

DB2

IBM

DB2 Version 9
for Linux, UNIX, and Windows

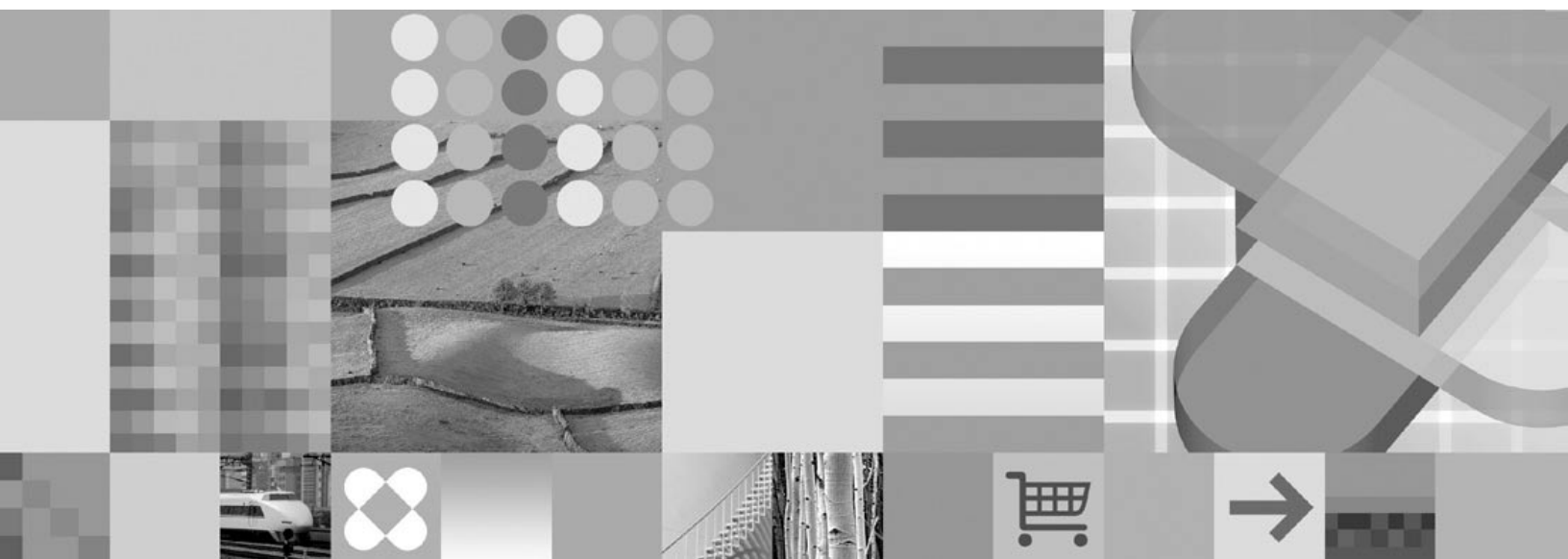


Getting Started with Database Application Development

DB2®

IBM

DB2 Version 9
for Linux, UNIX, and Windows



Getting Started with Database Application Development

Before using this information and the product it supports, be sure to read the general information under *Notices*.

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DB2 9 BETA

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Part 1. The DB2 database application development environment

Chapter 1. The DB2 database application development environment

The DB2[®] database application development environment is composed of several software elements:

- **operating system;**
- **DB2 Client;**
- **database application programming interface (API);**
- **programming language;**
- **transaction manager; and**
- **development tools.**

For each of these elements, there are multiple choices available. For example: there might be several operating systems available for your hardware; DB2 database supports several APIs; and any XA-compliant transaction manager can be used to manage distributed transactions with DB2 databases.

For each of these elements, choosing which software to use depends on a variety of factors:

- **what is supported;**

For example: DB2 supports a finite number of operating systems, and database APIs; and for each API, there is a finite list of supported programming languages.

- **ease of use;**

There are some integrated development environments that make developing database applications much easier.

- **the nature of the database application you are developing;**

A web-based application has particular needs that other applications don't have.

- **strengths of the particular software.**

For example: static, embedded SQL might perform better than dynamic SQL in some circumstances.

Related tasks:

- "Configuring the database application development environment" on page 45

Related reference:

- "Support for elements of the database application development environment" on page 5

Chapter 2. Support for elements of the database application development environment

Support for elements of the database application development environment

Supported operating systems for database application development:

DB2 database application development is supported on the following operating systems:

- AIX[®]
- HP-UX
- Linux[®]
- Solaris
- Windows[®]

There are restrictions about when you can use available 32-bit or 64-bit architectures:

- With Linux on x86 and 32-bit Windows operating systems, only 32-bit DB2 database instances are supported. On all other operating systems, only 64-bit db2; database instances are supported.
- 32-bit database applications can be run with either a 32-bit or 64-bit DB2 client, and developed with either a 32-bit or 64-bit DB2 Client.
- There are differences for building applications in 32-bit and 64-bit environments in most cases on these operating systems.

DB2 Client support for database application development:

A DB2 Client is required for database application development for DB2.

Supported database application programming interfaces:

The following application programming interfaces can be used to access a DB2 database:

- CLI or ODBC
- embedded SQL
- JDBC or SQLJ
- OLE DB
- Perl DBI
- PHP
- ADO .Net
 - OLE DB .Net
 - ODBC .Net
 - DB2 .Net

Supported programming languages and compilers for database application development:

DB2 database application development is supported in the following languages:

- C
- C++
- COBOL
- Fortran
- Java™
- Perl
- PHP
- REXX
- .Net languages

Supported transaction managers for use with database applications:

Any transaction manager that uses the XA interface can be used to manage DB2 distributed transactions.

Supported development tools for database application development:

The following integrated development environments and development tools can be used to develop DB2 database applications:

- IBM integrated database application development environments
 - The Developer Workbench
 - Rational Application Developer
- Database application plug-ins for integrated development environments
 - IBM DB2 Development Add-In for Visual Studio
 - Eclipse DB2 Plug-In
- Tools for developing SQL Statements
 - SQL Assist
 - SQL Builder
 - SQL Editor
 - Command line processor
- Database application monitoring and performance tuning tools
 - Event Monitor
 - Explain tools
 - CLI/ODBC/JDBC Static Profiling
- Tools for developing web applications
 - WebSphere Studio Application Developer
 - DB2 Alphablox

Related concepts:

- “Supported database application development tools” on page 42
- “Supported database application programming interfaces” on page 18
- “Supported transaction managers” on page 41
- Chapter 1, “The DB2 database application development environment,” on page 3

Related tasks:

- “Configuring the database application development environment” on page 45

Related reference:

- “DB2 Client support for database application development” on page 17
- “Supported operating systems for database application development” on page 7
- “Supported programming languages and compilers for database application development” on page 33

Supported operating systems for database application development

Supported operating systems for database application development

You can develop DB2 database applications on the following operating systems:

- AIX
- HP-UX
- Linux
- Solaris
- Windows

There are restrictions about when you can use available 32-bit or 64-bit architectures:

- With Linux on x86 and Windows operating systems on x86, only 32-bit DB2 database instances are supported. On all other operating systems, only 64-bit DB2 database instances are supported.
- 32-bit database applications can be run with either a 32-bit or 64-bit DB2 client, and developed with either a 32-bit or 64-bit DB2 Client.
- The steps for building applications in a 32-bit environment are sometimes different from the steps for building applications in a 64-bit environment.

Related reference:

- “Support for elements of the database application development environment” on page 5
- “Installation requirements for DB2 clients and servers (Linux)” on page 10
- “Installation requirements for DB2 clients and servers (Solaris Operating System)” on page 13
- “Installation requirements for DB2 clients and servers (Windows)” on page 15
- “Installation requirements for DB2 clients and servers (AIX)” on page 7
- “Installation requirements for DB2 clients and servers (HP-UX)” on page 9

Installation requirements for DB2 clients and servers (AIX)

For the most up-to-date prerequisite information, see <http://www.ibm.com/software/data/db2/udb/sysreqs.html>.

To install a DB2 client or server product, the following operating system, hardware, and communications prerequisites must be met:

Table 1. AIX installation prerequisites

| AIX Version | Operating System | Hardware |
|-------------------|--|--|
| AIX Version 5.2.0 | <p>DB2 client is available using the 64-bit AIX kernel.</p> <p>DB2 Enterprise Server Edition, for either single-partition or partitioned database environment, is available with the required 64-bit AIX kernel.</p> | <p>One of:</p> <ul style="list-style-type: none"> • IBM® RISC/6000 • eServer™ pSeries® |
| AIX Version 5.3.0 | <p>DB2 client is available using the 64-bit AIX kernel.</p> <p>DB2 Enterprise Server Edition, for either single-partition or partitioned database environment, is available with the required 64-bit AIX kernel.</p> | <p>One of:</p> <ul style="list-style-type: none"> • IBM RISC/6000 • eServer pSeries |

Software considerations:

- (Clients only:) If you plan to use Kerberos Authentication, you require IBM Network Authentication Service client v1.3 or later. The NAS client is provided with the AIX Bonus CD.
- Use the **bosboot** command to switch to the 64-bit kernel.
 To switch to a 64-bit kernel, you require root authority and should enter the following commands:


```
ln -sf /usr/lib/boot/unix_64 /unix
ln -sf /usr/lib/boot/unix_64 /usr/lib/boot/unix
bosboot -a
shutdown -Fr
```
- DB2 Version 9 requires the “IBM C++ Runtime Environment Components for AIX” which includes xIC.rte 8.0.0.4. This is available from the IBM AIX support web site.
- One of the following browsers is required to view online help and to run First Steps (db2fs):
 - Mozilla 1.4 and up
 - Firefox 1.0 and up
 - Netscape 7.0 and up

DB2 product installation on NFS (Network File System):

The installation of DB2 products on NFS (Network File System) is not recommended. Running DB2 products on NFS (for example, NFS mounting /opt/IBM/db2/V9.1 and then running off code that was physically installed on a remote system) requires several manual setup steps. There are also a number of potential issues with setting up NFS for DB2. These include possible problems that involve:

- Performance (impacted by network performance)
- Availability (you are allowing a single point of failure)
- Licensing (there is no checking done across machines)
- Diagnosing NFS errors can be difficult

As mentioned, the setup for NFS will require several manual actions including:

- Ensuring that the mount point preserve the install path

- Permission must be controlled (for example, write permission should not be given to the mounting machine)
- DB2 registries have to be set up manually and maintained across all mounting machines
- The list installed DB2 products and features command (db2ls) must be set up and maintained properly if you need to detect DB2 products and features
- More care is required when updating your DB2 product environment
- More steps are required when cleaning up on the exporting machine and the mounting machine

For detailed instructions, look for the “Setting Up DB2 on NFS Mounted File System” white paper which will be available soon after DB2 Version 9 is made available.

Related tasks:

- “An overview of installing your DB2 product (Linux and UNIX)” in *Quick Beginnings for DB2 Servers*

Related reference:

- “IBM Software Development Kit for Java levels for DB2 products” in *Quick Beginnings for DB2 Servers*
- “Communication protocols supported” in *Quick Beginnings for DB2 Clients*

Installation requirements for DB2 clients and servers (HP-UX)

For the most up-to-date prerequisite information, see <http://www.ibm.com/software/data/db2/udb/sysreqs.html>.

To install a DB2 client or server product, the following operating system, hardware, and communications prerequisites must be met:

Table 2. HP-UX installation prerequisites for HP-UX 11iv2

| Operating System | Hardware |
|---|--|
| DB2 products can run on HP-UX 11iv2 (11.23.0505) for PA-RISC 2.x-based (PA-8x00) and Itanium-based systems with: <ul style="list-style-type: none"> • May 2005 Base Quality (QPKBASE) bundle • May 2005 Applications Quality (QPAPPS) bundle and the PHNE_32606 patch. (64-bit HP-UX kernel is required; server only) | One of: <ul style="list-style-type: none"> • HP 9000 Series 700 or 800 system • HP Integrity Series server |

Kernel configuration considerations:

A system restart is required if you update the kernel configuration parameters. The kernel configuration parameters are set in /etc/system. Depending on the values of your kernel configuration parameters, you might need to modify some of them before you install the DB2 Version 9 client or server products. If the kernel configuration parameters are modified, a reboot is necessary to make the changes to /etc/system effective.

Software considerations:

- If you are installing the Application Development Client, you must have a C compiler to build SQL Stored Procedures.
- One of the following browsers is required to view online help and to run First Steps (db2fs):

- Mozilla 1.4 and up
- Firefox 1.0 and up
- Netscape 7.0 and up

DB2 product installation on NFS (Network File System):

The installation of DB2 products on NFS (Network File System) is not recommended. Running DB2 products on NFS (for example, NFS mounting /opt/IBM/db2/V9.1 and then running off code that was physically installed on a remote system) requires several manual setup steps. There are also a number of potential issues with setting up NFS for DB2. These include possible problems that involve:

- Performance (impacted by network performance)
- Availability (you are allowing a single point of failure)
- Licensing (there is no checking done across machines)
- Diagnosing NFS errors can be difficult

As mentioned, the setup for NFS will require several manual actions including:

- Ensuring that the mount point preserve the install path
- Permission must be controlled (for example, write permission should not be given to the mounting machine)
- DB2 registries have to be set up manually and maintained across all mounting machines
- The list installed DB2 products and features command (db2ls) must be set up and maintained properly if you need to detect DB2 products and features
- More care is required when updating your DB2 product environment
- More steps are required when cleaning up on the exporting machine and the mounting machine

For detailed instructions, look for the “Setting Up DB2 on NFS Mounted File System” white paper which will be available soon after DB2 Version 9 is made available.

Related tasks:

- “Modifying kernel parameters (HP-UX)” in *Quick Beginnings for DB2 Servers*

Related reference:

- “Communication protocols supported” in *Quick Beginnings for DB2 Clients*
- “IBM Software Development Kit for Java levels for DB2 products” in *Quick Beginnings for DB2 Servers*

Installation requirements for DB2 clients and servers (Linux)

For the most up-to-date prerequisite information, see <http://www.ibm.com/software/data/db2/udb/sysreqs.html>.

For the latest information on supported Linux distributions, point your browser to <http://www.ibm.com/db2/linux/validate>.

The supported operating systems for Linux include:

- Red Hat Enterprise Linux 4 (RHEL4) Update 2

- SUSE Linux Enterprise Server 9 (SLES9) Service Pack 2

To install a DB2 client or server product, the following distribution requirements, hardware, and communications prerequisites must be met:

Table 3. Linux prerequisites

| Distribution Requirements | Hardware |
|---|---|
| You should update your kernel configuration parameters in preparation for your Linux distribution. The default values for particular kernel parameters are not sufficient when running a DB2 database system. You may also have other products or applications that require Linux system resources. You should set the kernel configuration parameters based on the needs of your Linux system working environment. The kernel configuration parameters are set in <code>/etc/sysctl.conf</code> . See the Modifying kernel parameters (Linux) section of the DB2 Information Center. Refer to your operating system manual for information on setting and activating these parameters using the <code>sysctl</code> command. | DB2 server products are supported on: <ul style="list-style-type: none"> • x86 (Intel® Pentium®, Intel Xeon®, and AMD Athlon) • x86-64 (Intel EM64T and AMD64) • IA64 (Intel Itanium® 2 or higher) • POWER™ (any iSeries™ or pSeries that support Linux) • (Server only)eServer zSeries®. <ul style="list-style-type: none"> – The Database Partitioning Feature (DPF) is not supported. • (Client only)64-bit zSeries or System z9™ boxes. |

Package requirements (server only):

The following tables list the package requirements for SUSE Linux and Red Hat distributions for DB2 Version 9 partitioned servers.

- The `pdcksh` Korn Shell package is required for all DB2 systems.
- A remote shell utility is required for partitioned database systems. DB2 supports the following remote shell utilities:
 - `rsh`
 - `ssh`

By default, DB2 uses `rsh` when executing commands on remote DB2 nodes, for example, when starting a remote DB2 database partition. To use the DB2 default, the `rsh-server` package must be installed (see table below). For a comparison between `rsh` and `ssh`, see the “Security issues when installing DB2” section of the *Administration Guide: Implementation*. If you choose to use the `rsh` remote shell utility, `inetd` (or `xinetd`) must be installed and running as well. If you choose to use the `ssh` remote shell utility, you need to set the `DB2RSHCMD` registry variable immediately after the DB2 installation is complete. If this registry variable is not set, `rsh` is used. For more information on the `DB2RSHCMD` registry variable, see the *Performance Guide* book.

- The `nfs-utils` Network File System support package is required for partitioned database systems.

All required packages should be installed and configured before continuing with the DB2 setup. For general Linux information, see your Linux distribution documentation.

Package requirements for SUSE Linux

| Package name | Description |
|----------------------|--|
| <code>pdcksh</code> | Korn Shell. This package is required for partitioned database environments. |
| <code>openssh</code> | This package contains a set of server programs which allow users to run commands on (and from) remote computers via a secure shell. This package is not required if you use the default configuration of DB2 with <code>rsh</code> . |

Package requirements for SUSE Linux

| Package name | Description |
|--------------|--|
| rsh-server | This package contains a set of server programs which allow users to run commands on remote computers, login in to other computers, and copy files between computers (rsh, rexec, rlogin, and rcp). This package is not required if you configure DB2 to use ssh. |
| nfs-utils | Network File System support package. It allows access to local files from remote computers. |

Package requirements for Red Hat

| Directory | Package name | Description |
|-----------------------------|----------------|--|
| /System Environment/Shell | pdksh | Korn Shell. This package is required for partitioned database environments. |
| /Applications/Internet | openssh | This package contains a set of client programs which allow users to run commands on a remote computer via a secure shell. This package is not required if you use the default configuration of DB2 with rsh. |
| /System Environment/Daemons | openssh-server | This package contains a set of server programs which allow users to run commands from a remote computer via a secure shell. This package is not required if you use the default configuration of DB2 with rsh. |
| /System Environment/Daemons | rsh-server | This package contains a set of programs which allow users to run commands on a remote computer. Required for partitioned database environments. This package is not required if you configure DB2 to use ssh. |
| /System Environment/Daemons | nfs-utils | Network File System support package. It allows access to local files from remote computers. |

Software considerations:

- One of the following browsers is required to view online help and to run First Steps (db2fs):
 - Mozilla 1.4 and up
 - Firefox 1.0 and up
 - Netscape 7.0 and up
- An X Window System software capable of rendering a graphical user interface is required if you want to use the DB2 Setup wizard to install DB2 or if you want to use any DB2 graphical tools. (Available only on Linux for x86 and Linux on AMD 64/EM64T.)

DB2 product installation on NFS (Network File System):

The installation of DB2 products on NFS (Network File System) is not recommended. Running DB2 products on NFS (for example, NFS mounting /opt/IBM/db2/V9.1 and then running off code that was physically installed on a

remote system) requires several manual setup steps. There are also a number of potential issues with setting up NFS for DB2. These include possible problems that involve:

- Performance (impacted by network performance)
- Availability (you are allowing a single point of failure)
- Licensing (there is no checking done across machines)
- Diagnosing NFS errors can be difficult

As mentioned, the setup for NFS will require several manual actions including:

- Ensuring that the mount point preserve the install path
- Permission must be controlled (for example, write permission should not be given to the mounting machine)
- DB2 registries have to be set up manually and maintained across all mounting machines
- The list installed DB2 products and features command (db2ls) must be set up and maintained properly if you need to detect DB2 products and features
- More care is required when updating your DB2 product environment
- More steps are required when cleaning up on the exporting machine and the mounting machine

For detailed instructions, look for the “Setting Up DB2 on NFS Mounted File System” white paper which will be available soon after DB2 Version 9 is made available.

Related concepts:

- “Security issues when installing the DB2 database manager” in *Administration Guide: Implementation*

Related tasks:

- “Modifying kernel parameters (Linux)” in *Quick Beginnings for DB2 Servers*
- “Preparing to install DB2 for Linux on zSeries” in *Quick Beginnings for DB2 Servers*

Related reference:

- “Communication protocols supported” in *Quick Beginnings for DB2 Clients*
- “IBM Software Development Kit for Java levels for DB2 products” in *Quick Beginnings for DB2 Servers*
- “Communications variables” in *Performance Guide*

Installation requirements for DB2 clients and servers (Solaris Operating System)

For the most up-to-date prerequisite information, see <http://www.ibm.com/software/data/db2/udb/sysreqs.html>.

To install a DB2 client or server product, the following operating system, hardware, and communications prerequisites must be met:

Table 4. Solaris Operating System installation prerequisites

| Operating System | Hardware |
|--|-----------------------------------|
| DB2 client and server products are supported on the following Solaris Operating System versions: <ul style="list-style-type: none"> • Solaris 9 <p>The following patches are also required:</p> <ul style="list-style-type: none"> – 111711-12 – 111712-12 • Solaris 10 | Solaris UltraSPARC-based computer |

Kernel configuration considerations:

A system restart is required if you update the kernel configuration parameters. The kernel configuration parameters are set in `/etc/system` and if these parameters require modification to accommodate the DB2 client, a reboot is necessary to make the changes to `/etc/system` effective. These parameters must be set before you install a DB2 client.

Software considerations:

- (Clients only:) If you plan to use Kerberos Authentication, you require Solaris Operating System 9 or higher with IBM Network Authentication Service (NAS) client v1.4 or higher. The NAS client can be downloaded from Web site: <https://www6.software.ibm.com/dl/dm/dm-nas-p>.
- If you are installing the Application Development Client, you must have a C compiler to build SQL Stored Procedures.
- One of the following browsers is required to view online help and to run First Steps (db2fs):
 - Mozilla 1.4 and up
 - Firefox 1.0 and up
 - Netscape 7.0 and up

"Recommended & Security Patches" can be obtained from the <http://sunsolve.sun.com> Web site. From the SunSolve Online Web site, click on the "Patches" menu item in the left panel.

The Java2 Standard Edition (J2SE) Solaris Operating System Patch Clusters and the SUNWlibC software are also required and can be obtained from the <http://sunsolve.sun.com> Web site.

For DB2 on 64-bit Fujitsu PRIMEPOWER systems, you require the following:

- Solaris 9 Kernel Update Patch 112233-01 or later to get the fix for patch 912041-01.

The Fujitsu PRIMEPOWER patches for the Solaris Operating System can be downloaded from FTSI at: <http://download.ftsi.fujitsu.com/>.

DB2 product installation on NFS (Network File System):

The installation of DB2 products on NFS (Network File System) is not recommended. Running DB2 products on NFS (for example, NFS mounting `/opt/IBM/db2/V9.1` and then running off code that was physically installed on a remote system) requires several manual setup steps. There are also a number of potential issues with setting up NFS for DB2. These include possible problems that involve:

- Performance (impacted by network performance)
- Availability (you are allowing a single point of failure)
- Licensing (there is no checking done across machines)
- Diagnosing NFS errors can be difficult

As mentioned, the setup for NFS will require several manual actions including:

- Ensuring that the mount point preserve the install path
- Permission must be controlled (for example, write permission should not be given to the mounting machine)
- DB2 registries have to be set up manually and maintained across all mounting machines
- The list installed DB2 products and features command (db2ls) must be set up and maintained properly if you need to detect DB2 products and features
- More care is required when updating your DB2 product environment
- More steps are required when cleaning up on the exporting machine and the mounting machine

For detailed instructions, look for the “Setting Up DB2 on NFS Mounted File System” white paper which will be available soon after DB2 Version 9 is made available.

Related tasks:

- “Modifying kernel parameters (Solaris Operating Environment)” in *Quick Beginnings for DB2 Servers*

Related reference:

- “Communication protocols supported” in *Quick Beginnings for DB2 Clients*
- “IBM Software Development Kit for Java levels for DB2 products” in *Quick Beginnings for DB2 Servers*

Installation requirements for DB2 clients and servers (Windows)

For the most up-to-date prerequisite information, see

- www.ibm.com/software/data/db2/udb/sysreqs.html.

To install a DB2 client or server product, the following operating system, software, and hardware prerequisites must be met:

Table 5. Windows installation prerequisites

| Operating System | Service Pack | Hardware |
|---|-------------------------|---|
| Windows XP Professional (32-bit) | Service Pack 2 or later | All Intel and AMD processors capable of running the supported Windows operating systems (32-bit and 64-bit) |
| Windows XP Professional x64 | | |
| Windows 2003 Standard Edition (32-bit and 64-bit) | Service Pack 1 or later | |
| Windows 2003 Advanced Edition (32-bit and 64-bit) | | |
| Windows 2003 Datacenter Edition (32-bit and 64-bit) | | |

Additional client considerations

DB2 products continue to be supported on Windows 98, Windows ME, Windows NT®, and Windows 2000 until DB2 Universal Database Version 8.1 goes out of service. For existing installations and new installations of DB2 products, upgrading to a more current operating system version of Windows (such as Windows 2003) is recommended. Version 9 clients cannot be installed on Windows 98, Windows ME, or Windows NT Server 4 operating systems. If you wish to continue running DB2 products on back level releases of Windows, you require the following maintenance levels:

- Windows NT Version 4 with Service Pack 6a or later
- Windows 2000 with Service Pack 4 or later
- Internet Explorer 4.01 Service Pack 2

Windows XP Service Pack 1 is required for running DB2 applications in either of the following environments:

- Applications that have COM+ objects using ODBC; or
- Applications that use OLE DB Provider for ODBC with OLE DB resource pooling disabled

If you are unsure about whether your application environment qualifies, then it is recommended that you install the appropriate Windows service level.

For more information about this COM+ issue, see the following Microsoft® Knowledge Base article:

- <http://support.microsoft.com/default.aspx?scid=KB;EN-US;306414>

Additional software considerations

- MDAC 2.8 is required. The DB2 Setup wizard will install MDAC 2.8 if it is not already installed.

Note: If a previous version of MDAC (for example, 2.7) is already installed, DB2 install will upgrade MDAC to 2.8. For a typical install, MDAC 2.8 is installed. For a compact install, MDAC 2.8 is not installed. For a custom install, MDAC 2.8 is installed but only if you have not deselected the default which is to install it. If you deselect MDAC as part of a custom install, it will not be installed.

- If you plan to use LDAP (Lightweight Directory Access Protocol), you should use either a Microsoft LDAP client or the IBM Tivoli® Directory Server v6 client (also known as the IBM LDAP client which is included with DB2). Prior to installation of the Microsoft Active Directory, you will need to extend your directory schema using the db2schex utility, which can be found on the installation media.
The Microsoft LDAP client is included with the operating system for Windows XP, and Windows Server 2003.
- If you plan to use the Tivoli Storage Manager facilities for the backup and restoration of your databases, you need the Tivoli Storage Manager Client Version 4.2.0 or later.
 - For Windows 64-bit operating systems, you require the TSM client API Version 5.1.
- If you have the IBM Antivirus program installed on your operating system, it must be disabled or uninstalled to complete a DB2 installation.
- TCP/IP support must be enabled to view online help.
- One of the following browsers is required to view online help, run the DB2 install launchpad (setup.exe), and to run First Steps (db2fs):
 - Internet Explorer 5.5 and up
 - Mozilla 1.4 and up
 - Firefox 1.0 and up
 - Netscape 7.0 and up

Related concepts:

- “Support changes for 32-bit and 64-bit DB2 servers” in *Migration Guide*

Related tasks:

- “An overview of installing your DB2 product (Windows)” in *Quick Beginnings for DB2 Servers*

Related reference:

- “IBM Software Development Kit for Java levels for DB2 products” in *Quick Beginnings for DB2 Servers*
- “Communication protocols supported” in *Quick Beginnings for DB2 Clients*

DB2 Client support for database application development

There are two DB2 clients: the DB2 Client; and the DB2 Runtime Client. Of the two, only the DB2 Client is suitable for database application development.

The DB2 Client includes the following:

- **Precompilers for C/C++, COBOL, and Fortran**, (providing the language is supported for that platform).
- **Embedded SQL application support**, including programming libraries, include files and code samples.
- **ODBC and DB2 Call Level Interface (DB2 CLI) application support**, including programming libraries, include files, and code samples for developing applications which are easily ported to ODBC and compiled with an ODBC SDK. An ODBC SDK is available from Microsoft for Windows operating systems, and from various other vendors for many of the other supported platforms. On Windows operating systems, the ODBC and CLI driver is installed

by default with the DB2 Client, supporting applications developed with the Microsoft ODBC Software Developer's Kit. For all other platforms, the ODBC and CLI driver can optionally be installed with the DB2 Client, supporting applications that can be developed with an ODBC SDK for that platform, if one exists.

- **The IBM DB2 Driver for JDBC and SQLJ**, which includes:
 - JDBC support, for developing Java applications with dynamic SQL
 - SQLJ support, for developing Java applications with static SQL
- **An SDK for Java** is shipped with DB2 clients for all supported operating systems.
- **ActiveX Data Objects (ADO) and Object Linking and Embedding (OLE) automation routines (UDFs and Stored Procedures)** on Windows operating systems, including code samples implemented in Microsoft Visual Basic and Microsoft Visual C++. Also, code samples with Remote Data Objects (RDO) implemented in Microsoft Visual Basic.
- **Object Linking and Embedding Database (OLE DB) table functions** on Windows operating systems.
- **C# and Visual Basic .NET applications and CLR .NET routines** on Windows operating systems.
- **DB2 Developer Workbench** is an Eclipse-based tool that replaces the Development Center from DB2 Universal Database™ (DB2 UDB) for Linux, UNIX®, and Windows Version 8. Developer Workbench is a comprehensive development environment for creating, editing, debugging, deploying, and testing DB2 stored procedures and user-defined functions. You can also use Developer Workbench to develop SQLJ applications, and create, edit, and run SQL statements and XML queries.
- **Interactive SQL** through the Command Editor or Command Line Processor (CLP) to prototype SQL statements or to perform ad hoc queries against the database.
- **A set of documented APIs** to enable other application development tools to implement precompiler support for DB2 directly within their products. For example, IBM COBOL on AIX uses this interface.

Related concepts:

- “Types of clients - DB2 Runtime Client and DB2 Client” in *Quick Beginnings for DB2 Clients*

Related reference:

- “Support for elements of the database application development environment” on page 5

Supported database application programming interfaces

Supported database application programming interfaces

You can use several different programming interfaces to manage or access DB2 databases. You can:

- Use DB2 APIs to perform administrative functions such as backing up and restoring databases.
- Embed static and dynamic SQL statements in your applications.

- Code DB2 Call Level Interface (DB2 CLI) function calls in your applications to invoke dynamic SQL statements.
- Develop Java applications and applets that call the Java Database Connectivity application programming interface (JDBC API).
- Develop Microsoft Visual Basic and Visual C++ applications that conform to Data Access Object (DAO) and Remote Data Object (RDO) specifications, and ActiveX Data Object (ADO) applications that use the OLE DB Bridge.
- Develop ADO.NET applications using DB2 .NET Data Provider, OLE DB .NET Data Provider or ODBC .NET Data Provider.
- Develop applications using IBM or third-party tools such as Net.Data[®], Excel, Perl, and Open Database Connectivity (ODBC) end-user tools such as Lotus[®] Approach[®], and its programming language, LotusScript.

Related concepts:

- “OLE DB .NET Data Provider” on page 21
- “ADO.NET development for DB2 databases” on page 19
- “DB2 .NET Data Provider” on page 19
- “ODBC .NET Data Provider” on page 20
- “IBM OLE DB Provider for DB2” on page 26
- “Introduction to DB2 CLI and ODBC” on page 21
- “Introduction to embedded SQL” on page 23
- “Supported drivers for JDBC and SQLJ” on page 24
- “Perl DBI” on page 27
- “Introduction to PHP application development for DB2” on page 27

Related reference:

- “Support for elements of the database application development environment” on page 5

ADO.NET development for DB2 databases

ADO.NET development for DB2 databases

The DB2 .NET Data Provider is an extension of the ADO.NET interface that allows .NET applications to access a DB2 database through a secure connection, execute commands, and retrieve result sets.

Reference documentation is included with the DB2 .NET Data Provider, presenting detailed information about all the DB2 .NET Data Provider objects and their members. During the DB2 installation process, this documentation is registered with Microsoft Visual Studio .NET. To view the DB2 .NET Data Provider documentation from Microsoft Visual Studio .NET, select the Help menu option, and Contents. Once the help viewer opens, filter by *IBM DB2 .NET Data Provider Help*.

DB2 .NET Data Provider

The DB2 .NET Data Provider extends DB2 support for the ADO.NET interface. The DB2 .NET Data Provider delivers high-performing, secure access to DB2 data.

The DB2 .NET Data Provider allows your .NET applications to access the following database management systems:

- DB2 Database for Linux, UNIX, and Windows, Version 9

- DB2 Universal Database Version 8 for Windows, UNIX, and Linux-based computers
- DB2 Universal Database Version 6 (or later) for OS/390[®] and z/OS[®], through DB2 Connect[™]
- DB2 Universal Database Version 5, Release 1 (or later) for AS/400[®] and iSeries, through DB2 Connect
- DB2 Universal Database Version 7.3 (or later) for VSE & VM, through DB2 Connect

To develop and run applications that use DB2 .NET Data Provider you need the .NET Framework, Version 2.0 or 1.1.

In addition to the DB2 .NET Data Provider, the IBM Database Development Add-In enables you to quickly and easily develop .NET applications for DB2 databases in Visual Studio 2005. You can also use the Add-In to create database objects such as indexes and tables, and develop server-side objects, such as stored procedures and user-defined functions.

ODBC .NET Data Provider

The ODBC .NET Data Provider makes ODBC calls to a DB2 data source using the DB2 CLI Driver. Therefore, the connection string keywords supported by the ODBC .NET Data Provider are the same as those supported by the DB2 CLI driver. Also, the ODBC .NET Data Provider has the same restrictions as the DB2 CLI driver. There are additional restrictions for the ODBC .NET Data Provider, which are identified in the topic: ODBC .NET Data Provider restrictions.

In order to use the ODBC .NET Data Provider, you must have the .NET Framework Version 1.1 or Version 2.0 installed. For DB2 Universal Database for AS/400 and iSeries, the following fix is required on the server: APAR II13348.

The following are the supported connection keywords for the ODBC .NET Data Provider:

Table 6. ConnectionString keywords for the ODBC .NET Data Provider

| Keyword | Value | Meaning |
|---------|----------------|--|
| DSN | database alias | The DB2 database alias as cataloged in the database directory |
| UID | user ID | The user ID used to connect to the DB2 server |
| PWD | password | The password for the user ID used to connect to the DB2 server |

The following is an example of creating an `OdbcConnection` to connect to the SAMPLE database:

```
[Visual Basic .NET]
Dim con As New OdbcConnection("DSN=sample;UID=userid;PWD=password;")
con.Open()

[C#]
OdbcConnection con = new OdbcConnection("DSN=sample;UID=userid;PWD=password;");
con.Open()
```

OLE DB .NET Data Provider

The OLE DB .NET Data Provider uses the IBM DB2 OLE DB Driver, which is referred to in a `ConnectionString` object as `IBMDADB2`. The connection string keywords supported by the OLE DB .NET Data Provider are the same as those supported by the IBM OLE DB Provider for DB2. Also, the OLE DB .NET Data Provider has the same restrictions as the IBM DB2 OLE DB Provider. There are additional restrictions for the OLE DB .NET Data Provider, which are identified in the topic: OLE DB .NET Data Provider restrictions.

In order to use the OLE DB .NET Data Provider, you must have the .NET Framework Version 1.1 or Version 2.0 installed.

For DB2 Universal Database for AS/400 and iSeries, the following fix is required on the server: APAR ii13348.

The following are all the supported connection keywords for the OLE DB .NET Data Provider:

Table 7. **ConnectionString** keywords for the OLE DB .NET Data Provider

| Keyword | Value | Meaning |
|--------------------|----------------|--|
| PROVIDER | IBMDADB2 | Specifies the IBM OLE DB Provider for DB2 (required) |
| DSN or Data Source | database alias | The DB2 database alias as cataloged in the database directory |
| UID | user ID | The user ID used to connect to the DB2 server |
| PWD | password | The password for the user ID used to connect to the DB2 server |

The following is an example of creating an `OleDbConnection` to connect to the `SAMPLE` database:

```
[Visual Basic .NET]
Dim con As New OleDbConnection("Provider=IBMDADB2;" +
    "Data Source=sample;UID=userid;PWD=password;")
con.Open()

[C#]
OleDbConnection con = new OleDbConnection("Provider=IBMDADB2;" +
    "Data Source=sample;UID=userid;PWD=password;" );
con.Open()
```

Introduction to DB2 CLI and ODBC

DB2 Call Level Interface (DB2 CLI) is IBM's callable SQL interface to the DB2 family of database servers. It is a 'C' and 'C++' application programming interface for relational database access that uses function calls to pass dynamic SQL statements as function arguments. It is an alternative to embedded dynamic SQL, but unlike embedded SQL, DB2 CLI does not require host variables or a precompiler.

DB2 CLI is based on the Microsoft** Open Database Connectivity** (ODBC) specification, and the International Standard for SQL/CLI. These specifications were chosen as the basis for the DB2 Call Level Interface in an effort to follow

industry standards and to provide a shorter learning curve for those application programmers already familiar with either of these database interfaces. In addition, some DB2 specific extensions have been added to help the application programmer specifically exploit DB2 features.

The DB2 CLI driver also acts as an ODBC driver when loaded by an ODBC driver manager. It conforms to ODBC 3.51.

DB2 CLI Background information:

To understand DB2 CLI or any callable SQL interface, it is helpful to understand what it is based on, and to compare it with existing interfaces.

The X/Open Company and the SQL Access Group jointly developed a specification for a callable SQL interface referred to as the *X/Open Call Level Interface*. The goal of this interface is to increase the portability of applications by enabling them to become independent of any one database vendor's programming interface. Most of the X/Open Call Level Interface specification has been accepted as part of the ISO Call Level Interface International Standard (ISO/IEC 9075-3:1995 SQL/CLI).

Microsoft developed a callable SQL interface called Open Database Connectivity (ODBC) for Microsoft operating systems based on a preliminary draft of X/Open CLI.

The ODBC specification also includes an operating environment where database specific ODBC Drivers are dynamically loaded at run time by a driver manager based on the data source (database name) provided on the connect request. The application is linked directly to a single driver manager library rather than to each DBMS's library. The driver manager mediates the application's function calls at run time and ensures they are directed to the appropriate DBMS specific ODBC driver. Since the ODBC driver manager only knows about the ODBC-specific functions, DBMS-specific functions cannot be accessed in an ODBC environment. DBMS-specific dynamic SQL statements are supported via a mechanism called an escape clause.

ODBC is not limited to Microsoft operating systems; other implementations are available on various platforms.

The DB2 CLI load library can be loaded as an ODBC driver by an ODBC driver manager. For ODBC application development, you must obtain an ODBC Software Development Kit. For the Windows platform, the ODBC SDK is available as part of the Microsoft Data Access Components (MDAC) SDK, available for download from <http://www.microsoft.com/data/>. For non-Windows platforms, the ODBC SDK is provided by other vendors. When developing ODBC applications that may connect to DB2 servers, use the Call Level Interface Guide and Reference, Volume 1 and the Call Level Interface Guide and Reference, Volume 2 (for information on DB2 specific extensions and diagnostic information), in conjunction with the ODBC Programmer's Reference and SDK Guide available from Microsoft.

Applications written directly to DB2 CLI link directly to the DB2 CLI load library. DB2 CLI includes support for many ODBC and ISO SQL/CLI functions, as well as DB2 specific functions.

The following DB2 features are available to both ODBC and DB2 CLI applications:

- double byte (graphic) data types

- stored procedures
- Distributed Unit of Work (DUOW), two phase commit
- compound SQL
- user defined types (UDT)
- user defined functions (UDF)

Related concepts:

- “Comparison of DB2 CLI and Microsoft ODBC” in *Call Level Interface Guide and Reference, Volume 1*
- “DB2 Call Level Interface (CLI) versus embedded SQL” on page 30

Introduction to embedded SQL

Embedded SQL database applications connect to databases and execute embedded SQL statements. Embedded SQL statements are embedded within a host language application. Embedded SQL database applications support the embedding of SQL statements to be executed statically or dynamically.

You can develop embedded SQL applications for DB2 in the following host programming languages: C, C++, COBOL, FORTRAN, and REXX.

Note: Support for embedded SQL in FORTRAN and REXX has been deprecated and will remain at the DB2 Universal Database , Version 5.2 level.

Building embedded SQL applications involves two prerequisite steps prior to application compilation and linking.

- Preparing the source files containing embedded SQL statements using the DB2 precompiler.
The PREP (PRECOMPILE) command is used to invoke the DB2 precompiler, which reads your source code, parses and converts the embedded SQL statements to DB2 run-time services API calls, and finally writes the output to a new modified source file. The precompiler produces access plans for the SQL statements, which are stored together as a package within the database.
- Binding the statements in the application to the target database.
Binding is done by default during precompilation (the PREP command). If binding is to be deferred (for example, running the BIND command later), then the BINDFILE option needs to be specified at PREP time in order for a bind file to be generated.

Once you have precompiled and bound your embedded SQL application, it is ready to be compiled and linked using the host language-specific development tools.

To aid in the development of embedded SQL applications, you can refer to the embedded SQL template in C. Examples of working embedded SQL sample applications can also be found in the %DB2PATH%\SQLLIB\samples directory.

Note: %DB2PATH% refers to the DB2 installation directory

Static and dynamic SQL:

SQL statements can be executed in one of two ways: statically or dynamically.

Statically executed SQL statements

For statically executed SQL statements, the syntax is fully known at precompile time. The structure of an SQL statement must be completely specified for a statement to be considered static. For example, the names for the columns and tables referenced in a statement must be fully known at precompile time. The only information that can be specified at run time are values for any host variables referenced by the statement. However, host variable information, such as data types, must still be precompiled. You precompile, bind, and compile statically executed SQL statements before you run your application. Static SQL is best used on databases whose statistics do not change a great deal.

Dynamically executed SQL statements

Dynamically executed SQL statements are built and executed by an application at run-time. An interactive application that prompts the end user for key parts of an SQL statement, such as the names of the tables and columns to be searched, is a good example of a situation suited for dynamic SQL.

Related concepts:

- “Embedded SQL statements in REXX applications” in *Developing Embedded SQL Applications*
- “Embedded SQL statements in C and C++ applications” in *Developing Embedded SQL Applications*
- “Embedded SQL statements in COBOL applications” in *Developing Embedded SQL Applications*
- “Embedded SQL statements in FORTRAN applications” in *Developing Embedded SQL Applications*

Related reference:

- “PRECOMPILE command” in *Command Reference*

Supported drivers for JDBC and SQLJ

According to the JDBC specification, there are four types of JDBC driver architectures:

Type 1

Drivers that implement the JDBC API as a mapping to another data access API, such as Open Database Connectivity (ODBC). Drivers of this type are generally dependent on a native library, which limits their portability. The DB2 database system does not support a type 1 driver.

Type 2

Drivers that are written partly in the Java programming language and partly in native code. The drivers use a native client library specific to the data source to which they connect. Because of the native code, their portability is limited.

Type 3

Drivers that use a pure Java client and communicate with a server using a database-independent protocol. The server then communicates the client’s requests to the data source. The DB2 database system does not support a type 3 driver.

Type 4

Drivers that are pure Java and implement the network protocol for a specific data source. The client connects directly to the data source.

DB2 Version 9.1 supports a driver that combines type 2 and type 4 JDBC implementations. DB2 Version 9.1 also supports a .type 2 driver, although this support is deprecated. The DB2 Version 9.1 type 2 driver continues to use the DB2 CLI interface to communicate with DB2 database servers. The drivers that are supported in DB2 Version 9.1 are:

DB2 JDBC Type 2 Driver for Linux, UNIX and Windows (DB2 JDBC type 2 driver) (deprecated):

The DB2 JDBC type 2 driver lets Java applications make calls to DB2 through JDBC. Calls to the DB2 JDBC type 2 driver are translated to Java native methods. The Java applications that use this driver must run on a DB2 client, through which JDBC requests flow to the DB2 server. DB2 Connect Version 9.1 must be installed before the DB2 JDBC application driver can be used to access DB2 UDB for iSeries data sources or data sources in the DB2 for OS/390 or z/OS environments.

The DB2 JDBC type 2 driver supports these JDBC and SQLJ functions:

- Most of the methods that are described in the JDBC 1.2 specification, and some of the methods that are described in the JDBC 2.0 specification. See Comparison of driver support for JDBC APIs.
- SQLJ statements that perform equivalent functions to all JDBC methods
- Connection pooling
- Distributed transactions
- Java user-defined functions and stored procedures

The DB2 JDBC Type 2 Driver for Linux, UNIX and Windows will not be supported in future releases of the DB2 database system. You should therefore consider moving to the IBM DB2 Driver for JDBC and SQLJ.

IBM DB2 Driver for JDBC and SQLJ (type 2 and type 4):

The IBM DB2 Driver for JDBC and SQLJ is a single driver that includes JDBC type 2 and JDBC type 4 behavior, as well as SQLJ support. When an application loads the IBM DB2 Driver for JDBC and SQLJ, a single driver instance is loaded for type 2 and type 4 implementations. The application can make type 2 and type 4 connections using this single driver instance. The type 2 and type 4 connections can be made concurrently. IBM DB2 Driver for JDBC and SQLJ type 2 driver behavior is referred to as *IBM DB2 Driver for JDBC and SQLJ type 2 connectivity*. IBM DB2 Driver for JDBC and SQLJ type 4 driver behavior is referred to as *IBM DB2 Driver for JDBC and SQLJ type 4 connectivity*.

The IBM DB2 Driver for JDBC and SQLJ supports these JDBC and SQLJ functions:

- All of the methods that are described in the JDBC 3.0 specifications. See Comparison of driver support for JDBC APIs.
- SQLJ statements that perform equivalent functions to most JDBC methods.
- Connections that are enabled for connection pooling. WebSphere® Application Server or another application server does the connection pooling.
- Java user-defined functions and stored procedures (IBM DB2 Driver for JDBC and SQLJ type 2 connectivity only).
- Global transactions that run under WebSphere Application Server Version 5.0 and above.
- Support for distributed transaction management. This support implements the Java 2 Platform, Enterprise Edition (J2EE) Java Transaction Service (JTS) and Java Transaction API (JTA) specifications, which conform to the X/Open standard for distributed transactions (*Distributed Transaction Processing: The XA Specification*, available from <http://www.opengroup.org>) .

Related concepts:

- “How JDBC applications connect to a data source” in *Developing Java Applications*
- “Security under the IBM DB2 Driver for JDBC and SQLJ” in *Developing Java Applications*

Related reference:

- “Driver support for JDBC APIs” in *Developing Java Applications*
- “JDBC differences between the IBM DB2 Driver for JDBC and SQLJ and other DB2 JDBC drivers” in *Developing Java Applications*
- “SQLJ differences between the IBM DB2 Driver for JDBC and SQLJ and other DB2 JDBC drivers” in *Developing Java Applications*

IBM OLE DB Provider for DB2

Microsoft OLE DB is a set of OLE/COM interfaces that provides applications with uniform access to data stored in diverse information sources. The OLE DB architecture defines OLE DB consumers and OLE DB providers. An OLE DB consumer is any system or application that uses OLE DB interfaces; an OLE DB provider is a component that exposes OLE DB interfaces.

The IBM OLE DB Provider for DB2 allows DB2 to act as a resource manager for the OLE DB provider. This support gives OLE DB-based applications the ability to extract or query DB2 data using the OLE interface. The IBM OLE DB Provider for DB2, whose provider name is IBMDADB2, enables OLE DB consumers to access data on a DB2 database server. If DB2 Connect is installed, these OLE DB consumers can also access data on a host DBMS such as DB2 for MVS™, DB2 for VM/VSE, or SQL/400®.

The IBM OLE DB Provider for DB2 offers the following features:

- Support level 0 of the OLE DB provider specification, including some additional level 1 interfaces.
- A free threaded provider implementation, which enables the application to create components in one thread and use those components in any other thread.
- An Error Lookup Service that returns DB2 error messages.

Note that the IBM OLE DB Provider resides on the client and is different from the OLE DB table functions, which are also supported by DB2 database systems.

Subsequent sections of this document describe the specific implementation of the IBM OLE DB Provider for DB2. For more information on the Microsoft OLE DB 2.0 specification, refer to the Microsoft OLE DB 2.0 Programmer’s Reference and Data Access SDK, available from Microsoft Press.

Version Compliance:

The IBM OLE DB Provider for DB2 complies with Version 2.7 of the Microsoft OLE DB specification.

System Requirements:

Refer to the announcement letter for the IBM OLE DB Provider for DB2 Servers to see the supported Windows operating systems.

To install the IBM OLE DB Provider for DB2, you must first be running on one of the supported operating systems listed above. You also need to install the DB2 Client. This client includes Microsoft Data Access Components (MDAC).

Related reference:

- “IBM OLE DB Provider support for OLE DB components and interfaces” in *Developing ADO.NET and OLE DB Applications*

Perl DBI

DB2 supports the Perl Database Interface (DBI) specification for data access through the DBD::DB2 driver. The DB2 Perl DBI website is located at:

<http://www.ibm.com/software/data/db2/perl/>

and contains the latest DBD::DB2 driver, and related information.

Perl is an interpreted language and the Perl DBI Module uses dynamic SQL. These properties make Perl an ideal language for quickly creating and revising DB2 applications. The Perl DBI Module uses an interface that is quite similar to the CLI and JDBC interfaces, which makes it easy to port Perl applications to CLI and JDBC, or to port CLI and JDBC applications to Perl.

Related concepts:

- “Programming Considerations for Perl” in *Developing Perl and PHP Applications*

Introduction to PHP application development for DB2

PHP: Hypertext Preprocessor (PHP) is an interpreted programming language primarily intended for the development of Web applications. The first version of PHP was created by Rasmus Lerdorf and contributed under an open source license in 1995. PHP was initially a very simple HTML templating engine, but over time the developers of PHP added database access functionality, rewrote the interpreter, introduced object-oriented support, and improved performance. Today, PHP has become a popular language for Web application development because of its focus on practical solutions and support for the most commonly required functionality in Web applications.

For the easiest install and configuration experience on Linux, UNIX, or Windows operating systems, you can download and install Zend Core for IBM for use in production systems. Paid support for Zend Core for IBM is available from Zend. On Windows, precompiled binary versions of PHP are available for download from <http://php.net/>. Most Linux distributions include a precompiled version of PHP. On UNIX operating systems that do not include a precompiled version of PHP, you can compile your own version of PHP.

PHP is a modular language that enables you to customize the available functionality through the use of extensions. These extensions can simplify tasks such as reading, writing, and manipulating XML, creating SOAP clients and servers, and encrypting communications between server and browser. The most popular extensions for PHP, however, provide read and write access to databases so that you can easily create a dynamic database-driven Web site. IBM supports access to DB2 databases from PHP applications through two extensions offering distinct sets of features:

- `ibm_db2` is an extension written, maintained, and supported by IBM for access to DB2 databases. The `ibm_db2` extension offers a procedural application

programming interface (API) that, in addition to the normal create, read, update, and write database operations, also offers extensive access to the database metadata. You can compile the `ibm_db2` extension with either PHP 4 or PHP 5.

- `PDO_ODBC` is a driver for the PHP Data Objects (PDO) extension that offers access to DB2 databases through the standard object-oriented database interface introduced in PHP 5.1. Despite its name, you can compile the `PDO_ODBC` extension directly against the DB2 libraries to avoid the communications overhead and potential interference of an ODBC driver manager.

A third extension, Unified ODBC, has historically offered access to DB2 database systems. It is not recommended that you write new applications with this extension because `ibm_db2` and `PDO_ODBC` both offer significant performance and stability benefits over Unified ODBC. The `ibm_db2` extension API makes porting an application that was previously written for Unified ODBC almost as easy as globally changing the `odbc_` function name to `db2_` throughout the source code of your application.

Related tasks:

- “Setting up the PHP environment on Linux or UNIX” in *Developing Perl and PHP Applications*
- “Setting up the PHP environment on Windows” in *Developing Perl and PHP Applications*

Choosing an application programming interface

Choosing an application programming interface

Which application programming interface (API) you choose to use with your DB2 database applications has a large impact on the development of the application.

Procedure:

Choosing an API is a combination of eliminating the APIs that are unsuitable, and then selecting the most appropriate from the APIs that remain.

While researching the available APIs you might discover functionality that you did not know about. Because of this, you might actually choose an API that requires you to change your environment and application design.

To choose an API to access a DB2 database, do the following:

1. Eliminate APIs that don't support the functionality you require.
 - Application environment choices you have already made restrict your API choices.

There may be restrictions on which APIs you can use because of operating system, programming language, or other choices you have already made about your application environment.

Before choosing an API: list known environment details, read the restrictions for the APIs you are considering using, and eliminate those APIs that are not supported with your environment.
 - All APIs might not support the functionality your applications require.

There may be some functionality that you want for your applications that some APIs don't support, or don't support well.

Before choosing an API: list functionality that you know you need in your applications, read the supported functionality of the APIs you are considering using, and eliminate those APIs that do not support the functionality you need.

2. Of the APIs that have not been eliminated, compare desirable qualities.

- Some APIs might support desirable functionality that other APIs do not support.

Even if more than one API support the functionality you know your applications require, one API might support functionality you are interested to learn more about and that you might use in the future.

Before choosing an API: list and compare the desirable functionality supported by the APIs.

- Some APIs are easier to learn and simpler to use than others.

If many APIs satisfy your basic requirements, choosing an API that is easier for your developers to learn and to use will save you development time and money.

Before choosing an API: learn about the architecture and design of the APIs, read the supporting documentation, and choose an API that is intuitive to use and well documented.

- You might already be using an API with existing applications.

If you have existing applications, it may save you time or money to use the same APIs that the existing applications use. This is because, among other things:

- your developers are familiar with the APIs they have used before;
- you might be able to reuse code from existing applications; and
- your development and production environments would already be configured to use those APIs, so additional installation or configuration might not be required to develop or deploy new applications using the same APIs.

Before choosing an API: investigate what APIs are being used by existing applications.

3. Consider changing your requirements if an API is outstanding.

Instead of choosing your API based on environment and application requirements, you might choose to alter your environment and application design to suit an API.

While comparing the relative merits of different APIs, you might discover that one API supports functionality that the other APIs don't support and that is so desirable you would choose to use that API solely because of that functionality. If your environment doesn't support that API, you might choose to change your environment. If your applications don't even require that functionality, you might choose to redesign your applications to make use of the functionality.

There is risk in making changes to your environment and application design for the sake of an API. However, the process of reviewing the functionality of the different APIs, and the process of considering your requirements might result in an improved database application.

Before eliminating an API because of environment or application restrictions, consider the merits of changing your requirements and using the API.

Related concepts:

- “Application Types Supported by the IBM OLE DB Provider for DB2” in *Developing ADO.NET and OLE DB Applications*
- “DB2 .NET Data Provider database system requirements” in *Developing ADO.NET and OLE DB Applications*
- “IBM OLE DB Provider restrictions” in *Developing ADO.NET and OLE DB Applications*
- “Limitations for ADO applications” in *Developing ADO.NET and OLE DB Applications*
- “How to determine which type of IBM DB2 Driver for JDBC and SQLJ connectivity to use” in *Developing Java Applications*
- “Java applet considerations” in *Developing Java Applications*
- “Determining when to execute SQL statements statically or dynamically in embedded SQL applications” in *Developing Embedded SQL Applications*
- “Restrictions on embedded SQL applications” in *Developing Embedded SQL Applications*
- “Comparison of DB2 CLI and Microsoft ODBC” in *Call Level Interface Guide and Reference, Volume 1*
- “Considerations for mixing embedded SQL and DB2 CLI” in *Call Level Interface Guide and Reference, Volume 1*
- “DB2 Call Level Interface (CLI) versus embedded SQL” on page 30

Related reference:

- “OLE DB .NET Data Provider restrictions” in *Developing ADO.NET and OLE DB Applications*
- “Driver support for JDBC APIs” in *Developing Java Applications*
- “Recommendations for developing embedded SQL applications with XML and XQuery” in *Developing Embedded SQL Applications*
- “Support for elements of the database application development environment” on page 5

DB2 Call Level Interface (CLI) versus embedded SQL

Two important differences between embedded SQL and DB2 CLI are:

1. the method for building applications;

To build an embedded application:

- a. connect to the target database(s) and precompile the embedded SQL;
- b. compile the application code; and
- c. bind the application to the target database(s).

After this, you can run the application against the target database(s).

To build a CLI application:

- a. compile the application code.

After this, you can run the application against any DB2 database to which the bind files shipped with CLI have been bound.

Because of this difference, deploying CLI applications is easier than deploying embedded SQL applications, particularly in environments where the target databases are not known at build time or where the target databases might change.

and

2. it is much easier to use static SQL in embedded SQL applications than in DB2 CLI applications.

For this reason, whether you use static SQL will be a factor in choosing whether to use embedded SQL or DB2 CLI.

Strengths and weaknesses of embedded SQL and DB2 CLI:

When deciding whether to create your applications using DB2 CLI or embedded SQL, consider the following strengths and weaknesses of DB2 CLI and embedded SQL:

- DB2 CLI applications are easier to deploy and compatible across database management systems:
 - Embedded SQL applications must be precompiled, and are therefore dependant on precompiler software. DB2 CLI applications do not need to be precompiled.
 - You must bind embedded SQL applications to target databases, but you do not need to bind CLI applications to target databases. There are bind files shipped with DB2 CLI that need to be bound to target databases once for all CLI applications.
 - CLI provides a consistent interface to query catalog information contained in DBMS catalog tables; and the result sets returned are consistent across DBMSs. There is no such consistent interface available with embedded SQL.
- DB2 CLI is more flexible at runtime:
 - You can use parameter markers in CLI applications, but not in embedded SQL applications. CLI applications can process statements with parameter markers, and obtain data type information for those parameters using describe information.
 - CLI provides enhanced parameter input and fetching capability, allowing arrays of data to be specified on input, retrieving multiple rows of a result set directly into an array, and executing statements that generate multiple result sets.
- Some functionality is easier to achieve using DB2 CLI than using embedded SQL:
 - CLI objects like connection handles allow you to easily connect to multiple databases, and have multiple connections to the same database in a CLI application. To do the same thing in an embedded SQL application, you must use multi-threading, which entails using DB2 context management APIs to be thread-safe.

See: Mixed multithreaded CLI applications
 - Cursor management can be easier with DB2 CLI than with embedded SQL. For example, DB2 CLI does not require the explicit declaration of cursors, it has a pool of cursors that get used as needed. Also, you do not need to open cursors in CLI applications, the execution of a SELECT statement automatically causes a cursor to be opened. Finally, CLI has more extensive support for scrollable cursors, including using scrollable cursors with array output.
 - Embedded SQL applications use complex data areas, such as SQLDA and SQLCA. DB2 CLI provides handles to reference the same kind of information. For example, environment handles, connection handles, statement handles, and descriptor handles provide a means to refer to information like global variables, connection specific information, the parameters of an SQL statement, or the columns of a result set.

- It is easier to convert between various SQL and C data types in DB2 CLI applications than in embedded SQL applications, because DB2 CLI provides extended data conversion support that embedded SQL does not.
- Some functionality is easier to achieve using embedded SQL than using DB2 CLI:
 - Embedded SQL is supported in languages other than C or C++.
 - It is much easier to use static SQL in embedded SQL applications.

Strengths and weaknesses of static SQL and dynamic SQL:

When choosing whether to use static SQL, consider the following:

- Static SQL can perform better than dynamic SQL:

In CLI applications, dynamic SQL is prepared at run time. In embedded SQL applications, static SQL is prepared at precompile time. The performance cost of preparing statements at runtime is: 1) processing the prepare (precompiling the SQL); and 2) sending the prepare across the network.

It is important to note that despite these costs, static SQL will not always have better performance than dynamic SQL. For example, you can avoid precompiling dynamic SQL statements by caching the statements. Also, you can avoid the additional network traffic of preparing dynamic SQL by using deferred prepare. Finally, database statistics available when preparing dynamic SQL at runtime may result in a better access plan than database statistics available when preparing static SQL at BIND time. For example, there may be new indexes at runtime. A better access plan would result in better performance.
- Implementing security rules can be easier with static SQL than with dynamic SQL:

With static SQL, authorization to access objects like tables and views is associated with a package and is validated at package binding time. This means that a database administrator can grant execute access for a set of users on a particular package without having to grant those users explicit access to each database object. With dynamic SQL, authorization is validated at run time on a per statement basis. This means an administrator must grant explicit access to each database object, which permits these users access to parts of the objects that they do not have a need to access.

Static SQL in a DB2 CLI application:

It is possible to use static SQL in DB2 CLI applications:

- Using stored procedures with static SQL

It is possible to make use of static SQL within a CLI application by creating a stored procedure that contains the static SQL. The stored procedure is called from within a CLI application and is executed on the server. Once the stored procedure is created, any CLI or ODBC application can call it.
- Mixing embedded SQL and DB2 CLI

It is also possible to write a mixed application that uses both embedded SQL and DB2 CLI. In this case, CLI is used to provide the base application, with key modules written in embedded SQL using static SQL for performance or security reasons. This complicates the application design, and should only be used if stored procedures do not meet the application requirements.

See: Considerations for mixing embedded SQL and DB2 CLI and `dbusemx.sqc` -- How to execute embedded SQL statements in CLI

Related concepts:

- “Choosing an application programming interface” on page 28
- “Supported database application programming interfaces” on page 18

Supported programming languages and compilers for database application development

Supported programming languages and compilers for database application development

You can develop DB2 database applications in the following languages:

- C
- C++
- COBOL
- Fortran
- Java
- Perl
- PHP
- REXX
- .Net languages

The supported APIs and programming languages for developing external routines are generally compatible with those for database application development, however there are some minor differences in prerequisites and support. To review the supported APIs and programming language for external routine development see: Supported APIs and programming languages for external routine development

Related reference:

- “Support for database application development in Fortran” on page 38
- “Support for database application development in Perl” on page 39
- “Support for database application development in PHP” on page 40
- “Support for database application development in C” on page 34
- “Support for database application development in C++” on page 35
- “Support for database application development in COBOL” on page 37
- “Support for database application development in REXX” on page 41
- “Support for elements of the database application development environment” on page 5

Supported .NET development software

To develop and deploy .NET applications that run against DB2 databases, you will need to use supported development software and operating systems.

Supported operating systems for developing and deploying .NET Framework 1.1 applications:

- Windows 2000
- Windows XP (32-bit edition)
- Windows Server 2003 (32-bit edition)

Note: Windows 98, Windows ME, and Windows NT are also supported, but only for running DB2 client-side applications.

Supported operating systems for developing and deploying .NET Framework 2.0 applications:

- Windows 2000, Service Pack 3
- Windows XP, Service Pack 2 (32-bit and 64-bit editions)
- Windows Server 2003 (32-bit and 64-bit editions)

Note: Windows 98 and Windows ME are also supported, but only for running DB2 client-side applications.

Supported development software for .NET Framework applications:

In addition to a DB2 client, you will need one of the following options to develop .NET Framework applications.

- Visual Studio 2003 (for .NET Framework 1.1 applications)
- Visual Studio 2005 (for .NET Framework 2.0 applications)
- .NET Framework 1.1 Software Development Kit and .NET Framework Version 1.1 Redistributable Package (for .NET Framework 1.1 applications)
- .NET Framework 2.0 Software Development Kit and .NET Framework Version 2.0 Redistributable Package (for .NET Framework 2.0 applications)

Supported deployment software for .NET Framework applications:

In addition to a DB2 client , you will need one of the following two options to deploy .NET Framework applications.

- .NET Framework Version 1.1 Redistributable Package (for .NET Framework 1.1 applications)
- .NET Framework Version 2.0 Redistributable Package (for .NET Framework 2.0 applications)

Support for database application development in C

The following table lists C compilers that are supported for DB2 database application development.

Unless otherwise noted, the compilers listed in the following table support both 32-bit and 64-bit application development.

Table 8. Supported C compilers

| Operating System | Supported Compiler(s) |
|---------------------|--|
| AIX | <ul style="list-style-type: none"> • IBM XL C/C++ Enterprise Edition Version 7.0 for AIX (with the XL C/C++ Enterprise Edition Version 8.0 runtime library) • IBM XL C/C++ Enterprise Edition Version 8.0 for AIX • IBM C for AIX Version 6.0 |
| HP-UX on PA-RISC | <ul style="list-style-type: none"> • HP ANSI C Compiler Version B.11.11.14 |
| HP-UX on IPF (IA64) | <ul style="list-style-type: none"> • HP ANSI C Compiler Version A.06.05 |

Table 8. Supported C compilers (continued)

| Operating System | Supported Compiler(s) |
|--|---|
| Linux on x86 (32-bit DB2 instances and compilers only) | <ul style="list-style-type: none"> • GNU/Linux gcc versions 3.3 and 3.4 • Intel C Compiler Version 9.0 |
| Linux on AMD64/EM64T (x86-64, x64) | <ul style="list-style-type: none"> • GNU/Linux gcc versions 3.3 and 3.4 • Intel C Compiler Version 9.0 |
| Linux on IPF (IA64) (64-bit DB2 instances and compilers only) | <ul style="list-style-type: none"> • GNU/Linux gcc versions 3.3 and 3.4 • Intel C Compiler Version 9.0 |
| Linux on POWER (PowerPC®, iSeries, pSeries) | <ul style="list-style-type: none"> • GNU/Linux gcc versions 3.3 and 3.4 • IBM XL C/C++ Advanced Edition Version 7.0 for Linux |
| Linux on zSeries (s/390x) | <ul style="list-style-type: none"> • GNU/Linux gcc versions 3.3 and 3.4 |
| Solaris on UltraSPARC | <ul style="list-style-type: none"> • Solaris Studio 10 • Forte C++ Version 6.2 • Sun ONE Studio 7, Compiler Collection |
| Windows on x86 (32-bit DB2 instances only) | <ul style="list-style-type: none"> • Intel Proton Compiler for Windows 32-bit applications, Version 9.0.021 or later • Microsoft Visual C++ 2005 • Microsoft Visual C++ .NET |
| Windows on X64 (x86-64, AMD64/EM64T) | <ul style="list-style-type: none"> • Microsoft Platform SDK for Windows Server 2003 SP1 (Build 1830 or later), C/C++ compiler for x64 • Intel Proton Compiler for Windows x64, Version 9.0.024 or later |
| Windows on IPF (IA64) | <ul style="list-style-type: none"> • Microsoft Platform SDK for Windows Server 2003 (Build 3790 or later), C/C++ compiler for Itanium • Intel Proton Compiler for Windows Itanium, Version 9.0.024 or later |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Support for database application development in C++

The following table lists C++ compilers that are supported for DB2 database application development.

Unless otherwise noted, the compilers listed in the following table support both 32-bit and 64-bit application development.

Table 9. Supported C++ compilers

| Operating System | Supported Compiler(s) |
|---|---|
| AIX | <ul style="list-style-type: none"> • IBM XL C/C++ Enterprise Edition Version 7.0 for AIX (with the XL C/C++ Enterprise Edition Version 8.0 runtime library) • IBM XL C/C++ Enterprise Edition Version 8.0 for AIX • IBM VisualAge® C++ Version 6.0 with the March 2003 C++ Runtime PTF |
| HP-UX on PA-RISC | <ul style="list-style-type: none"> • HP aC++ Compiler Version A.03.63 |
| HP-UX on IPF (IA64) | <ul style="list-style-type: none"> • HP aC++ Compiler Version A.06.05 |
| Linux on x86 (32-bit DB2 instances and compilers only) | <ul style="list-style-type: none"> • GNU/Linux g++ versions 3.3 and 3.4 <p>Note: If you experience problems with the g++ version 3.4 compiler on RHEL 4, revert back to the g++ version 3.2 compiler which is available as a compat package on RHEL 4.</p> |
| Linux on AMD64/EM64T (x86-64, x64) | <ul style="list-style-type: none"> • GNU/Linux g++ versions 3.3 and 3.4 <p>Note: If you experience problems with the g++ version 3.4 compiler on RHEL 4, revert back to the g++ version 3.2 compiler which is available as a compat package on RHEL 4.</p> |
| Linux on IPF (IA64) (64-bit DB2 instances and compilers only) | <ul style="list-style-type: none"> • GNU/Linux g++ versions 3.3 and 3.4 <p>Note: If you experience problems with the g++ version 3.4 compiler on RHEL 4, revert back to the g++ version 3.2 compiler which is available as a compat package on RHEL 4.</p> |
| Linux on POWER (PowerPC, iSeries, pSeries) | <ul style="list-style-type: none"> • GNU/Linux g++ versions 3.3 and 3.4 • IBM XL C/C++ Advanced Edition Version 7.0 for Linux <p>Note: If you experience problems with the g++ version 3.4 compiler on RHEL 4, revert back to the g++ version 3.2 compiler which is available as a compat package on RHEL 4.</p> |
| Linux on zSeries (s/390x) | <ul style="list-style-type: none"> • GNU/Linux g++ versions 3.3 and 3.4 <p>Note: If you experience problems with the g++ version 3.4 compiler on RHEL 4, revert back to the g++ version 3.2 compiler which is available as a compat package on RHEL 4.</p> |
| Solaris on UltraSPARC | <ul style="list-style-type: none"> • Solaris Studio 10 • Forte C++ Version 6.2 • Sun ONE Studio 7, Compiler Collection |
| Windows on x86 (32-bit DB2 instances only) | <ul style="list-style-type: none"> • Intel Proton Compiler for Windows 32-bit applications, Version 9.0.021 or later • Microsoft Visual C++ 2005 • Microsoft Visual C++ .NET |
| Windows on X64 (x86-64, AMD64/EM64T) | <ul style="list-style-type: none"> • Microsoft Platform SDK for Windows Server 2003 SP1 (Build 1830 or later), C/C++ compiler for x64 • Intel Proton Compiler for Windows x64, Version 9.0.024 or later |

Table 9. Supported C++ compilers (continued)

| Operating System | Supported Compiler(s) |
|-----------------------|---|
| Windows on IPF (IA64) | <ul style="list-style-type: none"> • Microsoft Platform SDK for Windows Server 2003 (Build 3790 or later), C/C++ compiler for Itanium • Intel Proton Compiler for Windows Itanium, Version 9.0.024 or later |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Support for database application development in COBOL

The following table lists COBOL compilers that are supported for DB2 database application development.

Unless otherwise noted, the compilers listed in the following table support both 32-bit and 64-bit application development.

Table 10. Supported COBOL compilers

| Operating System | Supported Compiler(s) |
|--|--|
| AIX | <ul style="list-style-type: none"> • IBM COBOL Set for AIX Version 2.0 (32-bit only) • Micro Focus COBOL Server Express Version 4.0 with Service Pack 2 |
| HP-UX on PA-RISC | <ul style="list-style-type: none"> • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 (32-bit only) |
| HP-UX on IPF (IA64) | <ul style="list-style-type: none"> • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 |
| Linux on x86 (32-bit DB2 instances and compilers only) | <ul style="list-style-type: none"> • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 on SLES9 • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 on RHEL4 |
| Linux on zSeries (s/390x) | <ul style="list-style-type: none"> • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 on SLES9 |
| Solaris on UltraSPARC | <ul style="list-style-type: none"> • Micro Focus COBOL Server Express Version 4.0 - Service Pack 2 (32-bit only) |
| Windows on x86 (32-bit DB2 instances only) | <ul style="list-style-type: none"> • Micro Focus COBOL Net Express Version 3.1.0 • IBM VisualAge COBOL Version 3.0.4 or later |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Support for database application development in Fortran

The following table lists Fortran compilers that are supported for DB2 database application development.

Unless otherwise noted, the compilers listed in the following table support both 32-bit and 64-bit application development.

Table 11. Supported Fortran compilers

| Operating System | Supported Compiler(s) |
|-----------------------|--|
| AIX | <ul style="list-style-type: none"> • IBM XL Fortran for AIX Versions 4.1 (32-bit only) • IBM XL Fortran for AIX Versions 5.1.0 |
| HP-UX on PA-RISC | <ul style="list-style-type: none"> • HP-UX f90 B.11.01.06 |
| HP-UX on IPF (IA64) | <ul style="list-style-type: none"> • HP-UX F90 B.11.23 |
| Solaris on UltraSPARC | <ul style="list-style-type: none"> • SPARCCompiler Fortran Versions 4.2 and 5.0 (32-bit only) |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Supported Java application development software

To develop and deploy Java applications that run against DB2 databases, you need to use supported development software and operating systems.

When you install the IBM DB2 Driver for JDBC and SQLJ, the driver installation process does not install a software development kit (SDK) for Java. If the installation process for the DB2 Database for Linux, UNIX, and Windows product installs an SDK for Java, that installation process installs the latest SDK for Java that is available.

The following table lists the supported levels of the SDK for Java. Only the listed levels and forward-compatible later versions of the same level are supported. For example, if only level 1.4.2 is listed for a particular operating system, level 1.4.2 SR n is also supported, but level 5 is not supported. If level 1.4.2 to level 5 is listed, level 1.4.2 SR n and level 5 SR m are also supported.

Because there are frequent SDK for Java fixes and updates, not all levels and versions have been tested. If your database application has problems that are related to the SDK for Java, try the next available version of your SDK for Java at the given level.

Non-IBM versions of the SDK for Java are supported only for building and running stand-alone Java applications. For building and running Java stored

procedures and user-defined functions, only the IBM SDK for Java that is included with the DB2 Database for Linux, UNIX, and Windows product is supported.

Table 12. SDK for Java by DB2 Database for Linux, UNIX, and Windows

| Operating system | 31-bit, 32-bit, or 64-bit operating system | Supported levels of the SDK for Java |
|----------------------|--|--------------------------------------|
| AIX 5 | 32-bit/64-bit | 1.4.2 to 5 |
| HP-UX 11i | 32-bit/64-bit | 1.4.2 ¹ |
| Linux on Intel x86 | 32-bit | 1.4.2 to 5 ² |
| Linux on IA64 | 64-bit | 1.4.2 ^{2,3} |
| Linux on AMD64/EM64T | 32-bit/64-bit | 1.4.2 to 5 ² |
| Linux on PowerPC | 32-bit/64-bit | 1.4.2 to 5 |
| Linux on zSeries | 31-bit/64-bit | 1.4.2 to 5 |
| Solaris | 32-bit/64-bit | 1.4.2 ² |
| Windows on Intel x86 | 32-bit | 1.4.2 to 5 ² |
| Windows on IA64 | 64-bit | 1.4.2 ^{2,3} |
| Windows on x64 | 32-bit/64-bit | 1.4.2 to 5 ² |

Notes:

1. The same levels of the SDK for Java that are available from Hewlett-Packard are supported for building and running client applications with the IBM DB2 Driver for JDBC and SQLJ.
2. The same levels of the SDK for Java that are available from Sun Microsystems are supported for building and running client applications with the IBM DB2 Driver for JDBC and SQLJ.
3. A minimum level of SDK for Java 1.4.2 SR3 is required for Montecito processors.

Related tasks:

- “Installing the IBM DB2 Driver for JDBC and SQLJ” in *Developing Java Applications*

Support for database application development in Perl

The following table lists versions of the Perl programming language that are supported for DB2 database application development.

Unless otherwise noted, the versions listed in the following table support both 32-bit and 64-bit application development.

Table 13. Supported versions of the Perl programming language

| Operating System | Supported Version(s) |
|---|-------------------------------|
| AIX | • Perl 5.8 or later, DBI 1.41 |
| HP-UX on PA-RISC | • Perl 5.8 or later, DBI 1.41 |
| HP-UX on IPF (IA64) | • Perl 5.8 or later, DBI 1.41 |
| Linux on x86 (32-bit DB2 instances and compilers only) | • Perl 5.8 or later, DBI 1.41 |
| Linux on AMD64/EM64T (x86-64, x64) | • Perl 5.8 or later, DBI 1.41 |

Table 13. Supported versions of the Perl programming language (continued)

| Operating System | Supported Version(s) |
|--|-------------------------------|
| Linux on IPF (IA64) (64-bit DB2 instances and compilers only) | • Perl 5.8 or later, DBI 1.41 |
| Linux on POWER (PowerPC, iSeries, pSeries) | • Perl 5.8 or later, DBI 1.41 |
| Linux on zSeries (s/390x) | • Perl 5.8 or later, DBI 1.41 |
| Solaris on UltraSPARC | • Perl 5.8 or later, DBI 1.41 |
| Windows on x86 (32-bit DB2 instances only) | • Perl 5.8 or later, DBI 1.41 |
| Windows on X64 (x86-64, AMD64/EM64T) | • Perl 5.8 or later, DBI 1.41 |
| Windows on IPF (IA64) | • Perl 5.8 or later, DBI 1.41 |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Support for database application development in PHP

The following table lists versions of the PHP scripting language that are supported for DB2 database application development.

Though the base support is listed in the table below, using the latest version of PHP 5 is recommended.

Unless otherwise noted, the version listed in the following table support both 32-bit and 64-bit application development.

Table 14. Supported versions of the PHP scripting language

| Operating System | Supported Version(s) |
|---|----------------------|
| AIX | • PHP 4.3.4 or later |
| HP-UX on PA-RISC | • PHP 4.3.4 or later |
| HP-UX on IPF (IA64) | • PHP 4.3.4 or later |
| Linux on x86 (32-bit DB2 instances and language only) | • PHP 4.3.4 or later |
| Linux on AMD64/EM64T (x86-64, x64) | • PHP 4.3.4 or later |
| Linux on IPF (IA64) (64-bit DB2 instances and language only) | • PHP 4.3.4 or later |
| Linux on POWER (PowerPC, iSeries, pSeries) | • PHP 4.3.4 or later |

Table 14. Supported versions of the PHP scripting language (continued)

| Operating System | Supported Version(s) |
|---|----------------------|
| Linux on zSeries (s/390x) | • PHP 4.3.4 or later |
| Solaris on UltraSPARC | • PHP 4.3.4 or later |
| Windows on x86 (32-bit DB2 instances only) | • PHP 4.3.4 or later |
| Windows on X64 (x86-64, AMD64/EM64T) | • PHP 4.3.4 or later |
| Windows on IPF (IA64) | • PHP 4.3.4 or later |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Support for database application development in REXX

The following table lists versions of the REXX programming language that are supported for DB2 database application development.

Only 32-bit versions of REXX are supported.

Table 15. Supported versions of the REXX programming language

| Operating System | Supported Version(s) |
|---|--|
| AIX | <ul style="list-style-type: none"> • IBM AIX REXX/6000 AISPO® Product Number: 5764-057 • IBM Object REXX for AIX Version 1.1 • REXXSAA 4.00 |
| Linux on x86 (32-bit DB2 instances and compilers only) | • Object REXX Interpreter for Linux Version 2.1 |
| Linux on zSeries (s/390x) | • Object REXX 2.2.0 for Linux/390 |

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Related reference:

- “Supported programming languages and compilers for database application development” on page 33

Supported transaction managers

DB2 database can serve as a resource manager for any XA-compliant transaction manager.

Here is a list of some common XA-compliant transaction managers that can be used to coordinate distributed transactions involving DB2 databases:

- IBM TXSeries® CICS®

- IBM TxSeries Encina[®] Monitor
- IBMWebSphere MQ
- BEA Tuxedo
- BEA WebLogic
- Microsoft Distributed Transaction Coordinator (DTC)

Related concepts:

- “Multisite Updates” in *DB2 Connect User’s Guide*
- “Configuration considerations for XA transaction managers” on page 54
- Chapter 1, “The DB2 database application development environment,” on page 3

Supported database application development tools

The following integrated development environments and other development tools facilitate DB2 database application development:

- **IBM integrated database application development environments**
 - DB2 Developer Workbench
 - Rational[®] Application Developer
 - Rational Application Architect
- **Database application plug-ins for integrated development environments**
 - IBM Database Add-ins for Visual Studio 2005
- **Tools for developing SQL Statements**
 - SQL Assist Wizard
 - SQL Builder
 - SQL Editor
 - Command line processor
- **Database application monitoring and performance tuning tools**
 - Event monitors
 - Explain tools
 - CLI/ODBC/JDBC Static Profiling
- **Tools for developing web applications**
 - WebSphere Studio Application Developer
 - Rational Web Developer
 - DB2 Alphablox

IBM Database Enterprise Developer Edition:

The IBM Database Enterprise Developer Edition product enables an application developer to design, build, and prototype applications for deployment on any of the IBM Information Management client or server platforms. Using the software that comes with this product, you can develop and test applications that run on one operating system and access databases on the same or on a different operating system. For example, you can create an application that runs on a Windows operating system but accesses a database on a UNIX platform such as AIX.

For information on the software shipped with this product, see the IBM Web site: <http://www.ibm.com/software/data/db2/udb>

Related concepts:

- Chapter 1, “The DB2 database application development environment,” on page 3

Chapter 3. Configuring the database application development environment

Configuring the database application development environment

The DB2 database application development environment is composed of several software elements:

- **operating system;**
- **DB2 Client;**
- **database application programming interface (API);**
- **programming language;**
- **transaction manager;** and
- **development tools.**

Each of these elements requires some configuration for DB2 database application development.

Prerequisites:

To configure for DB2 database application development, you must have:

- a supported operating system
See: Supported operating systems for database application development.
- a DB2 Client installed
See: Methods for installing DB2 clients.
- API driver(s) and, if required, driver manager(s) installed
See: Supported database application programming interfaces.
- compiler(s) or interpreter(s) required for the programming language(s) you will be using installed
See: Supported programming languages and compilers for database application development.
- a transaction manager installed
See: Supported transaction managers.
- development tools installed
See: Supported database application development tools.

Procedure:

To configure for DB2 database application development, do the following:

1. configure the operating system
See: Configuring the operating system for database application development.
2. configure the DB2 Client
See: Configuring a DB2 client for database application development.
3. configure API driver(s) and, if required, driver manager(s)
See: Configuring the development environment for application programming interfaces.

4. configure the transaction manager

See: Configuration considerations for XA transaction managers.

Related concepts:

- “Methods for installing DB2 clients” in *Quick Beginnings for DB2 Clients*
- “Supported database application programming interfaces” on page 18
- “Supported transaction managers” on page 41
- “Supported database application development tools” on page 42
- “Configuration considerations for XA transaction managers” on page 54
- Chapter 1, “The DB2 database application development environment,” on page 3

Related tasks:

- “Configuring the operating system for database application development” on page 46
- “Configuring a DB2 client for database application development” on page 51
- “Configuring the development environment for application programming interfaces” on page 52

Related reference:

- “Supported operating systems for database application development” on page 7
- “Supported programming languages and compilers for database application development” on page 33
- “Support for elements of the database application development environment” on page 5

Configuring the operating system for database application development

Configuring the operating system for database application development

Part of configuring for DB2 database application development is configuring operating system local and global environment variables.

Prerequisites:

To configure environment variables for DB2 database application development, you must have:

- a supported operating system
See: Supported operating systems for database application development.
- a DB2 Client installed
See: Methods for installing DB2 clients.

Procedure:

The steps for configuring environment variables for DB2 database application development depend on the operating system:

- For UNIX operating systems:
See: Setting up the UNIX application development environment.

- For Windows operating systems:
See: Setting up the Windows application development environment.

Related concepts:

- “Methods for installing DB2 clients” in *Quick Beginnings for DB2 Clients*

Related tasks:

- “Setting up the UNIX application development environment” on page 47
- “Setting up the Windows application development environment” on page 48
- “Configuring the database application development environment” on page 45

Related reference:

- “Supported operating systems for database application development” on page 7

Setting up the UNIX application development environment

You need to set environment variables for your database instance. Each database manager instance has two files, `db2profile` and `db2cshrc`, which are scripts to set the environment variables for that instance.

Procedure:

Run the correct script for the shell you are using:

For bash or Korn shell:

```
. $HOME/sql1lib/db2profile
```

For C shell:

```
source $HOME/sql1lib/db2cshrc
```

where `$HOME` is the home directory of the instance owner.

If you include this command in your `.profile` or `.login` file, the command runs automatically when you log on.

If you will be using ODBC, DB2 CLI, or Java, do the steps in one of the following topics:

- Setting up the UNIX ODBC environment
- Installing the IBM DB2 Driver for JDBC and SQLJ

Related concepts:

- “UNIX environment variable settings” on page 48

Related tasks:

- “Setting up the UNIX ODBC environment” in *Call Level Interface Guide and Reference, Volume 1*
- “Installing the IBM DB2 Driver for JDBC and SQLJ” in *Developing Java Applications*
- “Configuring the operating system for database application development” on page 46

Related reference:

- “Supported operating systems for database application development” on page 7

UNIX environment variable settings

Depending on the UNIX platform you are on, values for the following environment variables are set, either in `db2profile` (for bash or korn shell) or `db2cshrc` (for C shell), and a call to these files are put in the instance owner's `.profile` (bash or korn shell) or `.login` (C shell) file.

AIX:

- `PATH`, includes several DB2 directories including `sqllib/bin`
- `LIBPATH`, includes the directory `sqllib/lib` (see note below)

HP-UX:

- `PATH`, includes several DB2 directories including `sqllib/bin`
- `SHLIB_PATH` (32-bit and 64-bit) or `LD_LIBRARY_PATH` (64-bit), includes the directory `sqllib/lib` (see note below)

Linux and Solaris:

- `PATH`, includes several DB2 directories including `sqllib/bin`
- `LD_LIBRARY_PATH`, includes the directory `sqllib/lib` (see note below)

The blank files `sqllib/userprofile` and `sqllib/usercshrc` are created during instance creation to allow users to place their own instance environmental settings. If you do not want the new environment settings in the `db2profile` or `db2cshrc` scripts, you can override them using the corresponding "user" script, which is called at the end of the `db2profile` or `db2cshrc` script. During an instance migration (`db2imigr`), the user scripts are copied over so that your environment modifications will still be in use.

Related tasks:

- "Setting up the UNIX application development environment" on page 47
- "Setting environment variables on UNIX systems" in *Administration Guide: Implementation*
- "Setting the DB2 environment automatically on UNIX" in *Administration Guide: Implementation*
- "Setting the DB2 environment manually on UNIX" in *Administration Guide: Implementation*

Setting up the Windows application development environment

When you install the DB2 Client on Windows operating systems, the install program updates the configuration registry with the environment variables `INCLUDE`, `LIB`, and `PATH`. The system-wide environment variable, `DB2INSTANCE`, is set by install to the default instance created, called `DB2`. `DB2PATH` is set inside a DB2 command window when the window is opened.

You can override these environment variables to set the values for the machine or the currently logged-on user. Exercise caution when changing these environment variables. Do not change the `DB2PATH` environment variable. `DB2INSTANCE` is defined as a system-level environment variable. You do not need to make use of the `DB2INSTDEF` DB2 registry variable which defines the default instance name to use if `DB2INSTANCE` is not set.

Procedure:

To override the environment variable settings, use the Windows Control Panel.

When using the variable %DB2PATH% in a command, put the full path in quotes, as in:

```
set LIB="%DB2PATH%\lib";%LIB%
```

The default installation value for this variable is \Program Files\IBM\SQLLIB, which contains a space, so not using quotes can cause an error.

In addition, you must take the following specific steps for running DB2 applications:

- When building C or C++ programs, you must ensure that the INCLUDE environment variable contains %DB2PATH%\INCLUDE as the first directory.

To do this, update the environment setup file for your compiler:

Microsoft Visual C++ 6.0

```
"C:\Program Files\Microsoft Visual Studio\VC98\bin\vcvars32.bat"
```

Microsoft Visual C++ .NET

```
"C:\Program Files\Microsoft Visual Studio .NET\Common7\Tools\vsvars32.bat"
```

These files have the following commands:

Microsoft Visual C++ 6.0

```
set INCLUDE=%MSVCDir%\ATL\INCLUDE;%MSVCDir%\INCLUDE;  
%MSVCDir%\MFC\INCLUDE;%INCLUDE%
```

Microsoft Visual C++ .NET

```
@set INCLUDE=%MSVCDir%\ATLMFC\INCLUDE;...;  
%FrameworkSDKDir%\include;%INCLUDE%
```

To use either file with DB2, first move %INCLUDE%, which sets the %DB2PATH%\INCLUDE path, from the end of the list to the beginning, as follows:

Microsoft Visual C++ 6.0

```
set INCLUDE=%INCLUDE%;%MSVCDir%\ATL\INCLUDE;  
%MSVCDir%\INCLUDE;%MSVCDir%\MFC\INCLUDE
```

Microsoft Visual C++ .NET

```
@set INCLUDE=%INCLUDE%;%MSVCDir%\ATLMFC\INCLUDE;...;  
%FrameworkSDKDir%\include
```

- When building Micro Focus COBOL programs, set the COBCPY environment variable to point to %DB2PATH%\INCLUDE\cobl_mf.
- When building IBM COBOL programs, set the SYSLIB environment variable to point to %DB2PATH%\INCLUDE\cobl_a.
- Ensure the LIB environment variable points to %DB2PATH%\lib by using:

```
set LIB="%DB2PATH%\lib";%LIB%
```

Note: To enable cross-developing 64-bit applications from a 32-bit environment, see Migrating 32-bit database applications to run on 64-bit instances

- Ensure that the DB2COMM environment variable is set at the server of a remote database.
- Ensure that the security service has started at the server for SERVER authentication, and at the client, when using CLIENT authentication.

Note: Because CLIENT authentication happens on the client side instead of the server side, the client application is running under the context of the user.

The Win32 authentication API requires certain privileges that might or might not be held by the user. In order to make sure that the CLIENT authentication takes place successfully, the authentication requests are passed from the client application to the security server (which runs under a privileged account local system by default, and has the right to call the authentication API).

To start the security service manually, use the NET START DB2NTSECSERVER command.

Normally, the only time you would want to set the security service to start automatically is if the workstation is acting as a DB2 client connecting to a server that is configured for Client Authentication. To have the security service start automatically, do the following:

Windows 2000 and Windows Server 2003

1. Click the "Start" button.
2. For Windows 2000, click "Settings" and then click "Control Panel". For Windows Server 2003, click "Control Panel".
3. Click "Administrative Tools".
4. Click "Services".
5. In the Services window, highlight "DB2 Security Server".
6. If it does not have the settings "Started" and "Automatic" listed, click "Action" from the top menu.
7. Click "Properties".
8. Make sure you are in the "General" tab.
9. Choose "Automatic" from the 'Startup Type' drop-down menu.
10. Click "OK".
11. Reboot your machine to have the settings take effect.

Windows XP

1. Click the "Start" button.
2. Click "Settings".
3. Click "Control Panel".
4. Click "Performance and Maintenance".
5. Click "Administrative Tools".
6. Click "Services".
7. In the Services window, highlight "DB2 Security Server".
8. If it does not have the settings "Started" and "Automatic" listed, click "Action" from the top menu.
9. Click "Properties".
10. Make sure you are in the "General" tab.
11. Choose "Automatic" from the 'Startup Type' drop-down menu.
12. Click "OK".
13. Reboot your machine to have the settings take effect.

The database manager on a Windows XP, Windows Server 2003, or a Windows 2000 environment is implemented as a service, and hence does not return errors or warnings when the service is started, though problems might have occurred. This means that when you run the db2start or the NET START command, no warnings will be returned if any communication subsystem failed to start.

Therefore, the user should always examine the event logs or the DB2 Administration Notification log for any errors that might have occurred during the running of these commands.

If you will be using DB2 CLI or Java, proceed to the appropriate task:

- Setting up the Windows CLI environment
- Setting up the Windows CLI environment

Related tasks:

- “Migrating 32-bit database applications to run on 64-bit instances” in *Migration Guide*
- “Setting up the Windows CLI environment” in *Call Level Interface Guide and Reference, Volume 1*
- “Installing the IBM DB2 Driver for JDBC and SQLJ” in *Developing Java Applications*
- “Configuring the operating system for database application development” on page 46
- “Setting environment variables on Windows” in *Administration Guide: Implementation*
- “Setting the default instance when using multiple DB2 copies (Windows)” in *Administration Guide: Implementation*

Related reference:

- “Supported operating systems for database application development” on page 7

Configuring a DB2 client for database application development

The DB2 Client supports database application development; the DB2 Runtime Client does not. Part of configuring for application development is configuring the DB2 Client.

Prerequisites:

To configure a DB2 Client for database application development, you must have:

- installed a DB2 Client
See: Installing DB2 clients (UNIX and Linux) and Installing DB2 clients (Windows).
- optional: created sample databases with which to test you applications
See: The SAMPLE database.
- completed basic configuration steps for your DB2 Client
See: Client-to-server communications configuration overview.

Restrictions:

The DB2 Runtime Client does not support database application development; to develop database applications, you need a DB2 Client.

Procedure:

Beyond normal installation and configuration steps for the DB2 client, there is no extra configuration of the DB2 Client required to enable database application development.

Related concepts:

- “Client-to-server communications configuration overview” in *Quick Beginnings for DB2 Clients*
- “DB2 client setup overview” in *Quick Beginnings for DB2 Clients*

Related tasks:

- “Installing DB2 clients (UNIX and Linux)” in *Quick Beginnings for DB2 Clients*
- “Installing DB2 clients (Windows)” in *Quick Beginnings for DB2 Clients*
- “Configuring the database application development environment” on page 45

Related reference:

- “The SAMPLE database” in *Samples Topics*
- “DB2 Client support for database application development” on page 17

Configuring the development environment for application programming interfaces

Configuring the development environment for application programming interfaces

Part of configuring for DB2 database application development is configuring the development environment for any application programming interfaces (APIs) that you will use in your applications.

Prerequisites:

To configure the application development environment for the API(s) you will use, you must have:

- a DB2 Client installed
See: Methods for installing DB2 clients.
- the API driver(s) installed
See: Supported database application programming interfaces.
- for the ODBC API only: an ODBC driver manager installed
See: Setting up the Windows CLI environment.

Procedure:

The steps for configuring the application development depend on which API(s) you will be using:

- ADO .NET
See: ADO.NET development for DB2 databases.
- DB2 CLI and ODBC
See:
 - Setting up the CLI environment,
 - Setting up the UNIX ODBC environment,
 - Setting up the Windows CLI environment and
 - Setting up the unixODBC Driver Manager.
- Embedded SQL

- See: Setting up the embedded SQL development environment
- JDBC and SQLJ
 - See: Installing the IBM DB2 Driver for JDBC and SQLJ
- OLE DB
 - See: Purpose of the IBM OLE DB Provider for DB2
- Perl
 - See: Perl DBI
- PHP
 - See: Setting up the PHP environment on Linux or UNIX and Setting up the PHP environment on Windows

Related concepts:

- “Methods for installing DB2 clients” in *Quick Beginnings for DB2 Clients*
- “ADO.NET development for DB2 databases” on page 19
- “IBM OLE DB Provider for DB2” on page 26
- “Perl DBI” on page 27
- “Supported database application programming interfaces” on page 18

Related tasks:

- “Setting up the Windows CLI environment” in *Call Level Interface Guide and Reference, Volume 1*
- “Setting up the CLI environment” on page 53
- “Setting up the UNIX ODBC environment” in *Call Level Interface Guide and Reference, Volume 1*
- “Setting up the unixODBC Driver Manager” in *Call Level Interface Guide and Reference, Volume 1*
- “Setting up the embedded SQL development environment” in *Developing Embedded SQL Applications*
- “Installing the IBM DB2 Driver for JDBC and SQLJ” in *Developing Java Applications*
- “Setting up the PHP environment on Linux or UNIX” in *Developing Perl and PHP Applications*
- “Setting up the PHP environment on Windows” in *Developing Perl and PHP Applications*
- “Configuring the database application development environment” on page 45

Setting up the CLI environment

Runtime support for DB2 CLI applications is contained in all DB2 clients. Support for building and running DB2 CLI applications is contained in the DB2 Client. This section describes the general setup required for DB2 CLI runtime support.

Prerequisites:

Before you set up your CLI environment, ensure you have set up the application development environment.

Procedure:

In order for a DB2 CLI application to successfully access a DB2 database:

1. Ensure the DB2 CLI/ODBC driver was installed during the DB2 client install.
2. Catalog the DB2 database and node if the database is being accessed from a remote client.

On the Windows platform, you can use the CLI/ODBC Settings GUI to catalog the DB2 database.

3. Optional: Explicitly bind the DB2 CLI/ODBC bind files to the database with the command:

```
db2 bind ~/sql1lib/bnd/@db2cli.lst blocking all sqlerror continue \  
messages cli.msg grant public
```

On the Windows platform, you can use the CLI/ODBC Settings GUI to bind the DB2 CLI/ODBC bind files to the database.

4. Optional: Change the DB2 CLI/ODBC configuration keywords by editing the `db2cli.ini` file, located in the `sql1lib` directory on Windows, and in the `sql1lib/cfg` directory on UNIX platforms.

On the Windows platform, you can use the CLI/ODBC Settings GUI to set the DB2 CLI/ODBC configuration keywords.

Once you have completed the above steps, proceed to setting up your Windows CLI environment, or setting up your UNIX ODBC environment if you are running ODBC applications on UNIX.

Related concepts:

- “Initialization and termination in CLI overview” in *Call Level Interface Guide and Reference, Volume 1*

Related tasks:

- “Initializing CLI applications” in *Call Level Interface Guide and Reference, Volume 1*
- “Setting up the UNIX ODBC environment” in *Call Level Interface Guide and Reference, Volume 1*
- “Setting up the Windows CLI environment” in *Call Level Interface Guide and Reference, Volume 1*

Related reference:

- “BIND command” in *Command Reference*
- “CATALOG DATABASE command” in *Command Reference*

Configuration considerations for XA transaction managers

You should consider the following configuration parameters when you are setting up your TP monitor environment:

- `tp_mon_name`

This database manager configuration parameter identifies the name of the TP monitor product being used (“CICS”, or “ENCINA”, for example).

- `tpname`

This database manager configuration parameter identifies the name of the remote transaction program that the database client must use when issuing an allocate request to the database server, using the APPC communications protocol. The value is set in the configuration file at the server, and must be the same as the transaction processor (TP) name configured in the SNA transaction program.

- `tm_database`

Because DB2 Database for Linux, UNIX, and Windows does *not* coordinate transactions in the XA environment, this database manager configuration parameter is not used for XA-coordinated transactions.

- *maxappls*

This database configuration parameter specifies the maximum number of active applications allowed. The value of this parameter must be equal to or greater than the sum of the connected applications, plus the number of these applications that may be concurrently in the process of completing a two-phase commit or rollback. This sum should then be increased by the anticipated number of indoubt transactions that might exist at any one time.

For a TP monitor environment (for example, TXSeries CICS), you may need to increase the value of the *maxappls* parameter. This would help to ensure that all TP monitor processes can be accommodated.

- *autorestart*

This database configuration parameter specifies whether the RESTART DATABASE routine will be invoked automatically when needed. The default value is YES (that is, enabled).

A database containing indoubt transactions requires a restart database operation to start up. If *autorestart* is not enabled when the last connection to the database is dropped, the next connection will fail and require an explicit RESTART DATABASE invocation. This condition will exist until the indoubt transactions have been removed, either by the transaction manager's resync operation, or through a heuristic operation initiated by the administrator. When the RESTART DATABASE command is issued, a message is returned if there are any indoubt transactions in the database. The administrator can then use the LIST INDOUBT TRANSACTIONS command and other command line processor commands to find get information about those indoubt transactions.

Related concepts:

- "X/Open distributed transaction processing model" in *Administration Guide: Planning*

Related reference:

- "tpname - APPC transaction program name configuration parameter" in *Performance Guide*
- "autorestart - Auto restart enable configuration parameter" in *Performance Guide*
- "LIST INDOUBT TRANSACTIONS command" in *Command Reference*
- "maxappls - Maximum number of active applications configuration parameter" in *Performance Guide*
- "RESTART DATABASE command" in *Command Reference*
- "tm_database - Transaction manager database name configuration parameter" in *Performance Guide*
- "tp_mon_name - Transaction processor monitor name configuration parameter" in *Performance Guide*

Part 2. Appendixes

Appendix A. DB2 Database technical information

Overview of the DB2 technical information

DB2 technical information is available through the following tools and methods:

- DB2 Information Center
 - Topics
 - Help for DB2 tools
 - Sample programs
 - Tutorials
- DB2 books
 - PDF files (downloadable)
 - PDF files (from the DB2 PDF CD)
 - printed books
- Command line help
 - Command help
 - Message help
- Sample programs

IBM periodically makes documentation updates available. If you access the online version on the DB2 Information Center at ibm.com[®], you do not need to install documentation updates because this version is kept up-to-date by IBM. If you have installed the DB2 Information Center, it is recommended that you install the documentation updates. Documentation updates allow you to update the information that you installed from the *DB2 Information Center CD* or downloaded from Passport Advantage as new information becomes available.

Note: The DB2 Information Center topics are updated more frequently than either the PDF or the hard-copy books. To get the most current information, install the documentation updates as they become available, or refer to the DB2 Information Center at ibm.com.

You can access additional DB2 technical information such as technotes, white papers, and Redbooks[™] online at ibm.com. Access the DB2 Information Management software library site at <http://www.ibm.com/software/data/sw-library/>.

Documentation feedback

We value your feedback on the DB2 documentation. If you have suggestions for how we can improve the DB2 documentation, send an e-mail to db2docs@ca.ibm.com. The DB2 documentation team reads all of your feedback, but cannot respond to you directly. Provide specific examples wherever possible so that we can better understand your concerns. If you are providing feedback on a specific topic or help file, include the topic title and URL.

Do not use this e-mail address to contact DB2 Customer Support. If you have a DB2 technical issue that the documentation does not resolve, contact your local IBM service center for assistance.

Related concepts:

- “Features of the DB2 Information Center” in *Online DB2 Information Center*
- “Sample files” in *Samples Topics*

Related tasks:

- “Invoking command help from the command line processor” in *Command Reference*
- “Invoking message help from the command line processor” in *Command Reference*
- “Updating the DB2 Information Center installed on your computer or intranet server” on page 65

Related reference:

- “DB2 technical library in PDF format” on page 60

DB2 technical library in PDF format

The following tables describe the DB2 library available from the IBM Publications Center at www.ibm.com/shop/publications/order.

Although the tables identify books available in print, the books might not be available in your country or region.

The information in these books is fundamental to all DB2 users; you will find this information useful whether you are a programmer, a database administrator, or someone who works with DB2 Connect or other DB2 products.

Table 16. DB2 technical information

| Name | Form Number | Available in print |
|--|--------------------|---------------------------|
| <i>Administration Guide: Implementation</i> | SC10-4221 | Yes |
| <i>Administration Guide: Planning</i> | SC10-4223 | Yes |
| <i>Administrative API Reference</i> | SC10-4231 | Yes |
| <i>Administrative SQL Routines and Views</i> | SC10-4293 | No |
| <i>Call Level Interface Guide and Reference, Volume 1</i> | SC10-4224 | Yes |
| <i>Call Level Interface Guide and Reference, Volume 2</i> | SC10-4225 | Yes |
| <i>Command Reference</i> | SC10-4226 | No |
| <i>Data Movement Utilities Guide and Reference</i> | SC10-4227 | Yes |
| <i>Data Recovery and High Availability Guide and Reference</i> | SC10-4228 | Yes |
| <i>Developing ADO.NET and OLE DB Applications</i> | SC10-4230 | Yes |
| <i>Developing Embedded SQL Applications</i> | SC10-4232 | Yes |
| <i>Developing SQL and External Routines</i> | SC10-4373 | No |

Table 16. DB2 technical information (continued)

| Name | Form Number | Available in print |
|--|-------------|--------------------|
| <i>Developing Java Applications</i> | SC10-4233 | Yes |
| <i>Developing Perl and PHP Applications</i> | SC10-4234 | No |
| <i>Getting Started with Database Application Development</i> | SC10-4252 | Yes |
| <i>Getting started with DB2 installation and administration on Linux and Windows</i> | GC10-4247 | Yes |
| <i>Message Reference Volume 1</i> | SC10-4238 | No |
| <i>Message Reference Volume 2</i> | SC10-4239 | No |
| <i>Migration Guide</i> | GC10-4237 | Yes |
| <i>Net Search Extender Administration and User's Guide</i> Note: HTML for this document is not installed from the HTML documentation CD. | SH12-6842 | Yes |
| <i>Performance Guide</i> | SC10-4222 | Yes |
| <i>Query Patroller Administration and User's Guide</i> | GC10-4241 | Yes |
| <i>Quick Beginnings for DB2 Clients</i> | GC10-4242 | No |
| <i>Quick Beginnings for DB2 Servers</i> | GC10-4246 | Yes |
| <i>Spatial Extender and Geodetic Data Management Feature User's Guide and Reference</i> | SC18-9749 | Yes |
| <i>SQL Guide</i> | SC10-4248 | Yes |
| <i>SQL Reference, Volume 1</i> | SC10-4249 | Yes |
| <i>SQL Reference, Volume 2</i> | SC10-4250 | Yes |
| <i>System Monitor Guide and Reference</i> | SC10-4251 | Yes |
| <i>Troubleshooting Guide</i> | GC10-4240 | No |
| <i>Visual Explain Tutorial</i> | SC10-4319 | No |
| <i>What's New</i> | SC10-4253 | Yes |
| <i>XML Extender Administration and Programming</i> | SC18-9750 | Yes |
| <i>XML Guide</i> | SC10-4254 | Yes |
| <i>XQuery Reference</i> | SC18-9796 | Yes |

Table 17. DB2 Connect-specific technical information

| Name | Form Number | Available in print |
|--|-------------|--------------------|
| <i>DB2 Connect User's Guide</i> | SC10-4229 | Yes |
| <i>Quick Beginnings for DB2 Connect Personal Edition</i> | GC10-4244 | Yes |

Table 17. DB2 Connect-specific technical information (continued)

| Name | Form Number | Available in print |
|---|-------------|--------------------|
| <i>Quick Beginnings for DB2 Connect Servers</i> | GC10-4243 | Yes |

Table 18. WebSphere Information Integration technical information

| Name | Form Number | Available in print |
|---|-------------|--------------------|
| <i>WebSphere Information Integration: Administration Guide for Federated Systems</i> | SC19-1001 | Yes |
| <i>WebSphere Information Integration: ASNCLP Program Reference for Replication and Event Publishing</i> | SC19-1000 | Yes |
| <i>WebSphere Information Integration: Configuration Guide for Federated Data Sources</i> | SC19-1034 | No |
| <i>WebSphere Information Integration: SQL Replication Guide and Reference</i> | SC19-1002 | Yes |

Note: The DB2 Release Notes provide additional information specific to your product's release and fix pack level. For more information, see the related links.

Related concepts:

- "Overview of the DB2 technical information" on page 59
- "About the Release Notes" in *Release notes*

Related tasks:

- "Ordering printed DB2 books" on page 62

Ordering printed DB2 books

If you require printed DB2 books, you can buy them online in many but not all countries or regions. You can always order printed DB2 books from your local IBM representative. Keep in mind that some softcopy books on the *DB2 PDF Documentation* CD are unavailable in print. For example, neither volume of the *DB2 Message Reference* is available as a printed book.

Printed versions of many of the DB2 books available on the DB2 PDF Documentation CD can be ordered for a fee from IBM. Depending on where you are placing your order from, you may be able to order books online, from the IBM Publications Center. If online ordering is not available in your country or region, you can always order printed DB2 books from your local IBM representative. Note that not all books on the DB2 PDF Documentation CD are available in print.

Note: The most up-to-date and complete DB2 documentation is maintained in the DB2 Information Center at <http://publib.boulder.ibm.com/infocenter/db2help/>.

Procedure:

To order printed DB2 books:

- To find out whether you can order printed DB2 books online in your country or region, check the IBM Publications Center at <http://www.ibm.com/shop/publications/order>. You must select a country, region, or language to access publication ordering information and then follow the ordering instructions for your location.
- To order printed DB2 books from your local IBM representative:
 - Locate the contact information for your local representative from one of the following Web sites:
 - The IBM directory of world wide contacts at www.ibm.com/planetwide
 - The IBM Publications Web site at <http://www.ibm.com/shop/publications/order>. You will need to select your country, region, or language to the access appropriate publications home page for your location. From this page, follow the "About this site" link.
 - When you call, specify that you want to order a DB2 publication.
 - Provide your representative with the titles and form numbers of the books that you want to order.

Related concepts:

- "Overview of the DB2 technical information" on page 59

Related reference:

- "DB2 technical library in PDF format" on page 60

Displaying SQL state help from the command line processor

DB2 returns an SQLSTATE value for conditions that could be the result of an SQL statement. SQLSTATE help explains the meanings of SQL states and SQL state class codes.

Procedure:

To invoke SQL state help, open the command line processor and enter:

```
? sqlstate or ? class code
```

where *sqlstate* represents a valid five-digit SQL state and *class code* represents the first two digits of the SQL state.

For example, ? 08003 displays help for the 08003 SQL state, and ? 08 displays help for the 08 class code.

Related tasks:

- "Invoking command help from the command line processor" in *Command Reference*
- "Invoking message help from the command line processor" in *Command Reference*

Accessing different versions of the DB2 Information Center

For DB2 Version 9 topics, the DB2 Information Center URL is <http://publib.boulder.ibm.com/infocenter/db2luw/v9/>.

For DB2 Version 8 topics, go to the Version 8 Information Center URL at: <http://publib.boulder.ibm.com/infocenter/db2luw/v8/>.

Related tasks:

- “Updating the DB2 Information Center installed on your computer or intranet server” on page 65

Displaying topics in your preferred language in the DB2 Information Center

The DB2 Information Center attempts to display topics in the language specified in your browser preferences. If a topic has not been translated into your preferred language, the DB2 Information Center displays the topic in English.

Procedure:

To display topics in your preferred language in the Internet Explorer browser:

1. In Internet Explorer, click the **Tools** → **Internet Options** → **Languages...** button. The Language Preferences window opens.
2. Ensure your preferred language is specified as the first entry in the list of languages.
 - To add a new language to the list, click the **Add...** button.

Note: Adding a language does not guarantee that the computer has the fonts required to display the topics in the preferred language.

- To move a language to the top of the list, select the language and click the **Move Up** button until the language is first in the list of languages.
3. Clear the browser cache and then refresh the page to display the DB2 Information Center in your preferred language.

To display topics in your preferred language in the Firefox browser:

1. In Firefox, select the **Tools** → **Options** → **Languages** button. The Languages panel is displayed in the Preferences window.
2. Ensure your preferred language is specified as the first entry in the list of languages.
 - To add a new language to the list, click the **Add...** button to select a language from the Add Languages window.
 - To move a language to the top of the list, select the language and click the **Move Up** button until the language is first in the list of languages.
3. Clear the browser cache and then refresh the page to display the DB2 Information Center in your preferred language.

On some browser and operating system combinations, you might have to also change the regional settings of your operating system to the locale and language of your choice.

Related concepts:

- “Overview of the DB2 technical information” on page 59

Updating the DB2 Information Center installed on your computer or intranet server

If you have a locally-installed DB2 Information Center, updated topics can be available for download. The 'Last updated' value found at the bottom of most topics indicates the current level for that topic.

To determine if there is an update available for the entire DB2 Information Center, look for the 'Last updated' value on the Information Center home page. Compare the value in your locally installed home page to the latest value which is available on the IBM hosted Information Center home page. If they are the same, you have the latest documentation level and no update is required. If they are not the same, you should update your locally-installed Information Center.

Updating your locally-installed DB2 Information Center requires that you:

1. Stop the DB2 Information Center on your computer, and restart the Information Center in stand-alone mode. Running the Information Center in stand-alone mode prevents other users on your network from accessing the Information Center, and allows you to download and apply updates.
2. Use the Update feature to determine if update packages are available from IBM. If update packages are available, use the Update feature to download the packages. (The Update feature is only available in stand-alone mode.)
3. Stop the stand-alone Information Center, and restart the DB2 Information Center service on your computer.

Procedure:

To update the DB2 Information Center installed on your computer or intranet server:

1. Stop the DB2 Information Center service.
 - On Windows, click **Start** → **Control Panel** → **Administrative Tools** → **Services**. Then right-click on **DB2 Information Center** service and select **Stop**.
 - On Linux, enter the following command:
`/etc/init.d/db2icdv9 stop`
2. Start the Information Center in stand-alone mode.
 - On Windows:
 - a. Open a command window.
 - b. Navigate to the path where the Information Center is installed. By default, the DB2 Information Center is installed in the C:\Program Files\IBM\DB2 Information Center\Version 9 directory.
 - c. Run the `help_start.bat` file using the fully qualified path for the DB2 Information Center:
`<DB2 Information Center dir>\doc\bin\help_start.bat`
 - On Linux:
 - a. Navigate to the path where the Information Center is installed. By default, the DB2 Information Center is installed in the `/opt/ibm/db2ic/V9` directory.
 - b. Run the `help_start.sh` file using the fully qualified path for the DB2 Information Center:
`<DB2 Information Center dir>/doc/bin/help_start`

The systems default Web browser launches to display the stand-alone Information Center.

3. Click the Update button (🔄). On the right hand panel of the Information Center, click **Find Updates**. A list of updates for existing documentation displays.
4. To initiate the download process, check the selections you want to download, then click **Install Updates**.
5. After the download and installation process has completed, click **Finish**.
6. Stop the stand-alone Information Center.
 - On Windows, run the `help_end.bat` file using the fully qualified path for the DB2 Information Center:

```
<DB2 Information Center dir>\doc\bin\help_end.bat
```
 - On Linux, run the `help_end.sh` file using the fully qualified path for the DB2 Information Center:

```
<DB2 Information Center dir>/doc/bin/help_end
```
7. Restart the DB2 Information Center service.
 - On Windows, click **Start** → **Control Panel** → **Administrative Tools** → **Services**. Then right-click on **DB2 Information Center** service and select **Start**.
 - On Linux, enter the following command:

```
/etc/init.d/db2icdv9 start
```

The updated DB2 Information Center displays the new and updated topics.

Related concepts:

- “DB2 Information Center installation options” in *Quick Beginnings for DB2 Servers*

Related tasks:

- “Installing the DB2 Information Center using the DB2 Setup wizard (Linux)” in *Quick Beginnings for DB2 Servers*
- “Installing the DB2 Information Center using the DB2 Setup wizard (Windows)” in *Quick Beginnings for DB2 Servers*

DB2 Visual Explain tutorial

The DB2 Visual Explain tutorial helps you learn about analyzing, optimizing, and tuning SQL statements for better performance. Lessons provide step-by-step instructions.

Before you begin:

You can view the XHTML version of the tutorial from the Information Center at <http://publib.boulder.ibm.com/infocenter/db2help/>.

Some lessons use sample data or code. See the tutorial for a description of any prerequisites for its specific tasks.

DB2 Visual Explain tutorial:

To view the tutorial, click on the title.

Visual Explain Tutorial

Analyze, optimize, and tune SQL statements for better performance using Visual Explain.

Related concepts:

- “Visual Explain overview” in *Administration Guide: Implementation*

DB2 troubleshooting information

A wide variety of troubleshooting and problem determination information is available to assist you in using DB2 products.

DB2 documentation

Troubleshooting information can be found in the DB2 Troubleshooting Guide or the Support and Troubleshooting section of the DB2 Information Center. There you will find information on how to isolate and identify problems using DB2 diagnostic tools and utilities, solutions to some of the most common problems, and other advice on how to solve problems you might encounter with your DB2 products.

DB2 Technical Support Web site

Refer to the DB2 Technical Support Web site if you are experiencing problems and want help finding possible causes and solutions. The Technical Support site has links to the latest DB2 publications, TechNotes, Authorized Program Analysis Reports (APARs or bug fixes), fix packs, and other resources. You can search through this knowledge base to find possible solutions to your problems.

Access the DB2 Technical Support Web site at <http://www.ibm.com/software/data/db2/udb/support.html>

Related concepts:

- “Introduction to problem determination” in *Troubleshooting Guide*
- “Overview of the DB2 technical information” on page 59

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