db2ssh`, see the IBM paper *Securely deploying and configuring the Db2 pureScale Feature by using db2ssh* at [http://www-01.ibm.com/support/docview.wss?uid=swg21994262](http://www-01.ibm.com/support/docview.wss?uid=swg21994262).

To enable one of the methods, follow the appropriate instructions in the IBM Knowledge Center:


It’s not necessary to create an additional user for `db2locssh`, you can use the Db2 instance owner (`db2<dbsid>`).
3.4 Preparing Disks for the General Parallel File System (GPFS)

You need shared disks for a Db2 pureScale cluster that correspond to the GPFS file systems, and an additional disk for the SA MP tiebreaker. For information about recommended disk space, see Installation Requirements [page 14].

Make sure these disks are shared on all machines and virtual machines that are part of the cluster (this includes members as well as CFs). In addition, you need local disk space, for example, for the Db2 software installation and local instance configuration.

The following figure shows a simple configuration with shared and local disks:
After the installation of SAP NetWeaver 7.0 SR3 or higher with Db2 10.1 or higher and SWPM 1.0 SP17 or higher, a typical Db2 directory hierarchy without the Db2 pureScale feature looks as follows:

```
/db2
   <DBSID>
     sqliib
     db2_software
     sapdata<n>
     saptmp<n>
     log_dir
     db2dump
```

Beside the above layout, you may use the following alternative structures:

```
/db2/<DBSID>/sapdata/sapdata<n>
```

instead of

```
/db2/<DBSID>/sapdata<n>
```

for data

```
/db2/<DBSID>/saptmp/saptmp<n>
```

instead of

```
/db2/<DBSID>/saptmp<n>
```

for temporary tablespaces

During the conversion, the Db2 layout needs to be converted in such a way that it uses shared GPFS file systems, or the database will be installed on a GPFS file system structure during the system copy or new
The complete Db2 pureScale file system and directory structure consist of local parts on each participating server and shared GPFS disks as shown in the following figure:

The home directory of the instance owner and subsequently the Db2 11.1 software installation location and the local instance directory must stay on the local file system. In addition, the database directory `/db2/<DBSID>` must exist on the local disk. Everything else is located on several shared file systems. A new extra GPFS file system that does not exist in installations without pureScale is used for the instance-shared directory. This directory holds files that are relevant to all installed instances. It also hosts files that must be available to all members and CFs at all times – for example, the `db2nodes.cfg` file – and it serves as a tiebreaker for the GPFS cluster by default.

You create the GPFS file systems either using the SAP installer (SWPM), or manually using Db2 commands. The names for the GPFS file systems and the mount points must follow the SAP naming conventions as shown in the following figure, which shows a simple configuration with four hosts, one local disk, and nine shared disks attached and available to all hosts. The installation starts with one host that is called the installation-initiating host (IIH):
In case you are converting an existing database to Db2 pureScale, you may have the former layout in place where the temporary tablespaces reside in the same directories/file systems as the data and index tablespaces. This means you will only have a structure of “/db2/<DBSID>/sapdata<n>” directories, but no dedicated directories for temporary tablespaces. The step of moving the database to a GPFS file system allows you to adopt the layout to the new structure as shown in the figures above.

During the lifetime of the database, many storage paths or file systems may have been added to the database and some installations may have 20 or more storage paths assigned to a database. This is due to various reasons like the inability to increase the file system size, the need to spread data across more physical disks or due to management reasons like backup performance, where large tables are assigned to dedicated tablespaces residing on dedicated storage paths.

Db2 pureScale adds one more dimension to the criteria on the number of file systems used to store the data. One of the main reasons to move to Db2 pureScale is to achieve optimal system availability and fast failover. During the failover process, the GPFS file systems are checked by the surviving members. This check typically takes up to a few seconds per file system. So if the installation has a small number of members - for example, two members - and there are many GPFS file systems to check, this will have an impact on the failover performance.
→ Recommendation

Therefore, do not increase the number of GPFS file systems. If you are converting an existing system, you may want to reduce the number of file systems.

The new file structure for tablespaces starting with Db2 10.1 and SWPM 1.0 SP17 allows you to use one file system.

→ Recommendation

We recommend that you use the same number of file systems for the tablespaces as in an SAP default installation. Furthermore, for performance reasons, we highly recommend that you use an extra GPFS file system only for Db2 logging.

This file system contains the log streams of all cluster members. Two more file systems are needed for the diagnostic data (db2dump directory) and the database directory. The database directory contains configuration files, the history file, and so on.

In theory, you can limit the number of GPFS file systems by using nested mount points. For example, you may think about creating a large GPFS and mount it under /db2/<DBSID>. Inside this file system, you plan to mount another GPFS for the log streams under /db2/<DBSID>/log_dir. However, a GPFS mounts its file systems in random order. If a mount point doesn’t exist, it’s automatically created. For the example shown in the figure above, this means that on system start or after a failover, it’s possible that the GPFS first mounts /db2/<DBSID>/log_dir and afterwards /db2/<DBSID>. In this situation, the last mount effectively hides the file system that was mounted first, which leads to an unusable cluster.

If you have installed your SAP system as described in the SAP NetWeaver installation guide (see References [page 79]), you have created separate file systems for the Db2 database, the db2dump directory (that contains Db2 diagnostic data), and the logging directory. All file systems reside on local disks. In the procedures that follow, we assume that this is the case for your actual system configuration.

Note

If you did not install your SAP system using separate file systems, you can still use this document. However, you have to adapt some of the steps described in the following sections. For example, if you are asked to unmount the sapdata file systems, you have to rename the corresponding directories instead.

Related Information

- Checking the Disks for GPFS File Systems on AIX [page 25]
- Checking the Disks for GPFS File Systems on Linux [page 25]
3.4.1 Checking the Disks for GPFS File Systems on AIX

To verify the GPFS file systems, log on to each cluster node as user root and run the lspv command. The following is an example output of the lspv command:

```
root@db2dsf1 / > lspv
hdisk0    00c5cc1479a245dd rootvg active
hdisk1    00c5ccf479278ca7 None
hdisk2    00c5ccf42dae2dbf None
hdisk3    00c5ccf478d1e33e None
hdisk4    00c5ccf478d1e49a None
hdisk5    00c5ccf4d5b68397 None
hdisk6    00c5ccf4d5b68539 None
hdisk7    00c5ccf43fb2a528 None
hdisk8    00c5ccf4756a832b None
hdisk9    00c5ccf429fbd7a8 None

root@db2dsf2 / > lspv
hdisk0    00c5cc1479a245dd rootvg active
hdisk1    00c5ccf479278ca7 None
hdisk2    00c5ccf42dae2dbf None
hdisk3    00c5ccf478d1e33e None
hdisk4    00c5ccf478d1e49a None
hdisk5    00c5ccf4d5b68397 None
hdisk6    00c5ccf4d5b68539 None
hdisk7    00c5ccf43fb2a528 None
hdisk8    00c5ccf4756a832b None
hdisk9    00c5ccf429fbd7a8 None
```

The shared disks must appear with the same device number on every node in the cluster. The device number is reported in the second column of the lspv output. Depending on the system setup, the device names (/dev/hdisk<n>) for the shared disks can differ on the nodes.

**Note**

If you want to determine the size of a disk in MB on AIX, you can use the following command:

```
getconf DISK_SIZE /dev/<disk_name>
```

Example:

```
getconf DISK_SIZE /dev/hdisk2
```

For more information, see *Configuring PVIDs for a Db2 pureScale instance (AIX)* in the IBM Knowledge Center at [https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/t0056777.html](https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/t0056777.html)

3.4.2 Checking the Disks for GPFS File Systems on Linux

To verify the GPFS file systems, log on to each cluster node as user root and run the multipath -l command.
The following is an example output of the `multipath -l` command:

```
[root@db6x01 ~]# multipath -l
mpathe (3600a0b8000472ba00004e88c528bab) dm-3 IBM,1815      FAStT
 size=250G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:0 sdb 8:16 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:0 sdl 8:176 active undef running
mpathd (3600a0b8000472ca000004cab4c5287d0) dm-2 IBM,1815      FAStT
 size=40G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:1:2 sdn 8:208 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:0:2 sdd 8:48 active undef running
mpathc (3600a0b8000472ba00004e8d4c528beb) dm-7 IBM,1815      FAStT
 size=50G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:3 sde 8:64 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:3 sdo 8:224 active undef running
mpathb (3600a0b8000472ba000004e8b4c528bbf) dm-4 IBM,1815      FAStT
 size=2.0G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:1 sdc 8:32 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:1 sdm 8:192 active undef running
[root@db6x02 ~]# multipath -l
mpathe (3600a0b8000472ca000004cab4c5287d0) dm-11 IBM,1815      FAStT
 size=40G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:1:2 sdn 8:208 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:0:2 sdd 8:48 active undef running
mpathc (3600a0b8000472ba00004e8d4c528beb) dm-5 IBM,1815      FAStT
 size=50G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:3 sde 8:64 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:3 sdo 8:224 active undef running
mpathg (3600a0b8000472ba000004e88c528bab) dm-3 IBM,1815      FAStT
 size=250G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:0 sdb 8:16 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:0 sdl 8:176 active undef running
mpathb (3600a0b8000472ba000004e8b4c528bbf) dm-4 IBM,1815      FAStT
 size=2.0G features='1 queue_if_no_path' hwhandler='1 rdac' wp=rw
 |++- policy='round-robin 0' prio=0 status=active
 |   `- 3:0:0:1 sdc 8:32 active undef running
 `--+ policy='round-robin 0' prio=0 status=enabled
   `- 3:0:1:1 sdm 8:192 active undef running
```

The shared disks must appear with the same World Wide ID (WWID) on every node in the cluster. Depending on the system setup, the device names (dm-7, dm-5 as shown in the example) for the shared disks can differ on the nodes. The `multipath` command also reports the disk sizes and other information.

For more information, see Preinstallation checklist for DB2 pureScale Feature (Linux) in the IBM Knowledge Center at https://www.ibm.com/support/knowledgecenter/SSEPBG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/r0057204.html.
3.5 Checking the Prerequisites for the Conversion to Db2 pureScale

Context

For a successful conversion to Db2 pureScale, it’s important that you check and meet all the prerequisites for your Db2 release as described in the previous sections. To assist with checking, you can use the Db2 tool `db2prereqcheck` that is located on the installation DVD. The tool provides several checks depending on your operating system and chosen infrastructure. Run this tool in two steps to ensure all prerequisites are met to convert the instance to Db2 pureScale or to set up a new cluster. In addition, you can use our Pre-Installation Checklist [page 74] in the appendix as a checklist to help you with the prerequisite checking.

Procedure

1. Check the basic prerequisites like IOCP, ssh and `db2locssh`, free space, operating system level, and Java version as follows:
   1. Log on to the database server as user `root`.
   2. Insert and mount the database DVD to `<DVD_mount>`.
   3. Change to the following directory: `cd <DVD_mount>/<platform>/ESE/disk1`
   4. Run the installation prerequisite check using the following command:
      
```
./db2prereqcheck -p -v <Db2 version> -f <file with prerequisites> -hl <list of hosts in cluster>
```

   Note the following when running this command:
   - As Db2 version, use a combination of version, release, Modification Pack, and Fix Pack number. For example, if you want to install Db2 Version 11 MP2 FP2SAP, use `11.1.2.2`.
   - The file that contains the information about the prerequisites is `DB2prereqs.xml`. It’s located in the following install directory of the installation media:
     `<DVD_mount>/<platform>/ESE/disk1/db2/<platform>/install`
   - Specify the host names that will be part of the Db2 pureScale cluster as comma-separated list.

5. Check the output of the command and verify that all prerequisites on all participating hosts are met. If the check returns errors, you need to perform the necessary actions before you can continue with the installation of the Db2 11.1 software. Necessary actions might be, for example, upgrading the technology level of AIX or applying an AIX service pack.

2. Check further details for the pureScale cluster by verifying that the shared disks are accessible on all participating host or by checking that the instance owner has the same user ID and group ID across the cluster. For more information about the usage and possibilities for checking further prerequisites, see `db2prereqcheck - Check installation prerequisites` in the IBM Knowledge Center at https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0059710.html.
3.6 Identifying the Cluster Interconnect Netname

For some tasks, you have to know the correct cluster interconnect netname of the cluster hosts. To find out this netname, run the following command as user root on each host:

\texttt{<inst\_dir>/instance/native/install/db2getnetwork}

The following is an example output of this command:

\texttt{db2dsf1,22.22.22.22,db2dsf1-ib0,ib0}

\texttt{db2dsf1,33.33.33.33,db2dsf1.wdf.sap.corp,en0}

In this example, \texttt{db2dsf1-ib0} is the cluster interconnect netname of \texttt{db2dsf1}. 


4 Adding the Db2 pureScale Feature and Creating GPFS File Systems

Learn how you can move an existing SAP system that has not been using the Db2 pureScale Feature before, or install a new SAP system including the Db2 pureScale Feature where the required GPFS file systems are created and used.

You have to perform the following steps:

1. Add the Db2 pureScale Feature to the existing Db2 software installation.
2. Create GPFS file systems.
3. Move existing data to the new file systems or install a new system on GPFS file systems.

There are several ways to move existing data to the new GPFS file systems:

- **In-place move of required Db2 files to GPFS on an existing Db2 database**
  You can use this procedure to get the database up and running on GPFS file systems; it’s optimized for minimal downtime. Use this option if you are converting a Db2 database to Db2 pureScale within an existing server. The procedure of moving the data form the current file system type to GPFS file systems is not automated with the SAP installer (SWPM). The detailed procedure depends on the tablespace layout of the current database. Use this procedure if you want to do an in-place conversion of an existing database.

- **Installation of a new or copy of an existing SAP system**
  Here you have the following options:
  - **Installation of a new SAP NetWeaver System with the Db2 pureScale Feature**
    You install the Db2 pureScale software component and create a new database on a GPFS file system. This procedure is supported by the SAP installer. Only use it if you want to install a new system.
  - **Homogeneous system copy with the Db2 pureScale Feature installed**
    You install the DB2 pureScale software component and restore an existing database to a set of GPFS file systems. Use this procedure if you want to convert an existing Db2 database on a new server or an existing server where you restore the database to GPFS file systems after you have removed the source database and Db2 instance. This procedure is supported by the SAP installer.
  - **Heterogeneous system copy**
    You install the Db2 pureScale software component and load a Db2 database on a set of GPFS file systems. Use this option if you want to convert an existing Db2 database on a new server together with implementing optimizations like data and index compression, or if you want to move from a different database product to Db2 with the pureScale Feature. This procedure is supported by the SAP installer.

Related Information

- In-Place Move of Db2 Files to GPFS on an Existing Db2 Database [page 30]
- Installing an SAP System on GPFS File Systems [page 43]
4.1 In-Place Move of Db2 Files to GPFS on an Existing Db2 Database

You can do an in-place move of data by rebalancing tablespaces. The advantage of tablespace rebalancing is that it requires the least system downtime. This means that during the tablespace rebalancing process, the system can stay online, but the tablespace rebalancing operations require additional CPU and disk capacity. Furthermore, this procedure also allows you to convert a non-automatic storage database to a database that uses automatic storage.

**i Note**

Tablespace rebalancing cannot be used if you have DMS raw device tablespaces in your system.

Alternatively, you can move data offline using operating system means (for example, by copying data using the `cp` command) or a redirected restore. The redirected restore requires longer system downtime, but is usually easier to perform than tablespace rebalancing.

The database conversion to Db2 pureScale consists of the following steps that you must perform in the specified order:

1. Upgrade the database to Db2 11.1.
2. Recommended: Run the `db2checkSD` utility.
3. Recommended: Perform an offline backup.
4. Add the Db2 pureScale Feature to the existing Db2 11.1 software.
5. Create the necessary GPFS file systems.
6. Rebalance tablespaces to the new file system.
7. Move remaining data to the GPFSs.
8. Mount GPFSs under new mount points and remove old file systems.
9. Run the `db2checkSD` utility again.

### 4.1.1 Upgrading the Database to Db2 11.1

The procedures in the following sections assume that your existing SAP system is running on Db2 11.1 with an AESE license installed. If this is not the case, first upgrade your system to DB2 11.1 and install the AESE license.

For more information, see the database upgrade guide *Upgrading to Version 11.1 of IBM Db2 for Linux, UNIX, and Windows* at [http://help.sap.com/viewer/db6_upgrade_11_1](http://help.sap.com/viewer/db6_upgrade_11_1).
4.1.2 Running the db2checkSD Utility

Context

To check if the prerequisites for the conversion to Db2 pureScale are met, you can use the db2checkSD utility:

Procedure

1. Log on to the database server as user db2<dbsid>.
2. Since the GPFS file system has not yet been set up, pass the -nogpfs option to the db2checkSD utility by running it as follows:

   `<inst_dir>/bin/db2checkSD <DBSID> -l <name of logfile> -nogpfs`

   The output of the db2checkSD utility should look as follows:

   DBT5000I The db2checkSD utility completed successfully. The specified database can be upgraded to a data-sharing environment. The output log file is named "/tmp/checksd.log".

   If your database is not yet enabled for automatic storage management, the db2checkSD utility reports an error. You can ignore this error message because during the upgrade to Db2 pureScale, a non-autostorage database is converted to an automatic storage database.
3. If the db2checkSD utility reports other errors, you need to review the log file and take appropriate actions. Run the db2checkSD utility again until all problems have been solved.

4.1.3 Performing an Offline Backup

Before you start any conversion tasks on your existing systems, we strongly recommend that you perform a full database offline backup.
4.1.4 Adding the Db2 pureScale Feature to the Existing Db2 11.1 Software Installation

Context

To create a Db2 pureScale instance, the Db2 pureScale Feature must be added to the existing Db2 software installation.

Procedure

1. Stop the SAP system and the DB2 database manager (`db2stop`).

   **i Note**
   Make sure that the database manager really is not running. If you perform the following procedure while the database manager is still running, the update of the database instance cannot complete successfully. As a consequence, you would need to perform manual steps to bring the database instance back to a normal state.

2. Log on to the database server as user root.

3. Insert and mount the database DVD to `<DVD_mount>`.

4. Ensure that your X Windows display is set up correctly and call the graphical installation tool `db2setup`.

5. On the Welcome screen, choose Work with Existing.

6. On the next screen, choose the appropriate Db2 software copy and choose `Db2 Version 11.1.<n>.<m> Server Editions with Db2 pureScale`.

7. On the next screen, choose Custom as installation type and then Next.

8. On the Languages screen, choose Next.


10. On the Host list screen, confirm the host list with Next.

   **i Note**
   Do not add any members or cluster caching facilities (CFs). The host list must contain one entry. Note that with this step, your Db2 instance is not automatically converted to Db2 pureScale.

11. On the Summary screen, verify the summary information, choose Finish and wait until the installation finishes.

12. Confirm the Setup complete dialog box with Finish.

13. After the installation finished successfully, restart the Db2 instance and the SAP system.
4.1.5 Creating the GPFS File Systems

Context

Before you can convert the existing Db2 11.1 AESE instance to a Db2 pureScale instance, you have to move the database to a GPFS file system. This file system can be managed either manually with GPFS-specific commands (user-managed file system) or automatically by Db2 (Db2-managed file system).

→ Recommendation

We strongly recommend that you use the Db2-managed file system approach because then Db2 performs all necessary GPFS configuration tasks, for example, while new cluster members are added.

To make sure that Db2 pureScale automatically manages the GPFS file system, you need to run the `db2cluster_prepare` command. Then, the GPFS file system is created for the instance-shared directory and certain entries in the Db2 global registry are made.
The starting point for the steps below is an existing SAP system running with non-shared disks as shown in the following figure:

**Procedure**

1. Log on to the database server as user root.
2. Run the `db2cluster_prepare` command as follows:

   ```bash
   <inst_dir>/instance/db2cluster_prepare -l <path and name of logfile> -instance_shared_dev<shared disk> -instance_shared_mount /db2/instance_shared
   ```

   **Example**

   ```bash
   /db2/db2<dbsid>/db2_software/instance/db2cluster_prepare -l /tmp/clusterprep.log -instance_shared_dev /dev/hdisk6 -instance_shared_mount /db2/instance_shared
   ```
If the `db2cluster_prepare` command reports errors, you need to review the log file and take appropriate actions.

3. To check that the instance-shared file system was created, you can use the `db2cluster` command as in the following example:

   ```bash
   <inst_dir>/bin/db2cluster -cfs -list -filesystem
   ```

   An example output of this command looks as follows:

<table>
<thead>
<tr>
<th>FILE SYSTEM NAME</th>
<th>MOUNT_POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>db2fs1</td>
<td>/db2/instance_shared</td>
</tr>
</tbody>
</table>

4. Create the GPFS file systems for the SAP database using the following commands:

   ```bash
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2data1 -disk <sapdata_disk>
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2data2 -disk <sapdata_disk>
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2tmp1 -disk <sapdata_disk>
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2tmp2 -disk <sapdata_disk>
   ```

   where `<sapdata_disk>` is the disk for the file system that is going to be used by the SAP database including the disks for the temporary tablespaces, for example, `/dev/hdisk1,...,/dev/hdisk4`.

5. Create the GPFS file system for the Db2 log files using the following command:

   ```bash
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2log -disk <log_disk>
   ```

   where `<log_disk>` is the disk for the file system that is used by the Db2 log files, for example, `/dev/hdisk7`.

6. Create the GPFS file system for the Db2 diagnostic data using the following command:

   ```bash
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2dump -disk <dump_disk>
   ```

   where `<dump_disk>` is the disk for the file system that is used by the Db2 diagnostic data, for example, `/dev/hdisk8`.

7. Create the GPFS for the Db2 database directory using the following command:

   ```bash
   <inst_dir>/bin/db2cluster -cfs -create -filesystem db2dbdir -disk <dbdir_disk>
   ```

   where `<dbdir_disk>` is the disk for the file system that is going to be used by the Db2 database directory, for example `/dev/hdisk9`.

8. Since the newly created file systems must be accessible by the instance owner, change their permissions as follows:

   ```bash
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2data1
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2data2
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2data3
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2data4
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2log
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2dump
   chown db2<dbsid>:db<dbsid>adm /db2fs/db2dbdir
   ```
9. Check that the required file systems are created by running the following command:

```
<inst_dir>/bin/db2cluster -cfs -list -filesystem
```

The output should look similar to the following example:

<table>
<thead>
<tr>
<th>FILE SYSTEM NAME</th>
<th>MOUNT_POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>db2data1</td>
<td>/db2fs/db2data1</td>
</tr>
<tr>
<td>db2data2</td>
<td>/db2fs/db2data2</td>
</tr>
<tr>
<td>db2tmp1</td>
<td>/db2fs/db2tmp1</td>
</tr>
<tr>
<td>db2tmp2</td>
<td>/db2fs/db2tmp2</td>
</tr>
<tr>
<td>db2dir</td>
<td>/db2fs/db2dir</td>
</tr>
<tr>
<td>db2dump</td>
<td>/db2fs/db2dump</td>
</tr>
<tr>
<td>db2fs1</td>
<td>/db2/instance_shared</td>
</tr>
<tr>
<td>db2log</td>
<td>/db2fs/db2log</td>
</tr>
</tbody>
</table>

**Results**

After the creation of the GPFS file systems, your system looks as shown in the following figure:
4.1.6 Rebalancing Tablespaces to the New File System

**Note**
Details like tablespace names, storage paths, layout of temporary tablespaces, and so on may vary depending on the setup and age of your system. Therefore, you might have to adapt the commands mentioned in this section.

Use the following procedure to move the Db2 database to the GPFS file systems.

**Prerequisites**

The database needs to be enabled for automatic storage. If this is not completely the case, enable the database with automatic storage and convert the tablespaces as described in the following documentation:

- SAP Note 1895425
- Enable Automatic Storage for Your SAP Database and Table Spaces on SAP Community

**Note**
Tablespace rebalancing affects the performance of the system. Make sure that you perform the following steps only during low system activity.

**Procedure**

1. Log on to the database server as user `db2<dbsid>`.
2. List the existing storage paths with the following command:
   ```
   db2pd -d <DBSID> -storagepaths
   ```
   The following is an example output of this command:
   ```
   Database Partition 0 -- Database DSJ -- Active --
   Up 4 days 03:08:31
   Database Storage Paths:
   Number of Storage Paths  4
   Address  PathID  PathState  PathName
   0x0700000020754F20 0  InUse  /db2/DSJ/sapdata1
   0x0700000020755200 1  InUse  /db2/DSJ/sapdata2
   0x07000000207554E0 2  InUse  /db2/DSJ/saptmp1
   0x07000000207557C0 3  InUse  /db2/DSJ/saptmp2
   ```
   If there are no storage paths listed (for example, the number of storage paths is 0), your database is not enabled for automatic storage.
3. Add the storage path of the new GPFS `db2data` file system and drop the existing storage paths using the following command:
   ```
   db2 "ALTER DATABASE DROP STORAGE ON '<old_path_1>', '<old_path_2>', ... ADD STORAGE ON '<new_path1>', '<new_path2>',..." 
   ```
Example

db2 "ALTER DATABASE DROP STORAGE ON '/db2/DSJ/sapdata1', '/db2/DSJ/sapdata2',
'/db2/DSJ/saptmp1', '/db2/DSJ/saptmp2' ADD STORAGE ON '/db2fs/db2data1', '/
db2fs/db2data2', '/db2fs/db2tmp1', '/db2fs/db2tmp2"

Db2 issues the following warning that you can ignore:

SQL2095W Storage path "/db2/DSJ/sapdata1" is in the drop pending state because
one or more automatic storage table spaces reside on the path. SQLSTATE=01691

4. Run the following command again:

   db2pd -d <DBSID> -storagepaths

   The output now looks as follows:

   Database Partition 0 -- Database DSJ -- Active -- Up 4 days 03:24:07
   Database Storage Paths:
   Number of Storage Paths       8
   Address            PathID PathState   PathName
   0x0700000020754F20 0      DropPending /db2/DSJ/sapdata1
   0x0700000020755200 1      DropPending /db2/DSJ/sapdata2
   0x07000000207554E0 2      DropPending /db2/DSJ/saptmp1
   0x07000000207557C0 3      DropPending /db2/DSJ/saptmp2
   0x0700000037F3EE60 4      NotInUse    /db2fs/db2data1
   0x0700000037F3EF82 5      NotInUse    /db2fs/db2data2
   0x0700000037F3FA2B 6      NotInUse    /db2fs/db2tmp1
   0x0700000037F3FBA5 7      NotInUse    /db2fs/db2tmp2

5. Rebalance all tablespaces (except the temporary tablespaces) by doing one of the following:

   ○ Rebalance a single tablespace by entering the following command:

       ALTER TABLESPACE <tablespace_name> REBALANCE

   ○ Generate a script that contains the statements required to rebalance all tablespaces using the
     following SQL statement:

       db2 -x "SELECT 'ALTER TABLESPACE ' || CHR(34) || tbspace || CHR(34) || ''
       REBALANCE;' FROM syscat.tablespaces WHERE TBSPACETYPE = 'D'" >/tmp/
       tbsprebalance.sql

     To execute the generated script, use the following command:

     db2 -tvf /tmp/tbsprebalance.sql

     Tablespace rebalancing is an asynchronous action. You can monitor the rebalancing process using the
     following command:

     db2 "LIST UTILITIES SHOW DETAIL"

6. Move the temporary tablespaces to the new storage path using the following commands:

   db2 "RENAME TABLESPACE PSAPTEMP16 TO oldTEMP16"
   db2 "RENAME TABLESPACE SYSTOOLSTMPSPACE TO oldTOOLSTMPSPACE"
   db2 "CREATE TEMPORARY TABLESPACE PSAPTEMP16 IN NODEGROUP IBMTEMPGROUP PAGESIZE
   16k MANAGED BY AUTOMATIC STORAGE USING STOGROUP "SAPTMPGRP" EXTENTSIZESIZE 2
   PREFETCHSIZE AUTOMATIC DROPPED TABLE RECOVERY OFF"
   db2 "CREATE USER TEMPORARY TABLESPACE SYSTOOLSTMPSPACE IN NODEGROUP IBMCATGROUP
   PAGESIZE 16k MANAGED BY AUTOMATIC STORAGE USING STOGROUP "SAPTMPGRP" EXTENTSIZESIZE
   2 PREFETCHSIZE AUTOMATIC DROPPED TABLE RECOVERY OFF"
   db2 "DROP TABLESPACE oldTEMP16"
   db2 "DROP TABLESPACE oldTOOLSTMPSPACE"
Note

Depending on your system history, the storage group `SAPTMPGRP` may not exist and needs to be created first. See SAP Notes 2544263 and 2520447 for information about recreating and assigning temporary tablespaces to storage groups.

7. Check that the database was moved to the new storage paths using the following command:

```
db2pd -d <DBSID> -storagepath
```

The output now looks as follows:

<table>
<thead>
<tr>
<th>Address</th>
<th>SGID</th>
<th>PathID</th>
<th>PathState</th>
<th>PathName</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0700000060464400</td>
<td>0</td>
<td>4</td>
<td>InUse</td>
<td>/db2fs/db2data1</td>
</tr>
<tr>
<td>0x0700000037F3EF82</td>
<td>0</td>
<td>5</td>
<td>InUse</td>
<td>/db2fs/db2data2</td>
</tr>
<tr>
<td>0x0700000037F3FA2B</td>
<td>0</td>
<td>6</td>
<td>InUse</td>
<td>/db2fs/db2tmp1</td>
</tr>
<tr>
<td>0x0700000037F3FBA5</td>
<td>0</td>
<td>7</td>
<td>InUse</td>
<td>/db2fs/db2tmp1</td>
</tr>
</tbody>
</table>

4.1.7 Moving Remaining Data to the GPFS

You can move remaining data from the old file systems to the new shared GPFS using the `cp` command.

Note

You must perform the following steps offline. Do not start the database again until you have mounted the GPFS file systems under new mount points.

Procedure

1. Stop the SAP system and the database.
2. Log on to the database server as user `root`.
3. Copy all data inside the directories – except the directories that contain database data – to the new GPFS using the following commands:
   
   ```
cd /db2/<DBSID>/log_dir
   cp -pR * /db2fs/db2log
   cd /db2/<DBSID>/db2dump
   cp -pR * /db2fs/db2dump
   cd /db2/<DBSID>/db2<dbsid>
   cp -pR * /db2fs/db2dbdir
   ```

Related Information

Mounting GPFSs Under New Mount Points [page 40]
4.1.8 Mounting GPFSs Under New Mount Points

To integrate the GPFS into the standard SAP/Db2 directory hierarchy, use the following procedure. Note that the Db2 instance needs to be stopped all the while executing the following commands.

**Procedure**

1. Stop the SAP system and the Db2 database.
2. Log on to the database server as user `root`.
3. Unmount the original SAP file systems using the following commands:
   ```
   unmount /db2/<DBSID>/sapdata1
   unmount /db2/<DBSID>/sapdata2
   unmount /db2/<DBSID>/saptmp1
   unmount /db2/<DBSID>/saptmp2
   unmount /db2/<DBSID>/db2dump
   unmount /db2/<DBSID>/log_dir
   unmount /db2/<DBSID>/db2<dbsid>
   ```
4. Create a new `sapdata` directory and change the permissions using the following commands:
   ```
   mkdir /db2/<DBSID>/sapdata1
   chown db2<dbsid>:db<dbsid>adm /db2/<DBSID>/sapdata1
   mkdir /db2/<DBSID>/sapdata2
   chown db2<dbsid>:db<dbsid>adm /db2/<DBSID>/sapdata2
   mkdir /db2/<DBSID>/saptmp1
   chown db2<dbsid>:db<dbsid>adm /db2/<DBSID>/saptmp1
   mkdir /db2/<DBSID>/saptmp2
   chown db2<dbsid>:db<dbsid>adm /db2/<DBSID>/saptmp2
   ```
5. Assign the correct permissions to the instance-shared directory using the following commands:
   ```
   chown db2<dbsid>:db<dbsid>adm /db2/instance_shared
   ```
6. To change the mount point of a GPFS, you have to use GPFS commands. Before changing the mount point, run the following command to list all GPFS and their mount points:
   ```
   /usr/lpp/mmfs/bin/mmlsfs all -T
   ```
   The following is an example output of this command:
   ```
   File system attributes for /dev/db2data1:
   flag      value           description
   -T   /db2fs/db2data1   Default mount point
   File system attributes for /dev/db2data2:
   flag      value           description
   -T   /db2fs/db2data2   Default mount point
   File system attributes for /dev/db2tmp1:
   flag      value           description
   -T   /db2fs/db2tmp1   Default mount point
   ```
File system attributes for /dev/db2tmp2:
flag value          description
---- -------------- ---------------------------------
-T  /db2fs/db2tmp2 Default mount point

File system attributes for /dev/db2dbdir:
flag value          description
---- -------------- ---------------------------------
-T  /db2fs/db2dbdir Default mount point

File system attributes for /dev/db2dump:
flag value          description
---- -------------- ---------------------------------
-T  /db2fs/db2dump Default mount point

File system attributes for /dev/db2fs1:
flag value          description
---- -------------- ---------------------------------
-T  /db2/instance_shared Default mount point

File system attributes for /dev/db2log:
flag value          description
---- -------------- ---------------------------------
-T  /db2fs/db2log Default mount point

7. Unmount the GPFS for the Db2 database using the following commands:
   /usr/lpp/mmfs/bin/mmumount /db2fs/db2data1
   /usr/lpp/mmfs/bin/mmumount /db2fs/db2data2
   /usr/lpp/mmfs/bin/mmumount /db2fs/db2tmp1
   /usr/lpp/mmfs/bin/mmumount /db2fs/db2tmp2

8. Change the mount point of the GPFS file systems for the Db2 data using the following commands:
   /usr/lpp/mmfs/bin/mmchfs /dev/db2data1 -T /db2/<DBSID>/sapdata1
   /usr/lpp/mmfs/bin/mmchfs /dev/db2data2 -T /db2/<DBSID>/sapdata2
   /usr/lpp/mmfs/bin/mmchfs /dev/db2tmp1 -T /db2/<DBSID>/saptmp1
   /usr/lpp/mmfs/bin/mmchfs /dev/db2tmp2 -T /db2/<DBSID>/saptmp2

9. Remount the GPFS file system for the Db2 database using the following command:
   /usr/lpp/mmfs/bin/mmmount /dev/db2data1
   /usr/lpp/mmfs/bin/mmmount /dev/db2data2
   /usr/lpp/mmfs/bin/mmmount /dev/db2tmp1
   /usr/lpp/mmfs/bin/mmmount /dev/db2tmp2

10. Change the mount points of the other file systems in the same way by using the following commands:
    /usr/lpp/mmfs/bin/mmumount /dev/db2dbdir
    /usr/lpp/mmfs/bin/mmchfs /dev/db2dbdir -T /db2/<DBSID>/db2<dsid>
    /usr/lpp/mmfs/bin/mmumount /dev/db2dump
    /usr/lpp/mmfs/bin/mmchfs /dev/db2dump -T /db2/<DBSID>/db2dump
    /usr/lpp/mmfs/bin/mmumount /dev/db2log
    /usr/lpp/mmfs/bin/mmchfs /dev/db2log -T /db2/<DBSID>/log_dir

11. Check if the GPFS are available at the new location using the following command:
    /usr/lpp/mmfs/bin/mmlsfs all -T

    The following is an example output of this command:

    File system attributes for /dev/db2data1:
    flag value          description
    ---- -------------- ---------------------------------
    -T /db2/DSJ/sapdata1 Default mount point
12. Adapt the Db2 autostorage paths using the `db2relocatedb` command as follows:

   1. Log on as user `db2<dbsid>` and create the `db2relocatedb` configuration file `relocASpath.cfg` that contains the following lines:

      ```
      DB_NAME=<DBSID>
      DB_PATH=/db2/<DBSID>
      INSTANCE=db2<dbsid>
      STORAGE_PATH=/db2fs/db2data1,/db2/<DBSID>/sapdata1
      STORAGE_PATH=/db2fs/db2data2,/db2/<DBSID>/sapdata2
      STORAGE_PATH=/db2fs/db2tmp1,/db2/<DBSID>/saptmp1
      STORAGE_PATH=/db2fs/db2tmp2,/db2/<DBSID>/saptmp2
      ```

   2. Run the `db2relocatedb` command as follows:

      ```
      db2relocatedb -f relocASpath.cfg
      ```

      The following example shows the message that should appear after you issued this command:

      ```
      Files and control structures were changed successfully.
      DBT1000I The tool completed successfully.
      ```

     **Note**

     The `db2relocatedb` command allows you to change the storage paths, but not the number of defined storage paths. Therefore, the number of original and changed storage paths must be the same.

13. You can now start the Db2 database and the SAP system or proceed with the pureScale conversion as described in [Converting the Db2 11.1 AESE Instance to a Db2 11.1 pureScale Instance](page 47).

---

**Result**

The database of your SAP system is now located on GPFS but not running on Db2 pureScale.
4.2 Installing an SAP System on GPFS File Systems

This section describes how you install a new SAP system on GPFS. The procedure is supported by the SAP software provisioning manager (SWPM), also referred to as SAP installer. Only some specific values must be entered in the dialog phase while using the installer. These guidelines apply for the following installation options:

- Installation of a new SAP NetWeaver system
- Homogeneous system copy for a target system using database means (backup/restore)
- Homogeneous or heterogeneous system copy using R3load

Prerequisites

Before you install a new SAP system on Db2 pureScale, the database of the SAP system must be located on a General Parallel File System (GPFS).
Recommendation

We recommend that you install a distributed system or SAP HA installation where the SAP application servers are installed on different hosts than the Db2 members and cluster caching facilities (CFs). You can install a standard system but you cannot install a switchover cluster infrastructure for the enqueue replication server instance (ERS instance) for the ASCS instance. Therefore, this setup is only recommended for test systems.

Procedure

1. You must first perform a standard SAP system installation on a Db2 11.1 AESE instance using the SAP installer. During the installation make sure that the existing Db2 software is used for the creation of the database instance and that the required GPFS file systems are created.

For more information about how to do a standard SAP system installation, see your relevant installation guide at https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/c8ed609927fa4e45988200b153ac63d1.html.

Make sure that you use a Db2 11.1 client DVD that matches the Db2 11.1 RDBMS DVD used during the Db2 software installation.

When you run the SAP installer to create the SAP database instance, pay attention to the following:

○ On the Parameter Mode Default Settings screen, choose the Custom option as parameter mode.

○ Check that the user IDs and group IDs used are also available on the other hosts in the planned Db2 pureScale cluster.

○ On the IBM Db2 pureScale screen, select the Install IBM Db2 pureScale checkbox.

○ Do not select to install IBM Tivoli System Automation for Multiplatforms (SA MP) (if this screen appears at all).
On the **IBM General Parallel File System** screen, specify the instance-shared device and the GPFS file system as in the following example:

<table>
<thead>
<tr>
<th>Defined</th>
<th>Name</th>
<th>Instance-Specific Device</th>
<th>Mount Point</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mksa Instance-shared</td>
<td></td>
</tr>
</tbody>
</table>

**Specifying the General Parallel File System (GPFS) During SAP System Installation**

For reasons of consistency, we recommend that you use the same file system names as shown in the above figure. Also make sure that you use the mount points as shown in the figure. In the **Disk** column, enter the path to the disks according to your system setup.
As a result, the installer performs a standard SAP system installation on a Db2 11.1 AESE instance as shown in the following figure. All database-relevant file systems are already located on the GPFS:

System Status After Installation of the SAP System on a Db2 Instance

2. Then proceed as described in Converting the Db2 11.1 AESE Instance to a Db2 11.1 pureScale Instance [page 47].
5 Converting the Db2 11.1 AESE Instance to a Db2 11.1 pureScale Instance

The following sections describe how you convert your instance from Db2 11.1 AESE to Db2 pureScale using the SAP Software Provisioning Manager (SWPM; in the following also referred to as SAP installer). This is the next step after you have installed the database on GPFS file systems or after you have copied a database to a GPFS file system.

Make sure you meet the following requirements:

**Space Prerequisites**

- Before you start the installer, make sure that the `/sapmnt` directory is available on all participating hosts. The installer modifies the Db2 client configuration that is located in the SAP global directory `/sapmnt/<SAPSID>/global/db6`.
- You need at least 500 MB of free space for the remote installation directory that the installer prompts you to specify during the dialog phase.

**Latest Kernel Patch**

Apply the latest available kernel patch for your SAP system before you continue. For more information about how to download and install a kernel patch, see SAP Note 19466.

**Related Information**

- Verifying Your License for Db2 and Tivoli System Automation [page 48]
- Setting the Required Configuration Parameters [page 49]
- Converting the Instance to Db2 pureScale Using SWPM [page 50]
- Adapting the JDBC URL (AS Java Only) [page 52]
- Testing the Db2 pureScale Installation [page 53]
- Validating the License [page 54]
- Adding Additional Members and Cluster Caching Facilities (CFs) [page 54]
- Checking the Configuration Settings [page 55]
5.1 Verifying Your License for Db2 and Tivoli System Automation

Context

To find out if you have a valid license for Db2 and Tivoli System Automation, perform the following steps:

Note

If you bought your Db2 license from SAP (OEM customers), install the Db2 license as described in SAP Note 81677.

Procedure

1. Log on to the database server as user `db2<dbsid>` and execute the following command:
   ```
   db2licm -l
   ```
   The output should be similar to the following example:
   - Product name: "DB2 Advanced Enterprise Server Edition"
   - License type: "CPU Option"
   - Expiry date: "Permanent"
   - Product identifier: "db2aese"
   - Version information: "11.1"
   - Enforcement policy: "Soft Stop"

2. Log on to the database server as user `user root` and execute the command:
   ```
   samlicm -s
   ```
   The output should be similar to the following example:
   - db6c1lp04: db2ps1 2> samlicm -s
   - Product: IBM Tivoli System Automation for Multiplatforms 4.1.0.0
   - Creation date: Fri Aug 16 00:00:01 CEST 2013
   - Expiration date: Thu Dec 31 00:00:01 CET 2037

3. Execute the following commands:
   ```
   samlicm -t; echo $?
   samlicm -p; echo $?
   ```
A value of “0” means you have a valid license, any other value means that your license is either expired or it’s a “Try & Buy” license (trial license). Therefore, make sure the output of the above commands does not equal “1” or “2”.

5.2 Setting the Required Configuration Parameters

Context

Db2 pureScale does not support the health monitor. Therefore, you have to set the database configuration parameter `HEALTH_MON` to OFF. Furthermore, during the conversion to pureScale, the database manager configuration parameter `PAGE_AGE_TRGT_MCR` needs to be set to a value of 240 or smaller. During the conversion to pureScale, the parameter `PAGE_AGE_TRGT_GRC` will be set to 240 by default. Its value must be greater or at least equal the value of `PAGE_AGE_TRGT_MCR`.

Procedure

1. Log on to the database server as user `db2<dbsid>`.
2. Update the database manager configuration using the following command:
   
   `db2 "update dbm cfg using HEALTH_MON OFF"
   
3. Update the database configuration using the following command:
   
   `db2 "update db cfg for <DBSID> using PAGE_AGE_TRGT_MCR 240"
   
4. To activate the changes, stop and restart the database manager.
5. To check that the parameters are set correctly, enter the following commands:
   
   `db2 "get dbm cfg" | grep HEALTH_MON`

   `db2 "get db cfg for <DBSID>" | grep PAGE_AGE_TRGT_MCR`
5.3 Converting the Instance to Db2 pureScale Using SWPM

Context

This section describes how you convert your instance from Db2 11.1 AESE to DB2 pureScale using the SAP Software Provisioning Manager (SWPM), also referred to as SAP installer.

Procedure

1. Stop the SAP system and the database server.
2. Log on to the database server as user root.
3. For the following steps of this conversion task, download the latest available SWPM from SAP Support Portal at https://support.sap.com/en/tools/software-logistics-tools.html (scroll down to System Provisioning) and copy it to your database server.
4. Start the installer as described in the relevant installation guide for your SAP system release that you can find at https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/c8ed609927fa4e45988200b153ac63d1.html.
5. For SAP NetWeaver 7.0 including enhancement packages:


   For SAP NetWeaver 7.1 and higher:

   On the Welcome screen, choose Generic Installation Options ⇒ IBM Db2 for Linux, UNIX, and Windows ⇒ Database Tools ⇒ Db2 pureScale Feature – Topology Management.

6. Choose Next and follow the instructions on the installer screens.
7. In the Converting the Instance dialog, add a member netname to the existing host and a CF with the netname on a different host. Also specify the instance-shared directory and the SA MP tiebreaker device.
8. On the Changing the Topology screen, don’t do anything, but leave it as it is.

9. On the Parameter Summary screen, you can check the specified parameters and – if required – change them by selecting the parameters and choosing the Revise button.

10. To start the installation, choose Next on the Parameter Summary screen.

11. After the installation has finished successfully, log on to the Db2 pureScale member as user db2<dbsid> and start the Db2 pureScale cluster using the db2start command.

Results

After the conversion of the Db2 11.1 instance to Db2 pureScale, you have a functioning Db2 pureScale cluster that looks as follows:
5.4 Adapting the JDBC URL (AS Java Only)

If your SAP system is a Java only system or contains an AS Java (for example, an SAP dual stack system), you have to adapt the JDBC URL that is used to establish a connection to the database.

**Note**
You need to perform the following procedure only on one AS Java instance.

**Procedure**

1. Log on to the AS Java as user `<sapsid>adm`.

**Note**
Make sure that your X Window settings allow this user to open a new X Window.
2. Start the AS Java configuration tool using the following command:
   
   ```bash
   cd /usr/sap/<SAPSID>/J(C)<instance-no>/j2ee/configtool ./configtool.sh
   ```

3. Confirm the dialog box *Do you want to use the default DB settings?* with *Yes.*

4. In the navigation frame of the configuration tool, choose *secure store.*

5. In the *Secure Store Data* group box, select the *jdbc/pool/<DBSID>/Url.*

6. In the *Value* field, change the value for this key as follows:
   
   ```
   jdbc:<DBSID>://
   <DBSID>:dsdriverConfigFile=<path_to_db2dsdriver.cfg>;<existing_jcc_properties>;
   ```

   **Example**

   The existing JDBC URL looks as follows:

   ```
   jdbc:db2://saphost1:5912/DSJ:deferPrepares=0;
   ```

   You change this JDBC URL to the following:

   ```
   db2dsdriver.cfg;deferPrepares=0;
   ```

7. From the menu, choose *File → Apply.*

8. Exit the configuration tool by choosing *File → Exit* from the menu.
   
   The changed JDBC URL is used upon the next restart of the AS Java.

### 5.5 Testing the Db2 pureScale Installation

**Procedure**

1. If the Db2 pureScale cluster has not started yet, log on to the database server as user *db2<dsid>.*

2. Start the Db2 pureScale cluster using the following command:
   
   ```bash
   db2start
   ```

3. Log on to an SAP application server as user *<sapsid>adm.*

4. Test the database connection with the following command:
   
   ```bash
   R3trans -d
   ```

   This should result in the following output:

   ```
   ...
   R3trans finished (0000).
   ```

   If `R3trans` finishes with a return code other than *0000*, review the *trans.log* file that was written by `R3trans` and correct the problem.

5. Start the SAP system.

6. Log on to the SAP system and perform some basic tasks.

7. Check the Db2 diagnostic log `db2diag.log` at `/db2/<DBSID>/db2dump/db2diag.log` for errors.
5.6  Validating the License

After the initial conversion to Db2 pureScale or after adding members or CFs, you have to check whether the appropriate permanent licenses are installed on all participating hosts of the cluster.

For every new host that is part of the pureScale cluster, perform the license check as described earlier in Verifying Your License for Db2 and Tivoli System Automation [page 48].

5.7  Adding Additional Members and Cluster Caching Facilities (CFs)

To add members and a secondary CF to your Db2 pureScale cluster, follow the procedure described in Converting the Instance to Db2 pureScale Using SWPM [page 50] and make the relevant changes on the Changing the Topology screen of the SAP installer.

**i Note**

Changes to the Db2 pureScale topology, such as adding and dropping a CF, are offline actions. Before you perform such an operation, stop the SAP system and the database. In general, we recommend to only add one member or CF at a time to allow for an easier error analysis in the case of a failure.
The following figure shows what your system looks like after you have, for example, created a secondary CF on host 
host db2dsf3 and after you have added an additional member on host db2dsf4:

5.8 Checking the Configuration Settings

Compare the settings for the database and database manager configuration parameters with the values suggested in SAP Note 1851832. This SAP Note always contains the most up-to-date recommendations for these parameters.
6 Homogeneous System Copy Into an Existing Db2 pureScale Cluster

You can combine a new SAP system installation with a homogeneous system copy, that is, with a restore of a source database from an offline backup into an already existing Db2 pureScale cluster.

Prerequisites

To restore the database from a non-pureScale system to a Db2 pureScale instance, the following preconditions and restrictions apply:

- You must check the feasibility to restore the source database to the Db2 pureScale cluster with the `db2checkSD` command.
- The SAP installer and the restore must be executed on member 0.
- You can only restore an offline backup; a rollforward is not possible.
- The structure of the database (for example, the storage paths) must match the target layout.
- The common backup and restore restrictions like operating system boundaries and Db2 releases also apply.

Context

A system conversion to Db2 pureScale typically is an iterative process:

1. You usually do a test conversion first by installing a new system or by converting a copy of the production system.
2. On this Db2 pureScale cluster, you run several infrastructure tests to understand the behavior of Db2 pureScale and to harden the environment. This test system can be installed as described earlier in this guide in Adding the Db2 pureScale Feature and Creating GPFS File Systems [page 29] and Converting the Db2 11.1 AESE Instance to a Db2 11.1 pureScale Instance [page 47].
3. When you’ve reached the desired resiliency and throughput targets, you perform the final conversion. For the final conversion of the production system, it’s helpful that you can retain the installed (and verified) Db2 pureScale cluster and only have to change the database with a copy of the source database. To do so, the SAP installer provides the option “System Copy”. With this option, you can restore a source database from an offline backup into an already existing Db2 pureScale cluster.

This procedure can also be part of the test process as you should validate the procedure – especially if you use the redirected restore functionality.

ℹ️ Note

Although the system copy option also allows you to unload and load the database using `R3load`, note, however, that this has not been tested and is not supported for a copy into a Db2 pureScale target. You must only use the homogeneous system copy as database copy method.
For information about the Db2 backup and restore process, see the following documents in the IBM Db2 11.1 Knowledge Center:

- RESTORE DATABASE command
- Backup and restore operations between different operating systems and hardware platforms
- Performing a redirected restore operation
- Restore from Db2 Enterprise Server Edition to Db2 pureScale instance

**Procedure**

1. Check the source database by running the `db2checkSD` command without the option to check the GPFS file systems as described in Running the db2checkSD Utility [page 31].

2. During the conversion of a database to pureScale, the parameter `PAGE_AGE_TRGT_GRC` is set to 240 by default. Since its value must be greater or at least equal the value of `PAGE_AGE_TRGT_MCR`, make sure the value of parameter `PAGE_AGE_TRGT_MCR` is not higher than 240.

   ```
   db2 "get db cfg for <DBSID>" | grep PAGE_AGE_TRGT_MCR
   ```

3. Manually check if the location for the Db2 log directory and the storage paths comply with the GPFS setup on the target cluster:

   ```
   db2 "get db cfg for <DBSID>" | grep "Path to log files"
   db2pd -d BWP -storagepath
   ```

4. If the location of the storage path or the log directory don’t match the target layout, you can either adapt the layout as described in Rebalancing Tablespaces to the New File System [page 37] or use the redirected restore to change the layout during the restore operation.

5. If the location of the storage path or the log directory matches the target layout, perform an offline backup of the source database.

6. Stop the SAP system that is connected to the Db2 pureScale cluster.

7. For the next steps of this conversion task, download the latest available SAP installer (“Software Provisioning Manager”) from SAP Support Portal at [https://support.sap.com/en/tools/software-logistics-tools.html](https://support.sap.com/en/tools/software-logistics-tools.html) (scroll down to System Provisioning) and copy it to your database server.

8. Log on to the database server hosting member 0 as user `root`.

9. Start the installer as described in the relevant System Copy Guide for your SAP system.

   - For SAP NetWeaver 7.0 including enhancement packages:

   - For SAP NetWeaver 7.1 and higher:
     - On the Welcome screen, choose [Your SAP NetWeaver Release] > IBM Db2 for Linux, UNIX, and Windows > IBM Db2 for Linux, UNIX, and Windows > System Copy > Target System > Distributed System > [System_Variant] > Refresh or Move Database Instance
Execute the dialog phase as described in the system copy guide and make sure to apply the following:

- Use the Custom Parameter mode.
- Use the copy method Homogeneous System Copy (Database Copy Method).
- When asked to create IBM GPFS during the installation procedure, disable the checkbox as the GPFS file systems already exist. Also confirm the message to create the GPFS file systems.

10. Perform the restore operation when asked to do so as user db2<dbsid> on the server hosting the member 0.

11. After the restore operation completes, run the db2checkSD command to convert the database to a Db2 pureScale database:

   ```
   <inst_dir>/bin/db2checkSD <DBSID> -l <name of logfile>
   ```

   The output of the `db2checkSD` utility should look like this:

   ```
   DBT5000I The db2checkSD utility completed successfully. The specified database can be used in a Db2 pureScale environment. The output log file is named "/tmp/db2checkSD.log".
   ```

   **Note**

   The `db2checkSD` command must be executed to check the GPFS file system as well. Therefore, do not specify the option `-nogpfs`.

12. Continue with the system copy using the SAP installer.

13. After the system copy has completed, check the database and verify that all relevant files reside on shared disks.

14. Optionally, perform a full database backup.
7 Implementation of SAP-Specific Enhancements

The following sections provide information about SAP-specific enhancements that you have to implement after an upgrade to Db2 pureScale or a new installation of an SAP system on Db2 pureScale:

- Adapting the Db2 Client Connectivity Setup [page 59]
- Partitioning of the Update Tables (AS ABAP Only) [page 65]
- Implementing SAP High Availability [page 69]
- Using the Db2 pureScale-Specific Monitoring Enhancements in the DBA Cockpit [page 81]

7.1 Adapting the Db2 Client Connectivity Setup

In a non-pureScale environment, all SAP application servers connect to one database server. In a Db2 pureScale environment with multiple Db2 members on different hosts, additional questions arise, such as:

- To which Db2 member should an SAP application server connect initially (first connect)?
- How should an SAP application server distribute its workload to the different Db2 members?
- What should happen if a Db2 member fails?

As of SAP NetWeaver 7.0 SR3, the AS ABAP uses the IBM Data Server Driver for ODBC and CLI (also known as CLI driver) whereas the AS Java uses the IBM Data Server Driver for JDBC and SQLJ (also known as JDBC driver) to connect to the database. Both clients are installed once in the /sapmnt/<SAPSID>/global/db6 directory. This /sapmnt/<SAPSID>/global directory is shared between all SAP application servers.

In a regular SAP system installation without Db2 pureScale, the db2cli.ini file is used for the configuration of the client connectivity. The installer creates the db2cli.ini file during the SAP system installation. It contains the necessary connection information as shown in the following example:

```plaintext
; Comment lines start with a semi-colon.
[DSJ]  Database=DSJ
  Protocol=tcpipl   Hostname=db2dsf1
  Servicename=5912  [COMMON]
  Diagpath=/usr/sap/DSJ/SYS/global/db6/db2dump
```

This client configuration is sufficient in an environment outside Db2 pureScale and in a Db2 pureScale environment with only one member.

In an SAP system with Db2 pureScale, you configure the CLI driver using the file db2dsdriver.cfg. If you use the SAP installer, it creates a default db2dsdriver.cfg file.

The db2cli.ini file is changed by the SAP installer and the database connection information is removed from this file. Other information like the Db2 diagpath or trace information is still stored in this file. Therefore, do not delete this file manually.

Db2 pureScale allows for workload balancing on connection-level and transaction-level. Since this workload balancing setup is not beneficial for SAP workloads, the SAP environment only allows for workload balancing...
on application level. Therefore, the only SAP-supported connectivity setup is client affinity, which is implemented either as round-robin affinity or as user-defined client affinity. The following sections describe the resulting default client connectivity behavior in a Db2 pureScale environment.

**Note**

Make sure that the `db2cli.ini` file is **not** deleted and that the correct client affinity setup is implemented in the `db2dsdriver.cfg` file.

Related Information

- Using the Round-Robin Connectivity Setup [page 60]
- Using a User-Defined Connectivity Setup [page 62]
- Adapting the Db2 Client Configuration After Installation or Deinstallation of SAP Application Servers [page 65]

### 7.1.1 Using the Round-Robin Connectivity Setup

During the upgrade to Db2 pureScale or during the installation of additional Db2 members, the SAP installation tool modifies the client configuration as follows:

- If necessary, comments out the connection information in the `db2cli.ini` configuration file
- If it does not exist, creates the `db2dsdriver.cfg` file
- Creates or updates a list with all Db2 members together with the respective connection information (that is, the host name and the port number) in the `db2dsdriver.cfg` file
- Creates or updates a list with all SAP application servers in the `db2dsdriver.cfg` file

As a result, the SAP applications servers connect in a round-robin way to the available Db2 members.

For example, an SAP system consists of six SAP application servers (`sapdsf1`, `...`, `sapdsf6`) and three Db2 members (`db2dsf1`, `...`, `db2dsf3`). During startup of the SAP application servers, all connections from `sapdsf1` are made to `db2dsf1`, all connections from `sapdsf2` to `db2dsf2`, all connections from `sapdsf3` to `db2dsf3`, and all connections from `sapdsf4` to `db2dsf1` (beginning again with the first Db2 member in the list), and so on. All further connects (for example, secondary connections or during an SAP work process restart) are made to the same Db2 member.

If a Db2 member fails, new connections are made again in a round-robin like fashion. If `db2dsf1` fails, `sapdsf1` and `sapdsf4` connect to `db2dsf2` and check regularly if `db2dsf1` is online again. As soon as `db2dsf1` is back online, they redirect their connections at the next transaction boundary back to `db2dsf1`. If `db2dsf1` is not online and `db2dsf2` also fails, all workload is directed to the third member `db2dsf3`. The SAP application servers `sapdsf1` and `sapdsf4` now check regularly whether either `db2dsf1` or `db2dsf2` has come back online. If possible, the SAP application servers `sapdsf1` and `sapdsf4` connect directly to their home host `db2dsf1`. If `db2dsf1` is not available but `db2dsf2` comes back online, they connect to `db2dsf2` and check regularly if `db2dsf1` comes back online. Once the first member `db2dsf1` is available, the SAP application servers `sapdsf1` and `sapdsf4` finally connect to this member.
The following table shows this connection scenario. The first fallback indicates the preferred Db2 member for the fallback, and the second fallback indicates the Db2 member to which an SAP application server falls back if the first fallback is not available.

<table>
<thead>
<tr>
<th>SAP Application Server</th>
<th>Primary Member</th>
<th>1st Failover</th>
<th>2nd Failover</th>
<th>1st Fallback</th>
<th>2nd Fallback</th>
</tr>
</thead>
<tbody>
<tr>
<td>sap_as_1</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
</tr>
<tr>
<td>sap_as_2</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
</tr>
<tr>
<td>sap_as_3</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
</tr>
<tr>
<td>sap_as_4</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
</tr>
<tr>
<td>sap_as_5</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
</tr>
<tr>
<td>sap_as_6</td>
<td>member_3</td>
<td>member_1</td>
<td>member_2</td>
<td>member_3</td>
<td>member_1</td>
</tr>
</tbody>
</table>

The following is an example of a db2dsdriver.cfg file that represents the scenario described in the above table:

```xml
<configuration>
  <dsncollection>
    <dsn alias="DSJ" name="DSJ" host="db2dsf1.wdf.sap.corp" port="5912" />
  </dsncollection>
  <databases>
    <database name="DSJ" host="db2dsf1.wdf.sap.corp" port="5912">
      <acr>
        <parameter name="enableAcr" value="true"/>
        <parameter name="enableSeamlessAcr" value="true"/>
        <parameter name="affinityFailbackInterval" value="300"/>
        <parameter name="maxAcrRetries" value="1"/>
        <parameter name="tcpipConnectTimeout" value="20"/>
        <alternateserverlist>
          <server name="server_1" hostname="db2dsf1.wdf.sap.corp" port="5912"/>
          <server name="server_2" hostname="db2dsf2.wdf.sap.corp" port="5912"/>
          <server name="server_3" hostname="db2dsf3.wdf.sap.corp" port="5912"/>
        </alternateserverlist>
        <clientaffinityroundrobin>
          <client name="sap_as_1" hostname="sapdsf1.wdf.sap.corp"/>
          <client name="sap_as_2" hostname="sapdsf2.wdf.sap.corp"/>
          <client name="sap_as_3" hostname="sapdsf3.wdf.sap.corp"/>
          <client name="sap_as_4" hostname="sapdsf4.wdf.sap.corp"/>
          <client name="sap_as_5" hostname="sapdsf5.wdf.sap.corp"/>
        </clientaffinityroundrobin>
      </acr>
    </database>
  </databases>
  <parameters>
    <parameter name="CommProtocol" value="TCP/IP"/>
  </parameters>
</configuration>
```

The relevant configuration is made in the automatic client reroute (ACR) section of the db2dsdriver.cfg file.
We recommend that you set the following parameters manually as they are not set automatically by the SAP installer:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>affinityFailbackInterval</td>
<td>Number of seconds to wait after the first transaction boundary to fail back to the primary server.</td>
<td>300</td>
</tr>
<tr>
<td>maxAcrRetries</td>
<td>Maximum number of connection attempts to each server in the list of alternate servers for automatic client reroute (ACR).</td>
<td>1</td>
</tr>
<tr>
<td>acrRetryInterval</td>
<td>Number of seconds to wait between retries.</td>
<td>0</td>
</tr>
<tr>
<td>tcpipConnectTimeout</td>
<td>Number of seconds to wait for a reply when an application tries to establish a connection to a server before the attempt is terminated.</td>
<td>20</td>
</tr>
</tbody>
</table>

The `db2dsdriver.cfg` file also contains a list of all Db2 members in `<alternateserverlist>` and a list of all SAP application servers in `<clientaffinityroundrobin>`.

For more information about the elements in the automatic client reroute (ACR) section of the `db2dsdriver.cfg` configuration file, see the following sections in the IBM Knowledge Center for Db2 10.5:

<table>
<thead>
<tr>
<th>Topic</th>
<th>URL</th>
</tr>
</thead>
</table>

### 7.1.2 Using a User-Defined Connectivity Setup

The round-robin connectivity setup provides a good distribution of the database workload to the Db2 members. For the scalability of the Db2 pureScale cluster, it’s important that the Db2 members work as much as possible on their own objects. If multiple Db2 members access a database object at the same time, the access to these database objects must be serialized with the help of locks. To avoid contention, it’s important
that the workload is distributed to the Db2 members in such a way that locking is minimized. In an SAP Db2 pureScale environment, you can avoid locking as much as possible by doing the following:

1. Distribute the SAP workload to the different SAP application servers by using logon groups.

   **Example**

   An SAP system with six applications servers is mostly used for HR- and CRM-related workload. To evenly distribute the workload, you create logon groups so that all HR-related workload is directed to SAP application servers sapdsf1 to sapdsf3 and all CRM-related workload is directed to SAP application servers sapdsf4 to sapdsf6.

   The definition and creation of SAP logon groups is not described in this document. For more information, see [Creating a New Logon Group](https://help.sap.com/viewer/0c333adb55cd4dbf8e92a5175703224c/7.4.18/en-US/4a954d1817335ff9e10000000a421937.html) on SAP Help Portal for your release, for example, for SAP NetWeaver 7.4.

2. For every SAP application server, manually define preferred Db2 members (which we call user-defined connectivity setup).

   **Example of a User-Defined Connectivity Setup**

   A Db2 pureScale cluster consists of two members. If you continue the example from above, you can define that the SAP application servers sapdsf1 to sapdsf3 primarily connect to the first Db2 member and the SAP application servers sapdsf4 to sapdsf6 primarily connect to the second Db2 member. It’s now likely that both Db2 members work on different database objects most of the time, which avoids locking and improves scalability.

   The following is an example of the specification of such a setup in the db2dsdriver.cfg file:

```
<configuration>
  <dscollection>
    <dsn alias="DSJ" name="DSJ" host="db2dsf1.wdf.sap.corp" port="5912" />
  </dscollection>
  <databases>
    <database name="DSJ" host="db2dsf1.wdf.sap.corp" port="5912">
      <acr>
        <parameter name="enableAcr" value="true" />
        <parameter name="enableSeamlessAcr" value="true" />
        <parameter name="affinityFailbackInterval" value="300" />
        <parameter name="maxAcrRetries" value="1"/>
        <parameter name="acrRetryInterval" value="0"/>
        <parameter name="tcpipConnectTimeout" value="20"/>
      </acr>
      <alternateserverlist>
        <server name="member_1" hostname="db2dsf1.wdf.sap.corp" port="5912" />
        <server name="member_2" hostname="db2dsf2.wdf.sap.corp" port="5912" />
      </alternateserverlist>
      <affinitylist>
        <list name="as_group_1" serverorder="member_1,member_2" />
        <list name="as_group_2" serverorder="member_2,member_1" />
      </affinitylist>
      <clientaffinitydefined>
        <client name="sap_as_1" hostname="sapdsf1.wdf.sap.corp"
          listname="as_group_1" />
        <client name="sap_as_2" hostname="sapdsf2.wdf.sap.corp"
          listname="as_group_1" />
        <client name="sap_as_3" hostname="sapdsf3.wdf.sap.corp"
          listname="as_group_1" />
      </clientaffinitydefined>
  </database>
</databases>
```
We recommend that you set the following parameters manually as they are not set automatically by the SAP installer:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>affinityFailbackInterval</td>
<td>Number of seconds to wait after the first transaction boundary to fail back to the primary server.</td>
<td>300</td>
</tr>
<tr>
<td>maxAcrRetries</td>
<td>Maximum number of connection attempts to each server in the list of alternate servers for automatic client re-route (ACR).</td>
<td>1</td>
</tr>
<tr>
<td>acrRetryInterval</td>
<td>Number of seconds to wait between retries.</td>
<td>0</td>
</tr>
<tr>
<td>tcpipConnectTimeout</td>
<td>Number of seconds to wait for a reply when an application tries to establish a connection to a server before the attempt is terminated.</td>
<td>20</td>
</tr>
</tbody>
</table>

The `<alternateserverlist>` contains all Db2 members again with their host name and communication port. Several ordered lists of these Db2 members are defined in the `<affinitylist>`. The order of the members in these lists defines the failover strategy. One of these lists is afterwards assigned to every SAP application server in the `<clientaffinitydefined>` section.

For example, if member db2dsf1 fails, all affected SAP application servers follow the order as specified in affinity list as_group_1 and fail over to member db2dsf2. If member db2dsf2 fails, all affected SAP application servers follow the order as specified in affinity list as_group_2 and fail over to member db2dsf1.

The following table shows this connectivity setup:

<table>
<thead>
<tr>
<th>SAP Application Server</th>
<th>List</th>
<th>Primary Member</th>
<th>1st Failover</th>
</tr>
</thead>
<tbody>
<tr>
<td>sap_as_1</td>
<td>as_group_1</td>
<td>member_1</td>
<td>member_2</td>
</tr>
<tr>
<td>sap_as_2</td>
<td>as_group_1</td>
<td>member_1</td>
<td>member_2</td>
</tr>
</tbody>
</table>
This user-defined connectivity setup allows for a detailed assignment of SAP application servers to the members in a Db2 pureScale cluster. Together with SAP logon groups of the AS ABAP, you can effectively minimize locking situations in the Db2 pureScale cluster.

7.1.3 Adapting the Db2 Client Configuration After Installation or Deinstallation of SAP Application Servers

As described in Using the Round-Robin Connectivity Setup [page 60], the SAP installation tool automatically adapts the db2dsdriver.cfg file if you install additional or drop existing members of the Db2 pureScale cluster.

However, if you install additional or drop existing SAP application servers using a current version of the software provisioning manager, this file is adapted automatically.

After the installation, check the db2dsdriver.cfg file and make further adaptations as necessary, for example, in a user-defined connectivity setup.

7.2 Partitioning the Update Tables (AS ABAP Only)

Context

A central component of AS ABAP is the update management. To perform updates to the database, the SAP application servers use special work processes of type UPD and UP2. Database updates are deferred until the end of an SAP transaction. During an SAP transaction, update requests are stored in the tables VBHDR, VBMOD, and VBDATA.

These tables are also called update tables. In highly parallel environments where many applications servers read from and write to these tables, the overall performance of the system can decrease due to locking issues. To overcome these problems, we recommend that you partition the update tables based on the SAP application server name if there is a considerable amount of update task activity in your system. In this way, each Db2 member works on its own set of table partitions, and contention due to database locking cannot occur.
Prerequisites

1. Log on to the SAP system.
2. Make sure that your SAP system includes all the Support Packages or corrections mentioned in SAP Note 1379362 and SAP Note 1594952.
3. You have installed the latest version of the DB6Conv report (see SAP Note 1513862) on your system.
4. Call SAP transaction SM13 and ensure that there are no open updates in the SAP system.

Procedure

The following procedures are based on the assumption that the system consists of the SAP application servers sapdsf1 and sapdsf2. Both servers are configured for update processing.

Configuring the SAP System

1. For performance and high-availability reasons, we strongly recommend that you set up local update processing, that is, every SAP application server can process updates. To do so, configure UPD and UPD2 work processes on each application server.
2. If local update processing is configured, load balancing of update tasks between the application servers takes place by default. To avoid lock situations, switch off this update task dispatching by setting the following SAP profile parameters on all SAP application servers:
   - rdisp/vb_dispatching = 0
   - rdisp/vbname = $(rdisp/myname)
3. The VBKEY field serves as partitioning key for all three update tables. To switch the VBKEY to a format that allows table partitioning based on the host name, specify the following SAP profile parameters for all application servers:
   - dynp/luw_id_format = 2
   - rdisp/vb_key_comp = HOST/SYNR/WPNR/DATETIME/STMP
4. To represent the host name in the VBKEY field, you can choose between the first 8 characters of the textual representation of the host name or the IPv4 address of the host. We recommend that you use the host name here. In this way, you can, for example, avoid problems with IPv6 addresses. To do so, specify the following SAP profile parameter for all SAP application servers:
   - rdisp/vb_key_use_hostname = 1
5. For reasons of SAP system high availability, it can be useful to specify a virtual host name and a virtual IP address for each SAP application server. These virtual addresses decouple the SAP application server (the running ABAP or Java kernel) from the underlying host. In this case, an application server can be moved from one host to another host if necessary, for example, due to a system outage. The following profile parameters specify the virtual host name:
   - SAPLOCALHOST = <virtual host name>
   - SAPLOCALHOSTFULL = <full qualified virtual host name>
   The SAP installation already sets these profile parameters if called with the installation option SAPINST_USE_HOSTNAME. For more information, see SAP Notes 962955 and 1564275.
   In such an environment, you must use the virtual host names for table partitioning of the update tables. In this way, after a failover of one SAP application server to another host, this server can still access its own update records in the update tables (in its own partition). To use the virtual IP address or virtual host name.
as specified in `SAPLOCALHOST` in the update key, set the following SAP profile parameter on all SAP application servers:

```
rdisp/vb_key_use_saplocalhost = 1
```

**Note**

You can set all profile parameters except for `rdisp/vbname` once in the `DEFAULT.PFL` profile (if it exists in your SAP release) so that they are valid for each application server.

6. Restart your SAP system so that all changes take effect.

**Partitioning the Update Tables**

The update tables are created unpartitioned during the SAP system installation. To perform the table partitioning, use the `DB6CONV` report together with the online table move UDF. Before starting the `DB6CONV` conversion, enter the storage parameters for the table partitioning as described in the following procedure:

1. Start transaction SE14, enter `VBHDR` as table name, and choose the **Edit** button.
2. Choose the **Storage Parameters** button and then the **For New Creation** button.
3. In the dialog window, choose the **Current Database Parameters** radio button.
4. To insert new `OPTIONS` lines for the partition clause, place the cursor on an `OPTIONS` line and use `SHIFT F5` (or the relevant button).
5. Enter the partitioning clause as shown in the following example:

   ![Storage Parameters for Table Partitioning](image-url)
In the partitioning clause, specify the following:

- Field `VBKEY` as partitioning key
- One partition for every SAP application server. We recommend that you choose `PART_<hostname>` as partition name.
- The low value and high value (as defined after `STARTING` and `ENDING`) for each partition must be a string literal with 32 characters. The first eight characters are determined by the respective application server host name. The low value is then filled with “0”s (the number zero), the high value is filled with “Z”. If the host name of the application server is less than 8 characters, it needs to be right-padded with “0” or “Z”.

6. Write down the regular tablespaces and index tablespaces in which the tables are located, for example, `<SID>#PROTD, <SID>#PROTI` (you must remember them in step 9).

7. Save the storage parameters.

8. In transaction SA38, start the `DB6CONV` report.

9. Enter the tablespaces from step 6 and perform a table move.

10. Perform the same steps for tables `VBMOD` and `VBDATA`.

11. To check the update functionality of a specific SAP application server, proceed as follows:
    1. Log on to the application server and call transaction SM12.
    2. From the menu, choose `Extras ➤ Diagnosis in Update`.

   ![DB6CONV 6.39 - New Conversion](image)
The log file that is displayed should contain no errors.

→ Recommendation
We strongly recommend that you perform this test on all SAP application servers.

More Information

- SAP Note 1379362: DB6: Support for partitioned tables in the ABAP DDIC
- SAP Note 1513862: DB6: Table conversion using DB6CONV version 6 or higher
- SAP Note 191191: Partitioning update tables
- SAP Note 962955: Use of virtual TCP/IP host names
- SAP Note 1282975: Use of virtual TCP/IP host names in Windows
- Update Management on SAP Help Portal for your SAP NetWeaver version, for example, at https://help.sap.com/viewer/10970dcb6c531014af68b7c1d32e9eab/7.0.34/en-US/e5de870535cd11d3acb00000e83539c3.html

7.3 Implementing SAP High Availability

Db2 11.1 with the pureScale feature provides high availability for the SAP NetWeaver database. To ensure that the whole SAP system is highly available, you should apply high availability concepts for the central services and primary application servers as well. Unlike some implementations where the database and the SAP central services are running within the same cluster manager, this is not recommended with Db2 pureScale. You should install the SAP central services together with a cluster manager on dedicated servers or virtual machines outside the pureScale cluster.

Since IBM Tivoli System Automation for Multiplatforms is already an integrated part of Db2 with the pureScale feature, you may want to use this cluster management software also for the SAP central services or primary application server. For more information, see the SAP guide IBM Db2 High Availability Solution: IBM Tivoli System Automation for Multiplatforms at https://help.sap.com/viewer/db6_samp.

Other SAP-certified cluster managers that support Db2 can be used as well. For a list of supported solutions, see SAP High Availability Partner Information at https://wiki.scn.sap.com/wiki/display/SI/High+Availability+Partner+Information.
8 Removing a Db2 pureScale Installation

To uninstall a Db2 pureScale cluster, follow the instructions below.

**i Note**

Before you install Db2 pureScale again, make sure that you perform all the steps of the following procedure. Otherwise, you might run into problems if you don’t start in a clean environment.

**Procedure**

1. Back up your database.
2. Stop the SAP system.
3. If you want to uninstall the SAP instances that are running on the database hosts, you can do so using the SAP installation tool.

**Caution**

You must **not** use the SAP installation tool to uninstall the database instance and the database. The Db2 pureScale instance and database must be uninstalled **manually**. You also have to make sure that the SAP installation tool does **not** delete any users during the deinstallation of the SAP system on the database hosts.

4. Log on to a Db2 pureScale member as user `db2<dbsid>` and drop the database using the following command:

   ```bash
db2 drop database <dbsid>
   ```

5. Stop the cluster using the following command:

   ```bash
db2stop
   ```

6. Check if all members and CFs are in status **STOPPED** using the following command:

   ```bash
db2instance -list
   ```

   If this is not the case, you can repeat the `db2stop` command with the force option. If the state of a member or CF is **ERROR**, use the following commands to display and clear the alert:

   ```bash
db2cluster -list -alert
db2cluster -clear -alert
   ```


**i Note**

If you delete an incomplete installation or a system that is running on GPFS file systems but is not converted to pureScale, the above step is not required.

7. Clean all Db2-related IPC resources on all hosts (including the CF hosts) using the following command:

   ```bash
   ipclean -a
   ```
8. Switch to user root.

9. Check on all hosts that no processes and no IPC resources are left over using the following commands:
   ```
   ps -ef | grep db2<dbsid>
   ipcs -a | grep db2
   ```

10. Terminate leftover processes manually using the `kill` command and remove remaining IP resource using the `ipcrm` command.

11. If the Db2 fault monitor is running on one of the hosts, disable the monitor using the `db2fmcu -d` command.

12. Drop the Db2 pureScale instance on one of the hosts of the Db2 pureScale cluster using the following command:
   ```
   <inst_dir>/instance/db2idrop -g db2<dbsid>
   ```

   **Note**
   You must perform the following steps (13 to 17) **only** on the hosts where you just dropped the instance.

13. Retrieve information about the GPFS cluster tiebreaker and remove the disk tiebreaker by entering the following command:
   ```
   <inst_dir>/bin/db2cluster -cfs -list -tiebreaker
   ```
   The output of this command might look as follows:
   The current quorum device is of type Disk with the following specifics: /dev/hdisk3.

   If the GPFS cluster uses a disk as tiebreaker (typically `/db2/instance_shared`), you must first change the tiebreaker to `Majority` to free the disk for removal using the following commands:
   ```
   <inst_dir>/bin/db2cluster -cfs -stop
   <inst_dir>/bin/db2cluster -cfs -set -tiebreaker -majority
   ```
   Start the GPFS cluster and verify that the tiebreaker is set to `Majority` using the following commands:
   ```
   <inst_dir>/bin/db2cluster -cfs -start
   <inst_dir>/bin/db2cluster -cfs -list -tiebreaker
   ```
   The output of this command may look as follows:
   The current quorum device is of type Majority Node Set.

14. To list the existing GPFS file systems and to delete the contents and subsequently the file system, enter the following command:
   ```
   <inst_dir>/bin/db2cluster -cfs -list -filesystem
   ```
   The output of this command may look as follows:
   ```
<table>
<thead>
<tr>
<th>FILE SYSTEM NAME</th>
<th>MOUNT_POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>db2data1</td>
<td>/db2/DSJ/sapdata1</td>
</tr>
<tr>
<td>db2data2</td>
<td>/db2/DSJ/sapdata2</td>
</tr>
<tr>
<td>db2tmp1</td>
<td>/db2/DSJ/saptmp1</td>
</tr>
<tr>
<td>db2tmp2</td>
<td>/db2/DSJ/saptmp2</td>
</tr>
<tr>
<td>db2dbdir</td>
<td>/db2/DSJ/db2dsj</td>
</tr>
<tr>
<td>db2dump</td>
<td>/db2/DSJ/db2dump</td>
</tr>
<tr>
<td>db2fs1</td>
<td>/db2/instance_shared</td>
</tr>
<tr>
<td>db2log</td>
<td>/db2/DSJ/log_dir</td>
</tr>
</tbody>
</table>
   ```

15. To remove a file system with the `db2cluster` command, it must be empty. Remove file system with the instance-shared directory using the following commands:
   ```
   rm -rf /db2/instance_shared/*
   <inst_dir>/bin/db2cluster -cfs -delete -filesystem db2fs1
   ```
16. Remove the file systems for the database directory, the Db2 log files, and the Db2 diagnostic information by using the following commands:

```bash
rm -rf /db2/<DBSID>/db2dsj
<inst_dir>/bin/db2cluster -cfs -delete -filesystem db2dbdir
rm -rf /db2/<DBSID>/db2dump
<inst_dir>/bin/db2cluster -cfs -delete -filesystem db2dump
rm -rf /db2/<DBSID>/log_dir
<inst_dir>/bin/db2cluster -cfs -delete -filesystem db2log
```

Remove the remaining file systems for data and temporary objects. The mount points depend on the tablespace layout that you’re using. Therefore, the following commands are only examples:

```bash
rm -rf /db2/<DBSID>/sapdata1
<inst_dir>/bin/db2cluster -cfs -delete -filesystem db2data1
rm -rf /db2/<DBSID>/saptmp1
<inst_dir>/bin/db2cluster -cfs -delete -filesystem db2tmp1
```

17. To list the GPFS domain name and to delete the GPFS cluster, enter the following commands:

```bash
<inst_dir>/bin/db2cluster -cfs -list -domain
```

The output of this command may look as follows:

```
Domain Name: db2cluster_20100217154241.wdf.sap.corp
```

Remove the GPFS cluster using the following commands:

```bash
<inst_dir>/bin/db2cluster -cfs -stop
<inst_dir>/bin/db2cluster -cfs -delete -domain <domain_name>
```

**Note**

Since deleting the GPFS file system takes some time, you may want to create a shell script and perform the above steps using the script.

18. Check if the system automation domain (`<SAMP_domain>`) still exists using the following command:

```
lsrpdomain
```

If it exists, the `lsrpdomain` command reports the domain name. Remove the domain using the following command:

```
rmrpdomain -f <SAMP_domain>
```

19. Remove the Db2 software by running the following command on each host:

```
<inst_dir>/install/db2_deinstall -a
```

20. Check that GPFS and SA MP are removed correctly on all hosts:

   - For AIX, enter the following commands:
     ```bash
     lslpp -l | grep sam
     lslpp -l | grep gpfs
     ```
     The first command should not return package names `sam.core, sam.rte, or sam.msg` (it might return packages with `sam` in the name, for example, `X11.samples.common`). The second command should not return any package names.

   - For Linux, enter the following commands:
     ```bash
     rpm -qa sam
     rpm -qa sam.*
     rpm -qa gpfs*
     ```
     All three commands should not return any package names.

21. Make sure that directory `/var/db2` is cleaned from all Db2 pureScale entries on all hosts. If no other Db2 installations reside on your hosts, remove directory `/var/db2` on all hosts.

22. Remove all log files that are related to Db2 pureScale from the `/tmp` directory on each host. This step is required so that if you install Db2 pureScale again, you see only newly generated log files.
You have to delete the following files:

- db2*
- ibm.db2.cluster*
- Any installGPFS or uninstallGPFS files
- Any installSAM or uninstallSAM files.

23. Check the file /etc/services on each host and make sure that all port entries that are associated with Db2 (for example, DB2CF_<instname>*, sapdb2<dbsid>) are removed.
A Appendix

A.1 Pre-Installation Checklist

You can use this checklist as a cheat sheet to ensure that you’ve done all the required preparations and checks on all the servers that are part of the cluster before you perform the conversion to pureScale. Also use this checklist when adding a new member or cluster caching facility (CF) to validate the settings on new servers.

In the HTML version of this documentation, you can export the list to an Excel spreadsheet by choosing the CSV button in the table header. Note that you’ll probably have to apply the convert-text-to-columns function (file type delimited) in Excel to convert the CSV file to a regular spreadsheet.

We also add this checklist to SAP Note 2593454 as an attachment for you to print or fill out electronically.

### Pre-Installation Checklist

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Server 1</th>
<th>Server 2</th>
<th>Server 3</th>
<th>Server 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interconnect Network Names</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cluster Role (Member/CF/PAS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation Role (IIH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating System Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firmware Level for Interconnect Adapter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Software for Interconnect Adapter</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OpenSSH Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C++ Runtime Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other OS Software Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage: SCSI-3 Persistent Reserve (Optional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requirement</td>
<td>Server 1</td>
<td>Server 2</td>
<td>Server 3</td>
<td>Server 4</td>
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<tr>
<td>--------------------------------------</td>
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<td>----------</td>
</tr>
<tr>
<td>Multipath I/O Driver Configuration</td>
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<tr>
<td>IOCP Configuration</td>
<td></td>
<td></td>
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<tr>
<td>Network Time Protocol Configuration</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Passwordless root access (openssh/</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>db2locsssh) verified</td>
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</tr>
<tr>
<td>Shared File System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiebreaker Disk Name (Optional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWID (Linux) or PVID (AIX) for shared file system: /db2/ &lt;DBSID&gt;/log_dir</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWID (Linux) or PVID (AIX) for shared file system: /db2/ &lt;DBSID&gt;/db2dump</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWID (Linux) or PVID (AIX) for Shared File System: /db2/ &lt;DBSID&gt;/db2 &lt;dbsid&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWID (Linux) or PVID (AIX) for Shared File Systems(s): /db2/ &lt;DBSID&gt;/sapdata&lt;n&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWID (Linux) or PVID (AIX) for shared file system(s): /db2/ &lt;DBSID&gt;/saptmp&lt;n&gt;</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Requirement</td>
<td>Server 1</td>
<td>Server 2</td>
<td>Server 3</td>
<td>Server 4</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Disk name for shared file system: (/db2/)(&lt;DBSID&gt;/log_dir)</td>
<td>(/db2/)(&lt;DBSID&gt;/log_dir)</td>
<td>(/db2/)(&lt;DBSID&gt;/log_dir)</td>
<td>(/db2/)(&lt;DBSID&gt;/log_dir)</td>
<td>(/db2/)(&lt;DBSID&gt;/log_dir)</td>
</tr>
<tr>
<td>Disk name for shared file system: (/db2/)(&lt;DBSID&gt;/db2dump)</td>
<td>(/db2/)(&lt;DBSID&gt;/db2dump)</td>
<td>(/db2/)(&lt;DBSID&gt;/db2dump)</td>
<td>(/db2/)(&lt;DBSID&gt;/db2dump)</td>
<td>(/db2/)(&lt;DBSID&gt;/db2dump)</td>
</tr>
<tr>
<td>Disk name(s) for shared file system(s): (/db2/)(&lt;DBSID&gt;/sapdata(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/sapdata(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/sapdata(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/sapdata(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/sapdata(&lt;n&gt;)</td>
</tr>
<tr>
<td>Disk names(s) for shared file system(s): (/db2/)(&lt;DBSID&gt;/saptmp(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/saptmp(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/saptmp(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/saptmp(&lt;n&gt;)</td>
<td>(/db2/)(&lt;DBSID&gt;/saptmp(&lt;n&gt;)</td>
</tr>
<tr>
<td>User ID (\text{db2&lt;dbsid}&gt;)</td>
<td>(\text{db2&lt;dbsid}&gt;)</td>
<td>(\text{db2&lt;dbsid}&gt;)</td>
<td>(\text{db2&lt;dbsid}&gt;)</td>
<td>(\text{db2&lt;dbsid}&gt;)</td>
</tr>
<tr>
<td>User ID for connect user: (\text{sap&lt;sapsid&gt;}) (ABAP)</td>
<td>(\text{sap&lt;sapsid&gt;}) (ABAP)</td>
<td>(\text{sap&lt;sapsid&gt;}) (ABAP)</td>
<td>(\text{sap&lt;sapsid&gt;}) (ABAP)</td>
<td>(\text{sap&lt;sapsid&gt;}) (ABAP)</td>
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<tr>
<td>User ID for connect user: (\text{sapsid&gt;db}) (Java)</td>
<td>(\text{sapsid&gt;db}) (Java)</td>
<td>(\text{sapsid&gt;db}) (Java)</td>
<td>(\text{sapsid&gt;db}) (Java)</td>
<td>(\text{sapsid&gt;db}) (Java)</td>
</tr>
<tr>
<td>User ID (\text{sapsid&gt;adm})</td>
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<td>(\text{sapsid&gt;adm})</td>
</tr>
<tr>
<td>Group ID (\text{db&lt;sapsid&gt;adm})</td>
<td>(\text{db&lt;sapsid&gt;adm})</td>
<td>(\text{db&lt;sapsid&gt;adm})</td>
<td>(\text{db&lt;sapsid&gt;adm})</td>
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<tr>
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<td>Group ID (\text{db&lt;sapsid&gt;mon})</td>
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<td>(\text{db&lt;sapsid&gt;mon})</td>
<td>(\text{db&lt;sapsid&gt;mon})</td>
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<tr>
<td>Requirement</td>
<td>Server 1</td>
<td>Server 2</td>
<td>Server 3</td>
<td>Server 4</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Group ID: sapsys</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group ID: sapinst</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAP system mount directory: /sapmnt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free space on local file system: /tmp</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Free space on local file system: /var</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Free space on local file system: /db2/ &lt;DBSID&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free space on local file system: /db2/ db2&lt;dbsid&gt;/ db2_software</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free space on local file system: /db2/ db2&lt;dbsid&gt;</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Free space on shared file system: /db2/ instance_shared</td>
<td></td>
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</tr>
<tr>
<td>Free space on shared file system: /db2/ &lt;DBSID&gt;/log_dir</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free space on shared file system: /db2/ &lt;DBSID&gt;/db2dump</td>
<td></td>
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</tr>
<tr>
<td>Free space on shared file system: /db2/ &lt;DBSID&gt;/db2&lt;dbsid&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free space on shared file system: /db2/ &lt;DBSID&gt;/sapdata&lt;n&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requirement</td>
<td>Server 1</td>
<td>Server 2</td>
<td>Server 3</td>
<td>Server 4</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Free space on shared file system: /db2/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;DBSID&gt;/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>saptmp&lt;n&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCM port range</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cluster caching facilities port range</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Db2 communication port</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Db2 cluster services ports</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>File /etc/dat.conf verified and saved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interconnect Net-Names in /etc/hosts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IB/RoCE/Socket Interconnect verified</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>db2prereqcheck executed successfully</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM Db2 license verified on IIH before member/CF is added</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM SA MP license verified on IIH before member/CF is added</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM Db2 license verified after member/CF is added</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM SA MP license verified after member/CF is added</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Db2 Configuration:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEALTH_MON=OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A.2 References

Are you looking for more documentation? Here’s an overview of information sources that are available for SAP systems on IBM Db2 for Linux, UNIX, and Windows.

Documentation by SAP

The following documentation is available on SAP Help Portal and SAP Support Portal:

→ Recommendation

For central access to all our documentation, use our SAP on IBM Db2 overview page on SAP Help Portal at https://help.sap.com/viewer/p/DB6.

<table>
<thead>
<tr>
<th>Documentation</th>
<th>Where to Find It</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Provisioning:</td>
<td><a href="https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/14678bf6e9a04f4f9dc3a1620e96c0b7.html">https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/14678bf6e9a04f4f9dc3a1620e96c0b7.html</a></td>
</tr>
<tr>
<td>Implementation documentation such as guides for installation, system copy, and SAP system upgrades</td>
<td>For example, installation guides for SAP Application Server systems based on SAP NetWeaver: <a href="https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/2bed609927fa4e459888200b153ac63d1.html">https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/2bed609927fa4e459888200b153ac63d1.html</a></td>
</tr>
<tr>
<td>System copy guides</td>
<td><a href="https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/14678bf6e9a04f4f9dc3a1620e96c0b7.html">https://help.sap.com/viewer/30839dda13b2485889466316ce5b39e9/CURRENT_VERSION/en-US/14678bf6e9a04f4f9dc3a1620e96c0b7.html</a></td>
</tr>
<tr>
<td>Documentation</td>
<td>Where to Find It</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DBA Cockpit videos and documentation</td>
<td><a href="https://help.sap.com/viewer/db6_dbacockpit">https://help.sap.com/viewer/db6_dbacockpit</a> (English)</td>
</tr>
<tr>
<td></td>
<td><a href="https://help.sap.com/viewer/db6_dbacockpit_de">https://help.sap.com/viewer/db6_dbacockpit_de</a> (German)</td>
</tr>
<tr>
<td>The current version of the document Database Administration Using the DBA</td>
<td>Also available in PDF format in English and German.</td>
</tr>
<tr>
<td>Cockpit: IBM Db2 for Linux, UNIX, and Windows provides you with a detailed</td>
<td>See also our DBA Cockpit videos.</td>
</tr>
<tr>
<td>description of how to perform administrative tasks using the DBA Cockpit.</td>
<td></td>
</tr>
<tr>
<td>SAP Business Warehouse on IBM Db2 for Linux, UNIX, and Windows: Administration Tasks</td>
<td>Db2 10.5 and higher:</td>
</tr>
<tr>
<td></td>
<td><a href="https://help.sap.com/viewer/db6_bw">https://help.sap.com/viewer/db6_bw</a> (PDF here)</td>
</tr>
<tr>
<td></td>
<td>Db2 10.1 and lower:</td>
</tr>
<tr>
<td></td>
<td><a href="http://help.sap.com/viewer/db6_bw_10_1">http://help.sap.com/viewer/db6_bw_10_1</a> (PDF here)</td>
</tr>
<tr>
<td>Database upgrade guides</td>
<td>Db2 11.1: <a href="https://help.sap.com/viewer/db6_upgrade_11_1">https://help.sap.com/viewer/db6_upgrade_11_1</a> (PDF here)</td>
</tr>
<tr>
<td></td>
<td>DB2 10.5: <a href="https://help.sap.com/viewer/db6_upgrade_10_5">https://help.sap.com/viewer/db6_upgrade_10_5</a> (PDF here)</td>
</tr>
<tr>
<td></td>
<td>DB2 10.1: <a href="https://help.sap.com/viewer/db6_upgrade_10_1">https://help.sap.com/viewer/db6_upgrade_10_1</a> (PDF here)</td>
</tr>
<tr>
<td></td>
<td>DB2 V9.7: <a href="https://help.sap.com/viewer/db6_upgrade_9_7">https://help.sap.com/viewer/db6_upgrade_9_7</a> (PDF here)</td>
</tr>
<tr>
<td>Central access to all SAP Notes</td>
<td><a href="https://support.sap.com/notes">https://support.sap.com/notes</a></td>
</tr>
<tr>
<td>Central access to all Db2 for LUW-related guides (including the above</td>
<td><a href="https://help.sap.com/viewer/p/DB6">https://help.sap.com/viewer/p/DB6</a></td>
</tr>
<tr>
<td>mentioned)</td>
<td></td>
</tr>
</tbody>
</table>

**SAP on Db2 for Linux, UNIX, and Windows Community**

Check out and participate in our SAP community for IBM Db2 at https://www.sap.com/community/topic/db2-for-linux-unix-and-windows.html. Here you’ll find blogs, Q&As, whitepapers, videos, and guides. You can also post blogs and questions and search the community archive for more.

**IBM Knowledge Center**


The IBM Knowledge Center also provides links to IBM Redbooks, developerWorks articles, IBM white papers, and so on.
A.3 Using Db2 pureScale Monitoring Functions in the DBA Cockpit (AS ABAP Only)

**i Note**

The following sections describe Db2 pureScale functions in the DBA Cockpit that are available with a transport attached to SAP Note 1954802. This is only relevant if your SAP system runs on low Support Package levels. As of the following SAP NetWeaver releases and Support Packages, Db2 pureScale functions have been integrated into the DBA Cockpit and you no longer need SAP Note 1954802:

- 7.02 SP 16
- 7.3 SP 12
- 7.31 SP 13
- 7.4 SP 8

*Only* if you are using the DBA Cockpit on lower SAP NetWeaver Support Packages, the following sections about Db2 pureScale monitoring using the special transport mentioned above are applicable.

To be able to use integrated Db2 pureScale monitoring functions in the DBA Cockpit, you need at least the above mentioned SAP NetWeaver releases and Support Packages.

**Db2 pureScale Monitoring Functions With Transport Attached to SAP Note 1954802**

The DBA Cockpit was enhanced with monitoring functions that let you monitor Db2 pureScale members and CFs. These Db2 pureScale-specific enhancements provide the following:

- Overview of the cluster topology and cluster alerts
- Overview of the Db2 member performance in the Db2 pureScale cluster
- Information about the group buffer pool and local buffer pool hit ratio
- Content of the (global) package cache
- Information about the memory configuration and consumption of the cluster caching facilities (CFs)
- Information about page contention in the Db2 pureScale cluster
- Information about connected clients and the client configuration (that is, the content of the `db2dsdriver.cfg` file)

**i Note**

The Db2 pureScale-specific monitoring functions are only available on the SAP GUI-based user interface of the DBA Cockpit.

After you have successfully imported the transport attached to SAP Note 1954802, you can access the additional monitoring functions by calling the DBA Cockpit (SAP transaction `DBACOCKPIT`) and choosing `Db2 pureScale Feature <monitoring function>` in the navigation frame of the SAP GUI-based user interface of the DBA Cockpit.
Most of the Db2 pureScale functions in the DBA Cockpit are available via remote monitoring. That is, you can monitor multiple Db2 pureScale systems by using a DBA Cockpit that contains the Db2 pureScale-specific enhancements and that uses remote database connections. For more information, see SAP Note 1954802.

More Information

- For more information about the Db2 pureScale monitoring functions that are part of the special transport for lower Support Packages, see SAP Note 1954802 and the following chapters in the appendix.
- For more information about the integrated Db2 pureScale monitoring functions in the DBA Cockpit on higher Support Packages as listed above, see Monitoring Db2 pureScale in the DBA Cockpit in the DBA Cockpit documentation at https://help.sap.com/viewer/db6_dbacockpit.

A.3.1 Monitoring the Cluster Status

The Cluster Status screen provides an overview of the members or CFs that are part of the current Db2 pureScale cluster. In addition, information about current or home host names and alerts per member is displayed as well as the current state of a member.
A.3.2 Monitoring the Cluster Performance

The Cluster Performance screen provides information about current wait times and buffer pool hit ratios for each member in the Db2 pureScale cluster. In addition, global metrics that are drilled down to a specific member are displayed.

You can display additional member-related performance metrics by double-clicking a line in the overview table. The information is displayed in the detail area below as shown in the following figure:

![DBA Cockpit - Cluster Performance Screen](image)

The following information is displayed in the left group area (a):

- Global lock-wait times (physical, page-related wait times)
- Number of global lock waits
- Number of global lock timeouts and lock escalations
- Number of local locklist escalations and maxlock lock escalations
- Local page and space mapping page (SPM) reclaim wait times
- CF wait time (total) and number of CF waits

In the Group Buffer Pools area (b), information about the group buffer pool hit ratio, invalid pages as well as page or read statistics are displayed.
The hit ratio metrics are calculated as follows:

<table>
<thead>
<tr>
<th>Hit Ratio Type</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total global hit ratio (global BP hit ratio)</td>
<td>( \frac{(\text{global logical data reads} + \text{global logical index reads}) - (\text{global physical data reads} + \text{global physical index reads})}{(\text{global logical data reads} + \text{global logical index reads})} \times 100 )</td>
</tr>
<tr>
<td>Global data hit ratio</td>
<td>( \frac{(\text{global logical data reads} - \text{global physical data reads})}{\text{global logical data reads}} \times 100 )</td>
</tr>
<tr>
<td>Global index hit ratio</td>
<td>( \frac{(\text{global logical index reads} - \text{global physical index reads})}{\text{global logical index reads}} \times 100 )</td>
</tr>
</tbody>
</table>

In the Local Buffer Pools area (c), information about the local buffer pool hit ratio is displayed as well as page or read statistics per member.

The hit ratio metrics are calculated as follows:

<table>
<thead>
<tr>
<th>Hit Ratio Type</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total local hit ratio</td>
<td>( \frac{(\text{local logical data reads} + \text{local logical index reads}) - (\text{local physical data reads} + \text{local physical index reads})}{(\text{local logical data reads} + \text{local logical index reads})} \times 100 )</td>
</tr>
<tr>
<td>Local data hit ratio</td>
<td>( \frac{(\text{local logical data reads} - \text{local physical data reads})}{\text{local logical data reads}} \times 100 )</td>
</tr>
<tr>
<td>Local index hit ratio</td>
<td>( \frac{(\text{local logical index reads} - \text{local physical index reads})}{\text{local logical index reads}} \times 100 )</td>
</tr>
</tbody>
</table>

### A.3.3 Monitoring Buffer Pools in the Db2 pureScale Cluster

The Buffer Pool screen provides information about computed hit ratio metrics of the buffer pools in the Db2 pureScale cluster. These metrics are grouped by the buffer pool name. Global and local hit ratios are drilled down to each member.

You can display detailed information about the metrics by double-clicking a line in the overview table.
The information is displayed in the **Buffer Pool <buffer pool name> – Member** detail area as shown in the following figure:

![DB2 pureScale Feature – Buffer Pools](image)

**DBA Cockpit - Buffer Pools Screen**

**i Note**

The values displayed in the **Prefetchers** area are drilled down to the local and global prefetcher processes.

The metrics used are calculated in a similar way to the metrics described in **Monitoring the Cluster Performance [page 83]**.

### A.3.4 Monitoring the Package Cache in the Db2 pureScale Cluster

The **Package Cache** screen displays statement texts in the package cache that are related to a specific Db2 pureScale member as well the related package cache statistics.

When you access the **Package Cache** screen, a **Selection Criteria** dialog box appears where you can limit the result set by specifying the number of executions, the total activity time and the statement text.
The following information is displayed in the overview table:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member</td>
<td>Member ID</td>
</tr>
<tr>
<td>Statement Text</td>
<td>Statement text</td>
</tr>
<tr>
<td>Executions</td>
<td>Number of executions per statement/member combination</td>
</tr>
<tr>
<td>Total Activity Time</td>
<td>Overall time of executions and prepares (in s)</td>
</tr>
<tr>
<td>Avg. Activity Time</td>
<td>Total activity time divided by the number of executions (in ms)</td>
</tr>
<tr>
<td>CF Wait Time</td>
<td>Overall CF wait time in seconds to process statement (including communication overhead with CF and lock waits)</td>
</tr>
<tr>
<td>Global Lock Wait Time</td>
<td>Global wait time in seconds that occurred on logical lock situations</td>
</tr>
<tr>
<td>Total Reclaim Wait Time</td>
<td>Sum of wait times for physical page reclaim in seconds</td>
</tr>
<tr>
<td>GBP Hit Ratio (%)</td>
<td>Percentage of the group buffer pool hit ratio that is related to statement</td>
</tr>
</tbody>
</table>

To display the complete statement text and other detailed metrics, such as additional global or local buffer pool statistics, double-click a line in the overview table.
The complete statement text is displayed as well as detailed package cache statistics as shown in the following figure:

```
DBA Cockpit - Package Cache
```

The metrics used are calculated in a similar way to the metrics described in Monitoring the Cluster Performance [page 83].

### A.3.5 Monitoring the Cluster Caching Facility (CFs)

The Cluster Caching Facility (CF) screen provides information about the current status of the cluster caching facilities (CFs) in the Db2 pureScale cluster as well as resource metrics that belong to a configured parameter setting per CF.
The information is displayed as shown in the following figure:

In the Resources detail area, the overall host-related resources are displayed.

### A.3.6 Checking for Page Contention

The Page Contention screen provides a detailed overview of events and statistics if competitive situations occur, for example, if different members try to access the same physical page at the same time.

The overview table on the Page Contention screen displays the following key figures about page contention:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schema</td>
<td>Name of database schema</td>
</tr>
<tr>
<td>Table</td>
<td>Name of table belonging to the schema</td>
</tr>
<tr>
<td>Reclaim Wait Time (sec)</td>
<td>Overall page reclaim wait times that are aggregated for each table</td>
</tr>
<tr>
<td>Column</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Page Reclaims X</td>
<td>Total number of page reclaims per table (exclusive)</td>
</tr>
<tr>
<td>Page Reclaims S</td>
<td>Total number of page reclaims per table (shared)</td>
</tr>
<tr>
<td>SPM Page Reclaims X</td>
<td>Total number of space map page reclaims per table (exclusive)</td>
</tr>
<tr>
<td>SPM Page Reclaims S</td>
<td>Total number of space map (SMP) reclaims per table (shared)</td>
</tr>
</tbody>
</table>

To access detailed statistics per Db2 pureScale members, double-click a line in the overview table. To drill down the metrics for a specific member, double-click the member to be analyzed in the *Details of Tables* area.

The detailed information is displayed as in the following figure:

![DBA Cockpit - Page Contention Screen](image)

In the *Table Page Contention* and *Index Page Contention* area, the number of shared and exclusive reclaims and currently initiated reclaims is displayed. These values relate to the selected member and table.
A.3.7 Checking the Client Affinity

The **Client Affinity** screen analyzes the client affinity file and displays which database connection is currently open on a specific member.

To check the current configuration parameters in the `db2dsdriver.cfg` file, double-click a line in the overview table. This function is only supported if a local database connection exists (local monitoring).

---

**DBA Cockpit - Client Affinity Screen**

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