

IBM Interact
Version 9 Release 1
March 20, 2014

Tuning Guide

IBM

Note

Before using this information and the product it supports, read the information in "Notices" on page 15.

This edition applies to version 9, release 1, modification 0 of IBM Interact and to all subsequent releases and modifications until otherwise indicated in new editions.

© **Copyright IBM Corporation 2001, 2014.**

US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Contents

About tuning Interact for best performance	1
Cache management	1
Working with Interact Extreme Scale Server	2
Working with Ehcache	4
Interact API.	6
Installation and network configuration.	6
Interactive flowchart management	7
Service tuning	7
Web application server tuning	8
JVM arguments	8
Connection pool	8

Tuning terminology	9
Database tuning	9
ETL Tuning.	9
Logging	12

Before you contact IBM technical support	13
---	-----------

Notices	15
Trademarks	17
Privacy Policy and Terms of Use Considerations	17

About tuning Interact for best performance

An installation of Interact consists of several components including third-party tools (such as web application servers, databases, and load balancers) and IBM® components such as Marketing Platform and Campaign. All of these components have several properties, features, and settings you can configure to improve performance. Interact itself has several configuration properties which you can use to tune your installation for best performance.

Defining 'best performance' is difficult. Every environment, every implementation has different requirements. For example, an implementation of Interact where all data for interactive flowcharts is gathered from real-time data, would be tuned differently than an implementation requiring information read from several database tables.

Interact runtime performance can be affected by many factors, including hardware configuration, network configuration, and Interact configuration. The following guidelines and recommendations can have different results in your environment.

The following guidelines are organized by related components. The order in which you modify any settings does not matter.

Cache management

In a large-volume Interact environment where you are using a large number of runtime servers, you can use cache management software to share the runtime load among the servers and improve the real-time performance of the runtime server group as a whole.

IBM Interact supports two cache management solutions by default:

- **Ehcache**, an open source caching solution that is included with every installation of Interact. When you enable the Ehcache solution, you can use multiple runtime servers fronted by a load balancer. The load balancer balances the workload across the runtime servers in the group, and helps to maintain something called *session affinity*, which means that when an incoming session is handled by runtime server A, then when the same user issues additional requests, those requests are fulfilled by the session on server A. This method of balancing connections among the runtime servers in the group can improve performance considerably, but has some limitations because all of the session information is maintained in memory, and the memory limits of each Java™ virtual machine (JVM) restrict how much session information can be maintained.

To read more about the Ehcache software, see <http://ehcache.org/files/documentation/EhcacheUserGuide-2.0-2.3.pdf>

- **Interact Extreme Scale Server**, a distributed cache solution for Interact runtime based on WebSphere® eXtreme Scale. This solution provides greater performance improvements for large installations than the Ehcache solution, and provides additional benefits that Ehcache does not. This is an optional installation, so contact your IBM EMM representative for more information about acquiring this solution.

Each of these solutions is described in more detail.

Working with Interact Extreme Scale Server

To improve performance for very large installations of an Interact runtime server group, you can use the optional Interact Extreme Scale Server caching solution that is based on WebSphere eXtreme Scale. You can configure Interact Extreme Scale Server by modifying a series of configuration properties in IBM Marketing Platform.

To enable Interact Extreme Scale Server as the cache manager for each Interact runtime server, you must perform the following steps:

1. Install and configure WebSphere eXtreme Scale server as described in its documentation.
2. For each Interact runtime server in the server group, run the Interact installer as described in the *IBM Interact Installation Guide* and select **Interact Extreme Scale Server** as the feature you want to install.
3. On each Interact runtime server in the server group, set the following configuration property in Marketing Platform to Extreme Scale:
Interact > cacheManagement > caches > Interact cache > cacheManagerName
To use Extreme Scale Server as the cache manager for storing event pattern states for a runtime server group, set the following parameter to Extreme Scale as well:
Interact > cacheManagement > caches > PatternStateCache > cacheManagerName

You must repeat this process on each Interact runtime server in the server group to enable Interact Extreme Scale Server as the cache manager for the server group.

After you have enabled Interact Extreme Scale Server as the cache manager, you can configure the settings to optimize the caching for your installation.

Configuring properties for Interact Extreme Scale Server

To enable the Interact Extreme Scale Server for caching runtime server activity, install it on each runtime server group. Set up the necessary configuration properties and files so that each runtime server communicates with the others in the caching group to ensure optimal performance.

Before you set the configuration properties in Marketing Platform, run the Interact installer and install the Interact Extreme Scale Server on each runtime server group. Interact Extreme Scale server caching solution is available for each Interact runtime environment that is configured in the server group.

Complete the following steps to set the configuration properties for Interact Extreme Scale Server in Marketing Platform:

1. On each Interact runtime server group, set the following configuration properties under the **interact | cacheManagement | Cache Managers | Extreme Scale | Parameter Data** category:
 - **catalogPropertyFile**. Set to the URL of the catalogServer.props file. For example, the URL is file:///EMM/Interact/interactWXSAdapter/config/catalogServer.props.
 - **containerPropertyFile**. Set to the URL of the containerServer.props file. For example, the URL is file:///EMM/Interact/interactWXSAdapter/config/containerServer.props.

- **deploymentPolicyFile.** Set to the URL of the deployment.xml file. For example, the URL is file:///EMM/Interact/interactWXSAdapter/config/deployment.xml.
- **objectGridConfigFile.** Set to the URL of the objectgrid.xml file. For example, the URL is file:///EMM/Interact/interactWXSAdapter/config/objectgrid.xml.
- **gridName.** Set the value to InteractGrid.
- **catalogURLs.** Set to the host name of the catalog server. For example, the host name is inemm234.in.ibm.com:2811.

You can enter host names of multiple catalog servers. Make sure that you start all the catalog servers at the same time.

The catalogServer.props, containerServer.props, deployment.xml, and objectgrid.xml files are in the config directory under the Interact installation.

2. To enable Extreme Scale Server as the cache manager for each Interact runtime server, set the following configuration properties under the **interact | cacheManagement | Caches | InteractCache** category:
 - **cacheManagerName.** Set the value to Extreme Scale.
 - **maxEntriesInCache.** Set the value to the maximum number of entries that are allowed in a cache.
 - **timeoutInSecs.** Set the value to the time after which the server becomes inactive for an entry in the cache.
3. To use Extreme Scale Server as the cache manager for storing event pattern states for a runtime server group, set the following configuration properties under the **interact | cacheManagement | Caches | PatternStateCache** category:
 - **cacheManagerName.** Set the value to Extreme Scale.
 - **maxEntriesInCache.** Set the value to the maximum number of entries that are allowed in a cache.
 - **timeoutInSecs.** Set the value to the time after which the server becomes inactive for every entry in the cache.
4. The Extreme Scale Server retrieves and updates the database. To configure the connection to the database, set the following configuration properties under the **interact | cacheManagement | Caches | PatternStateCache | loaderWriter | jdbcSettings** category:
 - **asmUser.** Set the value to the user name in Marketing Platform.
 - **asmDataSource.** Set the value to the data source name in Marketing Platform.
 - **maxConnection.** Set the value to the maximum number of connections that are allowed in a cache at a time.

To optimize performance of the Interact runtime environment, you can reduce the maximum number of connections that are allowed in the cache at a time.

For more information about the configuration properties, see the *IBM Interact Administrator's Guide*.

5. The Extreme Scale Server provides loader mechanism to retrieve and store data to and from cache. To configure the loader writer mechanism, set the following configuration properties under the **interact | cacheManagement | Caches | PatternStateCache | loaderWriter** category:
 - **writeMode.** Set the value to **WRITE_THROUGH** or **WRITE_BEHIND**. This value decides the mechanism that must be used for loading or writing the cache from Extreme Scale.

- **batchSize.** Set the value to the number of records that must be written or loaded in one trip.
- **maxDelayInSecs.** Set the value to the time for which the loader writer waits for the next round of loading or writing cache.

After you modify the configuration properties in Marketing Platform, you must restart the web application server where Marketing Platform is deployed.

Working with Ehcache

To improve performance for your Interact runtime server group, you can configure Ehcache by modifying a series of configuration properties in IBM Marketing Platform.

To enable Ehcache as the cache manager for each Interact runtime server, set the following configuration property in Marketing Platform to EHCACHE:

Interact > cacheManagement > caches > Interact cache > cacheManagerName

To use Ehcache as the cache manager for storing event pattern states for a runtime server group, set the following parameter to EHCACHE as well:

Interact > cacheManagement > caches > PatternStateCache > cacheManagerName

You must repeat this process on each Interact runtime server in the server group to enable Ehcache as the cache manager for the server group.

After you have enabled Ehcache as the cache manager, you can configure the settings to optimize the caching for your installation.

Modifying Ehcache Configuration Settings

When you specify that an Interact runtime server should use the built-in cache manager called Ehcache to improve performance, you can configure the settings used by Ehcache to optimize its value to your runtime server group.

To configure the Ehcache cache manager, you can open the following configuration properties in Marketing Platform:

Interact > cacheManagement > Cache Managers > EHCACHE > Parameter Data

This configuration category contains a set of default configuration properties for Ehcache that correspond to the settings you can specify in an Ehcache configuration file. You can also create additional parameters in this category by clicking (*Parameter*) and naming it to match the Ehcache parameter you want to modify.

For information on the configuration properties for Ehcache, see the *Interact Administrator's Guide, Appendix B: Interact runtime environment configuration properties*. You can also refer to the Ehcache documentation found at <http://ehcache.org/files/documentation/EhcacheUserGuide-2.0-2.3.pdf>.

Note that for optimal performance with Ehcache, in the IBM Marketing Platform configuration settings for the Interact runtime server, set the session timeout (Interact > cacheManagement > caches > InteractCache > TimeoutInSecs) to the smallest acceptable value.

Each Interact session contains some amount of session data in memory. The longer you maintain sessions, the more concurrent memory requirements you have. For example, if you are expecting 50 sessions per second, and each session can remain active for 20 minutes, you might require the memory to support 60,000 sessions at a time, if every session lasted the full 20 minutes.

The value must be logical for your scenario. For example, a call system session might need to remain active for a minute, but a website session should remain active for 10 minutes.

Supporting a greater number of concurrent sessions in Ehcache

When you are using Ehcache as the cache manager in some Interact environments, a high number of concurrent sessions may cause the Interact runtime to exceed its available memory, causing a system slowdown or out-of-memory error. An out-of-memory situation is more likely if you have increased the `maxEntriesInCache` configuration parameter (Interact > cacheManagement > Caches > InteractCache > `maxEntriesInCache`) to a number higher than the default setting, although it can occur even with the default setting of a maximum of 100,000 sessions. To avoid this issue, you can reduce the **maxEntriesInCache** value, or you can follow the instructions here to modify the system memory cache to roll the cached memory over to disk storage. This modification allows many more concurrent sessions than would otherwise be possible.

To prevent the Interact runtime from exceeding the available memory in the Java virtual machine (JVM) memory heap, you can modify the memory caching mechanism to use disk storage for caching the data that exceeds the available memory.

Interact uses an open source distributed caching system called Ehcache for caching data. By default, Interact uses the settings specified by the IBM Marketing Platform to manage the Ehcache caching. However, you can override those settings for Interact by creating your own Ehcache configuration file that is automatically loaded whenever Interact starts up.

To load a custom Ehcache configuration file on startup, the following must be true:

- Your JVM must include the parameter `interact.ehcache.config` property, as in the following example:

```
-Dinteract.ehcache.config=/temp/abc.xml
```

You can set a JVM property for your web application server in the startup command script (Oracle WebLogic) or Admin Console (IBM WebSphere). The information in `/temp/abc.xml` is the actual path to the XML file containing the Ehcache configuration you want to load at startup.

- A configuration file containing valid Ehcache configuration settings in XML format must exist at the location specified by the JVM property.

If you do not set this property, or if you set this property and there is no configuration file at the specified location, Interact uses its default cache configuration.

If both conditions are true, the Ehcache configuration file is loaded on startup, and its settings override any default Interact configuration parameters for caching session data.

The following example shows a sample configuration file (in XML format) that you might use to customize Ehcache:

```

<ehcache xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="../../main/config/ehcache.xsd">

<defaultCache
maxElementsInMemory="10"
eternal="false"
timeToIdleSeconds="5"
timeToLiveSeconds="10"
overflowToDisk="true"
/>

<cache name="InteractCache"
maxElementsInMemory="5"
eternal="false"
timeToIdleSeconds="600"
timeToLiveSeconds="600"
overflowToDisk="true">

<cacheEventListenerFactory
class="com.unicacorp.interact.cache.ehcache.EHCacheEventListenerFactory"
properties=""/>
<!--For InteractCache, use the following to use the
EHCacheEventListenerFactory:-->
<cacheEventListenerFactory
class="com.unicacorp.interact.cache.EHCacheEventListenerFactory"
properties=""/>
<!--For PatternStateCache, use the following to use
the EHCacheEventListenerFactory:-->
<cacheEventListenerFactory
class="com.unicacorp.interact.cache.PatternStateCacheEventListenerFactory"
properties=""/>
</cache>

</ehcache>

```

If you saved this file as `/IBM/Interact/conf/Ehcache.xml`, you would then set the JVM property for the web application as in the following example:

```
-Dinteract.ehcache.config=/IBM/Interact/conf/Ehcache.xml
```

For a complete list of the options available for modifying the Ehcache software, see <http://ehcache.org/files/documentation/EhcacheUserGuide-2.0-2.3.pdf>

Interact API

Use the Java Serialization API instead of SOAP API. The Serialization API provides better throughput (can be 5-10 times more depending on the application configuration) and a shorter response time.

For information on implementing a custom Java API timeout, see the API documentation installed with Interact at `<Interact_home>/docs/apiJavaDoc` or see the sample code and comments in `<Interact_home>/samples/api/SampleCustomizedInteractAPI.java`.

Installation and network configuration

If the Interact server is required to maintain session data across multiple Interact API calls and you are using the Ehcache cache manager to improve performance, use sticky load balancing and local session management instead of distributed session management.

Using Ehcache, distributed mode incurs the cost of communication between the Interact runtime servers to keep the sessions consistent. Local session management can avoid that cost.

In IBM Marketing Platform configuration settings for the Interact runtime server, set the Interact > cacheManagement > EHCACHE > Parameter Data > cacheType property to local.

Interactive flowchart management

Every interactive flowchart requires at least one thread to run. You can monitor a live system to see whether there are enough threads for all the interactive flowcharts. Using JMX console, monitor the JMX statistics `CurrentJobsInProcessBoxQueue` and `CurrentJobsInSchedulerQueue` under `com.unicacorp.interact.flowchart`. Ideally, they should be zero even under peak load, which implies there are enough threads to handle the requests for flowchart executions.

Note: Running the JMX console does impact performance. You should not run the JMX console in a production environment except when diagnosing an issue.

You can control these queues with the number of threads used by interactive flowcharts. You set flowchart thread pool sizes in IBM EMM for Interact runtime under Interact > flowchart.

- Set `maxNumberOfFlowchartThreads` to be at least the maximum number of concurrent users expected on the Interact client. For example, if the maximum number of concurrent users is 50 and each call to segmentation runs one flowchart, set `maxNumberOfFlowchartThreads` to 50.
- Set `maxNumberOfProcessBoxThreads` based on the average number of concurrent paths in the flowcharts and whether the flowcharts are CPU bound or I/O bound. It should be at least equal to `maxNumberOfFlowchartThreads`. For example, if the average number of concurrent paths in the flowcharts is 2 and all the process boxes are CPU bound, set `maxNumberOfProcessBoxThreads` to be $2 * \text{maxNumberOfFlowchartThreads}$. If the process boxes are I/O bound (for example if they perform database lookups or writes, such as a Select or Snapshot process), then that number might need to be set to a larger value.
- Set `minNumberOfFlowchartThreads` to be the same as `maxNumberOfFlowchartThreads`. Likewise, set `minNumberOfProcessBoxThreads` to be the same as `maxNumberOfProcessBoxThreads`.

Service tuning

Interact has several services that manage database reads and writes by various components of Interact, for example, the built-in learning module and the contact and response history module.

Set threshold for each of the services (under Interact > services > *service name* > cache > threshold) to appropriate values based on the number of operations per second and the time for each insert to database. For example, if the system throughput requirements are 500 transactions per second and each transaction has 2 log contact calls, then the `contactHist` threshold should be set to a value based on the average time to write a batch and 1000 log contacts per second.

Web application server tuning

Besides the following sections, also see the documentation for your web application servers and operating systems for information about best practices for performance tuning.

JVM arguments

Java virtual machine (JVM) arguments are defined in the startup command script (Oracle WebLogic) or Admin Console (IBM WebSphere) for your web application server.

- Confirm you have the latest service packs and patches installed for your operating system, web application server, and JVM.
- For best performance, when using Sun HotSpot VM, use the `-server` argument.
- Decide on a maximum heap size for the JVM, based on the memory availability in the server. (Interact is not a memory intensive application). Set the max and min sizes of the heap to be the same (using `-Xmx` and `-Xms` arguments), which increases the startup time, but gives better throughput.
- If the application is unresponsive periodically, for example, long response times running to few seconds, the Garbage Collection policy might need to be tuned. Monitor Garbage Collection runs using JMX console and by studying the Garbage Collection output after enabling the following arguments.

```
-verbosegc -XX:+PrintGCDetails
```

- In our tests, the Low Pause Collector was found to eliminate Garbage Collection-related slowness without sacrificing throughput. The following is one set of options was found to be useful for a 2 GB JVM heap.

```
-XX:+UseConcMarkSweepGC -Xmn512m -XX:SurvivorRatio=6
```

In general, the young collection should be about 1/4 to 1/2 of the total heap. The Survivor Space can be set to 1/8th the size of young collection.

References

- Tuning Garbage Collection with the 5.0 Java virtual machine (http://java.sun.com/docs/hotspot/gc5.0/gc_tuning_5.html)
- Java Tuning white paper (<http://java.sun.com/performance/reference/whitepapers/tuning.html>)

Connection pool

Set the size of the connection pool of the Interact runtime data source using the application server console. Take into account the number of concurrent users and the connections made during the lifetime of a session, which includes loading profile, loading offer suppression, reads and writes from flowcharts, and reads from learning.

Feature/Option	Connections Required If Enabled
At least one of the following features is enabled <ul style="list-style-type: none">• Load profile table• Load Offer Suppression table• Load Score Override table	1 connection per concurrent client call to <code>startSession</code> or <code>setAudience</code> It does not matter if only one table load or all three table loads are enabled.
Learning	2 connections

Feature/Option	Connections Required If Enabled
At least one logging or tracking service enabled	The value of Interact > services > threadManagement > flushCacheToDB > maxPoolSize. The default is 5.
Flowcharts that make at least 1 database call	The value of Interact > flowchart > maxNumberOfFlowchartThreads. The default is 25.

For example, if you have the following requirements.

- Require that 30 concurrent calls to `startSession` not wait when obtaining a database connection (30)
- Have learning turned on (2)
- All services turned on (5)
- Have at least one deployed flowchart that makes a db connection (25)
- Rely on current defaults (0)

Then you should set up a database connection pool size with a minimum of 62 (30+2+5+25) for optimal performance where no single consumer of the connection will wait.

Tuning terminology

The following tuning guidelines were determined based on the following terms.

Response time: The amount of time it takes for the Interact runtime server to respond to an API request as measured from the client side.

Throughput: The number of transactions per second.

Transaction: A call to the Interact runtime server by the Interact API, including calls defined by the InteractAPI class such as `startSession` and `setAudience`. The `executeBatch` call is one transaction, even though it can contain several commands. These do not include methods that work with response objects, for example, the `Offer` class.

Database tuning

Add appropriate indexes in Profile, Offer suppression, and Score override tables.

- Profile tables. Create a unique index on the audience level fields.
- Offer suppression tables. Create an index on the audience level fields.
- Score override tables. Create an index on the audience level fields.

Also, make sure that the statistics on these indexes are up to date. For example, if the Audience ID is a combination of two columns `CustomerId` and `HouseholdId`, create an index on these columns in all the tables and update the statistics.

ETL Tuning

When you configure the contact and response history module, the module uses a background Extract, Transform, Load (ETL) process to move data from the runtime staging tables to the Campaign contact and response history tables.

This section describes the optional configuration settings you might want to change in IBM Interact to improve the performance of the ETL tool. You might not need to modify any of these configuration parameters from their default settings; however, if you do, follow the guidelines here and in the *IBM Interact Administrator's Guide* to modify the tool's performance.

All of the properties described here are found in Campaign configuration properties, in Campaign | partitions | partition[n] | Interact | contactAndResponseHistTracking.

Configuration Property	Value and Description
processSleepIntervalInMinutes	The number of minutes the Interact contact and response history module waits between copying data from the Interact runtime staging tables to the Campaign contact and response history tables. The default value is 60.
purgeOrphanResponseThresholdInMinutes	This property determines how long Interact waits before purging responses that have no corresponding contact (also known as "orphaned responses"). The default is 180; however, for processing many records, the delay between processing contacts and responses may be greater, and you would therefore increase this value to prevent responses from being purged too quickly.
maxJDBCInsertBatchSize	<p>Out of the total number of records that the contact and response history module processes in one iteration, this is the maximum number of records of a JDBC batch to process (and assemble together in a batch) before committing the query into the Campaign system tables. The default value is 1000.</p> <p>Because this value works together with the maxJDBCFetchBatchSize property, you might need to increase this value if that property also increased significantly. For example, if you set maxJDBCFetchBatchSize to 2,500,000, you might increase this value to 10,000 to handle the increase in records.</p> <p>Note that memory requirements increase as you increase this value; a setting of 10,000 for this property is a good upper-limit due to memory demands.</p>

Configuration Property	Value and Description
maxJDBCFetchBatchSize	<p>Determines the maximum number of records to fetch from the staging database for an ETL batch processing operation. The default value is 1000, but to tune the performance of the contact and response history module, make sure to set this value to a number greater than the number of contact history records generally processed each day.</p> <p>This property is used together with maxJDBCFetchChunkSize and maxJDBCInsertBatchSize to determine how the records are processed. For example, suppose the values were set as shown here:</p> <ul style="list-style-type: none"> • maxJDBCFetchBatchSize: 30000 • maxJDBCFetchChunkSize: 1000 • maxJDBCInsertBatchSize: 1000 <p>In this example, 30,000 records are fetched (or the total number of records if there are under 30,000). Then, the contact and response history module loops through that 30,000 records, processing 1,000 at a time, so that 1,000 records are marked in the staging tables, and 1,000 are inserted into the detail contact history table.</p>
maxJDBCFetchChunkSize	<p>Determines the maximum number of records in a JDBC chunk (from a total of up to maxJDBCFetchBatchSize records) to process with each pass. The default value is 1000. In some cases, you might be able to improve performance by increasing this value above the MaxJDBCInsertBatchSize property value.</p>
deleteProcessedRecords	<p>This property, which specifies whether to retain contact and response history records after they are processed, is set to YES by default. Changing this value can give you more control over the data flow within the ETL process and affect performance (by delaying the purging of these records until a later time of your determination); however, you must be knowledgeable to handle the maintenance of these records manually to be sure that they are removed at appropriate times. Use caution when modifying this setting.</p>
fetchSize	<p>Providing a value for the JDBC fetchSize can improve performance for large batches of records, but the tradeoff for improved networking performance is the impact of larger fetch sizes on memory usage. See the description of this configuration property in the <i>IBM Interact Administrator's Guide</i> for more information about adjusting this setting.</p>

For detailed descriptions of each of the configuration properties described here, see the online help for that configuration page, or see the *IBM Interact Administrator's Guide*.

Logging

Make sure the log level is set to INFO or ERROR. Never use a verbose log setting like DEBUG or TRACE in a production environment.

There are three places where you can configure logging:

- Set the logging level in the `interact_log4j.properties` file. By default, this file is installed in `<install_dir>/Interact/conf` directory, where `<install_dir>` is the parent directory where your IBM products are installed.
- Confirm that Interact API is not logging. Logging is determined by Boolean setting available in the `startSession` and `setDebug` methods.
- Confirm that JMX monitoring is set to Info with the `activateInfo JMX` operation.

Before you contact IBM technical support

If you encounter a problem that you cannot resolve by consulting the documentation, your company's designated support contact can log a call with IBM technical support. Use these guidelines to ensure that your problem is resolved efficiently and successfully.

If you are not a designated support contact at your company, contact your IBM administrator for information.

Information to gather

Before you contact IBM technical support, gather the following information:

- A brief description of the nature of your issue.
- Detailed error messages that you see when the issue occurs.
- Detailed steps to reproduce the issue.
- Related log files, session files, configuration files, and data files.
- Information about your product and system environment, which you can obtain as described in "System information."

System information

When you call IBM technical support, you might be asked to provide information about your environment.

If your problem does not prevent you from logging in, much of this information is available on the About page, which provides information about your installed IBM applications.

You can access the About page by selecting **Help > About**. If the About page is not accessible, check for a `version.txt` file that is located under the installation directory for your application.

Contact information for IBM technical support

For ways to contact IBM technical support, see the IBM Product Technical Support website: (http://www.ibm.com/support/entry/portal/open_service_request).

Note: To enter a support request, you must log in with an IBM account. This account must be linked to your IBM customer number. To learn more about associating your account with your IBM customer number, see **Support Resources > Entitled Software Support** on the Support Portal.

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information about the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

For license inquiries regarding double-byte (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan, Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
170 Tracer Lane
Waltham, MA 02451
U.S.A.

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

All IBM prices shown are IBM's suggested retail prices, are current and are subject to change without notice. Dealer prices may vary.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not

been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

If you are viewing this information softcopy, the photographs and color illustrations may not appear.

Trademarks

IBM, the IBM logo, and [ibm.com](http://www.ibm.com)[®] are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at www.ibm.com/legal/copytrade.shtml.

Privacy Policy and Terms of Use Considerations

IBM Software products, including software as a service solutions, ("Software Offerings") may use cookies or other technologies to collect product usage information, to help improve the end user experience, to tailor interactions with the end user or for other purposes. A cookie is a piece of data that a web site can send to your browser, which may then be stored on your computer as a tag that identifies your computer. In many cases, no personal information is collected by these cookies. If a Software Offering you are using enables you to collect personal information through cookies and similar technologies, we inform you about the specifics below.

Depending upon the configurations deployed, this Software Offering may use session and persistent cookies that collect each user's user name, and other personal information for purposes of session management, enhanced user usability, or other usage tracking or functional purposes. These cookies can be disabled, but disabling them will also eliminate the functionality they enable.

Various jurisdictions regulate the collection of personal information through cookies and similar technologies. If the configurations deployed for this Software Offering provide you as customer the ability to collect personal information from end users via cookies and other technologies, you should seek your own legal advice about any laws applicable to such data collection, including any requirements for providing notice and consent where appropriate.

IBM requires that Clients (1) provide a clear and conspicuous link to Customer's website terms of use (e.g. privacy policy) which includes a link to IBM's and Client's data collection and use practices, (2) notify that cookies and clear gifs/web beacons are being placed on the visitor's computer by IBM on the Client's behalf along with an explanation of the purpose of such technology, and (3) to the extent required by law, obtain consent from website visitors prior to the placement of cookies and clear gifs/web beacons placed by Client or IBM on Client's behalf on website visitor's devices

For more information about the use of various technologies, including cookies, for these purposes, See IBM's Online Privacy Statement at: <http://www.ibm.com/privacy/details/us/en> section entitled "Cookies, Web Beacons and Other Technologies."



Printed in USA