



Infor Enterprise Server Technical Reference Guide for DB2 Database Driver

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About this guide

This document supplies technical reference information about the Infor Enterprise Server database driver for DB2 for UNIX and Windows operating systems.

The database driver is referred to as the Infor Enterprise Server DB2 database driver. The information is Infor-release independent and can be used for Infor Baan IVc, Infor Baan 5.0 and LN

For simplification, LN is used in this document and applies only to porting set 8.x. Unless specified, the information applies to all supported DB2 versions and any differences are stated.

The term 'Infor Enterprise Server' comprises the tools and porting set. However this document only handles issues related to the porting set, where the DB2 database driver is a part of.

The term UNIX refers to both UNIX and Linux. For details on other platform support, see the *Platform Support Matrix (U9757 US)*, see Infor Xtreme KB 1183466.

Intended audience

This document is intended for anyone who wants to configure or customize the Infor Enterprise Server database driver for DB2. To understand this document, a basic knowledge of UNIX or Windows and DB2, and an understanding of database technology, is required.

This document covers the database driver for Infor ERP Baan IVc, Infor ERP 5.0c and Infor LN.

Related documents

- You can find the documents in the product documentation section, as described in "Contacting Infor" on page 6.

For information on the installation procedure for DB2 and LN software, see these documents:

- *Infor Baan IVc - Pre installation Guide for Windows (U9739)*
- *Infor Baan IVc - Pre installation Guide for UNIX (U9740)*
- *Infor Baan IVc - Deployment Guide for Windows and UNIX (U9673)*

- *Infor LN - Installation Guide (U9498)*
- *Infor Enterprise Server - Technical Manual (U8172)*
- *Infor LN - Performance, Tracing and Tuning Guide (U9357)*
- *Infor LN - Performance, Tracing and Tuning Guide for DB2 Server (B0077)*

For detailed information regarding DB2, see IBM's information center for DB2.

Contacting Infor

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The database driver plays an important role in Infor's commitment to an open systems client/server architecture. Because the LN architecture includes the LN software and a third party relational database management system (RDBMS), the driver is required to provide a seamless interface between the LN software and the various RDBMS products. The database driver enables the majority of the LN processing to be independent of the RDBMS. This chapter provides an overview of the database driver and how the database driver fits into the LN architecture.

This chapter discusses these topics:

- LN architecture.
- Data flow through the LN architecture.
- LN hardware configurations.
- Level 2 database drivers

Infor ERP architecture

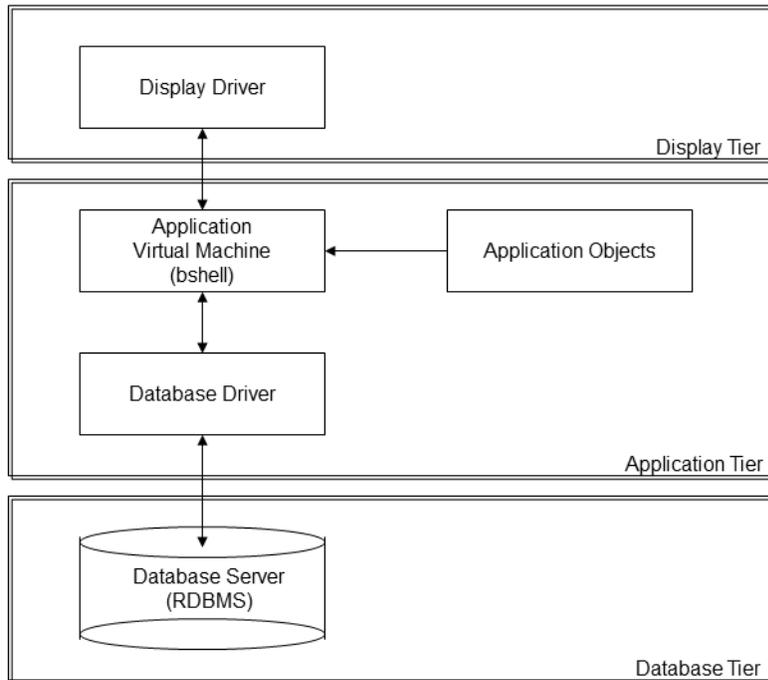
LN supports a three-tier architecture that consists of a display tier, an application tier, and a database tier. The display tier provides presentation services for user interaction. The application tier consists of the LN application virtual machine, the application objects, and the LN database driver.

The database tier consists of a third-party RDBMS product that acts as the database server..

The emphasis of this document is on the LN database driver, which is the database driver interface between the LN applications and the RDBMS server. The database driver translates database requests from the LN application virtual machine to RDBMS-specific SQL requests that the virtual machine sends to the database server. After the database server retrieves the requested information, the database driver passes the data back to the LN application virtual machine.

To put the functions of the database driver into perspective, the following sections briefly describe each of the three tiers of the total LN architecture.

This diagram illustrates the LN architecture:



Display tier

The display tier consists of the display driver that includes the LN user interface for Microsoft Windows (WebUI). The display driver facilitates the communication between the user and the application tier. Data input from the user through Web UI is relayed to the LN application virtual machine. The display driver displays data returned from the LN application virtual machine in graphical form.

Application tier

The application tier includes the application objects, the LN application virtual machine, and the database driver. Together, the application objects and the application virtual machine provide much of the functionality of LN, whereas the database driver provides connectivity to the database server to store and retrieve application data.

The application objects include the compiled LN applications and the data dictionary. These applications are written in Baan 3GL or Baan 4GL, which are programming languages supported by Infor ERP Enterprise Server, and are compiled into an intermediate code interpreted at run time by the virtual machine.

The data dictionary defines the data models the applications use. The data dictionary includes information about the domains, schemas, and referential integrity rules used by LN.

The LN application virtual machine schedules and runs the application objects, sends and receives information to and from the display server, and initiates an instance of the database driver as required for communication with the database server. A running database driver can support multiple connections to a single RDBMS instance. If an LN installation stores data tables in multiple RDBMS products or instances, the application virtual machine must start one instance of the database driver for each RDBMS product or RDBMS instance with which the virtual machine must communicate.

The LN application virtual machine has traditionally been called the LN shell or the bshell. Throughout this document, the bshell is referred to as the LN application virtual machine or the application virtual machine.

The LN database driver is also a part of the application tier. The database driver provides a common interface between the LN application virtual machine and the database server. Communication between the application virtual machine and the database driver is the same, no matter which RDBMS product is used as the database server. One database driver is available for each of the RDBMS products that LN supports.

Database tier

Usually, the database tier consists of a third-party database server product. Communication between the database driver and the database server is tailored to the RDBMS in use. The database driver communicates with the RDBMS through structured query language (SQL) statements and the native application-programming interface (API) of the RDBMS.

The database server consists of one of four third-party RDBMS products: Oracle, Informix, IBM DB2, or Microsoft SQL Server. All LN application data is stored in a relational database managed by an RDBMS. You can have multiple RDBMS products in one LN installation, with some data residing in one database server and some residing in another.

Data flow in the Infor ERP architecture

Note that the database driver provides an interface between the LN application virtual machine and the specific RDBMS server being used. The flow of data through the system is described later in this section.

When a user performs an operation at a GUI workstation, the display server interprets the input and sends the information to the LN application virtual machine. Based on the information the application virtual machine receives, the virtual machine causes the appropriate application object to be executed.

When a running application object requires information that is stored in the database, the application virtual machine sends the request to the database driver. Data requests from the client applications are RDBMS independent and made using LN SQL, an RDBMS-independent SQL language.

When the application virtual machine executes a database query from an application object, the virtual machine first determines whether a running database driver is available to process the query. If no database driver is running, or the running database driver instances communicate with a database

server other than the server that stores the required data, the application virtual machine starts a new instance of the database driver. The application virtual machine parses the LN SQL database query it receives from the application object and sends an internal representation of the query to the database driver. The internal representation of the query the database driver receives is still RDBMS-independent.

The database driver translates the database query into an appropriate database-specific query using SQL statements compatible with the RDBMS being used.

Each database driver takes advantage of the design of the particular RDBMS that the driver supports, so that the resulting SQL statements are valid for the RDBMS and provide the best possible performance. The RDBMS-specific SQL statements are then submitted to the RDBMS server, which processes the data request.

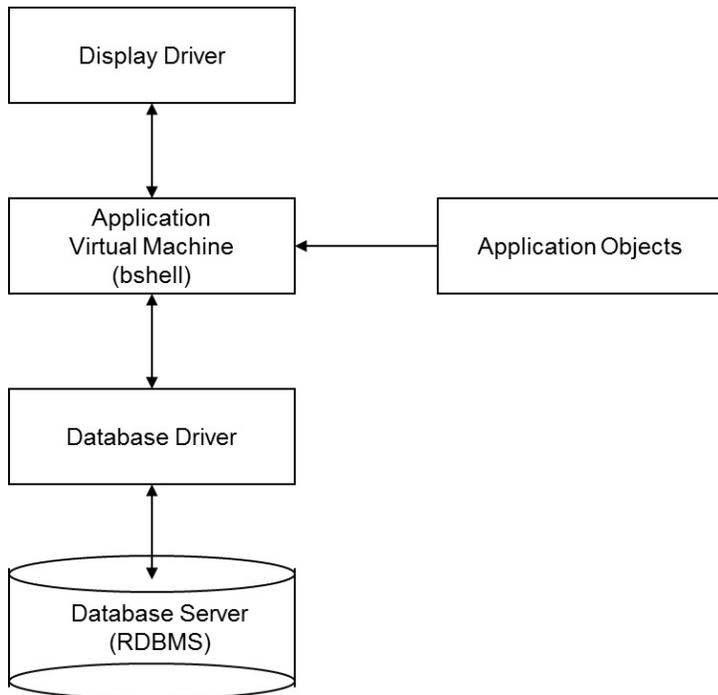
After the RDBMS processes the query, the RDBMS returns the data to the database driver. The database driver catches and handles any error conditions. The database driver then returns the data and status information to the application virtual machine, where the driver provides the information to the application that requested information. The application virtual machine can also send a message to the display server, which displays an appropriate message on the user's workstation.

Infor ERP hardware configurations

Several hardware configurations are supported for an LN implementation, including standalone mode and many variations of client/server mode. Available hardware, data storage requirements, and performance expectations determine the most appropriate hardware configuration.

Standalone mode refers to a configuration where all components of the LN architecture run on a single machine. In standalone mode, a user can work from the host machine or a thin client machine. However this is still possible, it is not commonly used anymore.

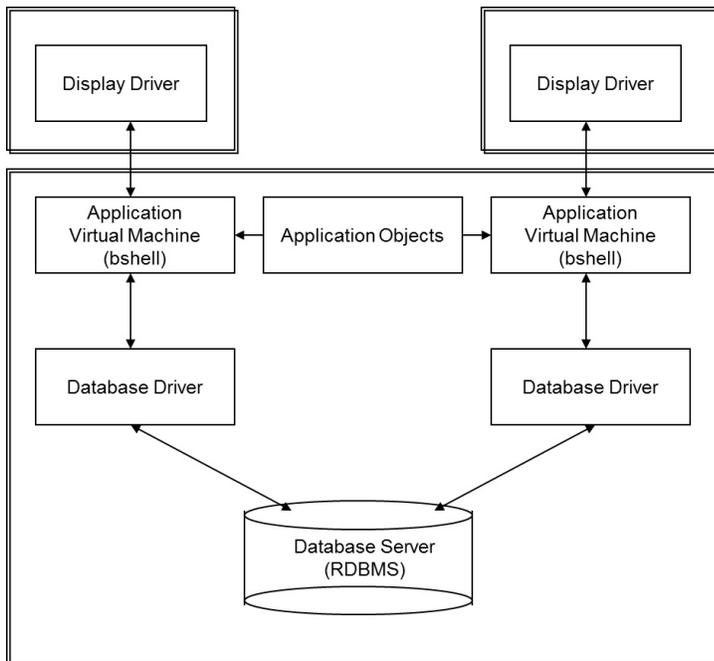
This figure illustrates the standalone mode configuration:



In a client/server configuration, the components of the LN architecture are distributed over two or more machines. Many client/server configurations are available; this section describes the most common.

The simplest client/server configuration is sometimes thought of as a variation of standalone mode. In this configuration, the application tier, database driver, and RDBMS are on one machine, while the display drivers are distributed among the user workstations. An instance of the application virtual machine and at least one instance of the database driver is started for each user. This configuration is also known as 2-tier or host-mode.

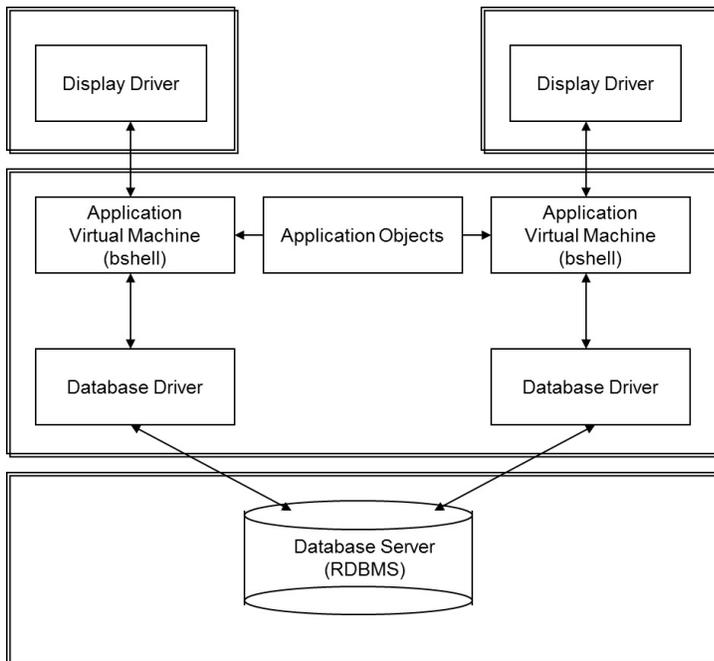
This figure illustrates this 2-tier or host-mode configuration:



If two machines are to be used as servers, two configurations are commonly used. In both configurations, the display drivers reside on the user workstations.

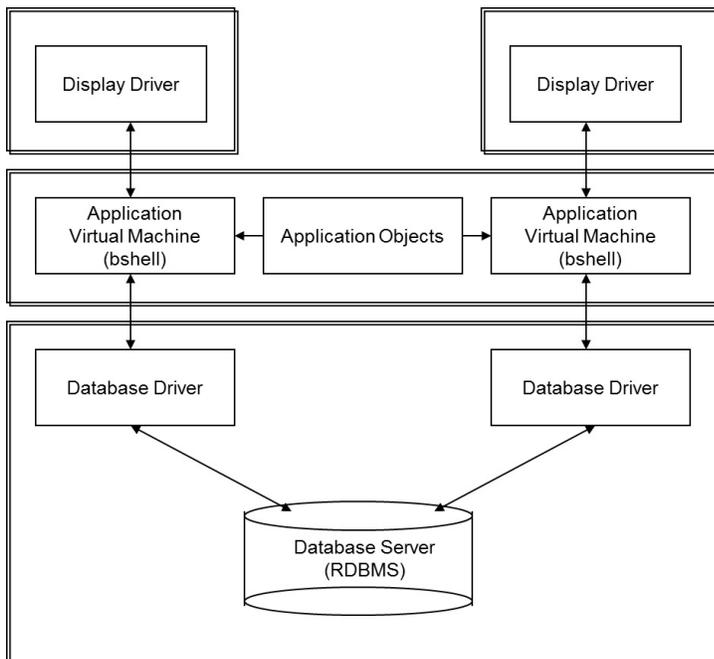
In the first configuration, the application tier and database driver are placed on one server, while the database server is placed on another. An instance of the application virtual machine and at least one instance of the database driver is started for each user. All users have access to the same application objects and database servers. This configuration is also known as 3-tier.

The following figure illustrates this client/server configuration. To provide client/server access, this configuration uses the RDBMS's networked client functionality.



In this second configuration, the application tier is placed on one server, while the database driver and database server are placed on another. As with the previous configuration, an instance of the application virtual machine and at least one instance of the database driver is started for each user. All users have access to the same application objects and database servers.

This client/server configuration is illustrated in the following figure. This configuration uses the LN method of client/server access between the application virtual machine and the database driver.



Many other configurations of client/server systems are available, including dividing the application logic among multiple servers or using multiple servers to distribute the database.

Note:

The LN installer does not support this configuration; therefore, you must manually set up this configuration.

Level 2 database drivers

Infor RDBMS database drivers are communicating with the RDBMS server in so called level 2 mode. This mode distinguishes itself from Level 1 in the way the LN SQL queries are processed and in the way the data is stored in the database. The Level 1 driver is obsolete.

A level 2 database driver sends more complex queries to the database server, which requires the RDBMS to do a larger portion of the work. An application program written for a Level 2 database driver typically uses set-oriented database access.

All of the application data that LN uses is stored in database tables in the RDBMS. To keep the majority of the LN processing independent from the RDBMS, LN uses a data dictionary. The data dictionary includes domain, schema, and referential integrity information stored in a database independent way.

Because so many tables are required, a convention is used for naming tables, columns in tables, and indexes to data in the tables. This chapter describes the data dictionary and naming conventions that the LN database drivers use to access data stored in the RDBMS. This chapter also discusses how LN data types are mapped to DB2 data types.

This chapter covers the following topics:

- LN data dictionary
- Table naming convention
- Column naming convention
- Index naming convention
- Data type mapping
- Additional data base objects
- Additional constraints

Infor ERP data dictionary

A data dictionary is a catalog that provides information about the data in a database. You can think of a data dictionary as data about the data, or metadata. You can use a data dictionary to find data that resides in a database table.

The LN database drivers maintains a data dictionary because the data that the LN applications use can differ from the database tables defined in the RDBMS. The LN data dictionary maps LN data types, domains, schemas, and referential integrity information to the appropriate information in the RDBMS. When storing or retrieving data in the RDBMS, the database driver maps data dictionary information to database table definitions.

LN data dictionary information can be kept in shared memory where the data will be available to all running LN application virtual machines. The data dictionary information is shared among all the sessions open in a single database driver.

The LN data dictionary cannot be directly used by the database driver to create DB2 tables because not all LN data types exactly match DB2 data types or limits. To create valid DB2 tables, the driver must perform some mapping or translation. When mapping the LN data dictionary to tables in DB2, conventions are used for the table names, column names, and index names.

Table naming convention

The table name of an LN table stored in DB2 has the following format:

```
t<Package><DD Table name><Company number>
```

The following list describes each of the components of the table name:

- **Package:**
A two-letter code that refers to the LN package that created the table. For example, a table created by the LN Tools package has the package code **tt**.
- **DD Table Name:**
The name of the table used in the data dictionary. The data dictionary table name consists of three letters followed by three digits. The letters refer to the application that uses the table, and the digits indicate the order in which the tables were created.
- **Company Number:**
In LN, three-digit company numbers are used to differentiate areas of functionality. A company must exist with the number **000**. Several other company numbers must also be present.

For example, the data dictionary table **adv999** with company number **000** is created in DB2 as **tttadv999000**.

Note:

For tables with the Multilanguage Application Data feature enabled, a secondary table exists, named as follows:

```
s<Package><DD Table name><Company number>
```

For tables with the Document Authorization (aka DBCM) feature enabled, another secondary table exists named as follows:

```
v<Package><DD Table name><Company number>
```

Column naming convention

Each column in the LN data dictionary corresponds to one or more columns in a DB2 table.

The rules for column names are as follows:

- General:

When an LN column name is created in DB2, the column name is preceded by the string **t_**. For example, the LN column with the name **cpac** is created in DB2 with the name **t_cpac**. By preceding column names with **t_**, you can avoid reserved words. If a column name contains a period, the period is replaced by the underscore character.

- Long string columns:

LN columns of type string can exceed the maximum length of character columns in DB2. The DB2 data type CHAR has a limit of 254 characters. This limit is different (larger) for Unicode installations. When an Infor ERP string column exceeds this limit, the column is split into segments with up to 254 characters each. The first 254 characters are placed in a column where the name of the column is extended with **_1**. The next 254 characters are placed in a column with a name extended by **_2**, and so on until all the characters of the string are placed in a column. For example, if an LN string column called **desc** contains 300 characters, the following two DB2 columns are created:

- **t_desc_1**: size 254
- **t_desc_2**: size 46

- Array columns:

In the LN data dictionary, array columns can be defined. An array column is a column with multiple elements in the column. The number of elements is called the depth. For example, a column that contains a date can be defined as an array of three elements: a day, a month, and a year. In DB2, the three elements of the array column are placed in separate columns. The names of these columns include a suffix with the element number. For example, an array column called **date** will become:

- **t_date_1**: element 1
- **t_date_2**: element 2
- **t_date_3**: element 3

Note that if the element is of type string, and one element type exceeds the maximum DB2 character size of 254, the element is split, such as:

- **t_str_1_1**: element 1, part 1
- **t_str_1_2**: element 1, part 2

- Array compression:

The maximum number of DB2 columns is 500. If the number of LN columns exceeds the maximum number of DB2 columns, the database driver tries to compress (join) array columns to reduce the number of columns. All array elements of one array column are stored as one column in the DB2 database with the elements concatenated in binary format. To start, the driver compresses the array column that yields the highest number of columns. The driver then continues to compress array columns until the number of columns is less than 500. The name of the compressed column in DB2 follows the same convention used for the other columns, such as the following:

- **t_array**: contains all elements of the compressed column

Note that when a compressed array column is longer than 254 characters, the column is split into segments of 254 characters or less.

Index naming convention

LN indexes are identified by a sequence number for each table; the sequence numbers start from one. Each table has at least one index: the primary index. DB2 requires that index names must be unique. For this reason, the table name and index number are included in the index name.

Index names have the following format:

```
i<Table name>_<Index number>
```

For example, the index name for an LN table with name **ttadv999**, index number **1**, company number **000** is as follows:

```
ittadv999000_1a
```

If an LN index is defined as a unique index, the DB2 index is created with the UNIQUE clause, which prevents duplicate rows from being created in the table.

Note:

- when a table has one or more BLOB columns the following additional index is created:

```
i<DD table name><company number>_UUID
```

- Indices are at default bidirectional and have 'a' as suffix in the index name.

Data type mapping

This table shows the mapping between LN data types and their DB2 counterparts:

Mapping between LN and DB2 data types	
LN data types	DB2 data types
CHAR	SMALLINT
ENUM	SMALLINT
INT	SMALLINT
LONG	INTEGER

Mapping between LN and DB2 data types	
UTC DATE	DATE
UTC TIME	TIMESTAMP
TEXT	INTEGER
BITSET	INTEGER
FLOAT	DOUBLE
DOUBLE	DOUBLE
STRING(N)	CHAR(N)/VARGRAPHIC(N)
MULTI-BYTE STRING	CHAR(N)/VARGRAPHIC(N)
DATE	DATE
RAW	CHAR FOR BIT DATA
BLOB4	BLOB

- The VARGRAPHIC data type is used in Unicode mode and not available for Infor Baan IVc.
- The DB2 CHAR FOR BIT DATA type is used to store UUID columns, generated if a table contains a BLOB column (except in Baan IV where the UUID column is a string column).

In Unicode mode, DB2 driver uses the VARCHAR data type for the Baan string type. Otherwise, the DB2 driver uses the CHAR data type. At LN application level, the data type is interpreted as normal string type, including any trailing spaces. Operations such as comparison and concatenation remain the same for earlier versions, regardless of the string data-type that is used at DB2 level.

LN converts multi-byte data into TSS (Triton Super Set) format for internal processing.

Multi-byte data can be stored in the database in TSS format or in the original native format. For storing in TSS or native format, the DB2 data type CHAR is used. Note that char data will be sorted on byte order because Infor databases are built with COLLATE USING IDENTITY. Also, the correct locale and code page must be specified when creating the Infor database for your multi-byte environment to function properly.

Unicode support

Besides native and multi-byte support, the Infor DB2 database driver supports Unicode, starting with porting set 8.4b. Unicode is supported only for LN.

The following are differences between native and multi-byte:

- For native/multi-byte installations, all string types use VARGRAPHIC instead of CHAR.
- The data type VARGRAPHIC is used because GRAPHIC has more limitations than the CHAR data type. Because GRAPHIC is equivalent to UTF-16 in the DB2 RDBMS, the limit of GRAPHIC data

type is 127 characters (=254 bytes). The VARGRAPHIC data type is used to prevent performance loss caused by many long string splits.

- The VARGRAPHIC limit is 16336 characters (=32672 bytes). If this limit is exceeded, long string columns are spitted into parts.
- Unicode databases in DB2 created at installation time are created with a Unicode aware collation. This is mandatory when using the Infor DB2 driver in Unicode mode.

Additional data base objects

For the Document Authorization feature the following data base objects are needed:

- The table ttocm999000 that holds an entry for each checked out object;
- The sequence SEQ_rcd_seqn, which is needed for cursor stability.

Additional constraints

Besides the naming conventions and data types previously described, when you map LN data to DB2 data, the following rules apply:

- All names generated by the database driver are in lowercase characters and are not enclosed in double quotation marks. DB2 treats object names with case sensitivity.
- All columns created by the DB2 driver have the NOT NULL constraint. LN applications do not support NULLS.
- If an LN index is defined as a unique index, the DB2 index is also created with the UNIQUE clause; otherwise, indexes that permit duplicates are not defined with the UNIQUE clause.

The date range for the LN application virtual machine is the same as the range for DB2, with one exception: the application virtual machine date 0 is mapped to the DB2 date 1. The application virtual machine date 1 is marked as an invalid date.

The DB2 database driver converts RDBMS independent database requests into specifically-designed requests for DB2. This chapter describes some of the internal processing that occurs in the LN DB2 driver. First, some of the features that ensure data integrity are discussed; then, the internal processing of an SQL statement in the driver is discussed. The final section describes the mechanisms that allow the default behavior of the database driver to be modified.

This chapter discusses the following LN DB2 driver internal issues:

- Data integrity.
- Database driver SQL processing.
- Setting driver behavior.

Data integrity

Several features of the LN database driver help ensure data integrity. These features include locking mechanisms, methods used for ensuring referential integrity, and methods used for distributed databases. Data integrity is also maintained while you use data buffering techniques to minimize network traffic. This section provides an overview of the features used by the LN DB2 driver to ensure referential integrity, to work with distributed databases, and to apply data buffering techniques.

Referential integrity

Referential integrity preserves the defined relationships between tables when records are maintained. The LN database driver has a built-in mechanism for preserving referential integrity. The driver does not depend on the underlying RDBMS to maintain referential integrity.

Data buffering

The application virtual machine can buffer updates and then flush the updates at the time of the transaction commit, or earlier; this reduces the number of network round trips and data volumes.

If multiple rows are returned from a query, the rows are buffered and sent back to the LN application virtual machine as one block. To compact the data, data reduction and compression is applied, which minimizes the amount of data transferred between the application virtual machine and database driver.

Database driver SQL processing

As discussed in "Infor ERP Database Driver Overview" on page 7, the application virtual machine sends RDBMS-independent database queries and update requests to the database driver. The database driver decides whether to convert these RDBMS-independent database requests into SQL statements appropriate to the specific RDBMS being used. This section details the SQL processing the LN DB2 driver performs. Because the LN DB2 driver uses the call-level interface to communicate with DB2, this chapter first describes this interface.

Call-level interface

To communicate with DB2, the DB2 driver uses the call level interface (CLI). CLI is a function library or a set of C functions that can be called from a C program to execute SQL statements.

The CLI functions that are called by the DB2 driver perform for example the following actions:

- Log onto DB2 (open session).
- Allocate a statement handle.
- Parse a SQL statement.
- Bind input variables.
- Bind output variables.
- Execute the SQL statement.
- Fetch the resulting rows.
- Break a query (asynchronous).
- Commit/abort transaction.
- Close a cursor.
- Log off from DB2 (close session).

The DB2 driver also uses these features of CLI:

- Array fetches (when enabled).
- Array inserts (when enabled and possible).

SQL processing

The database-dependent layer of the LN DB2 driver dynamically generates SQL statements. Because LN applications are dynamic, the tables that will be used at runtime are not known in advance; therefore, you cannot prepare the queries before runtime.

In the LN DB2 driver, SQL statements are processed in several steps, which are described in this section.

If the LN DB2 driver receives a query from the application virtual machine, the query is translated into a format suitable for DB2, and is passed to DB2 by CLI function calls. In DB2, a statement handle/cursor is allocated, and the query is executed by assigning the statement handle to the query. The SQL statement is parsed, input and output variables are bound, and the query is executed using the statement handle. Sometimes, DB2 internally opens a server cursor for query execution. After the query is executed, a fetch operation is completed and the resulting column values are placed in the bound output variables.

The rows returned by DB2 are passed to the database-independent layer of the LN DB2 driver, which sends the results back to the application virtual machine.

If a statement must be re-executed, the cursor from the previous execution is closed and the resulting rows are discarded, regardless of whether the re-execution is with the same input parameters. If new input values are required, the new values are assigned to the input parameter columns, and the query is re-executed. However, for re-execution, no re-parse of the statement or re-bind of input and output parameters is required; this improves the overall performance.

If array fetching is enabled, multiple rows are fetched in one call to the driver. Space is allocated in the driver to buffer multiple rows fetched in one operation. Multiple rows can be fetched to the buffer, and are returned to the application virtual machine when requested. If no rows are left in the buffer and more rows are requested, another array fetch operation is executed.

Inserts can also be buffered. When array inserting is enabled, the driver places the rows to be inserted in a buffer. When the buffer is full, or if required because of another event, the rows are flushed to DB2. The rows in the buffer are inserted with a multi-row insert.

Note:

To manually enter data in the database, use the LN utility **bdbpost**. Use this utility to place data into a new database table or to append data to an existing database table. When you use **bdbpost**, you can set particular options.

If you use **bdbpost** with the **-f** option, by default, the rows are buffered and are flushed when the array buffer is full. You must specify the array size, otherwise buffering is not carried out. Specify the array buffer size in the **db2_storage_param** file on a per table basis, or globally, using an environment variable or resource variable. The following sections describe the environment variables, resource variables, and parameter files.

Setting driver behavior

Several facilities can configure the LN DB2 driver, the most common being through driver resources. Two other facilities are environment variables and the parameter files. The driver resources and environment variables are described in more detail in "Driver Resources and Environment Variables" on page 51, while the parameter files are described in "Parameter File Formats and Configuration Options" on page 69.

Driver resources

The database driver resources are parameters you can set to modify the behavior of the LN DB2 driver. These parameters are set in a file called the resource file (**db_resource**). One resource file is available for all database drivers that run in an LN environment. This resource file contains all the resources for all the database driver types. When you first invoke the file, a database driver reads the parameters set in the resource file.

The resource file can contain multiple entries, with one entry for each line. Each entry is used to set a single resource parameter, with the resource name followed by a colon, and then the value to which the resource must be set. The following is an example of the contents of a resource file that contains two entries:

```
db2_retained_cursors:50
db2_max_open_handles:100
```

When you modify the behavior of the database driver, you must frequently modify the behavior of the LN application virtual machine to take advantage of the characteristics of the database driver. Therefore, two types of database driver resources are available: resources used to modify the behavior of the database driver, and resources used to modify the behavior of the application virtual machine.

Driver resources used to modify database driver behavior are called resources for the server. Driver resources used to modify behavior in the application virtual machine are called resources for the client.

In a UNIX environment, the resource file `db_resource` is located in the `$BSE/lib/defaults` directory, in which `$BSE` refers to the directory where the LN software environment is installed. In a Windows environment, the resource file `db_resource` is located in the `%BSE%\lib\defaults` directory, in which `%BSE%` refers to the directory in which the LN software environment is installed.

If the database driver and the application virtual machine run on the same machine, only one `db_resource` file will contain all the required resource parameters. If the database driver and the application virtual machine run on separate machines, one `db_resource` file must be located on the machine that runs the database driver that contains the server resources, and one `db_resource` file located on the machine that runs the application virtual machine that contains the client resources.

Besides the default resource file `db_resource`, you can set up an alternative resource file to override resource values for specific users or groups of users. The alternative resource file is specified with the environment variables `USR_DBS_RES` and `USR_DBC_RES`. You can use the `USR_DBS_RES` variable to specify the path to a file that contains an alternative resource file for the server. You must set this variable on the machine that runs the database driver. To specify the path to a file that contains an

alternative resource file for the client, use the `USR_DBC_RES` variable; you must set this variable on the machine that runs the application virtual machine. Any driver resource set in the alternative resource file overrides the setting of the same driver resource in `db_resource`. The following section describes how to set the database driver environment variables.

Environment variables

To override driver resources, use environment variables. Usually, a default set of resource parameters is configured in the resource file. The administrator can override these default settings with environment variables.

Essentially, an environment variable corresponds to each resource parameter. The environment variable name is usually the uppercase equivalent of the resource parameter name. As with the database driver resources, some environment variables can modify the behavior of the database driver (server), while some can modify the behavior of the application virtual machine (client). If you must use a database driver environment variable for the server, to override the corresponding driver resource, you must set the variable on the machine that runs the database driver.

When a database driver environment variable for the client is to be used, to override the corresponding driver resource, you must set the variable on the machine that runs the application virtual machine.

Server environment variables

To override the driver resources for all tables in a database or for specific tables and company numbers in the database, use the environment variables that affect the database driver. To set the database driver server environment variables, three methods are available:

- Use the LN Database Definitions (ttaa4510m000) session and Tables by Database (ttaa4111m000) session.
- Manually modify the LN `tabledef6.x` (`tabledef6.1` for Baan IV, `tabledef6.2` for Baan 5.0 and LN) file.
- Use the standard operating system mechanism.

The recommended method to modify database driver behavior is the LN Database Definitions session. When specific tables and companies must be configured for access with a specific database driver, use the Tables by Database session. These sessions cause environment variables for a particular database driver to override the defaults set in the resource file and allow you to centrally maintain the environment variables.

The Database Definitions session maintains database driver configuration information in a file called `tabledef6.x`, which is in the UNIX directory `$BSE/lib/` or the Windows directory `%BSE%\lib\`. This file resides on the machine where the database driver runs. While we recommend that you use the Database Definitions session to maintain this file, advanced users can manually modify this file. The format of the `tabledef6.x` file is as follows:

```
<table name>:<company number>:<driver type>(<env var>=<value>)
```

If multiple environment variables are to be specified for a single table and company number, these variables are listed in parentheses, and separated by commas. If all tables or all companies are to be specified, you use the asterisk (*) in place of the table name or company number. For example, you can make the following entry in the tabledef6.x file:

```
tccom010:812:db2 (DB2PROF=0.4)
```

In this example, all the queries on table tccom010812, which require at least 0.4 seconds, are logged in the DB2PROF file. Note that this table is considered to have a different database definition from other tables.

If a DB2 driver is already running, but accesses a different table, a separate driver will be started for this table.

Environment variables that appear in the driver specifications of the tabledef6.x file are placed into the driver's environment before the file is invoked, so the variables are available to the driver at startup.

If the default database driver resources must be overridden for specific users, use environment variables. These environment variables override the settings created in the Database Definitions session for these users.

Client environment variables

To override the client resources that affect the application virtual machine, use the database driver environment variables that affect the client. You must set these environment variables on the machine that runs the application virtual machine, and they must be set using the standard operating system methods used to set environment variables. Any client environment variables used override the equivalent resource variables set for the client in the db_resource file.

Storage parameter file

The storage parameter file provides a way to specify the distribution of table and index data in various segments. The database driver uses storage parameters whenever you execute a DDL statement, such as a create table or create index statement. This is an example of an entry in the storage parameter file:

```
*:*:*:T_SPACE dataspace I_SPACE indexspace
```

In this example, the database driver adds the 'in *<tablespace name>* index in *<index tablespace name>*' clause to the create statement during table creation.

A storage parameter file is defined for each database driver. The storage parameter file for the LN DB2 driver is called db2_storage_param and is located in the UNIX directory \$BSE/lib/db2 or the Windows directory %BSE%\lib\db2. The format of the storage parameter file is described in "Parameter File Formats and Configuration Options" on page 69.

The driver will scan storage parameter and driver parameter files top-down. The **first** matching line will be used (not the **best** matching line).

Note:

Infor Baan IVc has one single file, called db2_storage, for both storage parameters and driver parameters. See "Parameter File Formats and Configuration Options" on page 69 for more information.

To maintain security, the LN DB2 driver controls user access to the database and database objects. The LN database administrator (DBA) module uses LN sessions to enable the DBA to control access to the database. Using the DBA module makes DBA tasks easier and less prone to errors than directly using database driver tools. This chapter first discusses how the LN DB2 driver handles issues related to database security, and then describes the DBA module and the db2v5_maint tool.

This chapter discusses the following topics:

- Database security
- DBA module
- db2v5_maint tool

Security

Database security comprises two aspects: object security and authentication. Object security refers to the process of determining whether a user who has access to the database is authorized to access particular database objects. Authentication refers to the process of determining whether a user is authorized to access the database. To ensure security, object security and authentication use the concept of groups.

This section first describes the group concept, and then describes how the LN DB2 driver provides object security and authentication.

Groups

In any RDBMS, a group is defined as a collection of database users. All users assigned to a group are granted the same database privileges. After you define a group with a particular set of privileges, you can assign users to that group. Using groups simplifies management of a large number of groups with common requirements.

An LN group consists of a database name and methods for providing object security and authentication in the database. The LN group name is the same as the name of the database that contains the LN

data in the RDBMS. To provide object security and authentication, the LN group uses the mechanisms of the RDBMS.

An LN group is a superset of the usual RDBMS group because an LN group includes the RDBMS group and also the database name and an RDBMS login.

In DB2, an LN group consists of three components: a database, a login (for authentication), and an operating system group (for object security). The DB2 database has the same name as the LN group. The login is the same name as the LN group, and is assigned database owner privileges in the database. An operating system group is created, which becomes the target for privileges granted on objects in the database. Users are associated with the operating system group and, therefore, inherit the privileges granted to the group. The advantage of having a group table is that the members of the group can share and operate on the same data in a single table.

Note:

On Windows, the login for the LN group is always set to **baan**. The operating system group will have the same name as the DB2 database, and the user **baan** must belong to this group.

For example, users **Maria** and **John** can both be assigned to LN group **baandb**. Group **baandb** owns the tables and grants select, insert, delete, and update privileges to the operating system group; therefore, users **Maria** and **John** inherit the select, insert, delete, and update privileges granted to the operating system group, which allows these users to access and manipulate LN group table data.

The LN user is shielded from the RDBMS groups. The database driver performs all the processing required to use the RDBMS groups. Only the database administrator must be concerned about the RDBMS groups, and the LN DBA module allows the administrator to easily maintain the RDBMS groups.

Object security

In DB2, if a user creates an object such as a table, the user becomes the owner of that object, and only the owner can access the object. Other users can only access the object if these users have been granted privileges to do so. In an LN environment, in which many users access the same tables in the DB2 database, a mechanism has been developed to allow users to share these tables.

To allow multiple LN users to share the same DB2 table, the group concept is used. An LN group maps users to a database in DB2 and ensures that members of the group have sufficient privileges to access data in the LN group's tables.

To implement the LN group concept, the LN DB2 driver uses an operating system group. Initially, the group is granted **connect** and **createtab** privileges to the database. Whenever the LN group user creates a new table, select, insert, delete, and update privileges are granted to the operating system group.

Any user associated with the operating system group automatically inherits these privileges and can individually perform these operations on the LN group table.

When new users are added, these users only have to be associated with the operating system group. These users automatically inherit all privileges currently granted to the operating system group, without the need to grant privileges on every group object in the database to the user. When the user is dropped from the operating system group, these privileges are revoked and the user no longer has access to

tables in that operating system group. If the privileges to operate on the tables are explicitly granted to the user, these privileges must also be explicitly revoked when the user is dropped from the operating system group. The overhead of adding users is greatly reduced by granting privileges to the operating system group. This also provides flexibility and ease of maintenance.

Authentication

To determine whether a user is authorized to access a database, DB2 uses the operating system's authentication mechanism. When a database has been created, an administrator or DB2 database owner grants access permissions to an operating system group. Access permission can be granted for the entire database or for specific database objects.

LN users mapped to operating system users are permitted to establish a connection to DB2 with their own user name and password. To prevent unauthorized users from accessing the database, non-mapped users cannot establish a connection to the database.

The LN group user corresponds to the target database. The group name is the same as the database name. The members that belong to this group inherits the group privileges and can establish a connection to the database that uses a valid password stored in encrypted form in the driver administration files.

To add or drop a user from an LN group, use the LN Database Administration (DBA) module or the db2v5_maint utility (db2v5_maint6.2 for UNIX; db2v5_maint.exe for Windows). Note that any DBA module or db2v5_maint action will not affect the operating system user or group. This action only affects the LN administration files. For example, to change a user's password, you must change the user's operating system password and then change the password in LN using the DBA module or db2v5_maint.

Users authorized to access the database are registered in the LN driver administration files. The user name and password each LN user will use to log onto DB2 is maintained in the UNIX file \$BSE/lib/db2_users or the Windows file %BSE%\lib\db2_users.

All the LN users and their corresponding DB2 logon names, passwords, and the name of the group to which the users are assigned are defined in the file db2_users. The format of each entry in this file is as follows:

```
<Infor ERP user>:<DB2 user>:<Encrypted DB2 User password>:  
<Infor ERP group name>
```

The LN application virtual machine starts the LN DB2 driver on behalf of the user. From the db2_users file, the driver identifies the DB2 user and the user's password, and then establishes the connection to DB2.

The group logon procedure also includes a password, which is defined in the UNIX file \$BSE/lib/db2_groups or the Windows file %BSE%\lib\db2_groups. The format for these files is as follows:

```
<Group name>:<Encrypted group password>
```

The group name is the same as the database name.

DBA module

The DBA module maintains the database administration files used by the DB2 database driver. This module allows an administrator to register authorized users and provide users with access to data. This tool is provided with the LN DB2 driver to maintain the administration files the database driver needs at runtime. The administration files are stored in the directory \$BSE/lib/db2 for UNIX or %BSE%\lib\db2 for Windows.

The DBA module implements the user and group administration functions for all LN database drivers. The **db2v5_maint** utility (**db2v5_maint6.2** for UNIX; **db2v5_maint.exe** for Windows) is an executable program called by the DBA module that implements the functions needed to make changes in DB2. Although you can call the **db2v5_maint** utility from outside the DBA module, this is not recommended because the users and groups tables are not modified by **db2v5_maint**.

The DBA module is described in more detail in *Infor Enterprise Server 8.x Administrator's Guide (U8854 US)*.

Utility programs db2_admin6.2 and db2v5_maint6.2

In a UNIX environment, tools are provided with the Infor Baan IVc DB2 driver to administer the database. This utility is called db2v5_maint6.2.

Note: This paragraph is only applicable to Infor Baan IVc.

The tool db2_admin6.2 is a shell script that enables administration of users and groups. The tool db2v5_maint6.2 is an executable program that performs the actual maintenance on the administration files such as users, group, and storage files. The db2_admin6.2 shell script provides a user interface that calls db2_maint6.2 to do the actual work.

You must use the db2_admin6.2 user interface to administer the database files. The following section describes the db2_admin6.2 interface.

Make sure that BSE, DB2INSTANCE and DB2INSTANCEPATH environment variables are set to the appropriate values.

This list contains several definitions of terms used in the utility:

- BSE: Directory containing the Infor Baan IVc software
- DB2INSTANCE: Name of the DB2 instance which contains the Infor Baan IVc database
- DB2INSTANCE PATH: Instance directory path, usually the home directory of the instance owner.

You must be logged on as super user or DB2 DBA. After you start db2_admin6.2, the **Main** menu displays:

```
M A I N   M E N U
1.  User Administration.
2.  User Information.
3.  Escape to shell.
```

```
e. Exit.
```

The db2_admin6.2 tool provides user administration and information facilities. These facilities are described in the following sections.

If you select the **Escape to Shell** option, a UNIX shell starts. To return to the **Main** menu, you must select **Exit** or Ctrl+D to kill the shell

The User Administration menu

If you select the **Add User** option, the **User Administration** menu displays, as shown in this figure:

```
USER ADMINISTRATION
1. Add User.
2. Drop User.
3. Change DB2 Users Password.
4. Add Group.
5. Drop Group.
6. Change Groups Password.

e. Exit.
```

This menu enables you to choose from a number of user administration options. These options are described in the following sections.

The Add User option

With this option, a user who is already known to the DB2 database can be added to a particular group. The user is consequently added to the \$BSE/lib/db2/db2_users file.

To add a particular user to a group, you must specify the following information:

- The group to which the user must belong.
- The group password (not echoed).
- The Baan IV user name.
- The DB2 user name.
- The DB2 user's password (not echoed).

The new user cannot be an existing user or group name. In other words, there must not already be an entry in the db2_users or db2_groups file with the same name. Multiple Baan IV users cannot share the same DB2 user name. The new user must first be added at UNIX level and assigned to the UNIX group which represents the Baan group.

If the DB2 DBA or a super user adds a user to the group, the user will inherit all object privileges granted to the group user.

The Drop User option

With this option, a user who belongs to a particular group can be removed from the group. The user is consequently deleted from the \$BSE/lib/db2/db2_users file.

To remove a particular user from a group, the following information must be specified:

- The group to which the user belongs.
- The group password (not echoed).
- The Baan IV user name.

If the super user or a Baan administrator (bsp) user removes a user from the group, the user will no longer be able to access the database through Infor Baan IVc. However, the user can still access the database outside of Infor Baan IVc. To prevent this, the user must be removed from the UNIX group.

The Change DB2 Users Password option

Use the Change DB2 Users password option to change a password. This option updates the \$BSE/lib/db2/db2_users file with the new specified password. Note that this password is the UNIX password. Therefore, every time before the DB2 user password is changed, the UNIX password must first be updated.

To change the password of a particular user, the following information must be specified:

- The Baan IV user name.
- The DB2 user name.
- The new user password (not echoed).

The Add Group option

You can use this option you can add a new group to the administration file, which is a user/group already known to the DB2 RDBMS. The connect and create tab privileges are consequently given to the group user, and the group is added to the \$BSE/lib/db2/db2_groups file.

To add a group, you must specify the following information:

- The group name.
- The group password (not echoed).

A new group cannot have an existing user name or group name in the db2_users or db2_groups file. The group name must be both an existing UNIX group and a UNIX user.

The Drop Group option

With this option, you can remove an existing Baan IV group. The 'connect' and 'create' tab privileges are revoked from the group user and the group entry in the \$BSE/lib/db2/db2_groups file is removed.

To remove a group, you must specify the following information:

- The group name.
- The group password (not echoed).

The group logon is not removed from UNIX.

A group can only be removed if no users exist in the group, in other words, if the db2_users file contains no entries for this BAAN IV group.

The Change Groups Password option

With this option, you can change a group password. The \$BSE/lib/db2/db2_groups file will consequently be updated with the new specified password. Note that you must change the password of the group user if the group user password is changed at UNIX level.

To change the password of a group, you must specify the following information:

- The group name.
- The new group password (not echoed).

The User Information menu

If the **User Information** option is selected on the Main menu, the following menu appears:

```
USER Information
1. List Users.
2. List Groups.
3. List Storage.
4. Edit Storage.

e. Exit from this menu.
```

The options are described in the following sections.

The List Users option

This option displays all the users in the \$BSE/lib/db2/db2_users file, along with the DB2 user name and group name to which the users belong.

The List Groups option

This option displays all groups, along with all users included in each group.

The List Storage option

This option retrieves the parameters for a table or index from the \$BSE/lib/db2/db2_storage file.

You must specify the following information:

- The Baan IV user name.
- The DD Table name, for example, ttadv000.
- The Company number, for example, 000.
- The Object type (table or index), for example, T, I, or I1.

For tables, this information appears:

- The Owner (private/group).
- The Default index optimization.
- The Refresh time (has become obsolete).
- The DB2 storage parameters.

For indexes, the index optimization field values appear.

The Edit Storage option

This option will start the UNIX vi editor for the `$BSE/lib/db2/db2_storage` file, which enables you to change the parameters in this file. After you exit the editor, the **User Information** menu reappears.

If you change the `db2_storage` file, this action can have fatal consequences. Be sure to keep a copy of the file. If the storage file is lost, tuned parameter settings are lost, and, as a result, object security can be inconsistent.

db2v5_maint tool

The DBA module performs administration tasks by invoking **db2v5_maint** (**db2v5_maint6.2** for UNIX; **db2v5_maint.exe** for Windows). Although the user can directly call **db2v5_maint**, enabling the DBA module to invoke **db2v5_maint** is preferable.

Note: For Infor Baan IVc, the DBA module is supported on Windows only.

This section describes the administrative tasks the **db2v5_maint** utility performs, and the options and arguments of these tasks. Unless the options are listed in brackets, all options listed must be specified. For options in braces, {}, you must specify one set of the options in the brackets. Options in square brackets [] are optional.

Four additional options, `-b`, `-q`, `-n`, and `-F`, are available for each function. These options are defined as follows:

- `-b`: Allows you to process in batch mode.
- `-q`: Redirects error messages to a specified error file.
- `-n`: Will not update LN files `db2_users` or `db2_groups`.
- `-F`: Validates the user, group, or password, but will not make changes.

The administrative tasks the **db2v5_maint** utility performs (**db2v5_maint6.2** for UNIX; **db2v5_maint.exe** for Windows) are as follows; the Windows version is shown:

- Adds a user to a group:

```
db2v5_maint [-n] -a<Infor ERP user> -m<DB2 user> -p<DB2 password>
-G<Group name> {-F -c<dba> -i<dba password> | -P<Group password>}
```

- Removes a user from a group:

```
db2v5_maint [-n] -d<Infor ERP user> -G<Group name>
{-P<Group password> | -F -c<dba> -i<dba password>}
```

- Adds a group:

```
db2v5_maint [-n] -A<Group name> -P<Group password>
[-F -c<dba> -i<dba password>]
```

- Removes a group:

```
db2v5_maint [-n] -D<Group name>
{-P<Group password> | -F -c<dba> -i<dba password>}
```

- Changes a user password:

```
db2v5_maint [-n] -r<Infor ERP user> -m<DB2 user> -p<new password>
```

- Changes a group password:

```
db2v5_maint [-n] -R<Group name> -P<new password>
```

- Checks a user password:

```
db2v5_maint -h -m<DB2 user> -p<DB2 password> -G<Group name>
```

- Displays version information:

```
db2v5_maint {-v | -V}
```

- Displays usage:

```
db2v5_maint {-U | ?}
```

- Sets environment variables:

```
db2v5_maint -O<list of environment variables and their settings>
```


The LN DB2 driver provides a facility for monitoring system performance. This facility includes a profiling facility that allows the user to gather timing information for SQL statements, and a statistics facility to gather driver-wide statistics; also, the driver provides a facility for troubleshooting problems. This chapter discusses the profiling, statistics, and debugging features of the LN DB2 driver.

This chapter discusses these topics:

- Profiling
- Gathering statistics
- Troubleshooting

Profiling

The database driver allows users to log timing aspects and statistics. This functionality is useful for tuning because the information can help identify performance bottlenecks and can provide input into the tuning process.

The database driver's profiling option provides the user with a way to gather the timing of SQL statements being executed; however, logging all statements with their timings will result in a log file too large to be correctly analyzed.

You can define a logging threshold in which only statements that take more than a predefined number of seconds are logged.

With profiling, the following information is logged: the RDBMS request, the elapsed time, the user name, the date, and the time. The maximum precision that can be specified is 0.01 seconds.

To determine which table actions are most time-consuming, set the DB2PROF environment variable to a number of seconds. For example, you can set DB2PROF as follows:

```
export DB2PROF=5.0
```

This command sets DB2PROF to five seconds, which causes statements that take more than 5.0 seconds of elapsed time to be logged to the file db2prof. The file db2prof is stored in the directory where the driver was started.

To view statement execution time for individual tables, the user can set the DB2PROF environment variable in the UNIX file \$BSE/lib/tabledef6.2 or the Windows file %BSE%\lib\ttabledef6.2. For example, you can make the following entry in the file:

```
tccom010:812:db2 (DB2PROF=0.4)
```

In this example, all queries on table tccom010812, which require more than 0.4 seconds, are logged in the db2prof file. Note that a separate driver is started for this table. The table is considered to have a different database definition.

Profiling example

When you perform profiling, each phase in the SQL query processing that exceeds the profiling value is printed. The following example text provides a sample DB2PROF file:

```
1999-04-01[11:49:04]: Profiling value = 2.00 sec
----- Profiling value exceeded -----
<user001><tdsls4401m000>:1999-10-08[22:10:32.560]:
Time (exec) : 7.661545 seconds
SQL statement:
SELECT a.t_acti,a.t_akcd,a.t_amld,a.t_amod,a.t_bind,a.t_bkyn,a.t_bqco,a.t_bqua,a.t_ccty,
a.t_cdis_1,a.t_cdis_2,a.t_cdis_3,a.t_cdis_4,a.t_cdis_5,a.t_cfrw,a.t_chan,a.t_citg,a.t_ci
tt,a.t_clot,a.t_clyn,a.t_cmnf,a.t_comq,a.t_coop_1,a.t_coop_2,a.t_coop_3,a.t_copr_1,a.t_c
opr_2,a.t_copr_3,a.t_corn,a.t_corp,a.t_cors,a.t_cosn,a.t_cpcl,a.t_cpcp,a.t_cpln,a.t_cprj
,a.t_cpva,a.t_crcd,a.t_crte,a.t_csgs,a.t_ctcd,a.t_ctrj,a.t_cups,a.t_cuqs,a.t_cvat,a.t_cv
ps,a.t_cvqs,a.t_cwar,a.t_cwoc,a.t_damt,a.t_ddta,a.t_disc_1,a.t_disc_2,a.t_disc_3,a.t_dis
c_4,a.t_disc_5,a.t_dldt,a.t_dmde_1,a.t_dmde_2,a.t_dmde_3,a.t_dmde_4,a.t_dmde_5,a.t_dmse_
1,a.t_dmse_2,a.t_dmse_3,a.t_dmse_4,a.t_dmse_5,a.t_dmth_1,a.t_dmth_2,a.t_dmth_3,a.t_dmth_
4,a.t_dmth_5,a.t_dmt_1,a.t_dmt_2,a.t_dmt_3,a.t_dmt_4,a.t_dmt_5,a.t_dqua,a.t_drct,a.t
dtrm,a.t_elgb,a.t_fcop_1,a.t_fcop_2,a.t_fcop_3,a.t_invd,a.t_invn,a.t_iss, a.t_item,a.t
_ldam_1,a.t_ldam_2,a.t_ldam_3,a.t_ldam_4,a.t_ldam_5,a.t_leng,a.t_lsel,a.t_lseq,a.t_oamt,
a.t_odat,a.t_ofbp,a.t_oltp,a.t_opol,a.t_opri,a.t_oqua,a.t_orno,a.t_pmde,a.t_pmse,a.t_pms
k,a.t_pono,a.t_prdt,a.t_pric,a.t_pror,a.t_ratd,a.t_ratf_1,a.t_ratf_2,a.t_ratf_3,a.t_rats
_1,a.t_rats_2,a.t_rats_3,a.t_ratt,a.t_rdt, a.t_revi,a.t_scmp,a.t_scon,a.t_sdsc,a.t_shpm,
a.t_sqnb,a.t_stad,a.t_stbp,a.t_stcn,a.t_stdc,a.t_stpr,a.t_thic,a.t_ttyp,a.t_txta,a.t_vco
p_1,a.t_vcop_2,a.t_vcop_3,a.t_widt,b.t_txts,c.t_cadr,d.t_kitm,d.t_dsca,d.t_citg FROM ((
baan.ttdsls401570 AS a LEFT JOIN ( baan.ttdisa001570 AS b LEFT JOIN baan.ttcibd001570
AS d ON d.t_item = b.t_item) ON b.t_item = a.t_item) LEFT JOIN baan.ttcmcs003570 AS c
ON c.t_cwar = a.t_cwar) WHERE ((CAST(? AS INTEGER) = CAST(? AS INTEGER) AND a.t_oltp
= ?) OR (CAST(? AS INTEGER) != CAST(? AS INTEGER) AND a.t_oltp != ?)) AND (b.t_item =
a.t_item OR b.t_item IS NULL OR a.t_item IS NULL) AND (d.t_item = b.t_item OR d.t_item
IS NULL OR b.t_item IS NULL) AND (c.t_cwar = a.t_cwar OR c.t_cwar IS NULL OR a.t_cwar
IS NULL) AND a.t_orno >= ? AND a.t_orno <= ? ORDER BY 104,108,126 OPTIMIZE FOR 5 ROWS
```

Gathering statistics

The database driver provides an option to gather driver-wide statistics performed on actions, such as:

- Number of cursors: opened, closed, or current open.
- Number of parses, binds, executes, and fetches.

- Number of logons: sessions.
- Number of inserts, updates, and deletes.
- Number of commits and rollbacks.

For each action, the cumulative elapsed time spent, and the average time, is logged. You can enable the statistics with the environment variable DB2STAT. If the variable is set to zero, a statistics report is generated when the driver terminates (exit from Infor ERP Tools or session). If a value **n** greater than zero is specified, the driver logs an incremental report every **n** seconds (the driver must be active). The statistics report is written to the file DB2STAT in the current directory.

The following are examples of how you can set DB2STAT:

```
export DB2STAT=0
export DB2STAT=30
```

In the first example, DB2STAT is set to zero; with this value, only a final report is generated. In the second example, DB2STAT is set to 30; this logs a report every 30 seconds while the driver is active. The statistics report is logged in the file db2stat in the current directory.

The following example provides a sample output of DB2STAT.

Because the report is generic for all databases, some information, such as the specific row actions, might not be appropriate for a particular database driver.

```
<3472> 2009-06-23[16:36:47]: Statistics [interval = 300]
```

DB-Cursor	Open	Close	Parse	Bind	Define	Execute	Fetch	Break
Count	7	7	7	7	13	9	5	5
Time (s)	0.0001	0.0001	0.0003	0.0001	0.0002	0.0100	0.0037	0.0000
Avg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0007	0.0000
Count	DubIns	DubDel	DubUpd	db.eq	db.eq*			
Time (s)	0	0	0	0	0			
Avg	0.0000	0.0000	0.0000	0.0000	0.0000			
Count	BlobRd	BlobApp	BlobSz	BlobClr				
Time (s)	60	59	61	1				
Avg	0.0198	0.3063	0.0085	0.0008				
3/4GL	CrIdx	DrIdx	CrTbl	ClTbl	DrTbl	LkTbl	NrRow	
Count	0	0	0	0	0	0	0	
Time (s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Avg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Count	Logon	Logoff	Commit	Rollback	ReadOnly			
Time (s)	1	1	1	1	0			
Avg	0.0069	0.0014	0.0051	0.0723	0.0000			
	0.0069	0.0014	0.0051	0.0723	0.0000			

In the previous example, the first section refers to fetch cursor actions, the second section refers to row actions, the third section refers to lock actions, the fourth section refers to update cursors, the fifth section refers to table actions, and the sixth refers to transaction or database actions. The first section of the summary lists types of fetches and updates, the second section lists fetch optimization, and the third numbers the cursors that were forced closed, the open cursors, and sessions.

The tuning options to improve performance, as a result of studying the db2stat file, are as follows:

- Index optimization.
- Extend refresh time.
- Separate data from indices in tablespaces.

To check I/O times and process information, you can also use the DB2 **db2evmon** utility. For more information, refer to IBM DB2 documentation.

Troubleshooting

The LN DB2 driver provides a facility for troubleshooting problems. You can trace the actions the driver performs and store them in a log file. Additionally, any errors that occur are also logged. The following sections describe how to log trace information and how to find and interpret the error log.

Logging database driver trace information

The database driver provides an option to trace online information about the actions the driver performs. The resulting log file contains debugging information that can help solve problems.

If tracing is enabled, the information stored in the log files includes the following:

- Table and index information (data dictionary).
- The SQL statements being executed.
- Values of the input and output bind variables.
- Other function-level debug statements.

To enable tracing, use the environment variable DBSLOG. Debugging information is appended to the dbs.log file in the current directory. To enable tracing, enter the following command:

```
export DBSLOG=0560
```

To allow you to enable tracing strictly for categories of interest, several tracing categories are defined.

Logging errors

In a UNIX environment, the driver logs error messages in the log files in the \$BSE/log directory. The log files are called log.db2 and log.db2.mesg.

In a Windows environment, the driver logs error messages under the application logs in the Windows Event Viewer. To see the messages, click **Start**, point to **Programs and Administrative Tools (Common)**, and click **Event Viewer**.

You can retrieve the following information from the log files:

- The user name, date, time, source file, and line number.
- The function called.
- The error code returned by the database.
- The database error description.
- The BDB error code returned to the application.
- Sometimes, the failing SQL statement.

If a database error occurs, an attempt is made to map the database to some known or anticipated error condition. Generally, these mapped BDB errors have corresponding error numbers that fall within the range of one to 1,000. If a database specific error occurs, the error is mapped to the BDB error code over 1,000 with the following formula:

- $\text{abs}(\text{error_code}) + 1000$

Therefore, if an error -1652 occurs, BDB error 2652 is returned to the application.

Usually, the log entries from the display driver, application virtual machine, and database driver contain enough information to determine the nature of and solution to the problem. Whenever an error is encountered with an error code greater than 1,000, you are advised to check the log entries from the database driver.

The LN DB2 driver is designed to permit tuning for optimal performance. Several parameters used by the database driver are preset with default values that must provide acceptable system performance; however, because every environment is different, the default values of these parameters might not provide optimal performance. This chapter discusses the LN DB2 driver parameters that can be set, and the changes in driver behavior you can expect when you adjust these parameters.

This chapter discusses:

- Cursor management
- Array interface
- Optimistic and pessimistic reference checks
- Locking behavior

Cursor management

The LN DB2 database driver has two resource variables that influence the cursor handling: `db2_max_open_handles` and `db2_retained_cursors`. The following list describes these resource variables:

- **db2_max_open_handles:**

This resource influences the number of statement handles (DB2 cursors) that are kept for reuse by the driver. The default value is 100.

Whenever the application closes a query, most resources in the driver are freed. However, if the DB2 cursor being allocated will soon be reused, closing and opening of the cursor can be avoided. To avoid closing and re-opening cursors, the cursor is put in a free list that contains all cursors, which are disassociated from a query. When a request for a new cursor comes, a free cursor is taken from the free list. If no free cursors are available, a new cursor is opened; this way, the number of times a cursor is closed and opened is reduced. When the number of all open cursors exceeds the value of `db2_max_open_handles`, the DB2 cursor will be closed.

- **db2_retained_cursors:**

With this resource, the number of inactive cursors can be set; in this way, you can reduce the number of open cursors.

If a query fetches all the rows, a cancel is issued on the query, which means that DB2 is notified that no additional fetches will be performed; this gives DB2 the chance to free particular query resources. After the cancel, you can repeat the query without reopening (parsing, binding) the cursor. The driver does not know if a cursor in cancel state will be reused later. In a worst case scenario, the cursors are not reused, and the cursor will continue to be reserved for the query.

After all rows have been fetched, the driver has a facility to put inactive cursors (in cancel state) in a cancel list, so that these cursors become candidates for being assigned to a different query. The number of inactive cursors to be kept in this list is defined by the resource `db2_retained_cursors`, which defaults to 20.

If more than 20 cursors are in the cancel list, and a request for a new cursor is issued, the free list is checked. If a cursor exists on the free list, the cursor will be used for the new cursor.

If no cursors exist on the free list, the least recently inactivated cursor is used for this new cursor. This cursor is disassociated from the original query and assigned to a new query, which does parsing and binding on this cursor. When the original query is doing a re-execute, the driver detects that the cursor has been associated with another query and will get a new cursor, and then reparse and bind the query again.

If you increase the value of `db2_retained_cursors`, less reparsing and rebinding of queries occurs, which reduces CPU resources. However, the number of open cursors and memory is increased.

Array interface

The LN DB2 driver can use the DB2 array interface for array fetches and array inserts. With the array interface, communication between the LN DB2 driver and DB2 is more efficient: multiple rows are fetched or inserted simultaneously. However, because multiple rows must be stored in a buffer in the LN DB2 driver, more memory is consumed. Array interfacing is useful if you access a remote database, because this helps reduce the number of network round-trips.

To adjust the size of the buffers that hold array rows, you must set the **`db2_max_array_size`** resource variable or the `DB2_MAX_ARRAY_SIZE` environment variable. You can set the array buffer size on a per-table basis using the **`ARR_SIZE`** storage parameter in the `db2_storage_param` file. The following example shows an entry in the storage file to adjust the array size:

```
*:*:T:group:0400:5: ARR_SIZE 5 T_SPACE DATASPACE I_SPACE INDEXSPACE
```

Note:

If the environment variable `ARR_SIZE` is set, and the array size is specified in the storage parameter file, the size specified in the storage parameter file overrides the value set by environment variable.

You can enable/disable the array fetch interface with the environment variable **`DB2_ARRAY_FETCH`** or the resource variable **`db2_array_fetch`**. You must set the array size; otherwise, the inserts will not be buffered.

You can enable the array insert interface with the environment variable **`DB2_ARRAY_INSERT`** or the resource variable **`db2_array_insert`**. By default, array inserts are enabled when data is placed in the database tables using the **`bdbpost`** utility with the **`-f`** option.

Query tuning

This section describes how to externally influence the query generation performed by the DB2 driver.

Concatenated expressions

LN can use concatenated expressions, which operate on a combined column. The following are concatenated expressions that exist on combined columns:

- select >=
- select >
- select <=
- select <
- Select between and

For example, a Baan SQL statement can include a where clause:

```
WHERE comb >= {"tt", "adv", "000"}
```

Here, for example, comb is a combined column of columns c1, c2, and c3. This expression selects the following ranges of rows:

- c1 = "tt" and c2 = "adv" and c3 >= "000"
- c1 = "tt" and c2 > "adv"
- c1 > "tt"

The DB2 driver can allow DB2 to solve the WHERE clause using three different techniques: nested, iterative, and filter. These techniques are introduced because the DB2 optimizer cannot efficiently handle these queries in all situations. Instead, full table scans and sort operations can be introduced for these queries.

If you specify a different technique, this causes the DB2 optimizer to make different decisions on how to execute a query.

This method also provides some workarounds for typical optimizer behavior; however, the optimizer behavior can change in different DB2 versions. Therefore, you might be required to tune each version differently, which makes giving guidelines difficult.

To detect long running or bad performing queries, use the DB2PROF variable; subsequently, you can experiment with these various techniques. For a description of DB2PROF, refer to "Driver Resources and Environment Variables" on page 51.

The following list describes the nested, iterative, and filter techniques; these techniques are set in the index optimization field of the db2_driver_param file. For more information, refer to "Parameter File Formats and Configuration Options" on page 69:

- Nested technique:
The three conditions are ORed to the following expression:

- `c1 = "tt" and c2 = "adv" and c3 >= "000" OR`
- `c1 = "tt" and c2 > "adv" OR`
- `c1 > "tt"`

This can be rewritten as follows:

- `c1 > "tt" OR`
- `c1 = "tt" AND (c2 > "adv" OR`
- `c2 = "adv" AND (c3 >= "000"))`

The last expression has a nested AND/OR condition and is referred to as the nested technique.

- Iterative technique:

To resolve one query, multiple SQL statements are issued; these statements do not contain OR conditions, therefore, DB2 can efficiently handle these statements. You can only use the iterative technique for unbounded queries.

The iterative technique uses these conditions:

- `c1 = "tt" and c2 = "adv" and c3 >= "000"`
- `c1 = "tt" and c2 > "adv"`
- `c1 > "tt"`

First, a query with condition 1 is issued. When the query fails to return a row, the query continues with condition 2. When condition 2 does not return a row, the query continues with condition 3. Additionally, if one condition returns all rows, but more rows are required, the driver continues with the next condition.

- The filter technique:

This technique is related to the nested technique, but with a different approach. This technique initially selects too many rows, but then filters out those rows that do not match the total WHERE clause. This technique selects based on the first column in a concatenated index and filters out rows with the NOT() operator.

The query is solved as follows:

- `c1 >= "tt" AND NOT(c1 = "tt" AND (c2 < "adv" OR`
- `c2 = "adv" AND (c3 < "000"))`

The NOT() expression is like an inverted nested query. These rows are filtered out of the initial set determined by the first condition `c1 >= "tt"`.

Optimistic and pessimistic reference checks

To optimize concurrency, the LN DB2 driver supports optimistic and pessimistic reference checks. In lookup reference mode, when inserts are performed in a child table, the driver checks whether the reference exists in the parent table and locks the referenced record to ensure that another user cannot delete it within the current transaction. This approach is called the pessimistic approach.

This approach blocks an insert of another user referencing the same parent row, thereby affecting the concurrency. To avoid this problem, an approach is also available in which a row in the parent table that is not locked is used, depending on the user's choice. This approach is called the optimistic approach. Because the record is not locked, another user can still perform an insert operation, which improves the concurrency. Enabling of this option is configurable with the **dbsinitt** resource variable.

Locking behavior

To read rows from the table, the LN DB2 driver uses the dirty read isolation level. Unless explicitly stated in the query, the queries that return more than a single row do not acquire any type of lock, shared or exclusive. Queries such as SELECT FOR UPDATE, INSERT, DELETE and UPDATE acquire exclusive locks when the SQL_TXN_REPEATABLE_READ isolation level is used. Only in case of lookup references are shared locks acquired when the SQL_TXN_COMMITTED_READ isolation level is used. The locks are retained until the transaction is committed or aborted.

To ensure that queries do not wait indefinitely on locks, the DB2 database configuration parameter LOCKTIMEOUT must be set to something other than the value -1.

Driver Resources and Environment Variables



This appendix lists all the database driver resources and environment variables you can use as configuration parameters to modify the behavior of the DB2 database driver. Some of these resources are used with the client, while others are used with the server. In this context, the client is the LN application virtual machine and the server is the LN DB2 driver. If the LN application virtual machine and the database driver run on separate machines, you must set the client resources on the machine that runs the LN application virtual machine, and also set the server resources on the machine that runs the database driver. You can set the resources for the client and server on both machines.

For a description of how to set the database driver resources and environment variables, refer to "Setting driver behavior" on page 24.

This appendix provides the following information:

- A summary of DB2 resources and environment variables.
- A detailed description of DB2 resources and environment variables.

Summary of DB2 resources and environment variables

These types of resources and environment variables are available to use with the LN DB2 driver:

- Client and server resources used by all LN database drivers.
- Client resources used by all LN database drivers.
- Server resources used by all LN database drivers.
- Resources used only by the LN DB2 driver.

The following four tables provide a summary of each of these types of resources and environment variables. For detailed descriptions of each entry in the tables, refer to "Detailed description of DB2 resources and environment variables" on page 54.

Client and server resources used by all LN database drivers

Resource name	Environment variable	Description
---------------	----------------------	-------------

Client and server resources used by all LN database drivers		
baan_sql_cacherows	BAAN_SQL_CACHEROWS	Defines the size of internal buffers in the query processor
baan_sql_trace	BAAN_SQL_TRACE	Enables you to view SQL query information
rds_full	RDS_FULL	Sets maximum number of rows transferred in one block
tt_sql_trace*	TT_SQL_TRACE	Enables you to view the SQL query information
use_shm_info	USE_SHM_INFO	Enables or disables shared memory use

Note: tt_sql_trace is not applicable to Infor Baan IVc.

Client resources used by all LN database drivers		
Resource name	Environment variable	Description
bdb_debug	BDB_DEBUG	Sets a debugging link between the client and server
bdb_driver	BDB_DRIVER	Sets database specifications
bdb_max_server_schedule	BDB_MAX_SERVER_SCHEDULE	Defines mechanisms for terminating idle database drivers
ssts_set_rows	SSTS_SET_ROWS	Sets number of rows read ahead (single table, single row)
	USR_DBC_RES	Specifies alternative resource file for client
baan_sql_stmt_cache_size	BAAN_SQL_STMT_CACHE_SIZE	Defines the size of the query cache

Server resources used by all LN database drivers		
Resource name	Environment variable	Description
bdb_max_sessions	BDB_MAX_SESSIONS	Defines number of sessions per driver
bdb_max_session_schedule	BDB_MAX_SESSION_SCHEDULE	Defines mechanism for closing idle driver sessions
dbslog	DBSLOG	Enables driver profiling
	DBSLOG_LOCK_PROF	Specifies lock time above which locks are logged
dbslog_name	DBSLOG_NAME	Enables the file name to be specified for logging

Server resources used by all LN database drivers

dbssinit		Specifies optimistic or pessimistic reference checking
enable_refmsg	ENABLE_REFMSG	Causes logging of denied updates of delete actions
	USR_DBS_RES	Specifies alternative resource file for server

Resources used only by the LN DB2 driver

Resource name	Environment variable	Description
db2_array_fetch	DB2_ARRAY_FETCH	Enables/disables array fetching
db2_array_insert	DB2_ARRAY_INSERT	Defines maximum number of rows for array inserts
db2_bidi	DB2_BIDI	Obsolete
	DB2_DUMP_MESG	Specifies location for message log
	DB2_EXPLAIN	Enables Explain Snapshot facility
db2_level1	DB2_LEVEL1	Obsolete.
db2_max_array_size	DB2_MAX_ARRAY_SIZE	Adjusts buffer size for array fetches
db2_max_conn	DB2_MAX_CONN	Deprecated resource
db2_max_open_handles	DB2_MAX_OPEN_HANDLES	Sets number of open cursors per driver connection
db2_max_ret_rows	DB2_MAX_RET_ROWS	Sets maximum number of rows returned from DB2
db2_minmem	DB2_MINMEM	Deprecated resource.
db2_opt_level	DB2_OPT_LEVEL	Sets query optimization level
db2_opt_rows	DB2_OPT_ROWS	Adjusts number of rows retrieved
	DB2_PRINT_ERROR	Enables additional debugging information to be dumped
	DB2PROF	Enables profiling
db2_retained_cursors	DB2_RETAINED_CURSORS	Sets number of cursors in the "break" state per driver connection.
	DB2STAT	Allows you to gather statistics

Resources used only by the LN DB2 driver		
max_sql_buffer	MAX_SQL_BUFFER	Sets the maximum memory allocated for one SQL statement
oj_help_opt_choose_index	OJ_HELP_OPT_CHOOSE_INDEX	Deprecated

Detailed description of DB2 resources and environment variables

This section provides detailed information about the LN DB2 driver resources and environment variables. The driver resources are divided into two sections: those generic to all LN database drivers, and those specific to the LN DB2 driver. Each group of resources is listed in alphabetical order.

Generic driver resources

baan_sql_cacherows / BAAN_SQL_CACHEROWS	
Driver resource	baan_sql_cacherows
Environment variable	BAAN_SQL_CACHE_ROWS
Client/Server resource	Set for both client and server
Type	Integer
Default	71
Description	This variable influences the number of records that are, internally, the query processor caches for sorting, aggregation functions, or prepared sets. When this limit is exceeded, temporary files will be generated. For optimal performance of the internally used hash functions, a prime number must be specified.

baan_sql_stmt_cache_size / BAAN_SQL_STMT_CACHE_SIZE	
Driver resource	baan_sql_stmt_cache_size
Environment variable	BAAN_SQL_STMT_CACHE_SIZE
Client/Server resource	Set for client only
Type	Integer
Default	330

baan_sql_stmt_cache_size / BAAN_SQL_STMT_CACHE_SIZE

Description	This resource sets the number of inactive queries that must be retained for reuse.
-------------	--

baan_sql_trace / BAAN_SQL_TRACE

Driver resource	baan_sql_trace
Environment variable	BAAN_SQL_TRACE
Client/Server resource	Set for client only
Type	Integer (Octal)
Default	0
Description	<p>This variable is introduced to view the LN SQL query information being handled in client and server. When this variable is set, the client prints debug information to the log file (client) or dbs.log file (server). The information contains various categories you can enable separately, but most categories are not useable for the audience of this document. The baan_sql_trace variable has the following relevant values:</p> <ul style="list-style-type: none"> • 0002000: Major query interface logging • 0004000: Detailed query interface logging

bdb_debug / BDB_DEBUG

Driver resource	bdb_debug
Environment variable	BDB_DEBUG
Client/Server resource	Set for client only
Type	Integer (octal)
Default	0
Description	<p>You can use this variable to generate debugging information about the communication between the client and the database driver. When set, the client prints debugging information to standard error (stderr). You can specify the following categories of debugging information:</p> <ul style="list-style-type: none"> • 00001: Server types • 00002: Database actions • 00004: Delayed lock actions • 00010: Reference information • 00040: TSS info from \$BSE/lib/tss_mbstore (UNIX) or %BSE%\lib\tss_mbstore (Windows) • 00100: Permission information

bdb_debug / BDB_DEBUG

To define multiple categories, you can add the octal values. To determine if a given category must be logged, the value is compared bit-wise.

bdb_driver / BDB_DRIVER

Driver resource	bdb_driver
Environment variable	BDB_DRIVER
Client/Server resource	Set for client only
Type	String
Default	None
Description	You can use this variable to set a database specification, usually found in the file tabledef6.2. If you set this variable, all tables will be accessed using the database driver specified, and tabledef6.2 will not be read. The driver specified must be defined in the UNIX file \$BSE/lib/ipc_info or the Windows file %BSE%\lib\ipc_info.

bdb_max_server_schedule / BDB_MAX_SERVER_SCHEDULE

Driver resource	bdb_max_server_schedule
Environment variable	BDB_MAX_SERVER_SCHEDULE
Client/Server resource	Set for client only
Type	Integer
Default	3
Description	This variable defines the mechanism for terminating idle database drivers by the application virtual machine. Whenever the database driver has no more open sessions, the application virtual machine can terminate the database driver. Closing an idle database driver is done after a number of schedule ticks. A schedule tick is generated whenever an LN session is ended. At this point, all idle database drivers will have a schedule counter incremented. When the value of the schedule counter reaches the value of bdb_max_server_schedule, the database driver is terminated.

bdb_max_sessions / BDB_MAX_SESSIONS

Driver resource	bdb_max_sessions
Environment variable	BDB_MAX_SESSIONS
Client/Server resource	Set for server only
Type	Integer

bdb_max_sessions / BDB_MAX_SESSIONS

Default	0 (unlimited)
Description	This variable defines the number of sessions per driver. If any driver has reached this threshold, a new driver will be started to handle any new sessions.

bdb_max_session_schedule / BDB_MAX_SESSION_SCHEDULE

Driver resource	bdb_max_session_schedule
Environment variable	BDB_MAX_SESSION_SCHEDULE
Client/Server resource	Set for server only
Type	Integer
Default	3
Description	<p>This variable defines the mechanism for closing idle sessions in the driver. Whenever the client process has no more references (cursors or queries) to the session, the client can close the process. After a number of schedule ticks, you can close an idle session. A schedule tick is generated whenever an LN session is ended. At this point, all idle sessions will have a schedule counter incremented. When the value of the schedule counter reaches the value of bdb_max_session_schedule, the session is closed.</p> <p>The default for bdb_max_session_schedule is three. Setting bdb_max_session_schedule to one would result in fewer connections from the driver to the RDBMS because whenever an LN session is ended, the corresponding RDBMS session (logon) is closed (logoff).</p>

dbssinit

Driver resource	dbssinit
Environment variable	—
Client/Server resource	Set for server only
Type	Integer (octal)
Default	LN: 1 Infor Baan IVc: 0 Infor Baan IVc new installations: 1
Description	<p>This variable allows you to set flags to specify the optimizations to be used. At this time, legal values are 000 (not set) and 001. Other values are reserved and must not be used.</p> <p>A flag of 00001 specifies that when you check for references in parent tables, an optimistic approach should be used. The referenced row in the parent table is not locked, which improves the overall concur-</p>

dbssinit

rency. If this flag is not set, optimistic reference checking is not used. For more information, refer to "Optimistic and pessimistic reference checks" on page 48.

To define multiple categories, you can add the octal values. To determine if a given category must be logged, the value is compared bit-wise.

A flag of 00020 allows the driver to be less strict when selecting the iterative technique for query tuning. The driver applies the iterative method if the following conditions are met:

- The query has an ORDER BY clause.
- An index is present on one of the query tables so that the index columns match the columns of the order by clause.
- The columns in the combined column match with the columns of this index.
- If the operator is > or >=, the index order must be ascending. If the operator is < or <=, the index order must be descending.
- The WHERE clause can contain an OR condition; however, this OR might not be in the first nesting level of the WHERE clause.
- An expression (exactly one) exists with a combined column.

To use iteration, not all of these conditions are mandatory; nevertheless, if the driver is to use iteration, these conditions must be met. With the driver resource dbssinit, you can weaken or drop these unnecessary conditions. Other values are reserved for future use and must not be used.

dbsslog / DBSLOG

Driver resource	dbsslog
Environment variable	DBSLOG
Client/Server resource	Set for server only
Type	Integer (octal)
Default	0
Description	<p>This variable provides detailed debugging information about the online processing of the driver. The information is logged in the file dbss.log in the driver's current directory. The following debugging categories can be specified:</p> <ul style="list-style-type: none"> • 0000001: Data Dictionary info of tables within the driver • 0000010: Row action information • 0000040: Transaction action information • 0000100: DBMS input/output data

db slog / DBSLOG

- 0000200: Administration file info (SQL drivers)
- 0000400: DBMS SQL statements
- 0001000: General debug statements
- 0004000: Data buffering info (communication)
- 0100000: Lock retries logged (includes session name)
- 0200000: Logs successful locks and longest lock duration in a transaction

To define multiple categories, you must add the octal values. To determine if a given category must be logged, the value is compared bit-wise.

DBSLOG_LOCK_PROF

Driver resource	—
Environment variable	DBSLOG_LOCK_PROF
Client/Server resource	Set for server only
Type	Floating point number
Default	0
Description	Specifies the minimum duration of a lock that must be logged. Any locks of shorter duration will not be logged. This variable specifies the minimum number of seconds, to a precision of milliseconds, that must elapse before a lock is logged. Lock time is calculated as the time from when the first record in a transaction is locked to the time of the commit or abort. This time is the longest time a record remains locked during a transaction. Note that the appropriate db slog categories must be set.

db slog_name / DBSLOG_NAME

Driver resource	—
Environment variable	DBSLOG_NAME
Client/Server resource	Set for server only
Type	String
Default	db s.log
Description	Allows you to specify a file name in which DBS logging information is to be written. If a file with the same name already exists, the file will be used for logging. If the file is locked during write operations, multiple servers can use the same log file.

enable_refmsg / ENABLE_REFMSG

Driver resource	enable_refmsg
Environment variable	ENABLE_REFMSG
Client/Server resource	Set for server only
Type	Boolean
Default	0 (disabled)
Description	Two valid values already exist for this variable: 0 and 1. If this variable is set to 1, a log message is generated in the database driver log file when an update of a delete action has been denied due to existing references. If this variable is set to 0, no log messages are generated.

rds_full / RDS_FULL

Driver resource	rds_full
Environment variable	RDS_FULL
Client/Server resource	Set for both client and server
Type	Integer
Default	5
Description	This variable defines the maximum number of rows transferred between the LN application virtual machine and the driver as one block. If more rows are requested, multiple blocks (and network round trips) are transferred. This variable must be set to the same value for client and server.

ssts_set_rows / SSTS_SET_ROWS

Driver resource	ssts_set_rows
Environment variable	SSTS_SET_ROWS
Client/Server resource	Set for client only
Type	Integer
Default	3
Description	This variable defines the number of rows to be read ahead for a fetch request from the client. The default is three rows, which means that for one fetch request, three rows will be read. For the following two fetch requests, rows will be taken from the client row buffer or fetched from the database without re-executing the query.

tt_sql_trace / TT_SQL_TRACE

Driver resource	tt_sql_trace
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tt_sql_trace / TT_SQL_TRACE

Environment variable	TT_SQL_TRACE
Client/Server resource	Set for both client and server
Type	Integer (octal)
Default	0
Description	<p>This variable is introduced to view the Infor Baan IVc SQL query information being handled in client and server. When this variable is set, the client prints debug information to the display; the server prints information only if the dbalog variable permits information printing. The information contains several categories, which you can enable separately, such as evaluation trees, SQL statements, bind variables, timings, and communication debugging. The possible values of the TT_SQL_TRACE variable and their descriptions are shown below:</p> <ul style="list-style-type: none"> • 000040 (c) : Show queries with their QID • 000200 (c) : Show query execution times • 002000 (c) : Show calls of internal SQL functions • 004000 (c+s) : Show query execution tree • 010000 (s) : Show query evaluation plan • 020000 (s) : Show FullTableScan

use_shm_info / USE_SHM_INFO

Driver resource	use_shm_info
Environment variable	USE_SHM_INFO
Client/Server resource	Set for both client and server
Type	Boolean
Default	1 (enabled)
Description	<p>This variable can be used to enable or disable the use of shared memory to each of the database driver DDs. Two values are valid for this variable: 0 and 1. If this variable is set to 0, shared memory is disabled; if it is set to 1, shared memory is enabled.</p>

USR_DBC_RES

Driver resource	—
Environment variable	USR_DBC_RES
Client/Server resource	Set for client only
Type	String
Default	None

USR_DBC_RES

Description	This variable contains the file specification of an alternative resource file for the client. The file specification is based on the BSE directory and is within double quotes. When set, any resources in the alternative resource file override the same client resources set in db_resource.
-------------	---

USR_DBS_RES

Driver resource	—
Environment variable	USR_DBS_RES
Client/Server resource	Set for server only
Type	String
Default	None
Description	This variable contains the file specification of an alternative resource file for the client. The file specification is based on the BSE directory and is within double quotes. When set, any resources in the alternative resource file override the same server resources set in db_resource.

DB2 driver specific resources

db2_array_fetch/DB2_ARRAY_FETCH

Driver resource	db2_array_fetch
Environment variable	DB2_ARRAY_FETCH
Client/Server resource	Set for server only
Type	Boolean
Default	1 (enabled)
Description	This environment variable can enable or disable the array fetch interface. The valid values are 0 and 1. If this variable is set to 0, the fetch interface is disabled; if set to 1, the fetch interface is enabled. For more information, refer to "Array interface" on page 46.

db2_array_insert/DB2_ARRAY_INSERT

Driver resource	db2_array_insert
Environment variable	DB2_ARRAY_INSERT
Client/Server resource	Set for server only

db2_array_insert/DB2_ARRAY_INSERT

Type	Boolean
Default	0 (disabled)
Description	This environment variable can enable or disable the array insert interface. The valid values are 0 and 1. If this variable is set to 0, the array insert interface is disabled; if set to 1, the array insert interface is enabled. Note that you cannot always enable this option; for example, if references must be checked or updated, or if the application requires immediate response from the driver as to whether the insert is successful, you cannot perform an array insert. The valid values are 0 and 1. If set to 0, the array interface is disabled; if set to 1, the array interface is enabled. For more information, refer to "Array interface" on page 46.

DB2_DUMP_MESG

Driver resource	—
Environment variable	DB2_DUMP_MESG
Client/Server resource	Set for server only
Type	String
Default	\$BSE/log/log.db2 (UNIX) or %BSE%\log\log.db2 (Windows)
Description	This environment variable allows you to specify the location of the log.db2.mesg file. By default, this file is stored in the \$BSE/log (UNIX) or %BSE%\log (Windows) directory. This variable must be the fully qualified file name where error messages will be written.

DB2_EXPLAIN

Driver resource	—
Environment variable	DB2_EXPLAIN
Client/Server resource	Set for server only
Type	Boolean
Default	0
Description	<p>You can use this variable to enable the Enable Snapshot facility. You can set this variable to the following values:</p> <ul style="list-style-type: none"> • 0: No explain output. • 1: Set CURRENT EXPLAIN SNAPSHOT=yes will be sent to the server to enable the Explain Snapshot facility. The explained information is inserted in the SNAPSHOT column of the EXPLAIN_STATEMENT table.

DB2_EXPLAIN

Note that the EXPLAIN_STATEMENT table must have been created earlier.

db2_max_array_size / DB2_MAX_ARRAY_SIZE

Driver resource	db2_max_array_size
Environment variable	DB2_MAX_ARRAY_SIZE
Client/Server resource	Set for server only
Type	Integer
Default	1
Description	If the array interface is enabled, this variable defines the maximum number of rows fetched at once from the RDBMS. To set this value on a per-table basis, use the ARR_SIZE parameter in the db2_storage_param file. For more information, refer to "Array interface" on page 46.

db2_max_open_handles / DB2_MAX_OPEN_HANDLES

Driver resource	db2_max_open_handles
Environment variable	DB2_MAX_OPEN_HANDLES
Client/Server resource	Set for server only
Type	Integer
Default	100
Description	Limits the number of open cursors the driver maintains on a per-connection basis. Each cursor represents one type of SQL statement. A maximum of 200, and a minimum of one open statement handles, are permitted per connection.

db2_max_ret_rows / DB2_MAX_RET_ROWS

Driver resource	db2_max_ret_rows
Environment variable	DB2_MAX_RET_ROWS
Client/Server resource	Set for server only
Type	Integer
Default	0
Description	This variable specifies the maximum number of rows to be returned to the driver by the DB2 engine. The default is 0, which implies that all rows are returned.

db2_opt_level / DB2_OPT_LEVEL

Driver resource	db2_opt_level
Environment variable	DB2_OPT_LEVEL
Client/Server resource	Set for server only
Type	Integer
Default	0
Description	Sets the query optimization level for SQL queries. The default and recommended value is 0, which means that index scans are used. For possible query optimization class values and their respective meanings, refer to the DB2 documentation.

db2_opt_rows / DB2_OPT_ROWS

Driver resource	db2_opt_rows
Environment variable	DB2_OPT_ROWS
Client/Server resource	Set for server only
Type	Integer
Default	5
Description	This option allows you to specify to DB2 that no more than N rows will be retrieved; this enables DB2 to optimize the fetch request. The number of rows retrieved is assumed not to exceed N rows. Based on this value, DB2 determines a suitable communication buffer size to improve performance.

DB2_PRINT_ERROR

Driver resource	—
Environment variable	DB2_PRINT_ERROR
Client/Server resource	Set for server only
Type	Integer
Default	Not set
Description	You can set this environment variable to dump additional debugging information in the \$BSE/log (UNIX) or %BSE%\log (Windows) directory on error conditions.

DB2PROF

Driver resource	—
Environment variable	DB2PROF

DB2PROF

Client/Server resource	Set for server only
Type	Floating point
Default	Not set
Description	If a value is specified in this variable, any statement that takes more than the number of seconds specified will be logged. The maximum precision that can be specified is 0.01 seconds. This variable is used to determine which table actions are the most time-consuming.

db2_retained_cursors/DB2_RETAINED_CURSORS

Driver resource	db2_retained_cursors
Environment variable	DB2_RETAINED_CURSORS
Client/Server resource	Set for server only
Type	Integer
Default	20
Description	This variable is used to specify the number of inactive cursors to retain. These cursors can be reused and, therefore, save prepare/bind overhead, but will also need more resources, such as memory, than if the cursors were closed and released.

DB2STAT

Driver resource	—
Environment variable	DB2STAT
Client/Server resource	Set for server only
Type	Integer
Default	Not set
Description	This variable allows database driver statistics to be reported. If this variable is set to a value N greater than 0, statistics are logged every N seconds while the driver is active. If this variable is set to 0, a statistics report is generated when the driver terminates.

max_sql_buffer / MAX_SQL_BUFFER

Driver resource	max_sql_buffer
Environment variable	MAX_SQL_BUFFER
Client/Server resource	Set for server only
Type	Integer

max_sql_buffer / MAX_SQL_BUFFER

Default	32K
Description	(Level 2 only) To specify the maximum size of memory to be allocated for any one SQL statement, use this variable.

Parameter File Formats and Configuration Options

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Two parameter files affect the behavior of the database driver: the storage parameter file and the driver parameter file. This appendix defines their formats and the parameters used with these files.

For additional information on the storage parameter file, refer to "Storage parameter file" on page 26 and "Array interface" on page 46.

Parameter file formats

The parameter files consist of one or more entries, each of which consists of several fields separated by colons.

Storage parameter file format

The format of an entry in the storage parameter file is as follows:

```
[{<user list>}]<table/module specification>:<company number>:<object type>:[<compress specification>]<storage parameters>
```

Driver parameter file format

The format of an entry in the driver parameter file is as follows:

```
[{<user list>}]<table/module specification>:<company number>:<object type>:group:<table/index optimization>
```

Parameter file field descriptions

User list		
Description	This field consists of a list of comma-separated user names to which this entry applies. If no list is specified, the entry applies to all users.	
Example	{Maria, John}	
table/module specification		
Description	This field consists of a list of comma-separated table names or a module name to which the entry applies. An asterisk (*) indicates all tables.	
Example	ttadv000,ttadv999	Two specific tables
	ttadv	All tables package tt and module adv
	tt	All tables in package tt
	*	All tables
Company number		
Description	This field consists of a list of company numbers to which the entry applies. An asterisk (*) indicates all company numbers.	
Example	000,999	companies 000 and 999
	*	All companies
Object type		
Description	This field consists of a list of object (table or index) identifications to which the entry applies. You can specify the following options:	
	T	Table only
	I	All indexes
	I <index number>	Only specified index
	*	Both table and indexes
Example	I1,I2	Only index 1 and 2
	T	Only for table
Compress specification		
Description	When this field is present the table will be compressed. It is only valid for table entries, not for indexes.	
Example	COMPRESS=1;	Table compression will be used for the selected table(s) (COMPRESS YES)

Group									
Description	This field identifies the owner of the table group must be specified.								
Table/index optimization									
Description	<p>Specific flags related to indexes and tables can be set. When specified on a “T” object entry, this flag defines the default for all indexes. To set the flags for a specific index or table, use the octal values in this table.</p> <p>The octal values in this table can be used to set the flags for a specific index or table:</p> <table border="1"> <tbody> <tr> <td>0000</td> <td>No optimization</td> </tr> <tr> <td>0200</td> <td>Nested</td> </tr> <tr> <td>0400</td> <td>Iterative</td> </tr> <tr> <td>01000</td> <td>Filter</td> </tr> </tbody> </table>	0000	No optimization	0200	Nested	0400	Iterative	01000	Filter
0000	No optimization								
0200	Nested								
0400	Iterative								
01000	Filter								
Storage parameters									
Description	<p>These parameters are defined by the specific database driver implementation and often map to table and index creation options available in the host RDBMS.</p> <p>The following DB2 storage parameters are defined:</p> <table border="1"> <tbody> <tr> <td>ARR_SIZE</td> <td>Set the array size for array fetches and inserts.</td> </tr> <tr> <td>T_SPACE</td> <td>Set the tablespace in which the table is to reside.</td> </tr> <tr> <td>I_SPACE</td> <td>Set the tablespace in which the indexes for a table are to reside. Note that this goes on the T entry and not the I entry.</td> </tr> </tbody> </table>	ARR_SIZE	Set the array size for array fetches and inserts.	T_SPACE	Set the tablespace in which the table is to reside.	I_SPACE	Set the tablespace in which the indexes for a table are to reside. Note that this goes on the T entry and not the I entry.		
ARR_SIZE	Set the array size for array fetches and inserts.								
T_SPACE	Set the tablespace in which the table is to reside.								
I_SPACE	Set the tablespace in which the indexes for a table are to reside. Note that this goes on the T entry and not the I entry.								
Example	ARR_SIZE 5								

Examples

Storage parameter file

Whenever a CREATE TABLE or CREATE INDEX is performed, the storage parameter file is scanned from the beginning. The first entry that matches the table or index is taken, so the order in which the entries are specified is important.

The following example provides a sample of a storage parameter file:

```
{mary, john}ttadv999, ttadv000:000:T:T_SPACE userspace1 I_SPACE index1
{mary, john}ttadv999, ttadv000:000:
tdsfc:505:T: ARR_SIZE 5
*:*:T: T_SPACE dataspace1 I_SPACE index2
*:*:I:
```

In this example, the users **Mary** and **John** create tables ttadv999 and ttadv000 of company 000 in tablespace userspace1. The associated indexes will be created in tablespace index1. All users who create tables in module tdsfc will create tables and indexes in the default tablespace and will use array sizes of five. Other users create tables and indexes in tablespaces dataspace1 and index2.

If the tablespace for a table or index is not specified, the table and index data are created in the default tablespace. To separate the index data, you must also specify a tablespace for the table.

Driver parameter file

The driver parameter file is read-in at driver startup to specify several run time settings. An example of a driver parameter file is as follows:

```
{mary, john}ttadv999, ttadv000:000:T:group:0000:5:
{mary, john}ttadv999, ttadv000:000:
tdsfc:505:T:
*:*:T:
*:*:I:
```

Setting parameters in the driver parameter file

When you put the table or index specifications into the driver parameter file, ensure you do not create multiple specifications that refer to the same group table or index. For example, consider the following user file:

```
mary:mary:<Encrypted Password>:finance
john:john:<Encrypted Password>:finance
edward:edward:<Encrypted Password>:finance
```

In this example, three LN users, **Mary**, **John**, and **Edward** are in the same group, **Finance**.

```
{mary}ttadv:000:T:group:000:0
{joh}ttadv:000:T:group:0400:0
```

```
{edward}ttadv:000:T:group:0400:5  
*:*:I:::
```

Create a common entry for all LN users in the group, as follows:

```
{mary, john, edward}ttadv:000:T:group:0400:5
```

Now, only one set of specifications exists for the group table.

For group objects—table or index—you must create a single entry that consists of all LN users in the group.

Write permission for the driver parameter file must be controlled, and only the DBA must have write permission.

Storage parameter file performance tips

The following list provides several tips you can use to improve performance:

- A default table and index entry that covers all users, tables, and company numbers must be present; the following is an example of such a default table and index specification entry:

```
*:*:T: ARR_SIZE 5  
*:*:I:
```

Conversion from previous porting sets

Existing Baan installations, installed on Infor Baan 5.0 and later before porting set 7.1a, do not have the storage or driver parameter files. These porting sets only contain the db2_storage file.

If the driver parameter file and the storage parameter file do not exist, the LN database driver tries to open the db2_storage file, so that existing installations continue to work.

One Baan session is available, the Convert Table and Index Repository (ttdba0540m000) session, that converts the storage file to the storage parameter file and the driver parameter file. To convert the storage file to the new format, use this session.

Note: This functionality is not available for Infor Baan IVc.

