

IBM Informix
Version 11.70

*IBM Informix Installation Guide
for UNIX, Linux, and Mac OS X*



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Note

Before using this information and the product it supports, read the information in "Notices" on page B-1.

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Introduction

This introduction provides an overview of IBM® Informix® products and of this publication as well as the conventions that it uses.

About this publication

This publication describes how to install, configure, and initialize an Informix database server on a computer running a UNIX, Linux, or Mac OS X operating system for database administrators, application developers, and other IT professionals. The documentation assumes that you are familiar with the operating procedures of your computer and with its operating system.

The following additional products can be installed from the IBM Informix installation media :

- IBM Informix BladeManager
- IBM Informix JDBC Driver (JDBC)
- IBM Informix Client Software Development Kit (Client SDK) *or* IBM Informix Connect (Informix Connect)
- IBM Data Server Driver Package
- IBM Data Studio

The bundled version of the Mac OS X installation program provides the option to install Informix with either Client SDK or Informix Connect only. However, IBM Informix JDBC Driver and BladeManager are available on the bundled version of the installation media for Mac OS X, and they can be installed separately.

When the installation media contains Informix bundled with client programs, the Windows clients are on a different disk from the one with UNIX, Linux, and Mac OS X clients.

OpenAdmin Tool (OAT) for Informix is a PHP-based Web browser administration tool that can administer multiple database server instances using a single installation on a Web server. OAT is available for download at <http://www.openadmintool.com>.

IBM Informix Server Administrator (ISA) is not included with the Informix installation media. ISA is available for download at <http://www.ibm.com/software/data/informix/downloads.html>. ISA is not available for Informix products running on Mac OS X computers.

OAT is available for download at <http://www.openadmintool.com>.

For a general description of Informix products, see the *IBM Informix Getting Started Guide*.

What's new in installation for IBM Informix, Version 11.70

This publication includes information about new features and changes in existing functionality.

The following changes and enhancements are relevant to this publication. For a complete list of what's new in this release, see the release notes or the information center at http://publib.boulder.ibm.com/infocenter/idshelp/v117/topic/com.ibm.po.doc/new_features.htm.

Table 1. What's New in IBM Informix Installation Guide for UNIX, Linux, and Mac OS X for Version 11.70.xC1

Overview	Reference
<p>Installation application provides seamless installation and smarter configuration</p> <p>The new installation application, which you start with the new ids_install command, makes it easier to install and configure Informix products and features.</p> <ul style="list-style-type: none"> • The typical installation has improved default settings. Use it to quickly install all of the products and features in the software bundle, with preconfigured settings. • The custom installation is smarter than before. Use it if you want to control what is installed on your computer, for example, you can install specific products and features or you can enable role separation. • Regardless of which setup you use, you can create an instance that is initialized and ready to use after installation. You must use a custom installation setup if you want to configure the instance for your business needs. • Online help is available in the installation application (GUI mode) 	<p>See “Installing Informix and client products quickly with defaults (UNIX and Linux)” on page 2-1 or “Installing Informix with selected features and client products (UNIX and Linux)” on page 2-2.</p>
<p>Changes to installation commands</p> <p>Some installation commands changed to take advantage of new and changed functionality and to improve consistency across products and operating systems.</p> <p>The following commands are not available in Informix 11.70 installation media: installserver, installclientsdk, installconn. You must use the ids_install command to install the database server with or without bundled software. You can still download the standalone IBM Informix Client Software Development Kit (Client SDK), IBM Informix Connect, and IBM Informix JDBC Driver media to install the client software on other computers.</p> <p>Use the new uninstallids command to remove the server, any bundled software, or both. You can remove specific products by using the following commands, which are in new subdirectories relative to the root directory:</p> <ul style="list-style-type: none"> • uninstall/uninstall_server/uninstallserver • uninstall/uninstall_clientsdk/uninstallclientsdk • uninstall/uninstall_connect/uninstallconnect (formerly uninstallconn) • uninstall/uninstall_jdbc/uninstalljdbc.exe or java -jar uninstall/uninstall_jdbc/uninstaller.jar (depending on how you install the JDBC driver) 	<p>For installation commands, see the documentation topics in Chapter 2, “Installing Informix and client products on UNIX and Linux,” on page 2-1 or Chapter 3, “Installing Informix on Mac OS X,” on page 3-1.</p> <p>For commands related to uninstallation, see Chapter 6, “Removing or modifying IBM Informix and client products installations on UNIX and Linux,” on page 6-1 or Chapter 7, “Modifying installations on Mac OS X,” on page 7-1.</p>

Table 1. What's New in IBM Informix Installation Guide for UNIX, Linux, and Mac OS X for Version 11.70.xC1 (continued)

Overview	Reference
<p>IBM Data Studio installable files included</p> <p>You can install IBM Data Studio by using the files that are provided in the <i>media_dir/SERVER/IBM_DataStudio</i> directory.</p> <p>On Linux operating systems, launch the <i>install.bin</i> file.</p>	<p>See “Other IBM product installation files” on page 1-7 for more information.</p>
<p>Simpler configuration for silent installation</p> <p>As in previous releases, you can generate a response file by recording an installation setup done in interactive mode. However, now you can set configuration parameters by editing the response file in any text editor in addition to passing command-line options.</p> <p>Informix 11.70 comes with one response file, <i>bundle.properties</i>, for the server and related products. In previous releases there were two response files: <i>server.ini</i> and <i>bundle.ini</i>.</p>	<p>See “Response file (UNIX and Linux)” on page 1-6.</p>
<p>Information about embedding Informix instances</p> <p>In the previous release, information about deploying embedded instances of Informix was documented along with the information about installing the database server. In this release, information about deploying embedded Informix instances can be found in the Embedding Informix section of the online information center or in the new <i>IBM Informix Embeddability Guide</i>.</p>	<p>Embedding IBM Informix (Embeddability Guide)</p>
<p>New editions and product names</p> <p>IBM Informix Dynamic Server editions were withdrawn and new Informix editions are available. Some products were also renamed. The publications in the Informix library pertain to the following products:</p> <ul style="list-style-type: none"> • IBM Informix database server, formerly known as IBM Informix Dynamic Server (IDS) • IBM OpenAdmin Tool (OAT) for Informix, formerly known as OpenAdmin Tool for Informix Dynamic Server (IDS) • IBM Informix SQL Warehousing Tool, formerly known as Informix Warehouse Feature 	<p>For more information about the Informix product family, go to http://www.ibm.com/software/data/informix/.</p>

IBM Informix editions

Informix is available in different editions to fit different business needs.

For details on the differences between editions, see the following Web site:
<http://www.ibm.com/software/data/informix/ids/ids-ed-choice/>

The license agreement has the specific restrictions for each edition. To view a license for a particular edition, search for "IBM Informix" on the following Web site: <http://www.ibm.com/software/sla/sladb.nsf>

Example code conventions

Examples of SQL code occur throughout this publication. Except as noted, the code is not specific to any single IBM Informix application development tool.

If only SQL statements are listed in the example, they are not delimited by semicolons. For instance, you might see the code in the following example:

```
CONNECT TO stores_demo
...

DELETE FROM customer
  WHERE customer_num = 121
...

COMMIT WORK
DISCONNECT CURRENT
```

To use this SQL code for a specific product, you must apply the syntax rules for that product. For example, if you are using an SQL API, you must use EXEC SQL at the start of each statement and a semicolon (or other appropriate delimiter) at the end of the statement. If you are using DB–Access, you must delimit multiple statements with semicolons.

Tip: Ellipsis points in a code example indicate that more code would be added in a full application, but it is not necessary to show it to describe the concept being discussed.

For detailed directions on using SQL statements for a particular application development tool or SQL API, see the documentation for your product.

Additional documentation

Documentation about this release of IBM Informix products is available in various formats.

All of the product documentation (including release notes, machine notes, and documentation notes) is available from the information center on the web at <http://publib.boulder.ibm.com/infocenter/idshelp/v117/index.jsp>. Alternatively, you can access or install the product documentation from the Quick Start CD that is shipped with the product.

Compliance with industry standards

IBM Informix products are compliant with various standards.

IBM Informix SQL-based products are fully compliant with SQL-92 Entry Level (published as ANSI X3.135-1992), which is identical to ISO 9075:1992. In addition, many features of IBM Informix database servers comply with the SQL-92 Intermediate and Full Level and X/Open SQL Common Applications Environment (CAE) standards.

The IBM Informix Geodetic DataBlade® Module supports a subset of the data types from the *Spatial Data Transfer Standard (SDTS)—Federal Information Processing Standard 173*, as referenced by the document *Content Standard for Geospatial Metadata*, Federal Geographic Data Committee, June 8, 1994 (FGDC Metadata Standard).

IBM Informix Dynamic Server (IDS) Enterprise Edition, Version 11.50 is certified under the Common Criteria. For more information, see *Common Criteria Certification: Requirements for IBM Informix Dynamic Server*, which is available at <http://www.ibm.com/support/docview.wss?uid=swg27015363>.

Syntax diagrams

Syntax diagrams use special components to describe the syntax for statements and commands.

Table 2. Syntax Diagram Components







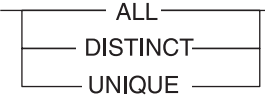
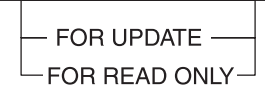
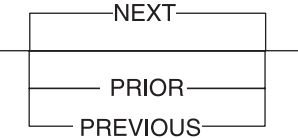
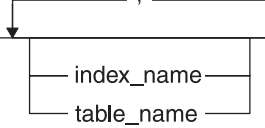

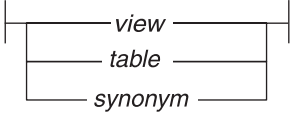
Component represented in PDF	Component represented in HTML	Meaning
	>>-----	Statement begins.
	----->	Statement continues on next line.
	>-----	Statement continues from previous line.
	-----><	Statement ends.
	-----SELECT-----	Required item.
	---+-----+--- '-----LOCAL-----'	Optional item.
	---+-----ALL-----+--- +---DISTINCT-----+ '---UNIQUE-----'	Required item with choice. Only one item must be present.
	---+-----+--- +---FOR UPDATE-----+ '--FOR READ ONLY--'	Optional items with choice are shown below the main line, one of which you might specify.
	.---NEXT-----. ---+-----+--- +---PRIOR-----+ '---PREVIOUS-----'	The values below the main line are optional, one of which you might specify. If you do not specify an item, the value above the line will be used as the default.
	.-----, v ---+-----+--- +---index_name---+ '---table_name---'	Optional items. Several items are allowed; a comma must precede each repetition.
	>>- Table Reference -><	Reference to a syntax segment.

Table 2. Syntax Diagram Components (continued)

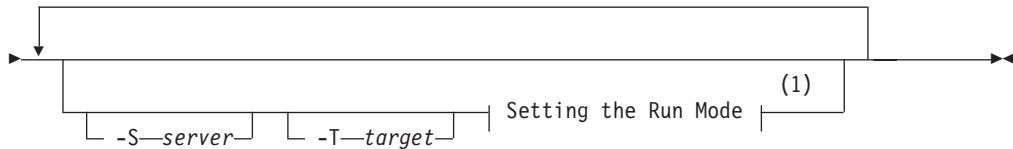
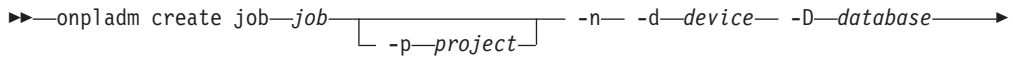
Component represented in PDF	Component represented in HTML	Meaning
<p>Table Reference</p> 	<p>Table Reference</p> <pre> ---+-----view-----+--- +-----table-----+ '-----synonym-----' </pre>	Syntax segment.

How to read a command-line syntax diagram

Command-line syntax diagrams use similar elements to those of other syntax diagrams.

Some of the elements are listed in the table in Syntax Diagrams.

Creating a no-conversion job

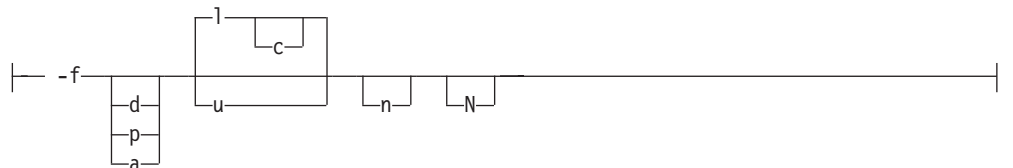


Notes:

- 1 See page Z-1

This diagram has a segment named “Setting the Run Mode,” which according to the diagram footnote is on page Z-1. If this was an actual cross-reference, you would find this segment on the first page of Appendix Z. Instead, this segment is shown in the following segment diagram. Notice that the diagram uses segment start and end components.

Setting the run mode:



To see how to construct a command correctly, start at the upper left of the main diagram. Follow the diagram to the right, including the elements that you want. The elements in this diagram are case-sensitive because they illustrate utility syntax. Other types of syntax, such as SQL, are not case-sensitive.

The Creating a No-Conversion Job diagram illustrates the following steps:

1. Type **onpladm create job** and then the name of the job.
2. Optionally, type **-p** and then the name of the project.
3. Type the following required elements:
 - **-n**
 - **-d** and the name of the device
 - **-D** and the name of the database
 - **-t** and the name of the table
4. Optionally, you can choose one or more of the following elements and repeat them an arbitrary number of times:
 - **-S** and the server name
 - **-T** and the target server name
 - The run mode. To set the run mode, follow the Setting the Run Mode segment diagram to type **-f**, optionally type **d**, **p**, or **a**, and then optionally type **l** or **u**.
5. Follow the diagram to the terminator.

Keywords and punctuation

Keywords are words reserved for statements and all commands except system-level commands.

When a keyword appears in a syntax diagram, it is shown in uppercase letters. When you use a keyword in a command, you can write it in uppercase or lowercase letters, but you must spell the keyword exactly as it appears in the syntax diagram.

You must also use any punctuation in your statements and commands exactly as shown in the syntax diagrams.

Identifiers and names

Variables serve as placeholders for identifiers and names in the syntax diagrams and examples.

You can replace a variable with an arbitrary name, identifier, or literal, depending on the context. Variables are also used to represent complex syntax elements that are expanded in additional syntax diagrams. When a variable appears in a syntax diagram, an example, or text, it is shown in *lowercase italic*.

The following syntax diagram uses variables to illustrate the general form of a simple SELECT statement.

►►—SELECT—*column_name*—FROM—*table_name*—►►

When you write a SELECT statement of this form, you replace the variables *column_name* and *table_name* with the name of a specific column and table.

Chapter 1. Preparing to install Informix and client products

You must prepare your system before you start the installation process and ensure that you have sufficient authority to perform the installation.

You should obtain root privileges before performing many of the installation-related tasks.

Preparation for installation encompasses some of the following tasks. Exactly which tasks you must complete depends on your operating system, host computer environment, and your installation preferences.

Preparing the operating system for installation

Before you install IBM Informix, you must apply all patches and install the shared library files that are described in the Machine Notes for your specific operating system.

To prepare the operating system on your system:

1. Read the Machine Notes, which are in the `ids_machine_notes_11.70.txt` file on the installation media. The Machine Notes also contain recommendations for tuning the operating system to support instances and any specific limitations to your operating system. The Machine Notes are also posted at the IBM Informix Information Center (<http://publib.boulder.ibm.com/infocenter/idshelp/v117/index.jsp>).
2. Apply the operating system patches as documented in the Machine Notes.
3. If you do not have all the required library files for your platform, install them on your system. IBM Informix documentation refers to the installation directory as `$INFORMIXDIR`. If `$INFORMIXDIR` is set in the environment, this will be the default install location.

After installation, the Machine Notes and the Informix Documentation Notes and Release Notes, are in the `$INFORMIXDIR/release` subdirectory.

Mac OS X users: If you upgraded the operating system to Snow Leopard (Mac OS X 10.6) and an existing Informix installation does not initialize or start after the upgrade, user `informix` and group `informix` might require changes. See the Release Notes for your edition for more information.

Tip: Verify that your host computer has sufficient disk space for the installation, as documented in “Disk space requirements for IBM Informix” on page 1-2.

Determine system requirements

Before you install any products, make sure your system meets all the requirements.

Read the following topics and make sure that your system meets all requirements:

- “Disk space requirements for IBM Informix” on page 1-2
- “Select an installation directory: `$INFORMIXDIR`” on page 1-5
- “Select installation options” on page 1-4

Disk space requirements for IBM Informix

See the IBM Informix machine notes for a list of supported UNIX, Linux, and Mac operating systems on which you can install the products.

Important: The following requirements might be lower for your system, depending on the operating system and environment.

A typical installation of the IBM Informix software bundle requires approximately 750 MB of disk space. Some installation choices require additional disk space. The installation application informs you of the total disk space required by your setup before you copy the binary files to your host computer.

The installation requires approximately 1 GB RAM.

Ensure that you have 2 GB free space available in your temporary directory (/tmp by default) before installation on UNIX or Linux. This is to allow the extraction of the installation media and for running the installation program. This location can be altered by setting the IATEMPDIR environment variable to a location that contains sufficient storage prior to invoking the installation program. If there is insufficient space in the default temporary location, the installation program attempts to write the information into the home directory for the user's account.

Computers with the Mac OS X operating system host the required JRE version. Therefore, an installation on this platform does not use the JRE bundled with the installation application.

Loading product files (UNIX and Linux)

Before you install, you must load the product files.

The directory where the media files are located, referred to as `media_location` in this documentation, can be on a disk device, such as a DVD, or on a file server where the downloaded source file is decompressed.

To load the product files on UNIX or Linux operating systems:

1. Access the installer directly from a disk device.
2. To access the installer from a file server, enter the appropriate **tar** or other command. For example:

```
tar xvf filename
```

In this command, *filename* is the path name of the **tar** file that contains the product files.

Extracting product files (Mac OS X)

If you do not see the `ids_install.app` icon when you open the installation media, double-click the self-extracting `.dmg` icon.

The `ids_install.app` icon is the installation application file.

Creating the group **informix** and user **informix**

Typically the installation application creates these required objects, but in a few situations you must create them before installing. The Mac OS X installation application automatically creates group and user **informix** in all circumstances, so this task does not apply to Mac computers.

You must create the objects before you run the installation application in the following situations:

- You want to specify a particular identifier (ID) number.
- The group **informix** exists on the system; however, the user **informix** does not. In this case, you must create the user only.

To create the group **informix** and user **informix**:

1. Create the group **informix** by using the **groupadd** utility followed by the name of the group, in this format: `groupadd n informix`
where *n* is an unused identifier (ID) greater than 100.
(On AIX®, use the **mkgroup** command instead of **groupadd**.)
2. Create the user **informix** by using the **useradd** utility followed by the group (**informix**) and user name (**informix**) in this format: `useradd -u n -g informix informix`
where *n* is an unused identifier (ID) greater than 100.

Important: Only add users to the group **informix** if the users need administrative access to the database server.

3. Create a password for user **informix** by running the **passwd** utility.

Group **informix**

The group **informix** must exist on the system for the user accounts required to install and administer IBM Informix.

The **informix** group definition establishes the set of user accounts to which you want to grant administrative access to the database server. User **informix** must be part of this group.

The Mac OS X installation application automatically creates user and group **informix** if they do not already exist on your computer.

If you are installing Informix for the first time on a UNIX or Linux system, you can create group **informix** manually before you run the installation application. Alternatively, when you run the installation application for Informix bundled with other IBM Informix products, the application can create it automatically.

User **informix**

User **informix** is a user account with main authority over an IBM Informix instance.

User **informix** is required because it has the unique user identifier (UID) to manage and maintain Informix instances and databases on the system. The password for this user account must be protected. Only allow trusted database and security administrators log in as user **informix**.

If you are installing Informix for the first time on your system, you can create user **informix** manually before you run the installation application. Alternatively, when you run the installation application for Informix bundled with other IBM Informix products on UNIX or Linux, the application can create the UID automatically in most situations. The situation when the installation application cannot create user **informix** is when group **informix** already exists on your system.

The Informix installation application for the Mac OS X operating system always creates group and user **informix** if they do not already exist on the host computer.

Select installation options

You can select from several installation options to install IBM Informix, its features, and related products.

When you install Informix or related products, you can use various installation options to install the products to suit your installation environment and goals:

- “Typical and custom installation options”
- “Select an installation directory: \$INFORMIXDIR” on page 1-5
- “Deployment wizard” on page 1-5
- “Role separation” on page 1-6
- “Response file (UNIX and Linux)” on page 1-6
- “Response file (Mac OS X)” on page 1-7

Typical and custom installation options

Typical setup installs all Informix products on the installation media, with all features, and requires minimal user input. Custom setup lets you select specific products and features to exclude from the installation to minimize the footprint (disk size) and provides options to install the Informix server with more advanced security and configuration features.

The installation application has two setup options:

Typical installation

Typical setup is recommended for most database server environments.

The typical setup installs the Informix server with all associated features and products. The typical setup also provides the option to create a server instance that is automatically configured to function in the host computer environment.

Custom installation

Custom setup lets you select products and features to exclude from the installation. Some features are mutually dependent, and must be installed with one another. The installation application enforces these dependencies.

In addition, with custom setup you can create a database server instance automatically after installation. If you create an instance in custom installation, you have the option to set specific configuration parameters or to allow the installation application set them automatically.

If you want to enable role separation, you must select custom setup.

After installation, you can install additional features, reinstall features, or remove installed features without changing anything else in the base server. Which setup type you select depends on your system architecture, technical expertise, and implementation requirements.

Select an installation directory: \$INFORMIXDIR

The directory for the IBM Informix installation, referred to as \$INFORMIXDIR, can be created before or during installation.

You can accept the default \$INFORMIXDIR path provided when you run the installation application.

Alternatively, you can select a different path from the default. If you have a particular directory to which you want to install, prepare this directory following these guidelines:

- The directory must be local or an NFS-mounted file system using regular operating-system files.
- The directory should be empty before you install Informix there.
- To preserve product files of earlier versions, create separate directories for each version of your IBM Informix products.
- The \$INFORMIXDIR path, including path separators, cannot contain spaces and should not exceed 200 characters.

The installation path (including all path elements) must be secure before IBM Informix can be initialized. The installation application automatically checks the permissions of the target path, and alerts you if the path is not secure. For most users, selecting the default path displayed by the installation application ensures that the \$INFORMIXDIR path is secure. See “Secure a nonsecure Informix installation path” on page 2-6 for more information.

Deployment wizard

The deployment wizard in the custom setup of the installation application allows you to include or exclude IBM Informix features and functions.

Some customers embed IBM Informix within their application. Many customers work with only a part of the capabilities available to them in Informix. For example, one customer might never be required to use the extra locales that are part of the Global Language Support (GLS) feature. A different customer might use GLS, but would use some but not all of the Performance Monitoring Utilities.

Informix consists of discrete, installable features. You can select to install only the database server features that your application and deployment require. Some features are mutually dependent, and must coexist in the instance. The wizard enforces these dependencies. The wizard automatically includes dependent features or informs you when a combination of selections is not supported. This flexibility benefits those who want to minimize the footprint on their systems and those who want to embed Informix in another system or application.

To use the deployment wizard, you must select the custom setup in the installation application. You can easily modify your installation by adding or removing features after Informix is installed without being required to install the base server again. Adding or removing features after you have installed Informix does not affect the integrity of your system.

All Informix features must run on the same version as the core database server.

Role separation

Role separation provides checks and balances to improve the security of your event-auditing procedures.

Event auditing tracks selected activities that users perform. With role separation enabled, members of certain group identifiers (group IDs) on your system manage and examine these records to ensure additional security.

Two roles must be associated with group IDs to enable role separation:

Database System Security Officer (DBSSO)

Controls what the auditing subsystem monitors and which actions database users can perform

Auditing Analysis Officer (AAO)

Controls whether auditing occurs, maintains the audit log files, and analyzes the audit records of those database activities that the DBSSO mandates to be audited

Important: You must select custom installation setup to enable role separation. If you enable role separation, you cannot turn it off after IBM Informix is installed. To remove role separation, you must uninstall the database server and reinstall it without role separation.

The installation application asks you whether to set up role separation or not. The group **informix** is the default group associated with the two roles. If you want to specify group IDs rather than accept the default ones, verify that the groups that you plan to specify in the role-separation panel exist on your system before you start the installation application.

Outside of the installation application, establish an audit-only user account for each individual who acts as a DBSSO or AAO. For example, a person with DBSSO responsibilities can have the user **DBSSO1** account, and also have the user **garcia5** account for general database server access.

Response file (UNIX and Linux)

A response file facilitates installation of IBM Informix products in silent mode.

The response file contains installation settings for a product and its features.

For an unattended installation on a UNIX or Linux operating system, you must use one of the following response file types that suits your installation goals:

Default response files

To use the installation media's `bundle.properties` file to install with default values, `LICENSE_ACCEPTED` should be set to `TRUE` by doing the following: `LICENSE_ACCEPTED=TRUE`.

Self-customized response files

Copy the `bundle.properties` file to your system, rename the file, and use it as a template for customizing your installation settings. Do not modify the original `bundle.properties` file.

Response files generated by a product installation application

If you want to use the same installation settings in more than one directory

or computer, first install a product in GUI- or console-mode to capture the installation settings in a response file. Run the product installation command with the `-r` option and specify a full path name. Do not name your response file `bundle.properties` or `ids.properties`. Use your `.properties` file to perform a silent installation elsewhere.

Response file (Mac OS X)

A response file facilitates installation of IBM Informix products in silent mode.

The response file contains installation settings for a product and its features.

For an unattended installation on Mac OS X, the response file is `bundle.properties`. You must copy the `bundle.properties` file from the installation media to your home directory, and then modify the installation settings for your requirements. For information about how to use the response file, see “Performing an unattended Informix installation (Mac OS X)” on page 3-3.

You can use the `bundle.properties` file on Mac OS X to install:

- IBM Informix with either Client SDK or Informix Connect
- IBM Informix alone
- Client SDK or Informix Connect alone

Other IBM product installation files

The IBM Data Server Driver Package and IBM Data Studio installation binaries are included in the installation media for some operating systems supported by Informix.

After completing an IBM Informix product installation in GUI or console mode on most operating systems, you are asked if you want to install the IBM Data Server Driver Package. If you select to install the driver, a separate, short installation application starts. If you do not install the driver during Informix product installation, you can install the driver separately later. The IBM Data Server Driver Package directory appears on the top level of the installation media. For more information about the driver, see the *IBM Informix Client Products Installation Guide*.

Similarly, the `SERVER` directory of the installation media contains an IBM Data Studio subdirectory of installation binaries if supported. On Linux operating systems, launch the `install.bin` file to start the installation application. Java Development Kit (JDK) 1.6 is required for installation and running of IBM Data Studio. For more information about IBM Data Studio, see <http://www.ibm.com/software/data/studio/> and <http://publib.boulder.ibm.com/infocenter/dstudio/v1r1m0/index.jsp>.

Chapter 2. Installing Informix and client products on UNIX and Linux

Most IBM Informix products, including the database server and the major client applications, can be installed using a packaged software bundle. You can select specific products you want to install. There is also a selection of supported installation methods offered to help meet the requirements of specific environments.

The installation binary files for the Informix software bundle are in the `ids_install` file on the installation media. If the `ids_install` file does not appear on the top directory of the media that you have, extract the `iif` tar file.

If you prefer, you can install each of the following client products individually by using a separate installation application for each one:

- Informix Client Software Development Kit (Client SDK)
- Informix Connect
- Informix JDBC Driver

For more information about these individual client installation applications, see the *IBM Informix Client Products Installation Guide* regarding Client SDK and Informix Connect or the *IBM Informix JDBC Driver Programmer's Guide*.

Installing Informix and client products quickly with defaults (UNIX and Linux)

You can install IBM Informix and all its features quickly by using the typical setup for installation.

Make sure that your system is ready for installation (see Chapter 1, "Preparing to install Informix and client products," on page 1-1). Also, obtain root privileges before running the installation application.

To install Informix and client products on Linux or UNIX:

1. From a command prompt, run the installation command for the products that you want to install and specify the options for the commands. The commands are in the directory where the media files are located, referred to as *media_location* in this documentation. The installation application runs in console mode by default, unless you specify GUI mode when you issue the command.

`media_location/ids_install`

Installs Informix with all features, and any bundled client products that you select.

2. Follow the instructions in the installation application.
 - a. Read and accept the license to proceed with the installation.
 - b. You can install into the default directory or select a different directory.

- c. Select **Typical** setup to install the product with all features. If the installation application notifies you that the target path is not secure, see “Secure a nonsecure Informix installation path” on page 2-6 for information about how to proceed.
- d. If you are prompted for an Informix administrator password, enter a password and record it in a secure location. The installation application creates the administrator account, and you will need the password to administer the Informix installation. This user account is referred to as *user informix* throughout Informix products and documentation.
- e. Optional: If you want to set up a ready-to-use Informix instance as part of the installation, ensure that the **Create a server instance** check box is selected. The check box is selected by default in console mode, but is not selected by default in GUI mode. Also, if you want the server instance to initialize at creation, click **Initialize server**.

Tip: Click **Help** in the installation application window for more information about automatic creation of a configured database server instance and automatic instance initialization.

If you do not select the **Create a server instance** option, you can configure and initialize the database server manually after installation is complete to create a running Informix instance.

- f. Verify that the installation summary accurately reflects your installation options, and that the server has enough free space for the total installation. Go back to adjust the installation options as necessary.
3. Complete the installation and exit the installation application.

Important: See Chapter 4, “Configuring a database server,” on page 4-1 to set up an instance of Informix if you did not create a server instance in the installation application.

Installing Informix with selected features and client products (UNIX and Linux)

Use the custom setup to install IBM Informix with only the features that you need.

Make sure that your system is ready for installation (see Chapter 1, “Preparing to install Informix and client products,” on page 1-1). Also, obtain root privileges before you begin the installation program.

To install Informix on Linux or UNIX:

1. From a command prompt, run the installation command for the products that you want to install and specify the options for the commands. The installation application runs in console mode by default, unless you specify GUI mode when you issue the command.

media_location/ids_install

Installs Informix and any bundled client products that you select.

2. Follow the instructions in the installation application.
 - a. Read and accept the license to proceed with the installation.
 - b. You can install into the default directory or select a different directory.
 - c. Select **Custom** setup to install the product or products with selected features.
 - d. Select the products and features that you want to install.

The installation application shows information about each product and each feature.

The installation application enforces dependencies among features and components. If you cannot configure the selected or deselected features exactly as you want, it is probably an unsupported installation configuration for your environment.

If the installation application notifies you that the target path is not secure, see “Secure a nonsecure Informix installation path” on page 2-6 for information about how to proceed.

- e. If you are prompted for an Informix administrator password, enter a password and record it in a secure location. The installation application creates the administrator account, and you will need the password to administer the Informix installation. This user account is referred to as *user informix* throughout Informix products and documentation.
- f. Optional: Enable role separation for auditing procedures.

Important: If you enable role separation, you cannot turn it off after the product is installed. To remove role separation, you must uninstall the database server and reinstall it without role separation. To learn more about role separation, click **Help** in the GUI window or see “Role separation” on page 1-6.

- g. Optional: If you want to set up a ready-to-use Informix instance as part of the installation, ensure that the **Create a server instance** check box is selected. The check box is selected by default in console mode, but is not selected by default in GUI mode. You can either accept default configuration parameters or customize configuration parameters of the instance.

Tip: In GUI mode of the installation application, click **Help** for information about default and customized configurations and configuration parameters to customize an instance.

If you do not select the **Create a server instance** option, you can configure and initialize the database server manually after installation is complete to create a running Informix instance.

- h. Verify that the installation summary accurately reflects your installation options, and that your system has enough free space for the total installation. Go back to adjust the installation options as necessary.
3. Complete the installation and exit the installation application.

Important: See Chapter 4, “Configuring a database server,” on page 4-1 to set up an instance of Informix if you did not create a server instance in the installation application.

Installation command for the IBM Informix software bundle

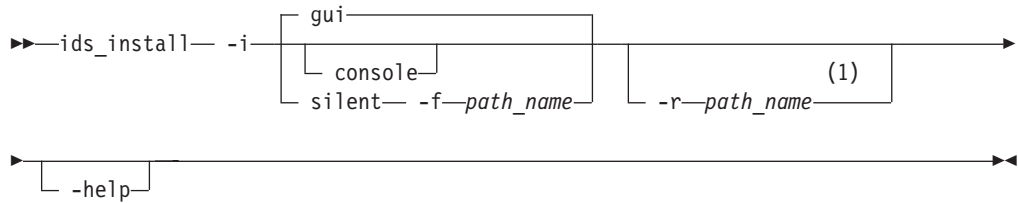
Syntax and usage for `ids_install` command on UNIX and Linux.

Purpose

This command installs IBM Informix and related products. The Informix database server can be installed alone or together with the client programs with this command. If you do not specify an installation mode (GUI, console, or silent), then the installation application starts in console mode.

Run the following commands as root user.

Syntax



Notes:

- 1 Do not use the `-r` option with the `silent -f` option in the same command. The `-r` option records the configuration of a GUI or console installation.

Parameters

Table 2-1. Syntax elements

Element	Purpose	Restrictions
<i>path_name</i>	Specifies the absolute path and file name for the response file. The response file is a customized installation properties file that you can use for silent installations elsewhere. The path must be absolute.	None

The following table describes the installation application options.

Table 2-2. Installation options

Option	Meaning
ids_install	Install Informix and related products.
<code>-i gui</code>	Start the installation program in GUI mode.
<code>-i console</code>	Start the installation program in console mode.
<code>-i silent -f path_name</code>	Start a silent installation using the response file specified in <i>path_name</i> . See “Performing a silent installation of Informix and client products” for more details.
<code>-r path_name</code>	Create a response file from the installation in the designated <i>path_name</i> location. The response file contains an installation configuration that you want to deploy in more than one location. Alternatively, you can edit a template response file that is shipped with the installation media and not record an installation (see “Performing a silent installation of Informix and client products”).
<code>-help</code>	Display list of supported options and their functions.

Performing a silent installation of Informix and client products

To perform a silent installation, which is sometimes referred to as an *unattended installation*, you must create a response file that contains information about how you want the product installed. You pass this response file in a command-line option to perform the silent installation.

You must be logged in as **root** user to run installation applications. Make sure that your system is ready for installation, see Chapter 1, “Preparing to install Informix and client products,” on page 1-1 for more information.

To deploy IBM Informix and client products in multiple directories:

1. Establish a response file by doing one of the following:
 - Start a product installation application in GUI or console mode and specify the `-r` option to generate a response file.
 - Save a local copy of the `bundle.properties` file that is on the installation media, rename the file, and configure the settings for the silent installation. Skip to step 3.

Attention: If you use the `bundle.properties` file as a template for your response file, you must accept the license terms agreement (`LICENSE_ACCEPTED=TRUE`) for the file to function during silent installation. The `bundle.properties` file is designed as a template for installing Informix alone or with one or more related client products.
2. Copy the response file to the computer where you want to install Informix or one of the bundled client programs.
3. Run the silent installation command, indicating the product or products that you want to install, indicating the relative or absolute path to the response file after the `-f` option:
 - `ids_install -i silent -f path_name` to install Informix and related products.
4. Repeat steps 2 and 3 for each location where you want to deploy the same installation setup.

If Informix does not initialize after installation, check the installation log file. If you cannot troubleshoot the problem in the log file, then open `/tmp/ids_install.stderr` file. Finally, if `stderr` does not help you troubleshoot, consider running the **onsecurity** utility to check if the entire installation path is secure or not. See the *IBM Informix Security Guide* for information about how to use the **onsecurity** utility.

Depending on the `securedirectoryaction` property in the response file, you might be required to complete an additional step to make the Informix installation usable:

- If you did not set the `securedirectoryaction` option in the response file, the script `$INFORMIXDIR/tmp/secure.sh` runs automatically after installation to secure all directories of the `$INFORMIXDIR` path.
- If you set the `securedirectoryaction` option to **auto** in the response file, then you are not required to take any other action to secure all directories of the `$INFORMIXDIR` path.
- If you set the `securedirectoryaction` option setting to **generate** or **custom** in the response file, then you must run the script `$INFORMIXDIR/tmp/secure.sh` after the installation completes.

Extracting and redistributing Informix products with scripts (UNIX, Linux)

You can use the `ids_install -DLEGACY=TRUE` command to extract Informix product files from the installation media and then redistribute the software on other computers by using scripts.

Use this command if you want to extract the product files to redistribute them without adding a JRE or an uninstallation application to multiple host systems. You extract the product files by starting the installation application with the `ids_install -DLEGACY=TRUE` command on one computer. After you finish running the installation application, you can copy the files in the installation directory of the first computer to redistribute Informix products on other computers.

Restriction: Do not use the `oninit` command if problems occur during the installation. If you use the `oninit` command, you can cause further installation problems.

1. Run the following command:

```
./ids_install -DLEGACY=TRUE
```

The installation application opens in console mode by default. If you want to run the installation application in GUI mode, enter the `-i gui` option at the end of the command.

2. Follow the instructions in the installation application.
3. Copy the contents of the installation directory and place them into the directory of another computer where you want to redistribute the products. The contents include the **RUNasroot** scripts that you use for redistribution.
4. Run the script for each Informix product that you want to deploy on the other computer. If you want to deploy a client product, you can deploy either Informix Client Software Development Kit (Client SDK) or Informix Connect in one location, not both.

Option	Description
<code>RUNasroot.installserver</code>	Completes the redistribution of the Informix database server files.
<code>RUNasroot.installclientsdk</code>	Completes the redistribution of the Informix Client Software Development Kit files.
<code>RUNasroot.installconnect</code>	Completes the redistribution of the Informix Connect files.

Important: Before starting the database server, run the `onsecurity` utility to verify that the path where the product has been redistributed is secure.

Secure a nonsecure Informix installation path

The installation application helps ensure that the permissions of key files and directories are set appropriately.

If the installation application detects a security problem, the application alerts you and provides options to fix the problem.

If you receive the message that the installation path is not secure, either go back to change the path or complete one of the tasks documented in one of the topic links.

Tip: You can minimize the threat of selecting a target installation path with a potential security vulnerability by selecting the default directory presented by the installation application or a default application directory on most host computers (for example, `/opt` on Linux or UNIX or the Applications folder on Mac OS X).

- “Automatically securing the installation path” on page 2-7
- “Securing the installation path after completing installation” on page 2-7

- “Configuring installation path permissions during installation” on page 2-8

The **onsecurity** utility is the component that the installation application uses to check that each directory in the target path has a secure owner, a secure group, and secure permissions settings. This utility is in the /SERVER/ directory on the installation media. After IBM Informix installation, you can find the utility in \$INFORMIXDIR/bin.

After you are finished with installing Informix, do not change the following settings:

- permissions on \$INFORMIXDIR and its subdirectories
- the installation path leading to \$INFORMIXDIR and the permissions to all the directories in the path
- permissions on the onconfig file
- permissions on the sqlhosts file
- total character count of the onconfig file name

See the *IBM Informix Security Guide* for more information about the **onsecurity** utility and other Informix security features.

Automatically securing the installation path

The installation application can reset the owners, groups, and permissions of directories if the target path is not secure.

By selecting the recommended option presented in the installation application, you can help ensure that the directories in the installation path have secure owners, groups, and permissions settings for the database server without performing any post-installation tasks and without needing to assess configuration of directory privileges.

When the installation application alerts you that the target path is not secure, select **Let the installation program secure the path (recommended)**

After you select this option, an autogenerated script to fix nonsecure directories along the installation path is run without user input. The target path conforms to the security standards of the **onsecurity** utility. Proceed with installation when prompted.

Securing the installation path after completing installation

You can run a security script if the target installation path is not secure and you do not want to adjust directory permissions during installation.

Use this procedure if you have other products installed in directories of the target installation path and want to verify that the autogenerated script will not interfere with other programs before you run the script. You can also use this method for securing the target path if your host environment does not have program interdependencies between installation directories.

Important: The IBM Informix installation will not initialize unless you run the `secure.sh` script and the installation path is secure.

1. When the installation application alerts you that the selected path is not secure, select **Continue installation; manually run script to secure the path later**.
2. Complete the Informix installation.

3. Run the following command to generate the `secure.sh` script:
`$INFORMIXDIR/bin/onsecurity -r $INFORMIXDIR`
4. Run the `secure.sh` script to secure the installation path: `$INFORMIXDIR/tmp/secure.sh`
Attention: On Mac OS X, you can run this script by doing the following:
 - a. Open a terminal window.
 - b. Use the `sudo -s` command to acquire user root privileges.
 - c. Go to to the directory with the command `cd $INFORMIXDIR/tmp`
 - d. Run `secure.sh`

After you run `secure.sh`, the directories along the installation path have owner, group, and permissions settings that conform to the security standards of the `onsecurity` utility.

Configuring installation path permissions during installation

If the IBM Informix installation application reports that the destination path is not secure, you can manually adjust the directories' permissions to ensure the `onsecurity` utility accepts the directories' existing permissions settings.

Know what constitutes a secure installation path in your environment, including the workings of user and group `informix`, before you do the following procedure. See the *IBM Informix Security Guide* for guidelines.

This procedure provides you with more granular control for dealing with the problem that arises when the `onsecurity` utility running in the Informix installation application detects that the target path is not secure.

1. When you are notified that the installation directory is not secure, read the message detailing information about nonsecure directories in the target path.
2. Select **View other options to make the installation directory secure**.
3. *If owner is not secure:* Select one of the following options if the security message about your target path indicates a potential problem with any directory owners:

Change the owner (most secure)

Changes the owner of a nonsecure directory to user `root` for all nodes above `$INFORMIXDIR`; changes owner of `$INFORMIXDIR` to user `informix`.

Add the owner to the list of trusted owners

Adds all existing directory owners who are not user `root` and not user `informix` to the `/etc/informix/trusted.uids` file. Selecting this option indicates that you trust these other owners sufficiently.

Ignore the owner problem

Allows Informix installation to proceed without resolving the potential security vulnerability.

Attention: If you select to ignore the owner problem and do not successfully secure the target path after installation, Informix will not initialize.

4. *If group is not secure:* Select one of the following options if the security message about your target path indicates a potential problem with any groups:

Change the group (most secure)

Changes the group of a nonsecure directory to `root` for all nodes above `$INFORMIXDIR`; changes group for `$INFORMIXDIR` to group `informix`.

Remove the write permission for the group

Removes write permission for all groups except **root** and group **informix**.

Add the group to trusted groups

Adds all non-**root** and non-**informix** groups assigned to directories in the target path to the `/etc/informix/trusted.gids` file. Selecting this option indicates that you trust these other groups sufficiently.

Ignore the group permissions problem

Allows Informix installation to proceed without resolving the potential security vulnerability.

Attention: If you select to ignore the group permissions problem and do not successfully secure the target path after installation, Informix will not initialize.

5. *If public write permissions exist:* Select one of the following options if the public write permission is identified as a problem in the installation application's message about security:

Remove public write permissions

Removes public write access to directories in the installation path.

Add the directory to the list of trusted but nonsecure directories

Adds any directories with public write access to the `/etc/informix/trusted.insecure.directories` file.

Important: Use the `trusted.insecure.directories` file only if special circumstances in your environment require it. This workaround can expose your installation to potential security problems. Select this option at your own risk.

Ignore the public permissions problem

Allows Informix installation to proceed without resolving the potential security vulnerability.

Attention: If you select to ignore the public write access problem and do not successfully secure the target path after installation, Informix will not initialize.

IBM Informix installation can proceed after you have decided how to deal with `$INFORMIXDIR` path permissions.

Installing client products

You can install IBM Informix JDBC Driver and either Client SDK or Informix Connect as part of the Informix installation application. For UNIX and Linux, you also have the option to use the client products' installation applications separately.

You must be logged in as root user to complete the installation

You can install the IBM Informix products in GUI, console, or silent installation mode.

For information on how to prepare and complete silent installations, see "Installation command for the IBM Informix software bundle" on page 2-3 and "Performing a silent installation of Informix and client products" on page 2-4.

To install an Informix client product on Linux or UNIX in GUI or console mode:

1. From a command prompt, run the installation script consisting of the following "Client Product Installation Command" and one of the following "Installation Mode Options". For example, if the installation media is located in the path `/Installdir/`, run `/Installdir/ids_install -i gui` to start the installation application in GUI mode.

Client Product Installation Command:

- `media_location/ids_install` to install Informix and the client products together

Installation Mode Options:

- `-i gui` or `-i swing` starts the installation application in GUI mode
- `-i console` starts the installation application in console mode

The installation application runs in console mode if you do not specify an installation mode option with the command.

2. Follow the instructions in the installation application.
 - You must accept the license to install the program.
 - You can install into the default directory or select a different directory.
 - If you selected to install client products along with Informix, you are prompted to select the client program or programs to include. You can select either Client SDK or Informix Connect, not both.
3. Review the summary information before proceeding with the installation and exiting the installation application.

Performing an inline Informix upgrade on UNIX and Linux

If you have earlier versions of IBM Informix installed, you must use an upgrade path that is appropriate for your environment.

Important: If you plan to complete an inline upgrade where a previous version of Informix is already located, before you upgrade you must back up the database server that you are using (including the data chunks of the existing installation) and the `onconfig` and `SQLHOSTS` files. Be sure to review the *IBM Informix Migration Guide* for detailed prerequisites and instructions about the upgrade method that is appropriate for your environment.

There is no inline upgrade support for Client SDK and Informix Connect installations. To upgrade one of these client products at the same time you perform inline upgrade of the database server, uninstall the old client product installation and select the client product in the installation application.

To complete an inline upgrade of the Informix database server:

1. Save copies of data chunks of the existing installation and the `onconfig` and `SQLHOSTS` files of the existing installation.
2. Shut down all instances of the Informix installation before installing the new version.
3. Install Informix in the `$INFORMIXDIR` path of the Informix installation that you want to upgrade.

If you want to remove any features from the upgraded installation, run the uninstallation application to selectively remove the features.

Log files

Installation log files can provide helpful information about a completed installation or help you identify problems about an installation attempt.

When you install Informix products, the installation application generates log files in `$INFORMIXDIR`. Log files are also created if you attempt to install any of the products but the installation application does not complete successfully.

The log file `$INFORMIXDIR/IBM_Informix_Software_Bundle_InstallLog.log` is created for any installation using the Informix software bundle. In addition, one or more of the following log files are created, depending on which product or products you have installed:

- `$INFORMIXDIR/IBM_Informix_11.70_InstallLog.log` for an Informix server installation
- `$INFORMIXDIR/IBM_Informix_Client_SDK_InstallLog.log` for a Client SDK installation
- `$INFORMIXDIR/IBM_Informix_Connect_InstallLog.log` for an Informix Connect installation
- `$INFORMIXDIR/IBM_Informix_JDBC_Driver_InstallLog.log` for an IBM Informix JDBC Driver installation
- `$INFORMIXDIR/IBM_Informix_GLS_InstallLog.log` for a GLS installation

Chapter 3. Installing Informix on Mac OS X

Major IBM Informix products for Mac OS X can be installed with a GUI program or by using an unattended installation command ("silent mode").

Prepare your system before you install any programs, as described in Chapter 1, "Preparing to install Informix and client products," on page 1-1. The GUI installation application will prompt you to enter valid system administrator credentials before installation setup can proceed. The command for unattended installation must be run by **root** user.

You can also select to install either IBM Informix Client Software Development Kit (Client SDK) or Informix Connect while running the installation application.

Installing Informix quickly with defaults (Mac OS X)

You can install IBM Informix and all its features quickly by using the typical setup for installation.

You must have system administrator privileges to complete the installation. Make sure that your system is ready for installation, as described in Chapter 1, "Preparing to install Informix and client products," on page 1-1.

To install Informix with typical setup:

1. Double-click the `ids_install.app` icon.
2. Enter the system administrator password when you are prompted for it.
3. Follow the instructions in the installation application.
 - a. Read and accept the license to proceed with the installation.
 - b. You can install into the default directory or select a different directory.
 - c. Select **Typical** setup to install the product with all features.
 - d. Select the products that you want to install. If the installation application notifies you that the target path is not secure, see "Secure a nonsecure Informix installation path" on page 2-6 for information about how to proceed.
 - e. Optional: Enable role separation for auditing procedures.

Important: If you enable role separation, you cannot turn it off after the product is installed. To remove role separation, you must uninstall the database server and reinstall it without role separation. To learn more about role separation, see "Role separation" on page 1-6.

- f. Enter a directory and password for the **informix** user account if you are prompted for these credentials, and store the password in a secure location. The installation graphical-user interface (GUI) does not prompt for the credentials if there is already an **informix** user account on the computer.
- g. Optional: If you want to set up a ready-to-use Informix instance as part of the installation, select the **Create a server instance** box. This option walks you through the process of configuring an Informix instance for your requirements. The GUI prompts you to enter information about parameters that reflect your intended usage of the database server instance. If you do

not select the **Create a server instance** box, you can configure and initialize the database server manually after installation is complete to create a running Informix instance.

- h. If the installation GUI prompts you about automatic tuning of the kernel settings, select **Yes** unless you are sure that you want to tune the kernel with command-line tools outside of the GUI. See the Informix machine notes for Mac OS X for more information about kernel settings.
 - i. Verify that the installation summary accurately reflects your installation options, and that the server has enough free space for the total installation. Go back to adjust the installation options as necessary.
4. Complete, and then exit, the installation application.

If you chose to create a server instance, a terminal icon appears in the installation directory. Click this icon to open a terminal window that points to the server instance.

Installing Informix with selected features (Mac OS X)

Select custom setup of the IBM Informix installation program to install the product with only the features that you need.

You must have system administrator privileges to run the installation application. Make sure that your system is ready for installation, as described in Chapter 1, “Preparing to install Informix and client products,” on page 1-1.

To install Informix with custom setup:

1. Double-click the `ids_install.app` icon.
2. Enter the system administrator password when you are prompted for it.
3. Follow the instructions in the installation application.
 - a. Read and accept the license to proceed with the installation.
 - b. You can install into the default directory or select a different directory.
 - c. Select **Custom** setup to install the product or products with selected features.
 - d. Select the products and features that you want to install.

The installation application enforces dependencies among features and components. If you cannot configure the selected or deselected features exactly as you want, it is probably an unsupported installation configuration for your environment.

If the installation application notifies you that the target path is not secure, see “Secure a nonsecure Informix installation path” on page 2-6 for information about how to proceed.

- e. Optional: Enable role separation for auditing procedures.

Important: If you enable role separation, you cannot turn it off after the product is installed. To remove role separation, you must uninstall the database server and reinstall it without role separation. To learn more about role separation, see “Role separation” on page 1-6.

- f. Enter a directory and password for the **informix** user account if you are prompted for these credentials, and store the password in a secure location. The installation graphical-user interface (GUI) does not prompt for the credentials if there is already an **informix** user account on the computer.

5. Run the silent installation command for the product or products that you want to install, indicating the relative or absolute path to the response file after the `-f` option:
 - `ids_install -i silent -f path_name` to install Informix and related products.
6. Repeat steps 1 on page 3-3, 2 on page 3-3, 4 on page 3-3, and 5 for each location where you want to install products using the same setup.

If Informix does not initialize after installation, check the `stderr` file or consider running the **onsecurity** utility to check if the entire installation path is secure or not.

Depending on the `securedirectoryaction` property in the response file, you might be required to complete an additional step to make the Informix installation usable:

- If you did not set the `securedirectoryaction` option in the response file, the script `$INFORMIXDIR/tmp/secure.sh` runs automatically after installation to secure all directories of the `$INFORMIXDIR` path.
- If you set the `securedirectoryaction` option to **auto** in the response file, then you are not required to take any other action to secure all directories of the `$INFORMIXDIR` path.
- If you set the `securedirectoryaction` option setting to **generate** or **custom** in the response file, then you must run the script `$INFORMIXDIR/tmp/secure.sh` after installation completes.

Chapter 4. Configuring a database server

The installed database server must be configured for your system's environment.

If you selected to create a server instance, it is already configured. Otherwise, you must set configuration parameters after installation to create a usable IBM Informix instance.

You can configure a newly installed database server or change the configuration settings of an existing instance by completing the following tasks:

- “Setting environment variables”
- “Preparing connectivity files” on page 4-2
- “Setting configuration parameters” on page 4-3
- “Initializing and starting a database server” on page 4-4

See the *IBM Informix Administrator's Guide* and *IBM Informix Administrator's Reference* for detailed information about database server configuration for your system's environment.

Setting environment variables

Set the environment variables after IBM Informix installation for any instance other than a demonstration database server created while running the installation application.

You must be logged in as **root** user or with sufficient group or user identifier privileges (usually group or user **informix**) to set environment variables.

To set the environment variables for an Informix instance:

1. Set the **INFORMIXDIR** variable to the directory where you installed the database server or other IBM Informix products.
2. Set the **PATH** environment variable to include `$INFORMIXDIR/bin` as follows:

- C shell:

```
setenv PATH ${INFORMIXDIR}/bin:${PATH}
```
- Bourne shell:

```
PATH=$INFORMIXDIR/bin:$PATH
export PATH
```

You must set the **INFORMIXDIR** variable and add `$INFORMIXDIR/bin` to the **PATH** environment variable for each user.

3. Set **INFORMIXSERVER** to specify the default database server to which IBM Informix DB-Access or an SQL API client makes an explicit or implicit connection.
4. Set the **ONCONFIG** variable to the name of a valid `onconfig` file. See “Setting configuration parameters” on page 4-3 to create or modify your `onconfig` file.
5. If using a locale or language other than the default, set the following:
 - a. Set **CLIENT_LOCALE** to specify a nondefault locale.
 - b. Set **DBLANG** to specify the subdirectory of `$INFORMIXDIR` that contains the customized language-specific message files that IBM Informix products use.
 - c. Set **DB_LOCALE**.

- d. Set **SERVER_LOCALE**.
- e. Set **GL_USEGLU** if you use UTF-8 character encoding.
- 6. Set **INFORMIXSQLHOSTS** to specify the file that contains the sqlhosts information. (The default location of this file is \$INFORMIXDIR/etc/sqlhosts.)
- 7. Set **INFORMIXTERM** to specify whether IBM Informix DB-Access uses the information in the termcap file or the terminfo directory. On character-based systems, the termcap file and terminfo directory determine terminal-dependent keyboard and screen capabilities, such as the operation of function keys, color and intensity attributes in screen displays, and the definition of window borders and graphic characters.
- 8. Set \$INFORMIXDIR/lib and any of its subdirectories to specify the shared-library path. The shared-library path environment variable specifies the library search path and is platform dependent.

Platform	Environment Variable
AIX	LIBPATH
HP-UX	SHLIB_PATH
Mac OS X	DYLD_LIBRARY_PATH
Solaris and most other platforms	LD_LIBRARY_PATH

For example, on Linux, set this environment variable as follows:

- Bourne shell:


```
LD_LIBRARY_PATH=$INFORMIXDIR/lib:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH
```
- C shell:


```
setenv LD_LIBRARY_PATH ${INFORMIXDIR}/lib:${LD_LIBRARY_PATH}
```

Preparing connectivity files

Prepare the files that the IBM Informix instance uses to communicate with client applications and with other database servers.

The connectivity information allows a client application to connect to any IBM Informix database server on the network. The connectivity data for a particular database server includes the database server name, the type of connection that a client can use to connect to it, the host name of the computer or node on which the database server runs, and the service name by which it is known.

Connectivity configuration determines whether your instance has a database server alias and a port for clients that use the Distributed Relational Database Architecture™ (DRDA®) protocol. DRDA is for open development of applications that allow access of distributed data. DRDA is interoperable with IBM Data Server clients. If you created a demonstration database server with the default configuration file while installing Informix, then your instance already supports DRDA connections. If not, then see the *IBM Informix Administrator's Guide* for details on how to enable DRDA support on your instance.

You must prepare the connectivity information even if the client application and the database server are on the same computer or node. You are not required to specify all possible network connections in the sqlhosts file or registry before you start the database server. But to make a new connection available after you have initialized the database server, you must take the database server offline and then bring it back to online mode again.

1. Edit the `sqlhosts` file as necessary to contain the correct connectivity information with a text editor or equivalent tool.
 - The default location of this file is `$INFORMIXDIR/etc/sqlhosts`.
 - If you set up several database servers to use distributed queries, use either one `sqlhosts` file to which `INFORMIXSQLHOSTS` points or separate `sqlhosts` files in each database server directory.
2. Enter settings in the `/etc/hosts` and `/etc/services` files if your system uses Internet Protocol network connections.

For more information about setting connectivity files, see the *IBM Informix Administrator's Guide*.

Setting configuration parameters

The configuration file for IBM Informix is named `onconfig`.

If you selected to create a demonstration database server or customized the default configuration file while running the installation application, manual setup of the configuration parameters is not required for a functioning Informix instance. However, all instances created without using the default configuration file in the installation application require further action to set values for at least some configuration parameters.

An Informix installation includes a default configuration file at `$INFORMIXDIR/etc/onconfig.std`. This file has initial values for many of the configuration parameters. You can use `onconfig.std` as a template configuration file that you can copy and customize to how you will use the product and to the host environment.

The command-line `genoncfg` utility provides an alternate way to set the configuration parameters of an Informix instance. With this feature, you set a short list of parameters in an input file, from which the utility then generates an Informix configuration file that is optimized for both your anticipated usage and your host environment. For this method, you are not required to copy and modify an `onconfig` file as described in the following procedure.

For information about why to modify the default configuration parameters, see *IBM Informix Administrator's Guide* documentation about configuring the database server. The *IBM Informix Administrator's Reference* provides detailed information about all the configuration parameters and the `genoncfg` utility.

Important: Do not modify or delete `onconfig.std`, which is a template and not a functional configuration.

To prepare an Informix configuration file:

1. Copy the `onconfig.std` template file.
2. Modify the *copy* of the template file. The default value for the `DUMPDIR` parameter is `$INFORMIXDIR/tmp`. If you change this value in your configuration file, make sure that you specify a valid directory on your computer.
3. Set the `ONCONFIG` environment variable to the name of your customized configuration file.

If you omit a parameter value in your copy of the configuration file, the database server either uses default values in `onconfig.std` or calculates values based on other parameter values.

Initializing and starting a database server

Before the database server can start, it must be initialized.

Important: Only user **informix** or root user can initialize the database server.

The database server must be initialized at least once.

Important: If you reinitialize IBM Informix and it contains databases, the existing data is deleted.

If you chose not to initialize the database server automatically during installation, you can initialize it manually after the product is installed.

To initialize a new database server manually:

Run one of the following commands, depending on your setup.

- The **oninit -i** command overwrites any existing Informix databases on your host computer. Use caution when you run this command if there are existing databases.
- The **oninit** command (without the `-i` option) does not overwrite an existing database.

See the *IBM Informix Administrator's Reference* for more information about the **oninit** utility.

Chapter 5. Setting up multiple residency

You can set up multiple independent database server environments on the same computer.

Complete the following tasks to set up multiple residency:

- “Host multiple database servers”
- “Plan for multiple residency”
- “Creating multiple residency of a database server” on page 5-2
- “Setting up an instance-specific onconfig file” on page 5-2
- “TCP/IP connectivity” on page 5-3
- “Prevent data from being overwritten” on page 5-4
- “Prepare the backup environment for multiple residency” on page 5-4
- “Modify operating system startup for multiple server instances” on page 5-4
- “Reset the INFORMIXSERVER environment variable” on page 5-5

Host multiple database servers

Multiple residency refers to multiple database servers and their associated shared memory and disk structures that coexist on a single computer.

Multiple independent database server environments on the same computer allow you to:

- Separate production and development environments to protect the production system from the unpredictable nature of the development environment.
- Isolate sensitive applications or databases that are critically important, either to increase security or to accommodate more frequent backups than most databases require.

When you use multiple residency, each database server has its own configuration file. Thus, you can create a configuration file for each database server that meets its special requirements for backups, shared-memory use, and tuning priorities.

- Test distributed data transactions on a single computer. If you are developing an application for use on a network, you can use local loopback to perform your distributed data simulation and testing on a single computer. (See the information about using a local loopback connection in the *IBM Informix Administrator's Guide*.) Later, when a network is ready, you can use the application without changes to application source code.

Plan for multiple residency

Running multiple database servers on the same computer is not as efficient as running one database server. You must balance the advantages of separate database servers with the extra performance cost.

When you plan for multiple residency on a computer, consider the following factors:

- Memory

Each database server requires its own memory. Ensure that your computer can handle the memory usage that an additional database server requires.

- Storage space

Each database server must have its unique storage space. You cannot use the same disk space for more than one instance of a database server. When you prepare an additional database server, you must repeat some of the planning that you did to install the first database server. For example, consider these questions:

- Will you use buffered or unbuffered files? Will the unbuffered files share a disk partition with another application? (For more information about buffered and unbuffered files, see the topic on direct disk access in the *IBM Informix Administrator's Guide*.)
- Will you use mirroring? Where will the mirrors be located?
- Where will the message log be located?
- Can you dedicate a tape drive to this database server for its logical logs?
- What kind of backups will you perform?

Creating multiple residency of a database server

Before you set up multiple residency, you must install one database server as described in Chapter 2, "Installing Informix and client products on UNIX and Linux," on page 2-1 or Chapter 3, "Installing Informix on Mac OS X," on page 3-1.

Important: You are not required to install more than one copy of the database server binary files. All instances of the same version of the database server on one computer can share the same binary files.

To create multiple residency of a database server:

1. Prepare a new configuration file and set the **ONCONFIG** environment variable to the new file name. See "Setting up an instance-specific onconfig file."
2. Optional: Set up connectivity for the new database server instance. See "TCP/IP connectivity" on page 5-3.
3. Initialize disk space for the new database server instance. See "Prevent data from being overwritten" on page 5-4.
4. Prepare the backup environment for multiple residency. See "Prepare the backup environment for multiple residency" on page 5-4.
5. Modify the operating system startup to start the new database server instances automatically. See "Modify operating system startup for multiple server instances" on page 5-4.
6. Check the **INFORMIXSERVER** environment variables for users. See "Reset the INFORMIXSERVER environment variable" on page 5-5.

Setting up an instance-specific onconfig file

Each instance of the database server must have its own onconfig configuration file.

To set up an instance-specific onconfig file:

1. Make a copy of an onconfig file that has the basic characteristics that you want for your new database server.

2. Give the new file a name that you can easily associate with its function. For example, you might select the file name `onconfig.acct` to indicate the configuration file for a production system that contains accounting information.
3. Set the **ONCONFIG** environment variable to the file name of the new `onconfig` file. Specify only the file name, not the complete path.
4. In the new configuration file, set the following configuration parameters:

SERVENUM

Specifies an integer (between 0 and 255) that is associated with a database server configuration. Each instance of a database server on the same host computer must have a unique **SERVENUM** value. For more information about the **SERVENUM**, **DBSERVERNAME** and **ROOTPATH** AND **ROOTOFFSET** parameters, see the *IBM Informix Administrator's Reference*.

DBSERVERNAME

Specifies the `dbservername` of a database server. It is suggested that you enter a name that provides information about the database server, such as `ondev37` or `hostnamedev37`.

MSGPATH

Specifies the path name of the message file for a database server. You should specify a unique path name for the message file because database server messages do not include the `dbservername`. If multiple database servers use the same **MSGPATH** parameter, you cannot identify the messages from separate database server instances. For example, if you name the database server `ondev37`, you might specify `/usr/informix/dev37.log` as the message log for this instance of the database server.

ROOTPATH and ROOTOFFSET

Used together, specify the location of the root dbspace for a database server. The root dbspace location must be unique for every database server configuration.

If you put several root dbspaces in the same partition, you can use the same value for the **ROOTPATH** parameter. However, in that case, you must set the **ROOTOFFSET** parameter so that the combined values of the **ROOTSIZE** and **ROOTOFFSET** parameters define a unique portion of the partition.

You are not required to change **ROOTNAME**. Even if both database servers have the name `rootdbs` for their root dbspace, the dbspaces are unique because **ROOTPATH** specifies a unique location.

For more information about the **SERVENUM**, **DBSERVERNAME**, **ROOTPATH**, and **ROOTOFFSET** parameters, the configuration parameters documentation in the *IBM Informix Administrator's Reference*.

You can also set the **MIRRORPATH** and **MIRROROFFSET** parameters. If the root dbspace is mirrored, the location of the root dbspace mirror must be unique. For information about the **MIRRORPATH** and **MIRROROFFSET** parameters, see the *IBM Informix Administrator's Guide*.

TCP/IP connectivity

If you use the TCP/IP communication protocol, you might be required to add an entry to the `services` file for the new database server instance.

The `sqlhosts` file must have an entry for each database server. If IBM Informix products on other computers access this instance of the database server, the administrators on those computers must update their `sqlhosts` files.

If you plan to use Internet Protocol network connections with an instance of a database server, the system network administrator must update the `hosts` and `services` files.

For information about these files, see the topics on client/server communications in the *IBM Informix Administrator's Guide*.

Prevent data from being overwritten

Before you initialize disk space, check the setting of the `ONCONFIG` environment variable. If it is not set correctly, you might overwrite data from another database server. When you initialize disk space for a database server, the database server initializes the disk space that is specified in the current configuration file.

Important: As you create new blobspaces or dbspaces for a database server, assign each chunk to a unique location on the device. The database server does not allow you to assign more than one chunk to the same location within a single database server environment, but you must ensure that chunks that belong to different database servers do not overwrite each other.

Prepare the backup environment for multiple residency

Depending on your backup method, you must prepare the backup environment for multiple residency.

The ON-Bar utility backup

The `ON-Bar` utility allows you to back up data from various database server instances to a single storage device if the storage manager allows it. The storage manager keeps track of what data has been backed up. However, keep storage-space and logical-log backups on separate storage devices.

The ontape utility backup

When you use multiple residency, you must maintain separate storage space and logical log backups for each database server instance.

If you can dedicate a tape drive to each database server, use the continuous logging option to back up your logical log files. Otherwise, you must plan your storage space and logical log backup schedules carefully so that use of a device for one database server instance does not cause the other database server instance to wait. You must reset the `ONCONFIG` configuration parameter each time that you switch backup operations from one database server instance to the other.

Modify operating system startup for multiple server instances

You can ask your system administrator to modify the system startup script so that each of your database server instances starts whenever the computer is rebooted; for example, after a power failure. For more information about startup scripts, see the topics on preparing startup and shutdown scripts in the *IBM Informix Administrator's Guide*.

To start a second instance of a database server, change the **ONCONFIG** and **INFORMIXSERVER** environment variables to point to the configuration file for the second database server and then run the **oninit** command. Do not change the **INFORMIXDIR** or **PATH** variables.

Similarly, you can ask the system administrator to modify the shutdown script so that all instances of a database server shut down normally.

Reset the INFORMIXSERVER environment variable

If a new instance of a database should be the default database server, you must reset the **INFORMIXSERVER** environment variable.

Chapter 6. Removing or modifying IBM Informix and client products installations on UNIX and Linux

Removing IBM Informix products and features (UNIX and Linux)

The following topics describe how to remove Informix, its features, and related products on UNIX and Linux:

- “Removing Informix software bundle installations”
- “Uninstalling an Informix database server installation (UNIX and Linux)”

Removing Informix software bundle installations

Use the **uninstallids** command to remove both the database server and all client products that were installed with the **ids_install** command of the Informix software bundle. This method to remove the installed software bundle is faster than uninstalling each individual product separately.

You must have root user privileges to complete the uninstallation.

Important: Using the **uninstallids** command removes all Informix server and client product installations in the folder, without the option to uninstall only specific features of an installation. You must start the uninstallation of a specific product in order to remove some of its features without entirely removing the program installation. The uninstallation of either Client SDK or Informix Connect alone is documented in the *IBM Informix Client Products Installation Guide*. The uninstallation of the JDBC Driver alone is documented in *IBM Informix JDBC Driver Programmer’s Guide*

If you have multiple installations of the software on the computer, the uninstallation application affects only the installations located in the \$INFORMIXDIR path indicated in the command.

Run the **uninstallids** command as follows:

- \$INFORMIXDIR/uninstall/uninstall_ids/uninstallids -i gui to uninstall the products in GUI mode.
- \$INFORMIXDIR/uninstall/uninstall_ids/uninstallids -i console to uninstall the products in console mode.

After the Informix products are removed, you can manually delete the \$INFORMIXDIR directory. It is not deleted automatically.

Uninstalling an Informix database server installation (UNIX and Linux)

Use the **uninstallserver** command to remove an Informix database server installation or to remove some of the database server features. The uninstallation application started by this command does not remove or modify Client SDK, Informix Connect, or the JDBC Driver.

To remove IBM Informix, you must have root privileges.

Important: Do not remove any IBM Informix products by manually deleting files.

If you have multiple installations of the product on the computer, the uninstallation application affects only the server installation located in the \$INFORMIXDIR path that you indicate in the command.

To remove Informix from Linux or UNIX systems by using the uninstaller:

1. Run the **uninstallserver** command as follows:
 - \$INFORMIXDIR/uninstall/uninstall_server/uninstallserver -i gui to uninstall Informix in GUI mode. Alternatively, you can run the command as \$INFORMIXDIR/uninstall/uninstall_server/uninstallserver -i swing.
 - \$INFORMIXDIR/uninstall/uninstall_server/uninstallserver -i console to uninstall Informix in console mode.
2. Follow the instructions in the application. By default, the product and all its features are selected to be removed. If you want to remove just some features, ensure that only those features are selected.

After Informix is removed, you can manually delete the \$INFORMIXDIR directory. It is not deleted automatically.

Chapter 7. Modifying installations on Mac OS X

To complete uninstallation, remove IBM Informix and any related client products that you have installed separately. You can add or remove database server features without reinstalling.

Adding features to installed Informix (Mac OS X)

If you have a custom installation of IBM Informix that does not include some features, and you want to add one or more of those features, you can do so without reinstalling the server.

Your system must have enough free disk space for the features that you want to install.

Adding features to an existing installation requires you to run the Informix installation GUI for \$INFORMIXDIR again. The installation application detects features that are not installed and lets you add them. The GUI shows the amount of disk space your selection of features requires before actual installation of the files.

Some database server features are mutually dependent to function properly. When you add features to an existing instance, the installation application enforces these interdependencies.

While adding features to an instance, it is possible that the computer prompts you for the administrator password.

To add features to an instance on Mac OS X:

1. Open the Informix installation media (the `ids_install.app` application) on the computer hosting the database server instance.
2. Read and accept the license to proceed with the installation.
3. If your \$INFORMIXDIR path does not appear by default, specify the correct path.
4. Select **Custom** setup type.
5. Select the features that you want to add.
6. Complete, and then exit, the installation application.

Removing Informix and installed features (Mac OS X)

Use the `uninstallserver` command to start the uninstallation application for removal of the product and its features.

You must have the privilege to run the `sudo` command for uninstalling on your system to remove IBM Informix and its features.

To remove Informix from Mac OS X systems by using the uninstallation application:

1. Open a terminal window so that you can work in a command-line environment.
2. Change directory to \$INFORMIXDIR.

3. Set the `$INFORMIXDIR` environment variable to the current directory.
4. Run `sudo open uninstall/uninstall_server/uninstallserver.app`. The uninstallation application runs in the same installation mode that was used when the database server was installed.
5. Follow the instructions in the application. By default, the product and all its features are selected to be removed. If you want to remove just some features, ensure that only those features are selected. You cannot remove the base server without all the other features.

Important: If Client SDK is installed in the same directory as Informix:

- You must uninstall Informix before you uninstall Client SDK.
- Do not remove the Global Language Support (GLS) and Messages features because both products have dependencies on the features.

Appendix. Accessibility

IBM strives to provide products with usable access for everyone, regardless of age or ability.

Accessibility features for IBM Informix products

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use information technology products successfully.

Accessibility features

The following list includes the major accessibility features in IBM Informix products. These features support:

- Keyboard-only operation.
- Interfaces that are commonly used by screen readers.
- The attachment of alternative input and output devices.

Tip: The information center and its related publications are accessibility-enabled for the IBM Home Page Reader. You can operate all features by using the keyboard instead of the mouse.

Keyboard navigation

This product uses standard Microsoft Windows navigation keys.

Related accessibility information

IBM is committed to making our documentation accessible to persons with disabilities. Our publications are available in HTML format so that they can be accessed with assistive technology such as screen reader software.

You can view the publications in Adobe Portable Document Format (PDF) by using the Adobe Acrobat Reader.

IBM and accessibility

See the *IBM Accessibility Center* at <http://www.ibm.com/able> for more information about the IBM commitment to accessibility.

Dotted decimal syntax diagrams

The syntax diagrams in our publications are available in dotted decimal format, which is an accessible format that is available only if you are using a screen reader.

In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), the elements can appear on the same line, because they can be considered as a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that your screen reader is set to read punctuation. All syntax elements that have the same dotted decimal number (for example, all syntax elements that have the number 3.1) are mutually exclusive

alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, the word or symbol is preceded by the backslash (\) character. The * symbol can be used next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is read as 3 * FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3* * FILE indicates that syntax element * FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol that provides information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, that element is defined elsewhere. The string following the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you should refer to a separate syntax fragment OP1.

The following words and symbols are used next to the dotted decimal numbers:

- ? Specifies an optional syntax element. A dotted decimal number followed by the ? symbol indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element (for example, 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that syntax elements NOTIFY and UPDATE are optional; that is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.
- ! Specifies a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicates that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the same dotted decimal number can specify a ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In this example, if you include the FILE keyword but do not specify an option, default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In

this example, if the FILE keyword is omitted, default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP only applies to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

- * Specifies a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data-area, you know that you can include more than one data area or you can include none. If you hear the lines 3*, 3 HOST, and 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write HOST STATE, but you cannot write HOST HOST.
3. The * symbol is equivalent to a loop-back line in a railroad syntax diagram.

- + Specifies a syntax element that must be included one or more times. A dotted decimal number followed by the + symbol indicates that this syntax element must be included one or more times. For example, if you hear the line 6.1+ data-area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. As for the * symbol, you can only repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loop-back line in a railroad syntax diagram.

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