insure/ANALYSIS

User Guide and Reference

Version 8.0

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1 Overview of HomeRun

The HomeRun toolset allows you to efficiently design, deploy, manage, and support all aspects of an SQL-based environment. The set of tools in HomeRun includes:

insure/INDEX
insure/ANALYSIS
insure/MONITOR
insure/RESOURCES
insure/SECURITY

All tools make use of the HomeRun server on the iSeries. The password you enter on the server controls which tools are available for your use. However, the manual for each of these tools is included in your product download.

In addition, the following tools are included with every HomeRun installation:

Autonomic DBA
Visual SQL Explain (a.k.a. sql/OPTIMIZER)
Database Explorer
Lock Detector
Semaphore Wait Detector
Mutex Wait Detector

See the Appendixes for more information on using these built-in tools.

1.1 Product Contents

The product you received from Centerfield Technology, Inc. contains the following items:

1.1.1 HomeRun installation

The download contains the software for both your iSeries and your Windows 2000/XP/Vista/7 client workstation. Refer to the Product Installation section for instructions on installing the software.

Also, for JDE OneWorld® (aka Oracle E1®) environments there is an additional piece of software that needs to be installed on the Windows® Terminal Server (i.e. Citrix® server).

1.1.2 User Guide and Reference

Manuals for all tools in the HomeRun toolset can be found in your product download. Each manual is intended to help you get started with the tool, explain the tool's features, and provide guidance on the effective use of the product.

1.2 Product libraries

Centerfield uses a naming convention where all IBM System i™ object names are prefixed with the letters "XC".

As part of that naming convention throughout this manual the Centerfield ***{program library}*** will be "XCENTER80" and the Centerfield ***{data library}*** will be "XCENTERD80".

This version of the product uses TCP/IP port number 9920 by default. The rest of this document refers to this port as the default port "**{default port}**". If that port is in use, the installation will incrementally search for unused port numbers starting at **{default port}** and continue looking until one is found. To determine the port that was chosen use the following command:

```
WRKSRVTBLE SERVICE(CENTERFIELD_SERVER_80)
```

2 Introduction to insure/ANALYSIS

insure/ANALYSIS provides an easy slice-and-dice interface that allows you to analyze database performance information to identify:

- The types of SQL activity on the system
- High impact SQL jobs, users, programs, files, and statements
- Key indicators that show either appropriate use or inappropriate use of resources when running SQL

The insure/ANALYSIS tool consists of two functions:

- Usage tracking
- Data analysis

3 Getting started with insure/ANALYSIS

This section describes how to get started with insure/ANALYSIS. It summarizes the steps you need to take in order to begin analyzing your database performance. For in-depth information about advanced features of insure/ANALYSIS, and for tips on scenarios in which you might use insure/ANALYSIS, see the following sections.

The steps outlined in this Getting Started section are:

1. Install the product
2. Secure the use of insure/ANALYSIS for authorized users only
3. Become familiar with the basic concepts of insure/ANALYSIS. It is important that you have an understanding of the general concepts involved in database performance tuning before you use the tool. With this knowledge, you will be able to analyze your collected data more efficiently and productively. For more in-depth information on database performance tuning, please see the Appendix ***Introduction to Database Performance Management***.
4. Use the Usage tracking feature to collect one or more database profiles
5. Use the insure/ANALYSIS tool to analyze the collected data

3.1 HomeRun requirements and installation

3.1.1 Product Requirements

The HomeRun toolset requires specific System i and Windows hardware and software before it will install and perform correctly.

Here is the list of required IBM PTFs:

- ✓ V5R4:
  - MF39418, MF39419, MF39466, SI24100, SI23714, SI23713, SI24580, SI23891, SI23890, SI24569, SI24504, SI23485, SI25668, SI25041, SI23365, SI23514, SI28951, SI28952, SI28953, SI30076, SI30013, SI30014, SI31631, SI31633
- ✓ V5R4M5:
  - SI24100, SI23714, SI23713, SI24580, SI23891, SI23890, SI24569, SI24504, SI23485, SI25668, SI25041, SI23365, SI23514, SI28951, SI28952, SI28953, SI30076, SI30013, SI30014, SI31631, SI31633
- ✓ V6R1:
  - SI31727, SI31641, SI31407

NOTE: PTFs listed above are current with the release date of this document. Centerfield may learn of new PTFs after the document release so we strongly encourage you to check our website for latest PTF requirements – www.centerfieldtechnology.com

3.1.1.1 System i

- ✓ i5/OS V5R4, or V6R1, V7R1
- ✓ TCP/IP configured

3.1.1.2 Windows

- ✓ Windows 2000, Windows XP, Windows Vista, Windows 7
- ✓ Minimum 80486 @ 66Mhz, 32 MB RAM
- ✓ 50 MB of disk space for product
- ✓ TCP/IP installed and configured
- ✓ ODBC driver installed

3.1.1.3 Citrix Windows Terminal Server for E1

- ✓ Windows NT Server, Windows 2000 Server, Windows 2003 Server

3.1.2 Product Installation

The HomeRun toolset has software that needs to be installed on the System i and on the workstations. The installation processes for both the System i and the workstations are

designed to be simple interfaces that provide good default values. The following sections in combination with the on-screen documentation help you understand the installation processes.
If you're re-installing HomeRun you **MUST** refer to the **"HomeRun Installation Guide"** document rather than these 1st time installation instructions.

3.1.2.1 System i Installation

1) Before beginning the installation on the System i, please review this list of the impacts the installation will have on your system. For more detailed information about the HomeRun System i installation, see the Appendix titled *System-Wide Installation Impacts*.

   ✓ This product uses TCP/IP to communicate between the System i and the personal computer. TCP/IP needs to be configured before the HomeRun server will function. Before continuing, make sure your Windows PC client can *ping* the System i system. See one of the following IBM System i references for information on configuring TCP/IP.

   - *TCP/IP Fastpath Setup (SC41-3430)*
   - *TCP/IP Configuration and Reference (SC41-3420)*

   ✓ The installation uses TCP/IP port number **{default port}**. If that port is in use, the installation will search for unused port numbers starting at **{default port}** and continue looking until one is found. To determine the port that was chosen use the following command:

```
WRKSRVTBLE SERVICE(CENTERFIELD_SERVER_80)
```

   ✓ The HomeRun server installs into a library named *{PROGRAM LIBRARY}. The installation process will copy over existing programs if the library exists.*

   ✓ The HomeRun data files install into a library named *{DATA LIBRARY}. The installation process will selectively replace the data files and preserve information specific to your configuration and settings if they exist.*

   ✓ The HomeRun server requires an active subsystem for proper installation and operation. Determine the subsystem you wish to use. It will be needed later in the installation process. If you have no special work management requirements, you may use the default of *{PROGRAM LIBRARY}*/XCSBS80.

- ✓ If you are installing over the top of an existing HomeRun or Database Essentials product library, the jobs currently using that library will be ended before the installation begins. The server will be re-started at the end of the installation if a valid password is entered during the install, or if you have installed over an existing library that already has a valid password.

2) Sign-on to a 5250 session with QSECOFR or a user profile that has security officer special authorities. This user profile must have a minimum of *ALLOBJ, *IOSYSCFG, *JOBCTL, *SECADM, and *SAVSYS special authorities.

3) The system value QUSEADPAUT must be set to *NONE.

   You can verify and change this system value using the following command.

   ```
   WRKSYSVAL QUSEADPAUT
   ```

   In addition, if the system value QUSEADPAUT is secured with an authorization list, the user profile used for the installation must be on that authorization list.

4) Place the CD-ROM containing the HomeRun product into your System i primary CD-ROM drive and issue the following command (does not apply when performing a fully electronic installation).

   ```
   LODRUN *OPT
   ```

5) When you are prompted to configure the HomeRun server subsystem, either take the default (i.e. XCSBS80) or enter the subsystem where you want the HomeRun server and client jobs to run, and press Enter. It is recommended that the default be taken. You can reconfigure the server's subsystem after the installation by running the CFGSVR command.

6) When you are prompted to enter the HomeRun license password, enter the license password that was provided with your product and press Enter. The license password is based on the serial number of the System i and the LPAR number. Hence, a different license password is needed for each System i that you install.

   If you do not know the license password for your System i, you can skip this step of the installation by pressing F12. You can enter the license password after the installation by running the PASSWORD command from the *{PROGRAM LIBRARY}* library.
   If you defer adding the license password, the HomeRun server will not start automatically. No client machines will be able to connect to the System i using any of the HomeRun tools until the password is entered.

7) You will be returned to an System i command line when the installation is complete. If you did not skip any of the installation steps, the HomeRun server will be automatically started for you. If you skipped any steps in the installation process, you should perform the configuration steps that you skipped before you continue.

8) If you skipped configuring the server or the license password as part of the installation, or if the server did not automatically start as part of the product installation, you need to start the HomeRun server before clients can connect to the System i using any of the HomeRun tools. Prior to trying to start the server, you should ensure that TCP/IP is active on your system. If it is not active, issue the following command using the correct options for starting the TCP/IP servers on your system.

   STRTCP STRSVR(***YES/*NO**)

9) Issue the following command to start the HomeRun server:

   {PROGRAM LIBRARY}/STRSVR

10) Verify the server is active in the subsystem that you specified. The job name will be XCSERVER. The following command can be used to check for the active job and to verify that the subsystem is correct.

   WRKACTJOB JOB(XCSERVER*)

11) The server will need to be restarted every time the associated subsystem is ended or the system is restarted. You may add the *{PROGRAM LIBRARY}*/STRSVR command to your system startup routine **(recommended)** or add an autostart job entry in the subsystem if you would like to automatically start the server. If you start the server in your system startup procedure, the i5/OS command STRTCP must be issued and TCP must be completely started before the server will start.

12) If you plan to use insure/SECURITY or insure/MONITOR, you will need to register Centerfield's exit point programs with the System i registration facility:

   {PROGRAM LIBRARY}/ADDMON

   This enables the policies you define to take effect. More information can be found in the manuals for each of these tools.
   NOTE: you will have to recycle the host servers for the exit point registration to take effect (refer to the table on next page as well as the Appendix for more detailed information).

13) If you plan to use insure/RESOURCES, you must install policy managers before your resource policies will take effect. This can be done either with the:

{PROGRAM LIBRARY}/ADDQCEXIT

or with the menus in insure/RESOURCES PC client GUI.

ODBC exit may need recycling database host server and corresponding prestart jobs (i.e. ENDHOSTSVR *DATABASE, ENDPJ QUSRWRK QZDASOINIT, STRHOSTSVR *DATABASE)
More information can be found in the insure/RESOURCES manual.

14) You are now ready to begin the workstation installation.

3.1.2.2 Windows 2000/XP/Vista/7 Installation

We recommend Administrator authority on the PC to run the install:

1) Go to wedsite: http://www.centerfieldtechnology.com/downloads.asp

2) Click on the download link for HomeRun

3) Follow the online instructions in the START HERE pdf.

4) If the installation needed to replace DLLs, you will be prompted to restart your system.

5) You may now use the HomeRun tools for which you have a license.

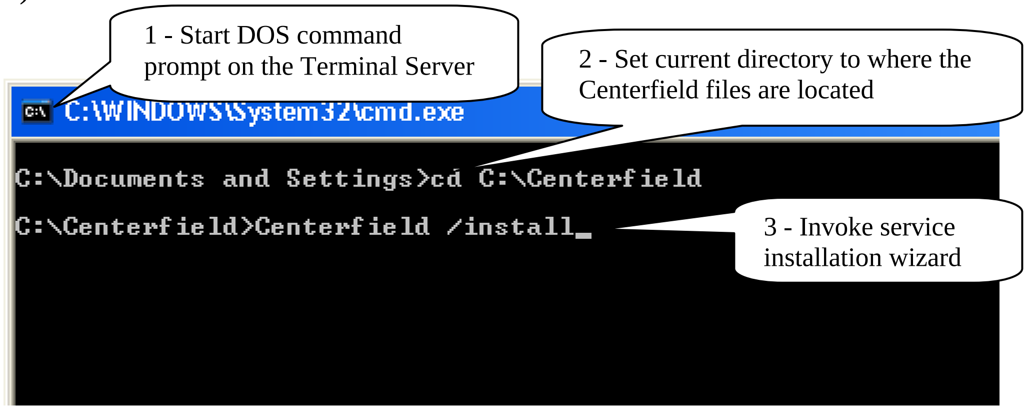
3.1.2.3 Installation instructions for OneWorld® customers using Windows® Terminal Server (i.e. Citrix® server)

These instruction apply **only** to customers that are running JDE OneWorld® (a.k.a. PeopleSoft EnterpriseOne® aka Oracle E1®) on their System i and have purchased insure/Monitor for OneWorld® license. Furthermore, customers using Terminal Servers (TS) in their environment and require Centerfield windows service running on those TS to achieve correlation of System i ODBC jobs to the OneWorld users will follow these instructions.

If these conditions do **NOT** apply to your scenario, do **NOT** follow these installation steps.

These instructions are to be performed by the Terminal Server administrator (i.e. OneWorld® CNC specialist) with Administrator authority to the server.

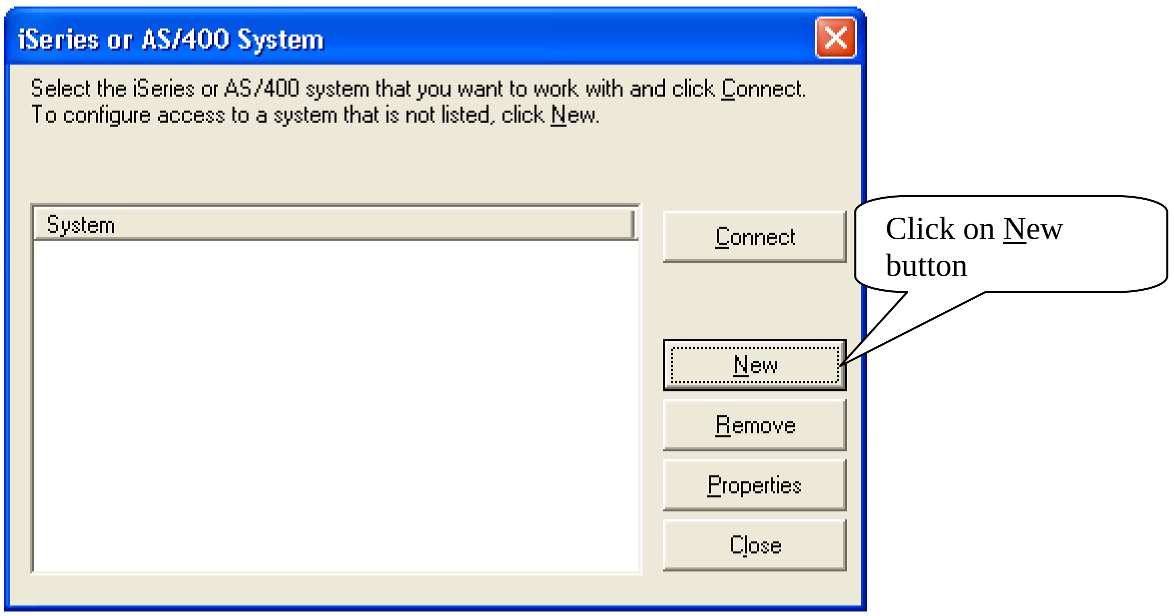
1) Locate **Centerfield.exe, Centerfield.dll and CenterfieldServiceConfiguration.exe** on the installation CD using Windows Explorer
2) Create a new folder on the Terminal Server (i.e. C:\Centerfield)
3) Copy and paste **Centerfield.exe, Centerfield.dll and CenterfieldServiceConfiguration.exe** to the newly created folder
4)


1 - Start DOS command prompt on the Terminal Server
2 - Set current directory to where the Centerfield files are located
3 - Invoke service installation wizard
C:\WINDOWS\System32\cmd.exe

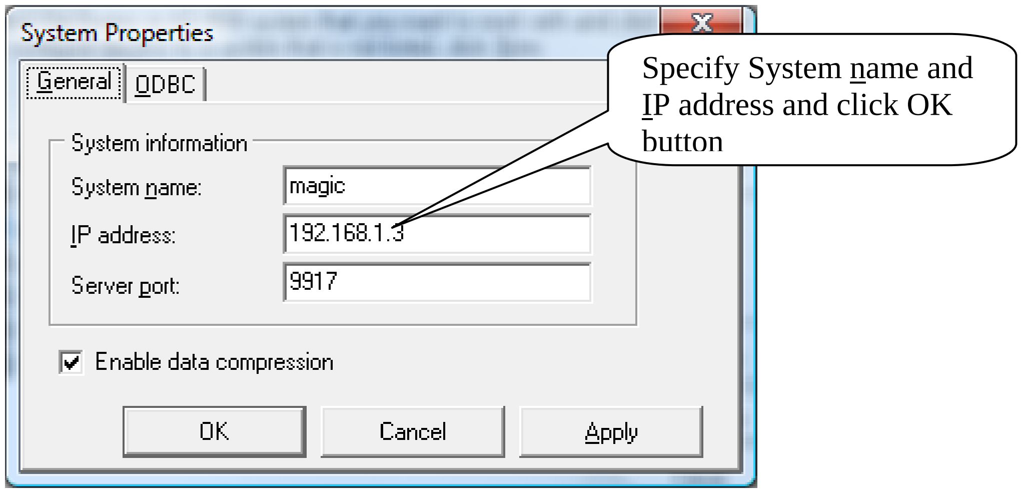
```
C:\Documents and Settings>cd C:\Centerfield

C:\Centerfield>Centerfield /install_
```

5) Several one time configuration windows will appear.



Select the iSeries or AS/400 system that you want to work with and click Connect.
To configure access to a system that is not listed, click New.



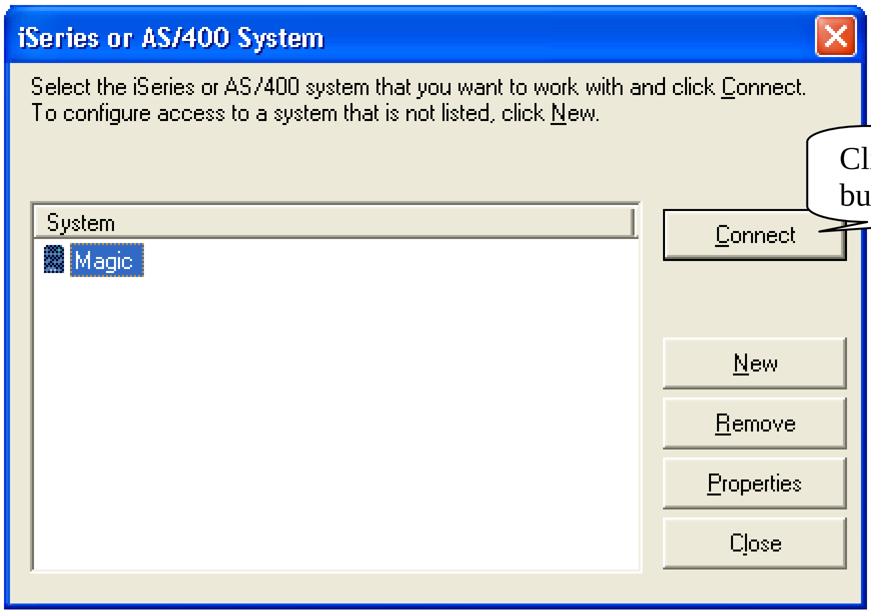
System information

System name: magic

IP address: 192.168.1.3

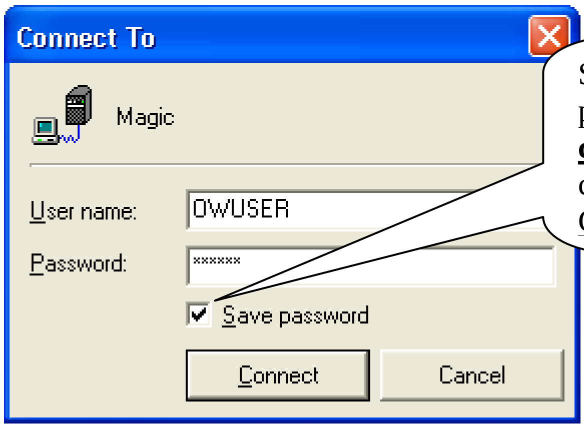
Server port: 9917

☑ Enable data compression


iSeries or AS/400 System

Select the iSeries or AS/400 system that you want to work with and click Connect.
To configure access to a system that is not listed, click New.

Click on Connect button

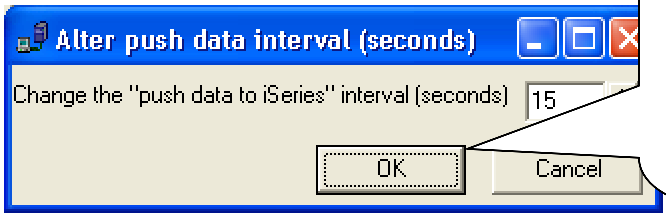

Connect To

User name: OWUSER

Password: ******

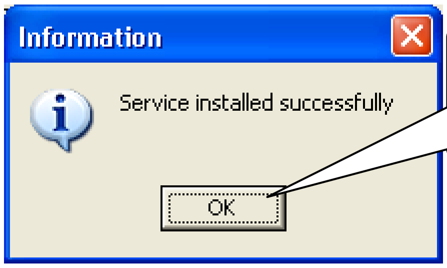
[✓ Save password]

Specify iSeries profile and password, make sure you **check** the Save password checkbox then hit the Connect button.


Alter push data interval (seconds)

Change the "push data to iSeries" interval (seconds) 15

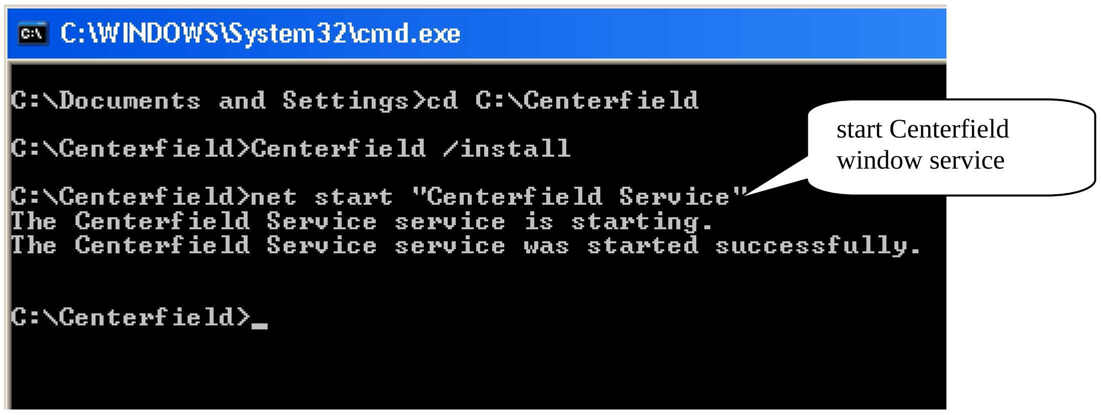
Default 'push data to System i' interval is 15 seconds, but you can change it at this time.
Good rule of thumb is to use 5 seconds per Terminal Server on which our service is running (i.e. 8 * 5 = 40 seconds).
When done click OK button


Information

Service installed successfully

Upon successful installation of the Centerfield Terminal Server windows service you will see this window. Click OK to return to DOS prompt screen.

6)


```
C:\WINDOWS\System32\cmd.exe

C:\Documents and Settings>cd C:\Centerfield

C:\Centerfield>Centerfield /install

C:\Centerfield>net start "Centerfield Service"
The Centerfield Service service is starting.
The Centerfield Service service was started successfully.


C:\Centerfield>_
```

You can check Centerfield service status in a couple of ways. One is to invoke the services applet via Start->Run->services.msc. Another is to check for the existence of Centerfield.exe process in the Task Manager on the Terminal Server.

If there are active OneWorld connections on the Terminal Server, there should be an XCCLIENT job on the System i with the joblog message:
"Serving Terminal Server at IP address 0.0.0.0." where 0.0.0.0 will list the true IP address of the Terminal Server. If there are no active OneWorld connections on the Terminal Server, Centerfield service will not push any data to the System i.

This completes the Centerfield service installation on the Terminal Server. Service should auto-start every time Terminal Server reboots. For the Centerfield service to push data, XCSERVER job needs to be active on the System i. You can start it by executing *{PROGRAM LIBRARY}*/STRSVR command, or automate this by adding STRSVR command to your IPL startup routine (DSPSYSVAL QSTRUPPGM).

There is one final configuration step that has to be performed from the insure/MONITOR for OneWorld® PC client.
Refer to the documentation located under section **"Configuration for OneWorld® customers"** in the **"insure Monitor User Guide and Reference"** document for details.

3.1.3 Connecting to the server for the first time

Once you have the product installed, you are ready to connect to the server from the Windows based workstations. The workstation installation adds a program group to your start menu called *Centerfield HomeRun*. Within the program group there are one more features that can be selected depending on the options that were selected at installation time. To start the HomeRun tool you want to use, choose its name from this group.

The HomeRun tools use a consistent interface for connecting to the System i. When you start one of the HomeRun tools for the first time on your workstation, you will need to configure your connection to a server.

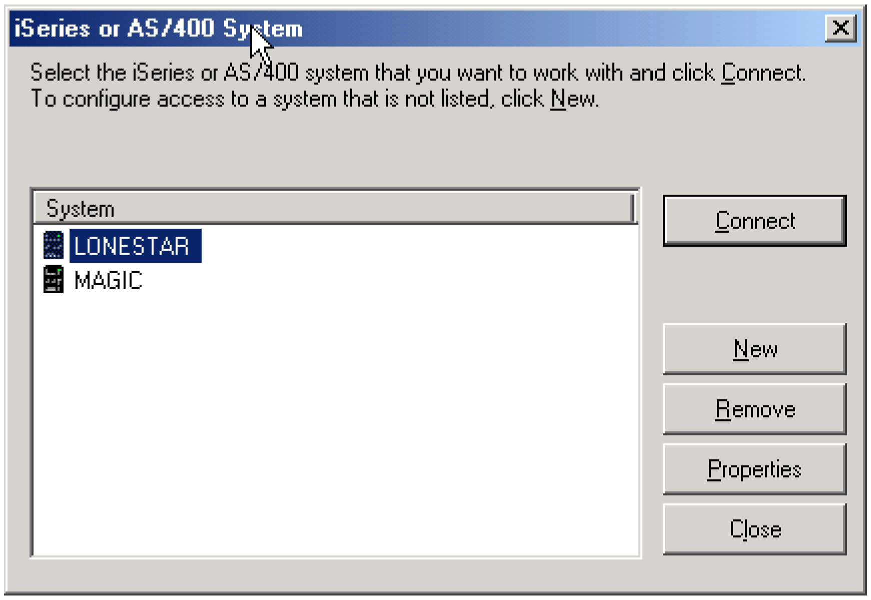
Auto-configuration

When you start the tool, it will try to auto-detect the System i systems in your environment and configure itself to connect to them.

The auto-configuration interface will show you all of the systems that it can detect. If no systems are detected, the auto-configuration will be skipped and you will need to define your system connection information manually.

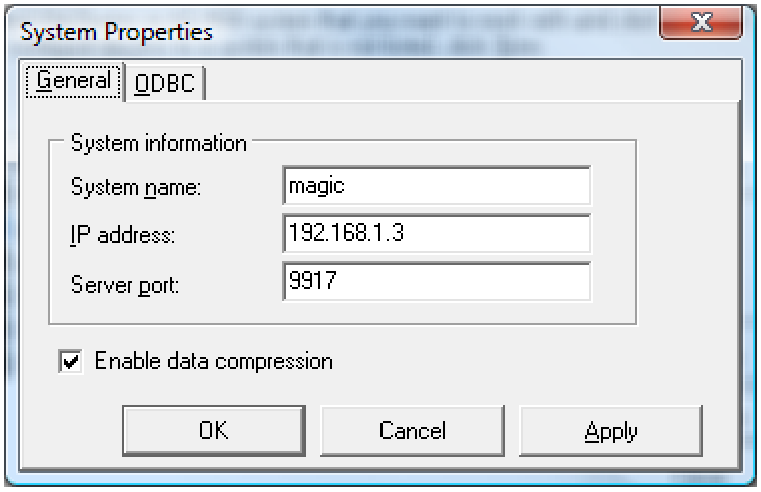
Manual configuration

If the auto-configuration interface did not detect your system, or you want to manually configure a connection, use the following instructions.



Select the iSeries or AS/400 system that you want to work with and click Connect.
To configure access to a system that is not listed, click New.

When the *System i system* window is displayed, press **[New]** to add a new system.


System name: magic

IP address: 192.168.1.3

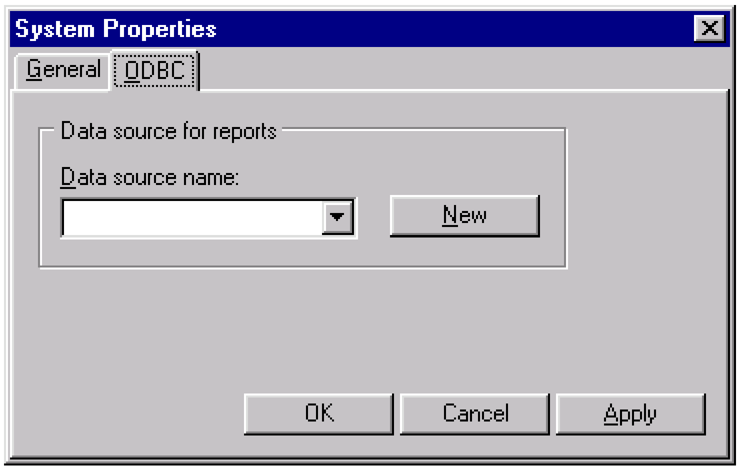
Server port: 9917

[✓] Enable data compression

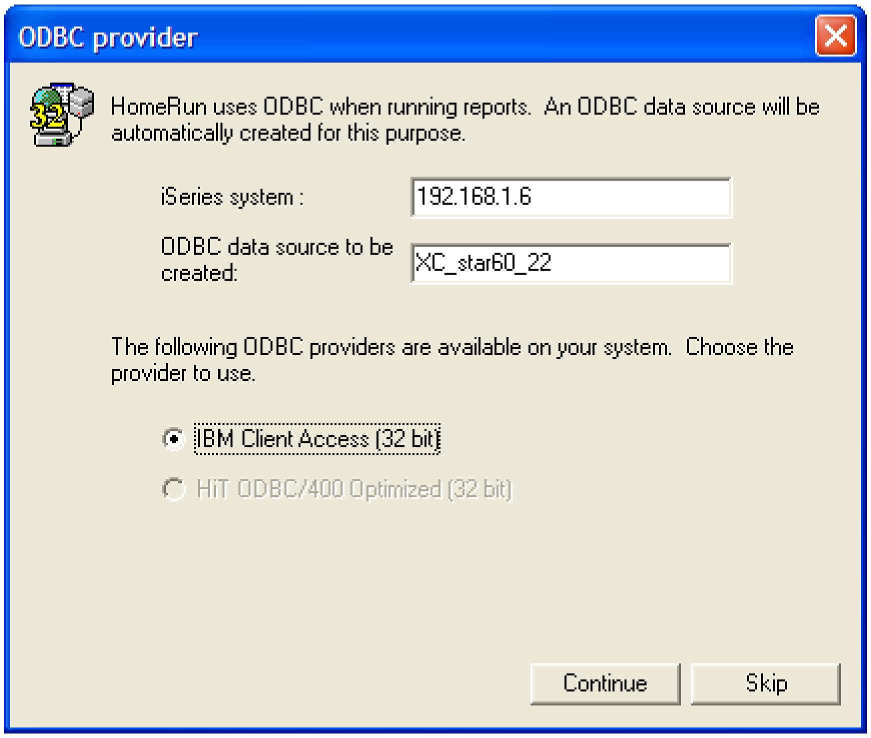
For *System name*, enter a descriptive name that identifies your system.

For *IP address*, enter either the symbolic name or dotted IP address for your System i system.

For the *TCP/IP port*, use the port that was selected during the System i installation process, by default **{default port}** is used.


Data source name:

On the *ODBC* tab, specify a name for your ODBC data source and press **[New]** to create a data source for this system. If you already have a Client Access ODBC data source that is configured to your system, you can specify your existing data source. If you choose to create a data source, you will see a display similar to the following.


ODBC provider

HomeRun uses ODBC when running reports. An ODBC data source will be automatically created for this purpose.

iSeries system : 192.168.1.6

ODBC data source to be created: XC_star60_22

The following ODBC providers are available on your system. Choose the provider to use.

[✓ IBM Client Access (32 bit)]

HiT ODBC/400 Optimized (32 bit)

Specify the name of the System i as defined in your connection software, and select the data source type that you want, and press **[Continue]**. You must have either Client Access or HIT ODBC installed to use this fast path interface for creating your data source. If you have another ODBC provider, you must create the data source with the ODBC Administrator utility that is provided with Windows and then specify the data source name within the *System Properties* window on the *ODBC* tab.

After you have created your data source and specified values for all of the appropriate prompts on the *System properties* window, press **[OK]** to create the connection definition.

Connecting to a system

Select the system that you want to work with from the list provided in the *System i system* window, and press the **[Connect]** button. Enter your user profile and password and press **[Connect]**.

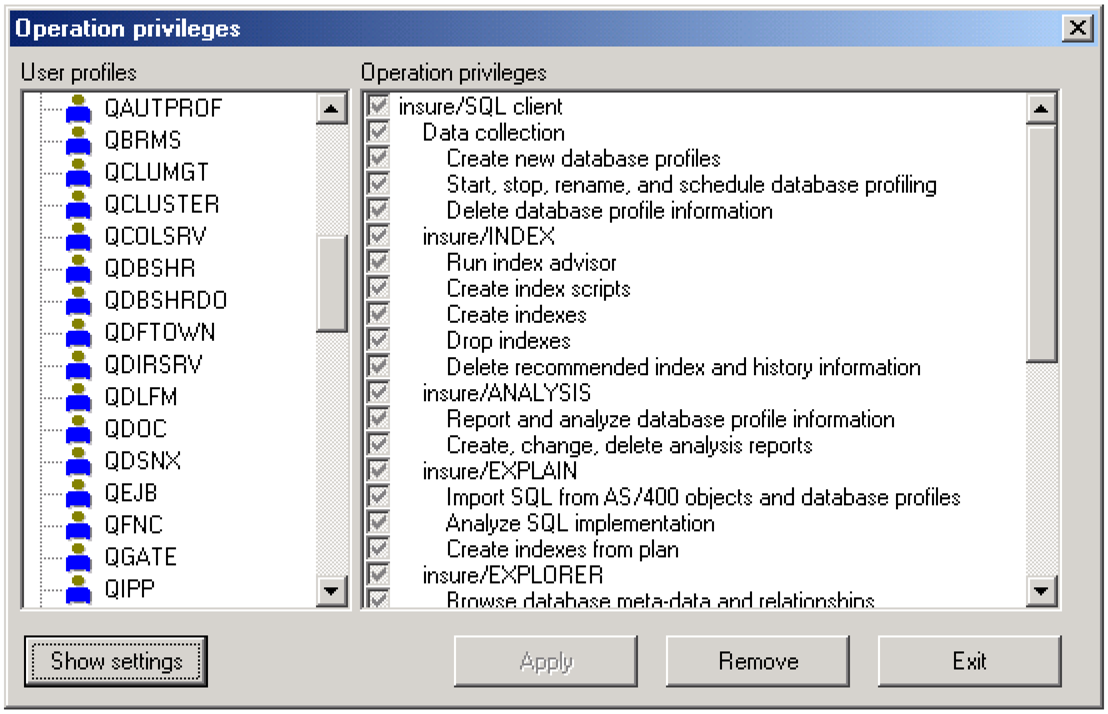
3.2 Securing the use of HomeRun tools

HomeRun provides a broad suite of powerful functionality to the IT organization. Often, duties are split among various specialists. In this situation, it may be desirable to control what functions in the toolset each specialist can use. HomeRun provides a set of granular controls to allow an IT administrator to determine who can and should use each part of the toolset.

To implement security settings for a user or group profile use the following procedure:

1. In any of the HomeRun tools, select Tools | Privileges.

2. The next dialog has a list of users and groups on the left side and an itemized list of product features on the right as seen below:



QAUTPROF
QBRMS
QCLUMGT
QCLUSTER
QCOLSRV
QDBSHR
QDBSHRDO
QDFTOWN
QDIRSRV
QDLFM
QDOC
QDSNX
QEJB
QFNC
QGATE
QIPP

- ✓ insure/SQL client
  - ✓ Data collection
    - ✓ Create new database profiles
    - ✓ Start, stop, rename, and schedule database profiling
    - ✓ Delete database profile information
  - ✓ insure/INDEX
    - ✓ Run index advisor
    - ✓ Create index scripts
    - ✓ Create indexes
    - ✓ Drop indexes
    - ✓ Delete recommended index and history information
  - ✓ insure/ANALYSIS
    - ✓ Report and analyze database profile information
    - ✓ Create, change, delete analysis reports
  - ✓ insure/EXPLAIN
    - ✓ Import SQL from AS/400 objects and database profiles
    - ✓ Analyze SQL implementation
    - ✓ Create indexes from plan
  - ✓ insure/EXPLORER
    - ✓ Browse database meta-data and relationships

3. To quickly restrict usage to a few users, select the *PUBLIC user profile and unclick the top-most box. At the same time, you should make sure one user profile has the capability to update privileges. To do that, pick one user profile and make sure *Administration* and *Edit HomeRun privileges* are checked. If you do not do this step, only the QSECOFR profile will still be able to edit privileges.

4. To change the settings for a particular user, click on their profile and push the "Show settings" button. On the right you will then see the parts of the product that profile is

authorized to use. If the box is gray, the user does not have explicit authority defined and will get authority from either their group profile or global settings (the authority set for *PUBLIC).

5. To restrict a user from a particular feature, simply uncheck the box in front of that feature and click the “Apply” button. If the user attempts to use that function, they will be given a message saying they are not authorized to that feature and that they should contact their system administrator.

6. To remove settings, choose a profile (or set of profiles with multi-select) and click “Remove settings”. This will result in all settings being picked up from the group profile or *PUBLIC.

NOTE: When settings are changed for a user, they will not take effect until the user connects to that iSeries again (i.e. exits the client GUI and restarts it).

3.3 insure/ANALYSIS basic concepts

insure/ANALYSIS is the tool in the HomeRun toolset for learning about the type and amount of SQL activity that occurs on your system. It allows you to identify high impact activity based on criteria that is important for your environment. insure/ANALYSIS supports a multi-dimensional approach for performing analysis of SQL performance information. The information can be analyzed from the following different dimensions:

- Usage Tracking profile
- Job identifier
- User profile
- Program/package
- File
- Index
- SQL statement
- Individual run of an SQL statement

Each dimension has a set of reports that help you identify key performance indicators. The main performance indicators that are exposed by insure/ANALYSIS are:

- CPU usage
- Elapsed time delays
- I/O requests
- Repetitive requests that can cause performance expensive operations

The following sections explain these four indicators:

3.3.1 CPU Usage

In insure/ANALYSIS, the term “CPU usage” indicates how many seconds of main processor time were required to process one or more SQL statements. If CPU usage is high, it means that the system needed to spend a lot of time processing the information to satisfy the SQL request before the final results could be returned. Other activity on the system may have been slowed as a result of CPU-intensive SQL. While high CPU usage can lead to long elapsed times, elapsed time and CPU time are different measurements. (See the next section for more information on elapsed time.) CPU seconds consumed can be either more or less than elapsed time. In a single processor environment, CPU time will almost always be less than elapsed time. The exception to this rule on a single processor system is when the i5/OS query optimizer does not provide explicit start and stop information for the statement or query. This can occur in cases where queries are run using Query/400, OPNQRYF, or other non-SQL based products. In situations where the query optimizer does not provide start and stop information, insure/ANALYSIS makes an estimate of the elapsed time by using other information that it has available from the optimizer. On a system with multiple processors it will be common for CPU time to be greater than elapsed time when an SQL statement can be implemented using parallelism.

The i5/OS database support provides CPU statistics for all SQL based activity as a final summary step when a statement operation finishes. When query activity is non-SQL based like Query/400, OPNQRYF, and QQ API applications, the database support does not provide summary information. Since summary information is not available, CPU statistics for these types of operations will be shown as zero within insure/ANALYSIS. Similarly, SQL operations that have not reached completion when a collection ends will also display zero for CPU statistics. This is because the summary information for the operation is not recorded until the operation completes. In cases where CPU statistics are not available, total elapsed time should be used to get a relative measure for finding poor performing activity.

3.3.2 Elapsed time

In insure/ANALYSIS, elapsed time is the measurement in wall clock seconds of how long an operation took. Elapsed time can be a good measurement of how long a user waited for a response to an SQL statement or how long a particular part of an SQL statement ran. It can work well for determining if a SELECT statement is I/O bound. For example, if a SELECT statement took a total of 300 seconds, 298 seconds were spent opening the statement, 1 second was spent fetching data, and 1 second was spent closing the statement, you should probably focus your attention on the open/implementation of the statement and not on optimizing I/O usage. While elapsed time can be a good indicator for finding cases of long response times and I/O problems, the measurement can sometimes be misleading. Long elapsed times can be caused by heavy system loads or intentional low prioritization as well as poorly performing SQL. In general, statements that have both long elapsed times and high CPU usage or high amounts of I/O probably identify statements that have potential performance problems. If CPU usage and I/O requests are low and elapsed times are high, it may indicate contention for other system resources and a potential work management problem.

The i5/OS database support provides elapsed time statistics for all SQL based activity as a final summary step when a statement operation finishes. The database support for SQL based queries (not insert, update, and delete statements) provides broken down elapsed time measurements for the open, fetch, and close operations. Total elapsed time for an SQL query statement is the sum of the open, fetch, and close times. When query activity is non-SQL based like Query/400, OPNQRYF, and QQ API applications, the database support does not provide any summary information. Since each type of statement or query gets a different level of reporting, it can be useful to understand how insure/ANALYSIS calculates and represents the numbers:

- In cases where summary information is not available (Query/400, OPNQRYF, QQ API, etc.), insure/ANALYSIS does its best to calculate the total elapsed time of the statement. It calculates elapsed time by determining how long the optimizer's implementation took. The total does not include the statement fetch and close times in the total elapsed time calculation. The individual open, fetch, and close times will remain zero since there is not a method for determining the individual amounts of time.

- In non-query SQL cases (INSERT, UPDATE, DELETE, etc.), insure/ANALYSIS can only determine the total elapsed time of a statement. The individual open, fetch (I/O), and close times will remain zero since there is not a method for determining the individual amounts of time.
- In query SQL (SELECT) cases, insure/ANALYSIS identifies the open, fetch, and close times individually. The elapsed time total is calculated by adding the open, fetch, and close times.

3.3.3 I/O Requests

In insure/ANALYSIS, I/O statistics are available if the data is collected using the built-in collection facilities, or if the data has been imported from database monitor data that was collected using the *DETAIL collection level attribute (on the STRDBMON command). I/O statistics can provide important information for identifying statements that require a lot of random I/O and hence may indicate an implementation problem. The I/O statistics can also provide valuable information for identifying situations where fetching is performed one row at a time as opposed to using blocked fetch operations. If I/O statistics are not available, insure/ANALYSIS displays zero, “None”, or “Not available” depending on the analysis being performed.

3.3.4 Repetitive requests causing performance expensive operations

Several reports in insure/ANALYSIS show information about requests that cause potentially expensive operations to occur. Some of the operations that can be easily identified that may indicate a performance problem are:

- Full statement opens
- Query optimizer timeouts
- Temporary index builds
- Data conversions
- Lock contentions
- Access plan rebuilds

Many of these operations do not indicate a problem if they are infrequent. If they occur over and over, it probably indicates a problem or a potential area for performance improvement. For example, suppose we have a statement that was opened 5000 times. Of the 5000 opens 4990 opens were full opens and 10 opens were able to reuse previous opens of the statements. If the full open takes 1 second and the reused open only takes .0001 seconds, we may try to further analyze the statement implementation to determine why the full opens are occurring.

3.4 Usage Tracking and Database Profiles

The first step in optimizing your database or identifying a performance problem is to record the activity that is occurring. HomeRun refers to this activity as **database profiling**. Both insure/INDEX and insure/ANALYIS have a Usage Tracking feature which records and collects database performance information into a **database profile**, also called a **collection profile**.

3.4.1 Understanding Database Profiles

A database profile has several important attributes including name, type, and collection time periods. These correspond to the tabs you will initially see in the Profile Definition dialog box.

3.4.1.1 Profile Name

When you create a new database profile, you are asked to give it a name. This name should uniquely identify the profile and thus should not be a duplicate of an existing profile. You will use this name later when you work with the database profile in insure/INDEX or insure/ANALYSIS. It is suggested you name your profiles to include:

- The purpose for the data collection.
- The date it was created.
- Who created the profile.

Since all users of the HomeRun toolset will be able to see all profiles, this naming convention will help everyone using the product identify the purpose and owner of each profile.

3.4.1.2 Collection Type

The collection type dictates which jobs on your system are included in the profile.

The most exhaustive method is to collect for **all jobs** on your system. The advantage of this approach is that you can quickly get a complete picture of all query activity happening against your database. The disadvantage is that the collection may require a significant amount of disk storage and additional CPU resource. If your environment does not have a high rate of SQL-based insert, update, and delete transactions (for example, you are collecting information for an IBM System i™ used as a data warehouse), then collecting data for all jobs is a good place to start. If you are resource-constrained, then it is recommended you use other methods described next.

Another approach is to collect information for a subset of **currently active jobs**. The advantage of this approach is that you can pinpoint specific jobs or users to collect data for and thus do targeted analysis. The disadvantage of this approach is that once a database profile is started you cannot add new jobs to that profile.

The third approach is to pre-define **criteria to select jobs** of interest. With this method you can specify a job name, a job user name, or a subsystem. For example, you may want to monitor all jobs running queries using IBM's ODBC driver. To do this you would specify the job name of the ODBC servers (e.g. QZDASOINIT if they are connected with TCP/IP). The advantage of this method is that you can target certain jobs rather than collecting data for the whole system. Another advantage is that new jobs that come into the system that meet your criteria will automatically become part of the active profile.

If you specify more than one type of criteria, they will be combined to identify the specific jobs of interest. For example, you may want to monitor all jobs that start with QP and jobs in subsystem QSERVER. To do this, simply specify QP* for the job name to identify the generic job name on the "Job Name" tab and specify QSERVER on the "Subsystems" tab.

If more than one item is listed in the criteria (for example you want jobs in the QSERVER or QBASE subsystems), add both names to the list. Multiple choices for a single category (like "Job Name") are "ORed" together. Criteria for multiple categories are "ANDed" together. For example, if you want to monitor all jobs with a job user of JOE in subsystems QINTER or QSERVER you can simple enter these criteria.

3.4.1.3 Collection Time

The final attribute of a database profile is the time period chosen to collect data.

One method is to dynamically start and stop profiles. You might use this approach when doing interactive analysis or trying to diagnose a performance problem. If you start the profile it is important to remember that it must be stopped. If you fail to stop a profile, you may collect a large amount of data and thus consume a lot of disk space.

The second method is to schedule data collection for predefined periods of time. For example, you may know that many reports are run on Friday morning. If you wish to find out who runs them, against what files, and if there are performance problems, a profile can be set up to automatically collect information every Friday morning. The advantage of a scheduled profile is that you do not have to remember to start or end a profile since it is done automatically for you.

The Usage Tracker also lets you simply create the profile and not start or schedule it. To use the profile at a later time, it must either by started interactively or scheduled.

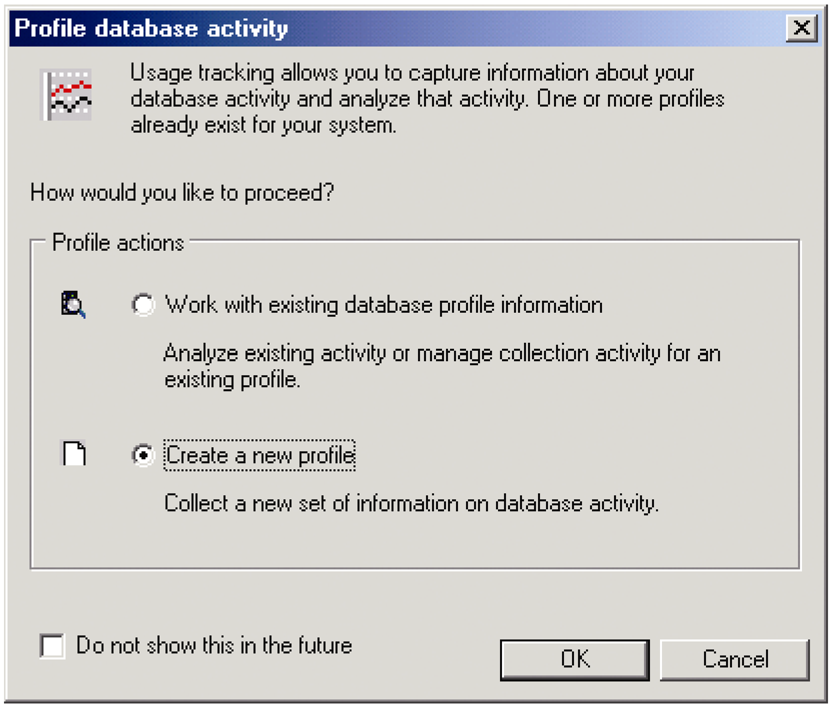
3.4.2 Creating a database profile

To create a new database profile:

Access the Usage Tracking window by doing one of the following:

- From the *Welcome* screen, select *Track database activity*.
- From the *Tools* menu, choose *insure/INDEX* or *insure/ANALYSIS*, then choose *Usage Tracking*.

You will be presented with the following window. Choose to create a new profile.


Profile database activity

Usage tracking allows you to capture information about your database activity and analyze that activity. One or more profiles already exist for your system.

How would you like to proceed?

Profile actions

( ) Work with existing database profile information

Analyze existing activity or manage collection activity for an existing profile.

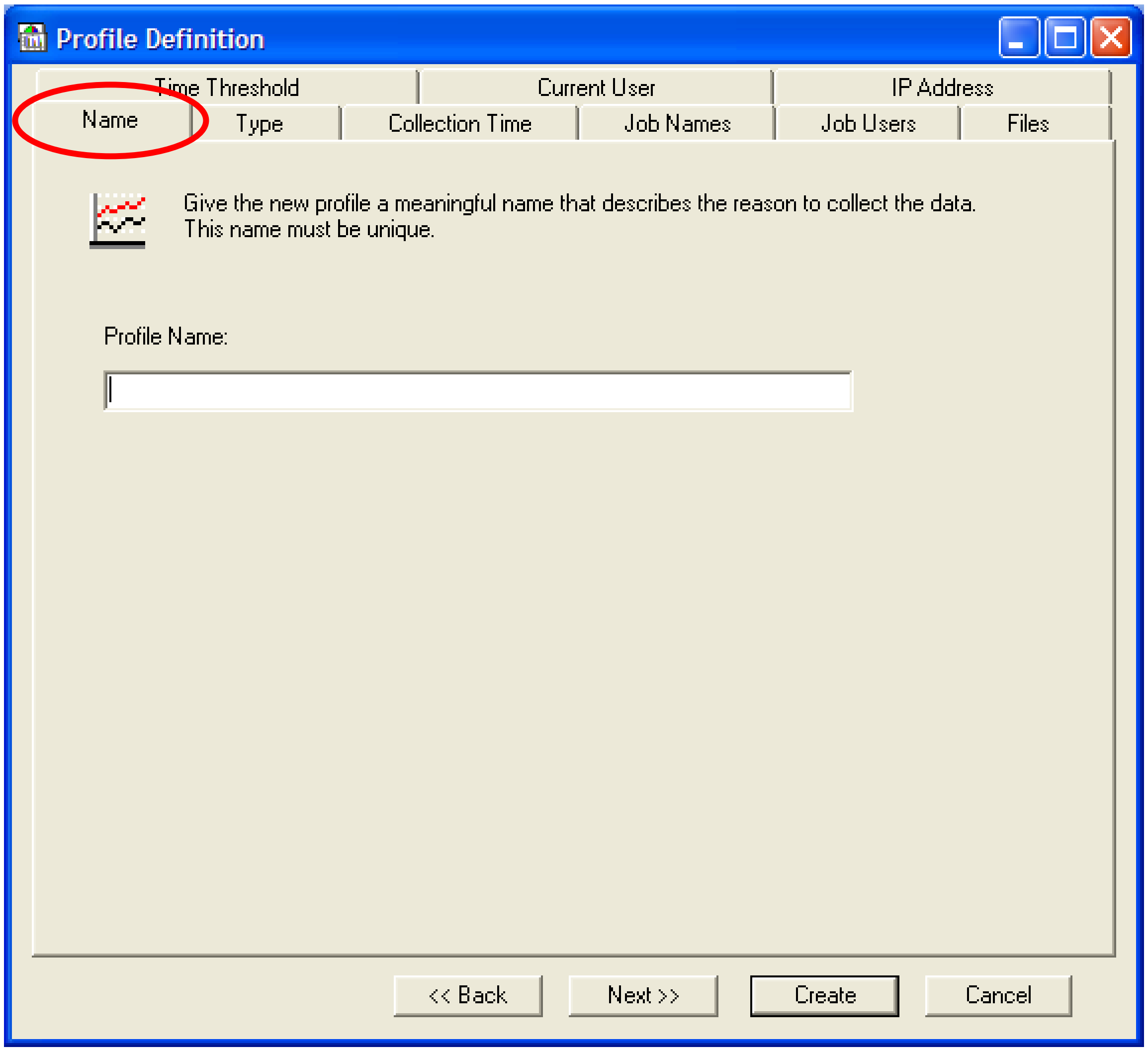
(●) Create a new profile

Collect a new set of information on database activity.

☐ Do not show this in the future

NOTE: some of the tabs in the following screen captures are release and/or PTF level dependent, so they may not appear on your specific installation.
All of the following screen captures were captured on i5/OS V5R4 current on PTFs.

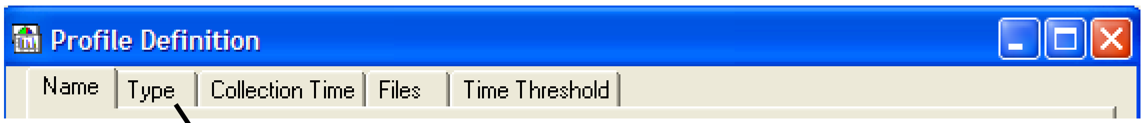
The *Profile Definition* window will pop up, with the *Name* tab showing. Enter a name that identifies the activity you are going to capture. Press the **[Next]** button to move to the next tab.



Give the new profile a meaningful name that describes the reason to collect the data. This name must be unique.

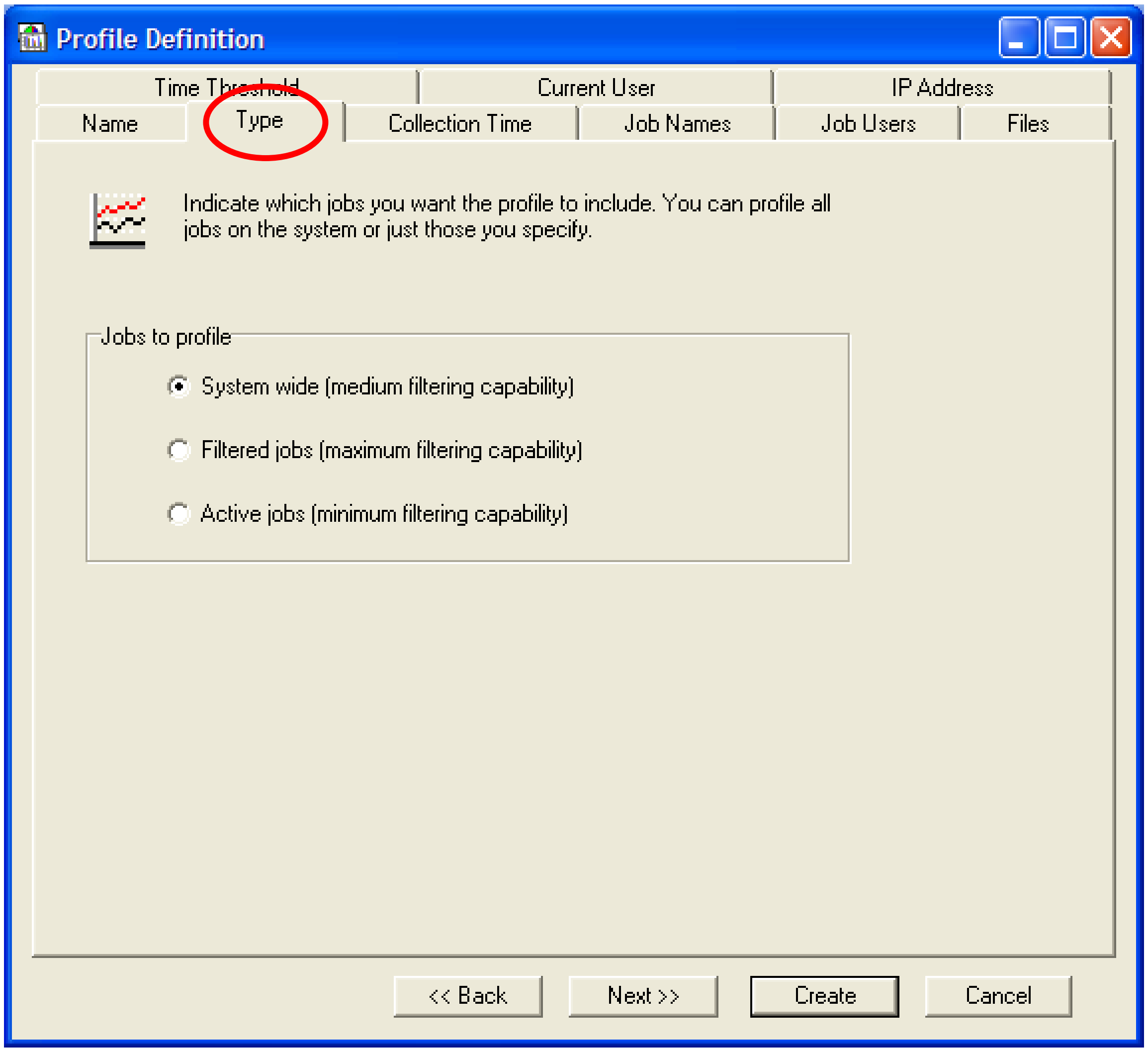
Profile Name:

On V5R3 and earlier releases of the i5/OS you will <u>subset</u> of tabs for ***System wide*** collection type:



Tabs available on V5R3 and V5R2 for **System Wide** collection type; **Filtered Jobs** collection type tabs are much more expansive and consistent across different i5/OS releases.

The next tab is the *Type* tab. If you choose a collection type other than ***System wide***, you will see additional tabs appear that allow you to specify the additional criteria.



Indicate which jobs you want the profile to include. You can profile all jobs on the system or just those you specify.

Jobs to profile

[✓ System wide (medium filtering capability)]

Filtered jobs (maximum filtering capability)

Active jobs (minimum filtering capability)

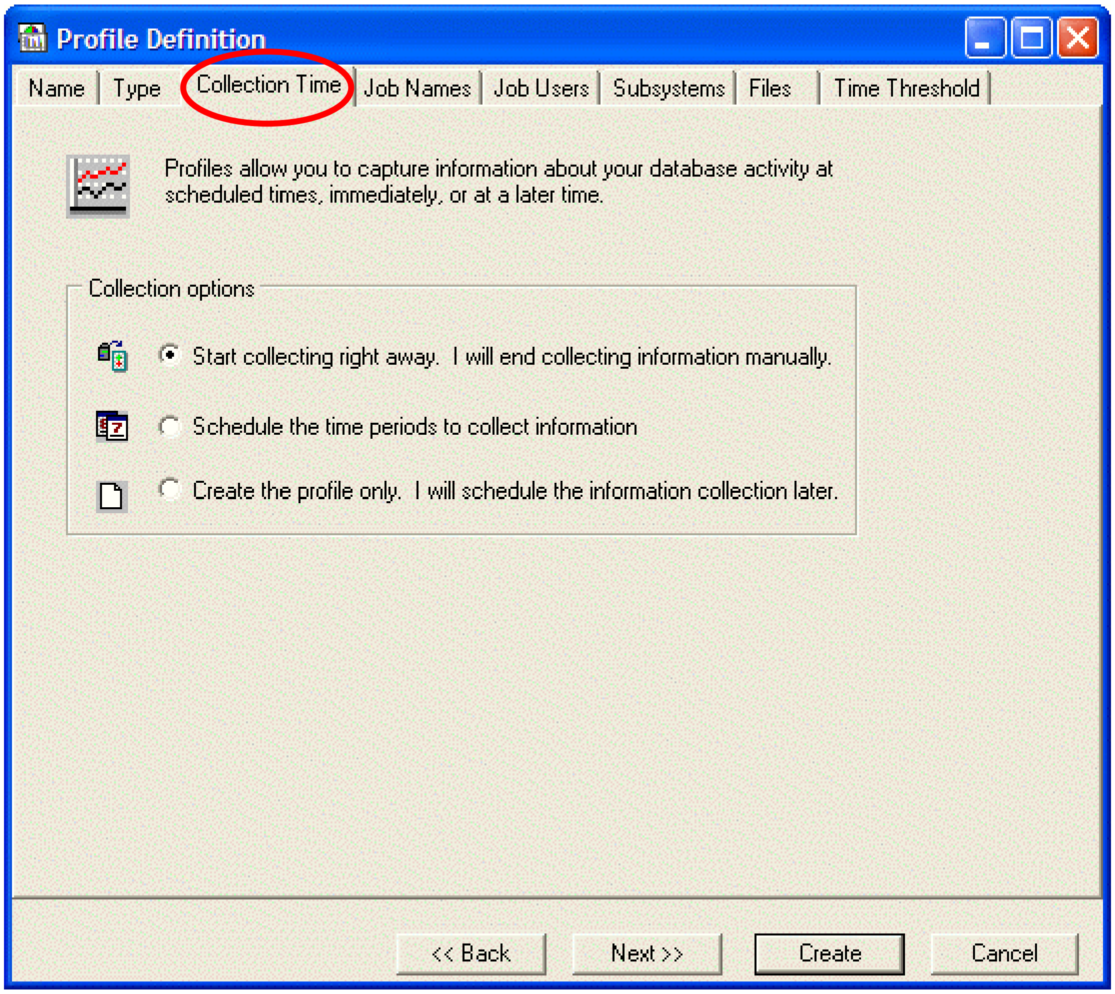
If you choose to collect ***System wide*** with little or no filters, you should be aware of these restrictions:

- The IBM System i™ STRDBMON command should not be actively collecting data (outside of HomeRun) when HomeRun attempts to start a collection to monitor all SQL activity.
- The IBM System i™ ENDDBMON command should not be used to stop collecting system-wide SQL activity while using this collection technique.

Starting with V5R4 version of i5/OS up to 10 public (system wide) filters are allowed.

When you have selected a Profile type, press **[Next].**

The collection time tab presents the following options:


Profile Definition

Name | Type | Collection Time | Job Names | Job Users | Subsystems | Files | Time Threshold

Profiles allow you to capture information about your database activity at scheduled times, immediately, or at a later time.

Collection options

[✓ Start collecting right away. I will end collecting information manually.]

Schedule the time periods to collect information

Create the profile only. I will schedule the information collection later.

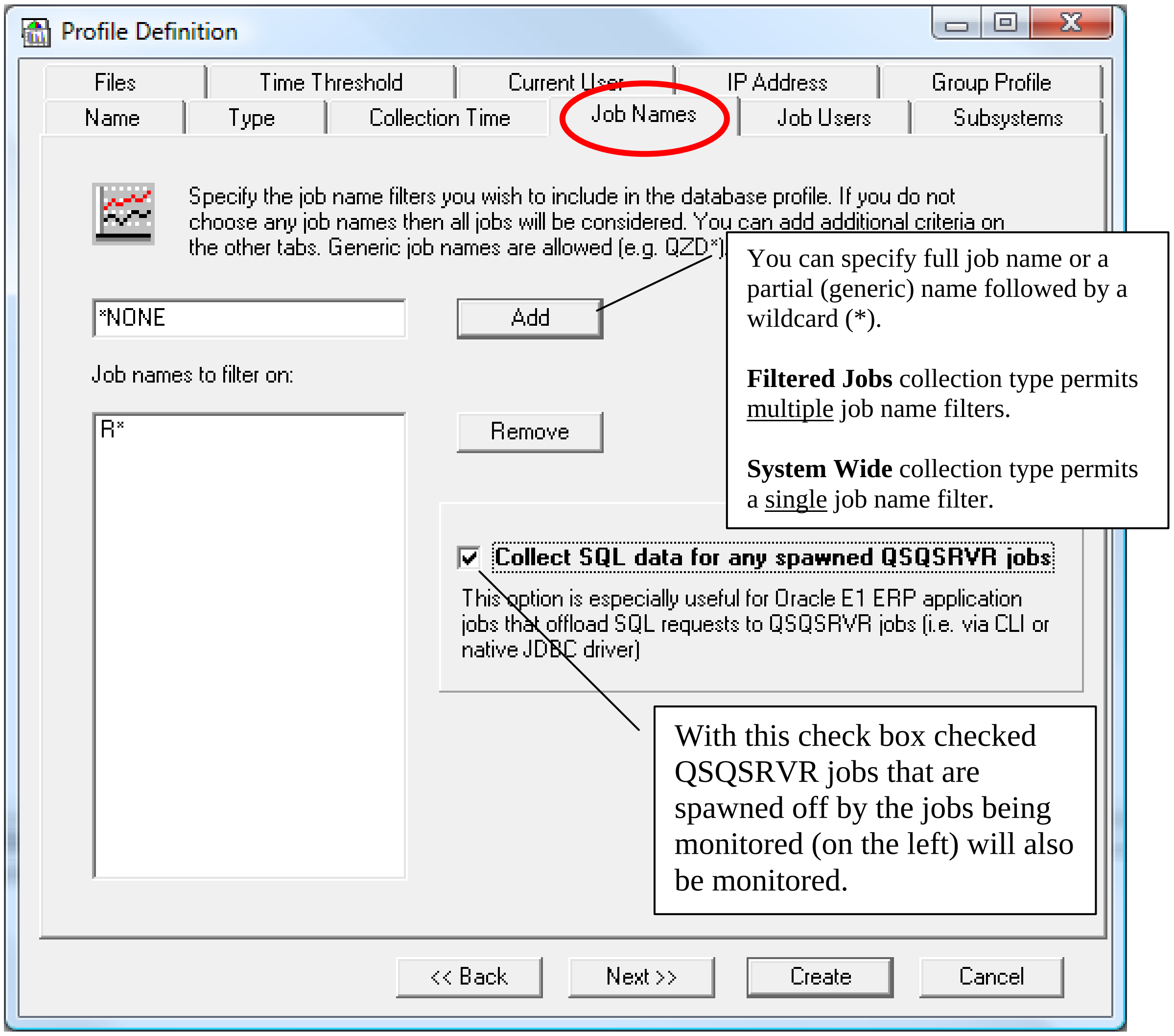
If you want to start collecting information right away, choose to ***Start collecting right away***. You will be responsible for stopping the collection after the activity you want to analyze is complete. This information is stored on the IBM System i™ in several files. If you forget to stop collecting information, these files will continue to grow and may use a lot of your IBM System i's ™ storage. So make sure you do not forget to stop the collection if you start it manually.

You can also schedule the data collection. The Usage Tracker will automatically start and stop the collection at the times you specify. This way you do not have to remember to start and stop the data collection yourself. The schedule information is maintained on the IBM System i™, so you do not have to have the Windows PC active for the scheduling to work.

If you choose to only create the profile, a profile will be created without any collection time specifications. You will have to explicitly start it or schedule it at a later time.

Once you have selected a collection time option, press **[Next].**

The ***Job names*** tab allows you to choose the names of jobs that you wish to profile. If you have a common naming convention for jobs, you can specify generic names such as BCH* to include all jobs that start with the letters "BCH". The following example will include all jobs that start with "QZDASOIN".



Specify the job name filters you wish to include in the database profile. If you do not choose any job names then all jobs will be considered. You can add additional criteria on the other tabs. Generic job names are allowed (e.g. QZD*).

*NONE

Job names to filter on:

R*

[✓] Collect SQL data for any spawned QSQSRVR jobs

This option is especially useful for Oracle E1 ERP application jobs that offload SQL requests to QSQSRVR jobs (i.e. via CLI or native JDBC driver)

You can specify full job name or a partial (generic) name followed by a wildcard (*).

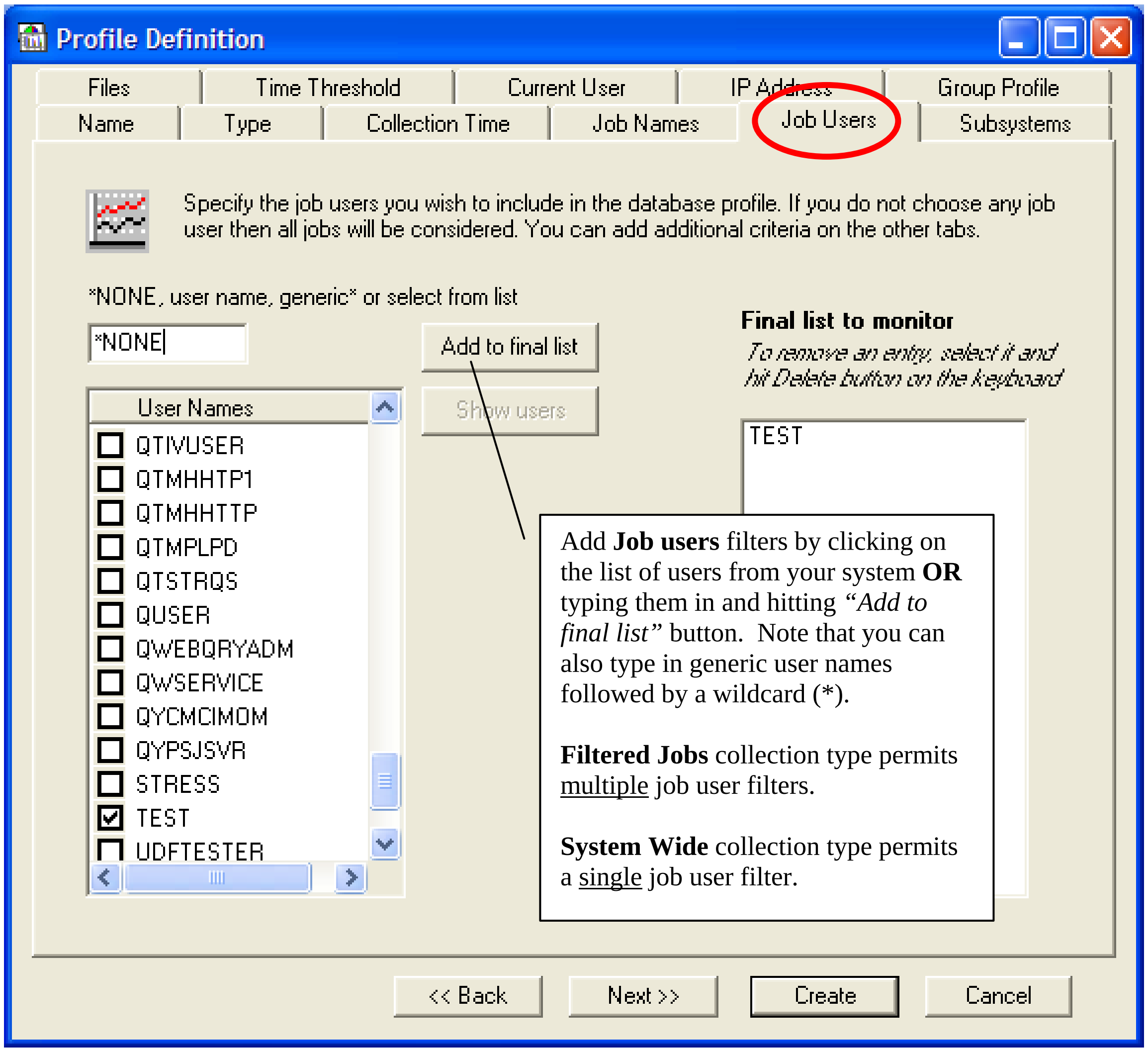
Filtered Jobs collection type permits multiple job name filters.

System Wide collection type permits a single job name filter.

With this check box checked QSQSRVR jobs that are spawned off by the jobs being monitored (on the left) will also be monitored.

When you are finished with **Job name** option, press **[Next].**

The ***Job users*** tab allows you to identify jobs that have a certain job user name. To identify job users a list of actual system users is presented on the ***Job users*** tab. Note that some jobs, such as the server jobs that run on behalf of IBM's ODBC driver, typically run under QUSER.



Specify the job users you wish to include in the database profile. If you do not choose any job user then all jobs will be considered. You can add additional criteria on the other tabs.

NONE, user name, generic or select from list

*NONE

Final list to monitor

To remove an entry, select it and hit Delete button on the keyboard

- [ ] QTIVUSER
- [ ] QTMHHTP1
- [ ] QTMHHTTP
- [ ] QTMPLPD
- [ ] QTSTRQS
- [ ] QUSER
- [ ] QWEBQRYADM
- [ ] QWSERVICE
- [ ] QYCMCIMOM
- [ ] QYPSJSVR
- [ ] STRESS
- [x] TEST
- [ ] UDFTESTER

TEST

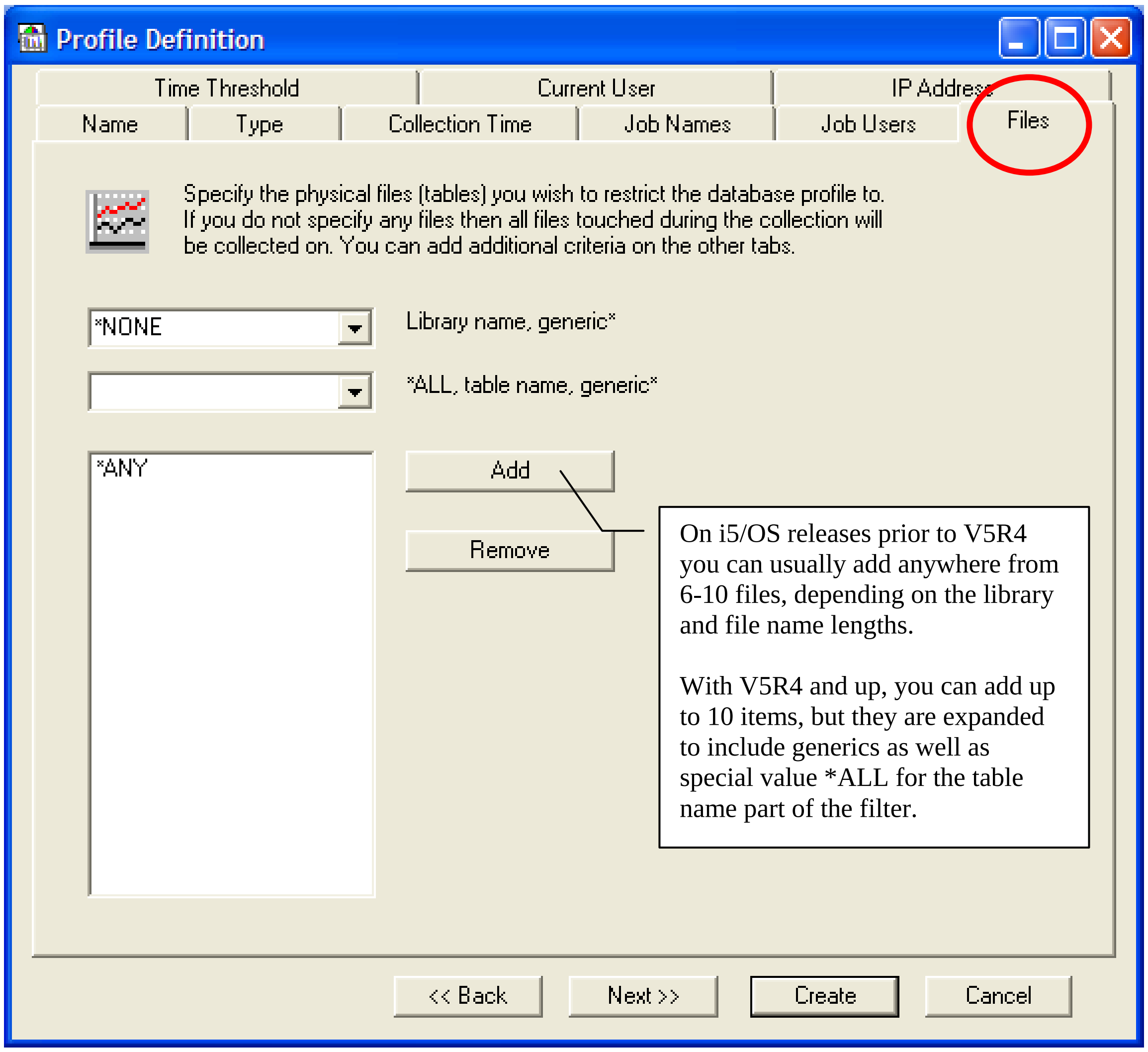
Add **Job users** filters by clicking on the list of users from your system **OR** typing them in and hitting *"Add to final list"* button. Note that you can also type in generic user names followed by a wildcard (*).

Filtered Jobs collection type permits multiple job user filters.

System Wide collection type permits a single job user filter.

When you are finished with **Job users** option, press **[Next].**

The **Files** option is especially useful if you want to focus your collection on specific files (SQL tables). For example if you have a large Master file that you know is being queried heavily and want to build appropriate indexes over it, you could narrow down your collection to queries that hit only your Master file. Subsequent index recommendations and query analysis will display results only pertaining to the queries that hit the Master file.



Specify the physical files (tables) you wish to restrict the database profile to. If you do not specify any files then all files touched during the collection will be collected on. You can add additional criteria on the other tabs.

NONE — Library name, generic

ALL, table name, generic

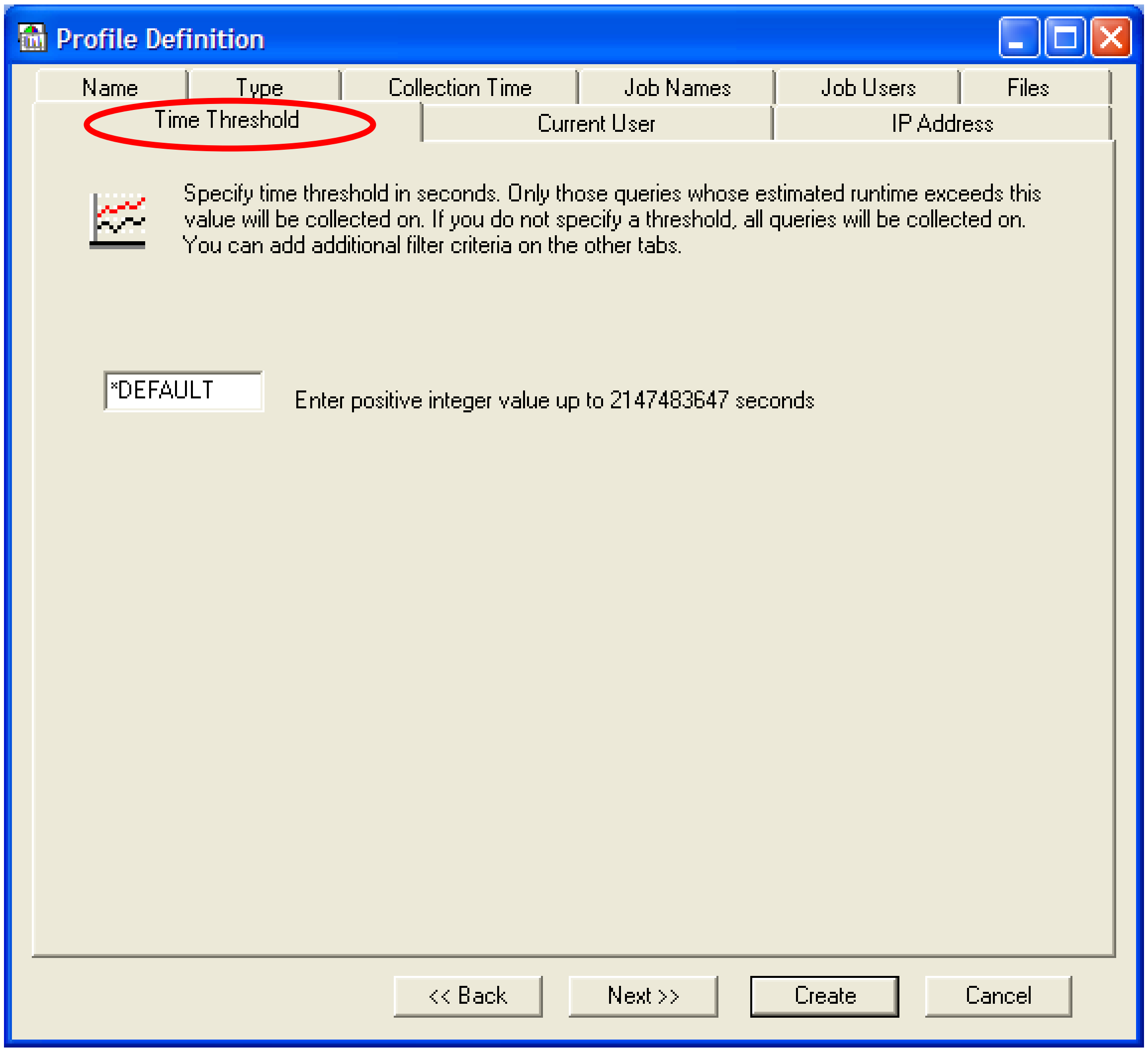
*ANY

On i5/OS releases prior to V5R4 you can usually add anywhere from 6-10 files, depending on the library and file name lengths.

With V5R4 and up, you can add up to 10 items, but they are expanded to include generics as well as special value *ALL for the table name part of the filter.

When you are finished with **Files** option, press **[Next].**

The **Time Threshold** option is especially useful for batch jobs that have long running queries you may want to tune for performance. By specifying a time threshold you will filter out any queries whose estimated run time is less than the threshold specified. Subsequent index recommendations and query analysis will display results only for queries that met your criteria.

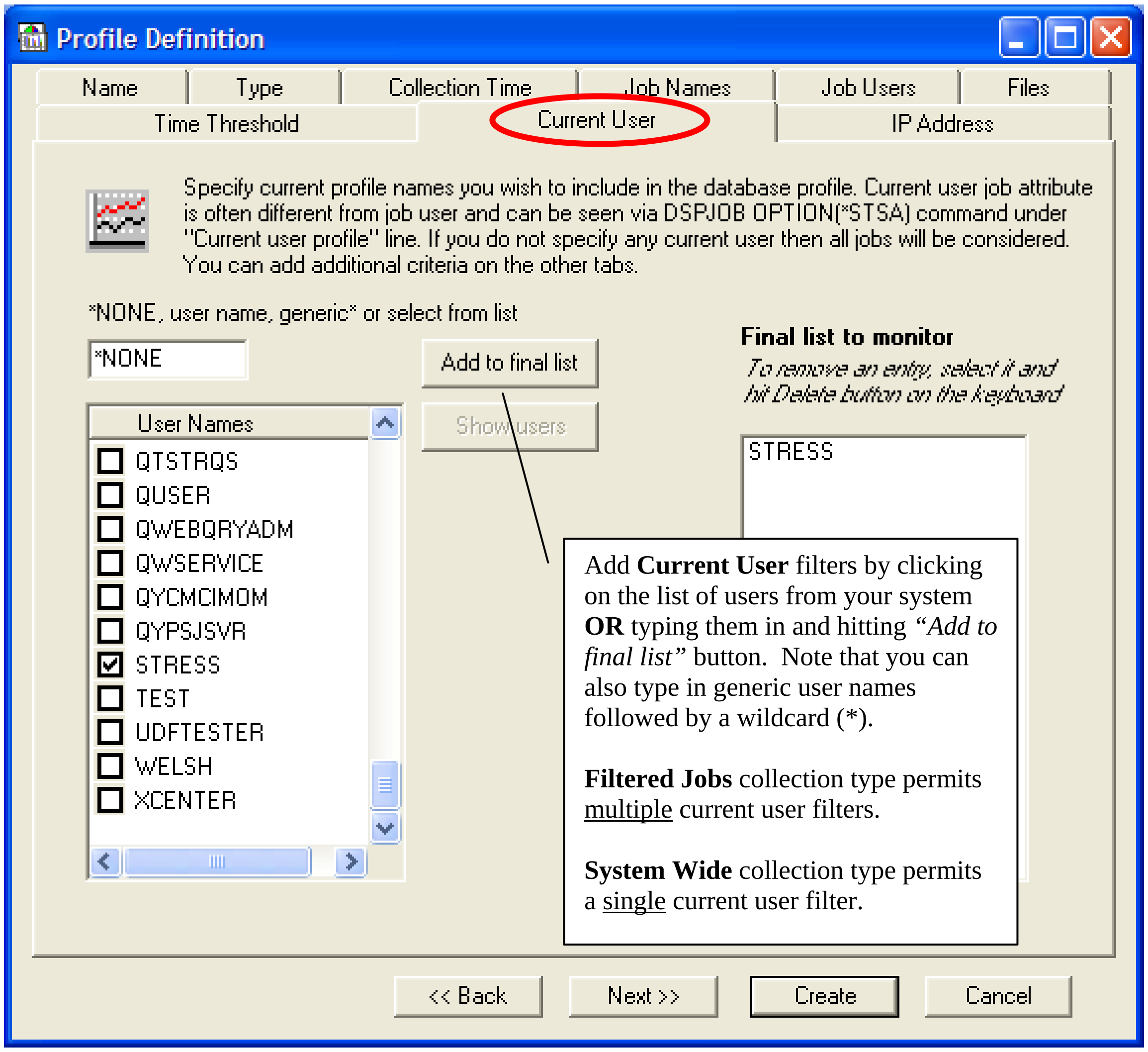

Profile Definition

Specify time threshold in seconds. Only those queries whose estimated runtime exceeds this value will be collected on. If you do not specify a threshold, all queries will be collected on. You can add additional filter criteria on the other tabs.

*DEFAULT Enter positive integer value up to 2147483647 seconds

When you are finished with **Time Threshold** option, press **[Next].**

The **Current User** option is especially useful for collecting on number of IBM host server prestarted jobs. Perfect situations for this type of filter are ODBC/JDBC server jobs (QZDASOINIT,QSQSERVER job names) as well as DRDA server jobs (QRWTSRVR).



Specify current profile names you wish to include in the database profile. Current user job attribute is often different from job user and can be seen via DSPJOB OPTION(*STSA) command under "Current user profile" line. If you do not specify any current user then all jobs will be considered. You can add additional criteria on the other tabs.

NONE, user name, generic or select from list

*NONE

User Names:
- [ ] QTSTRQS
- [ ] QUSER
- [ ] QWEBQRYADM
- [ ] QWSERVICE
- [ ] QYCMCIMOM
- [ ] QYPSJSVR
- [x] STRESS
- [ ] TEST
- [ ] UDFTESTER
- [ ] WELSH
- [ ] XCENTER

Final list to monitor

To remove an entry, select it and hit Delete button on the keyboard

STRESS

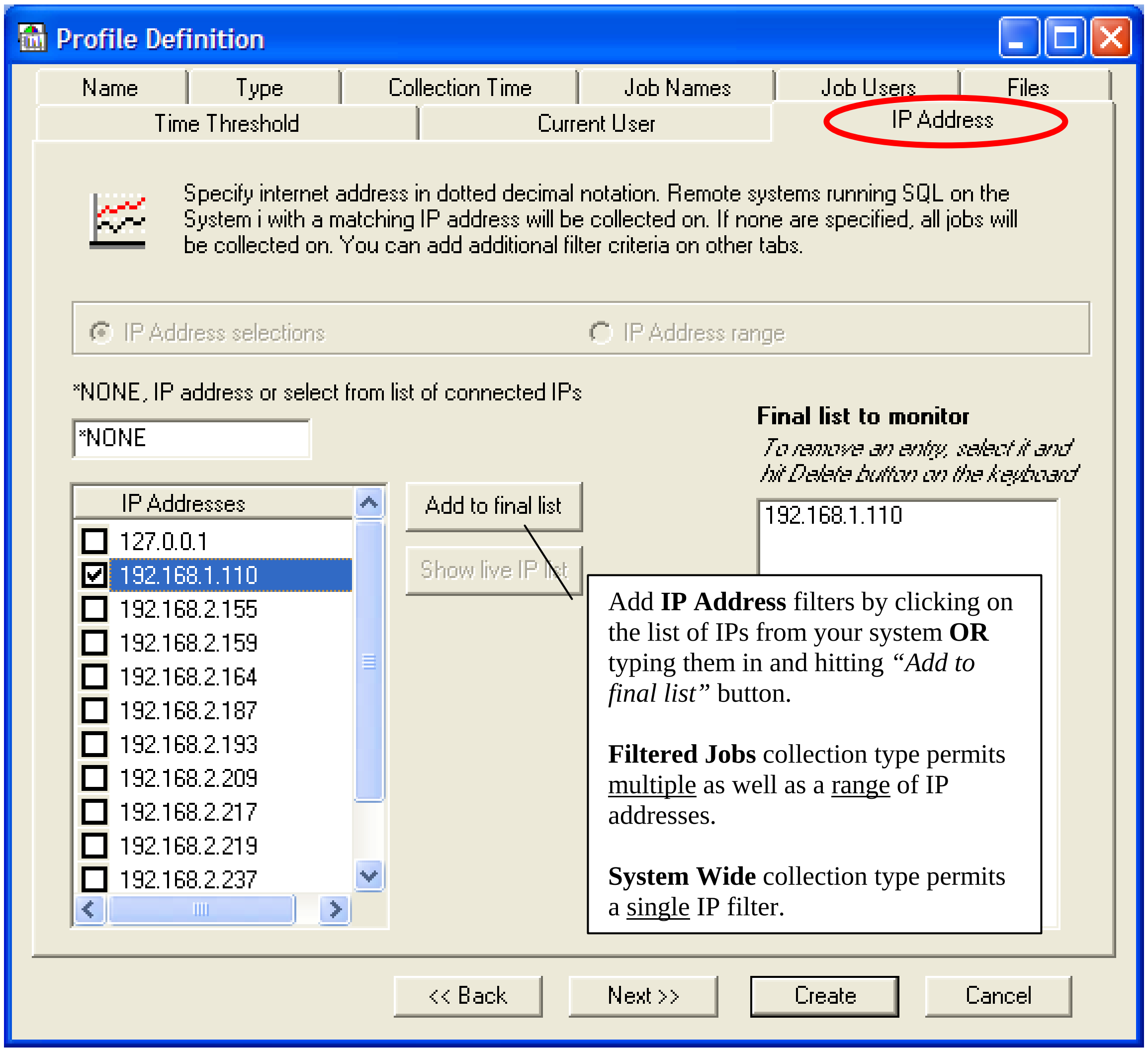
Add **Current User** filters by clicking on the list of users from your system **OR** typing them in and hitting *"Add to final list"* button. Note that you can also type in generic user names followed by a wildcard (*).

Filtered Jobs collection type permits multiple current user filters.

System Wide collection type permits a single current user filter.

When you are finished with **Current User** option, press **[Next].**

The **IP Address** option is especially useful for collecting on a specific Web server IP address. Filtered Jobs collection type also permits for IP address range filtering.



Specify internet address in dotted decimal notation. Remote systems running SQL on the System i with a matching IP address will be collected on. If none are specified, all jobs will be collected on. You can add additional filter criteria on other tabs.

[✓ IP Address selections] IP Address range

*NONE, IP address or select from list of connected IPs

*NONE

IP Addresses
☐ 127.0.0.1
☑ 192.168.1.110
☐ 192.168.2.155
☐ 192.168.2.159
☐ 192.168.2.164
☐ 192.168.2.187
☐ 192.168.2.193
☐ 192.168.2.209
☐ 192.168.2.217
☐ 192.168.2.219
☐ 192.168.2.237

Final list to monitor

To remove an entry, select it and hit Delete button on the keyboard

192.168.1.110

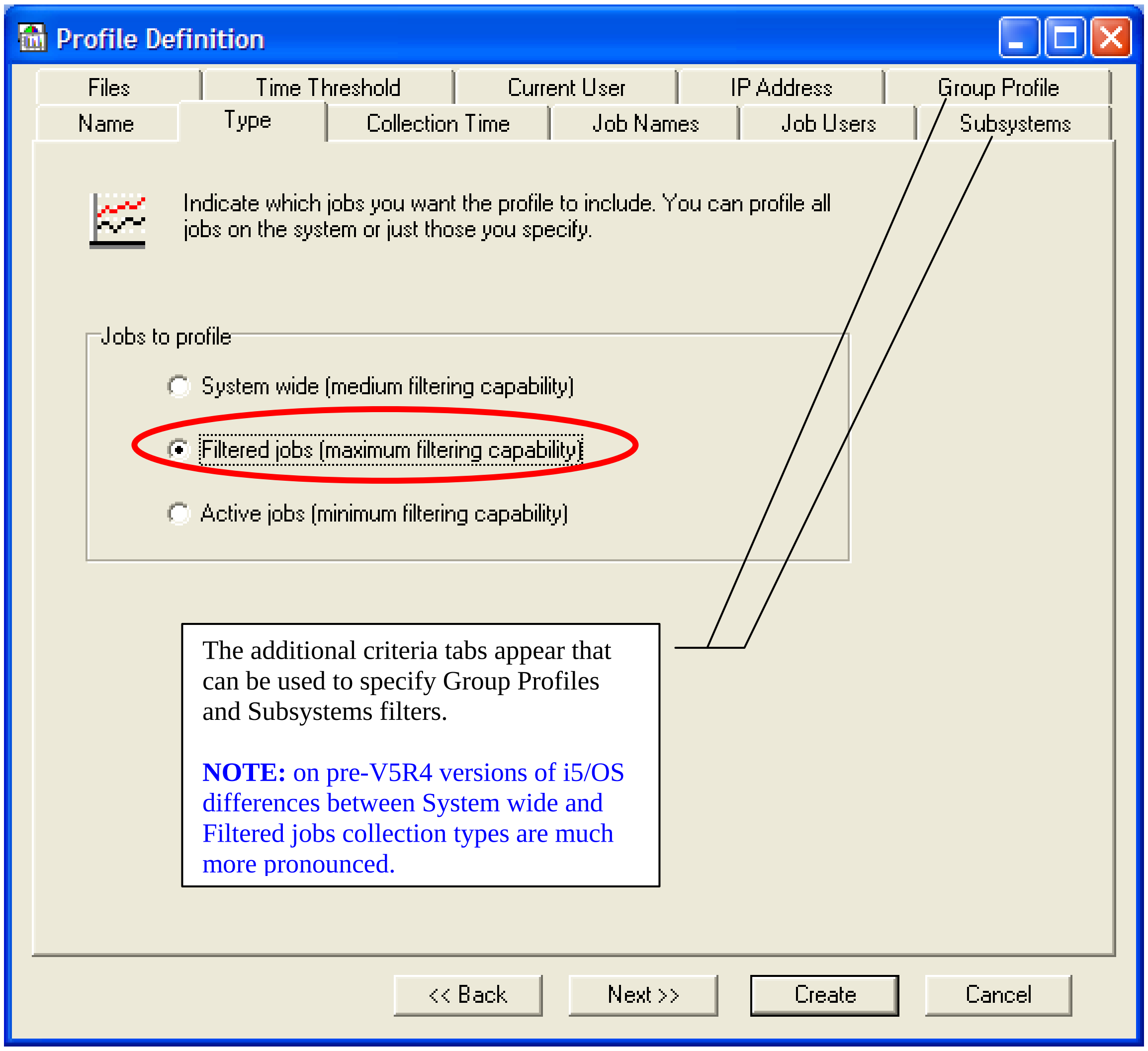
Add **IP Address** filters by clicking on the list of IPs from your system **OR** typing them in and hitting *"Add to final list"* button.

Filtered Jobs collection type permits multiple as well as a range of IP addresses.

System Wide collection type permits a single IP filter.

When you are finished with **IP Address** option, press **[Next].**

If you choose to ***Filtered jobs*** collection type, you will see additional tabs appear.



Indicate which jobs you want the profile to include. You can profile all jobs on the system or just those you specify.

Jobs to profile

System wide (medium filtering capability) [✓ Filtered jobs (maximum filtering capability)] Active jobs (minimum filtering capability)

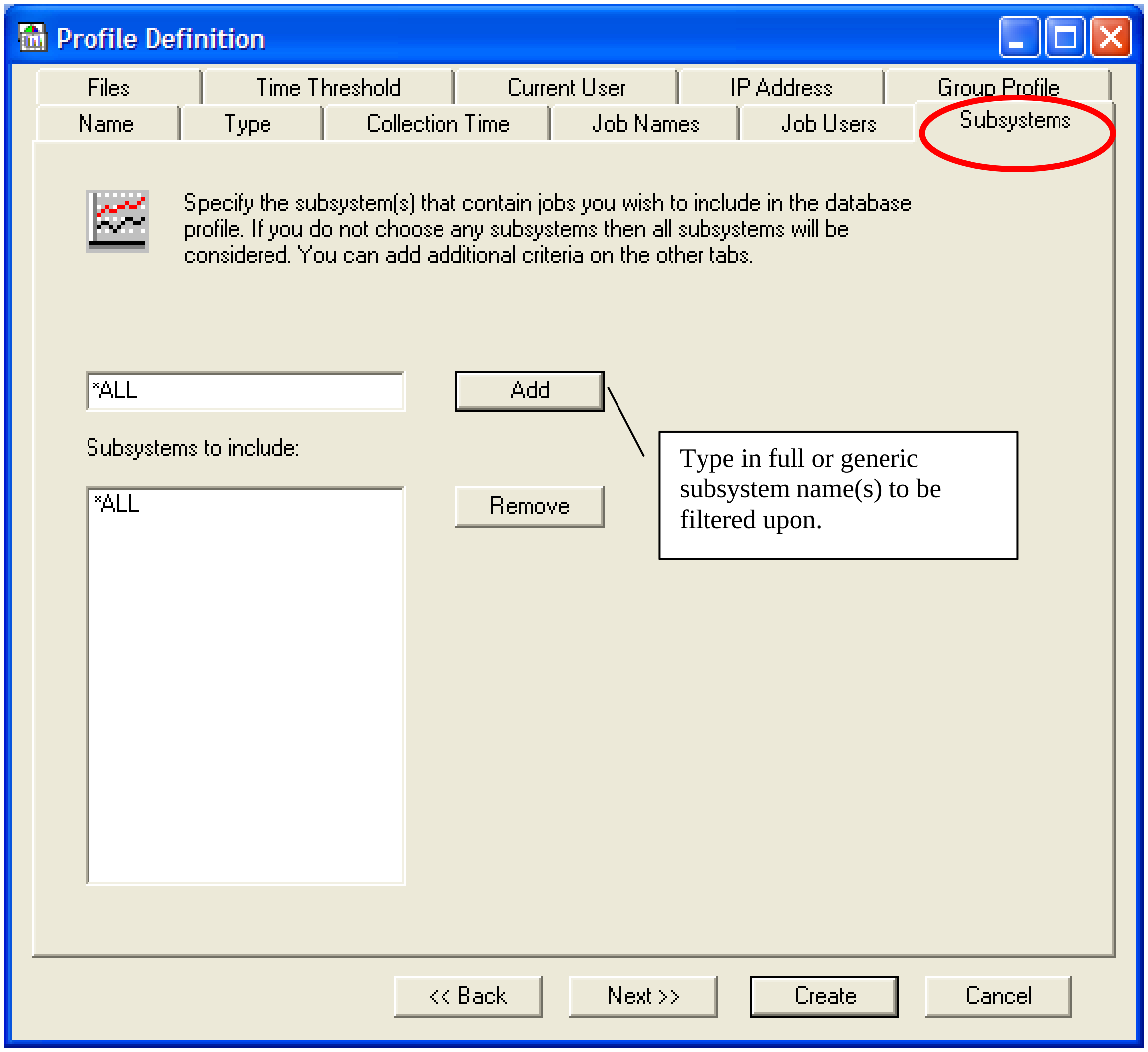
The additional criteria tabs appear that can be used to specify Group Profiles and Subsystems filters.

NOTE: on pre-V5R4 versions of i5/OS differences between System wide and Filtered jobs collection types are much more pronounced.

If you choose to ***Filtered jobs*** collection type, you should be aware of this prerequisite:

- The first time you choose this option after installing the HomeRun server, any subsystem that might contain a job that would be monitored must be restarted before the monitoring will take effect. (This is because HomeRun registers a program with the subsystem, and the registration is only recognized at subsystem startup time.)

The ***Subsystems*** tab allows you to identify jobs that run under a certain subsystem. This and other filters are ANDed together so subsystem may help in situations where you may want to collect for a particular job only when running in a certain subsystem.


Profile Definition

Specify the subsystem(s) that contain jobs you wish to include in the database profile. If you do not choose any subsystems then all subsystems will be considered. You can add additional criteria on the other tabs.

*ALL

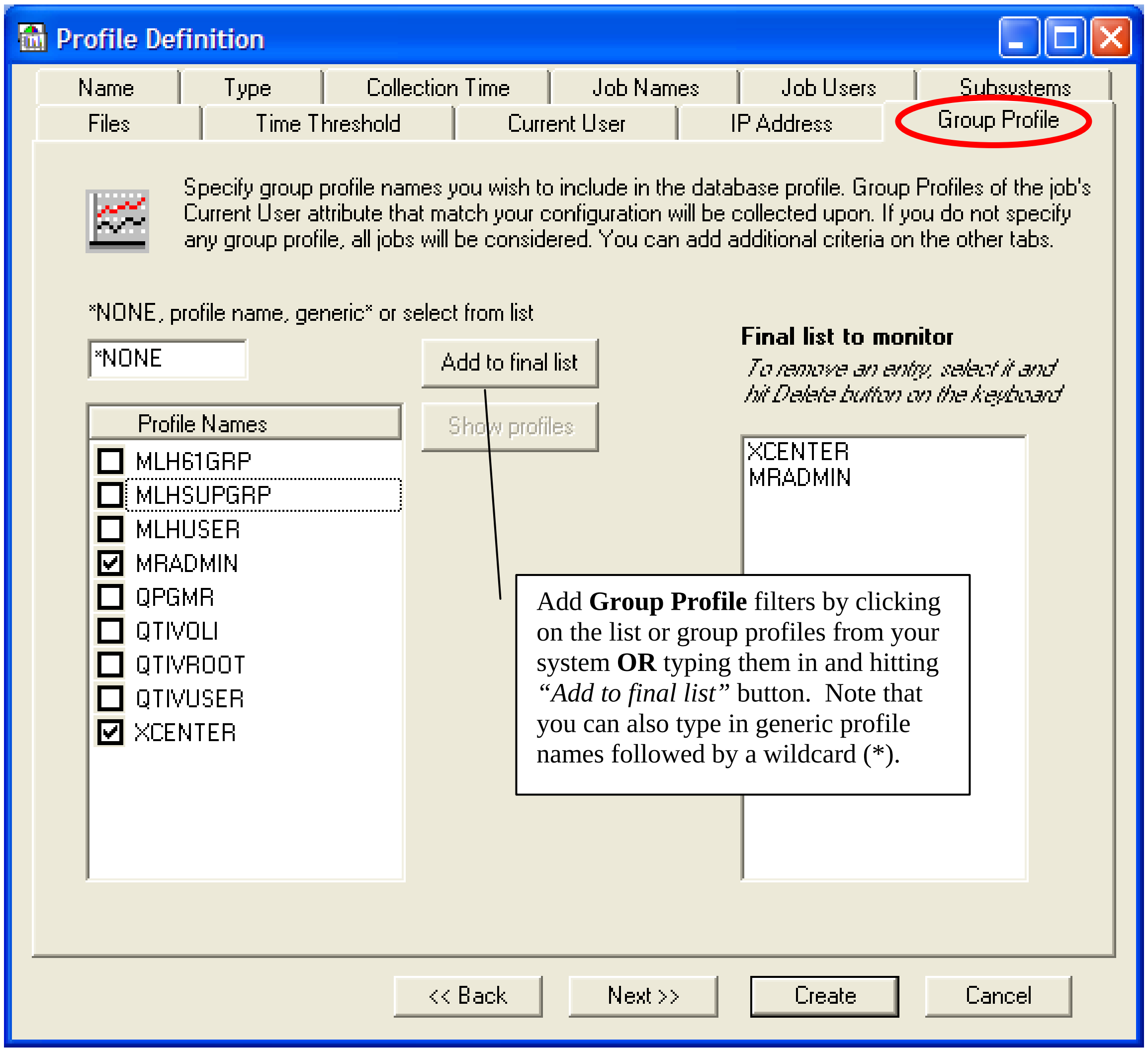
Subsystems to include:

*ALL

Type in full or generic subsystem name(s) to be filtered upon.

When you are finished with **Subsystems** option, press **[Next].**

The ***Group Profile*** tab allows you to identify jobs whose current user's group profile matches your configuration. This filter is especially useful in organizations whose workload is divided by the group they belong to (i.e. HR or DEVELOPERS)



Specify group profile names you wish to include in the database profile. Group Profiles of the job's Current User attribute that match your configuration will be collected upon. If you do not specify any group profile, all jobs will be considered. You can add additional criteria on the other tabs.

NONE, profile name, generic or select from list

*NONE

Profile Names

- [ ] MLH61GRP
- [ ] MLHSUPGRP
- [ ] MLHUSER
- [x] MRADMIN
- [ ] QPGMR
- [ ] QTIVOLI
- [ ] QTIVROOT
- [ ] QTIVUSER
- [x] XCENTER

Final list to monitor

To remove an entry, select it and hit Delete button on the keyboard

XCENTER
MRADMIN

Add **Group Profile** filters by clicking on the list or group profiles from your system **OR** typing them in and hitting *"Add to final list"* button. Note that you can also type in generic profile names followed by a wildcard (*).

Once you have all of the information for the database profile properly filled in on all the tabs, press **[Create].**

Now, you need to wait until the SQL or query activity that you want to analyze is complete. Once the activity you are capturing is complete, end the collection (if you are manually controlling the process). When the last active database profile ends, all data that is buffered or ready for loading is prepared for analysis. The process of preparing data for analysis involves cleaning the data and transforming it into a form that is more suitable for reporting. This process can take several minutes.

3.4.3 Controlling the Usage Tracker’s use of resources

Collecting database performance data can be both CPU- and memory-intensive, and can quickly consume lots of disk storage. The process of collecting the data can slow down jobs which are running SQL, and the data collected can get very large. Because of these resource demands at collection time, you must weigh your tuning and analysis needs against the affect the collection activity will have on the system.

To get the most complete picture of SQL activity on your system, you would want to collect profile information for all jobs. Yet, that could well slow down jobs running SQL which does not need to be tuned. It might also unnecessarily consume disk space with information about jobs you do not need to tune.

By choosing to collect profile information on only some subset of jobs, you can significantly reduce the amount of information that you collect requiring less system resources to store and analyze the information. You also affect the performance of only the SQL activity that you are monitoring and not all SQL activity on the system.

You must balance these considerations when deciding how much information to collect.

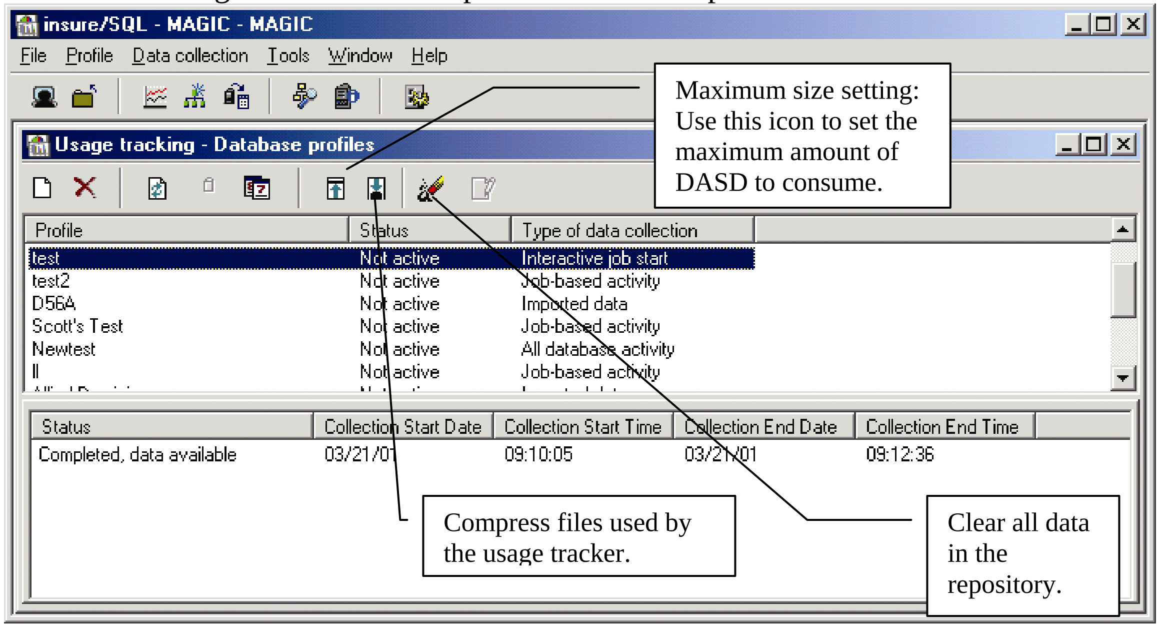
3.4.3.1 Controlling disk space usage

While the most effective way to control space utilization is by profiling a subset of jobs, HomeRun also contains a global setting to control how much space can be consumed by the current set of active collections. If the amount of disk space exceeds this limit, all of the active profiles will automatically be stopped to avoid consuming additional DASD. The maximum can be adjusted based on the amount of space you can allocate to active collections.

If necessary, you can also recover disk space by reorganizing the files used to collect and hold performance information. During normal use, this space is recovered automatically when profiles are deleted. If it is necessary to recover the disk space quickly however, you can use the compress icon on the main profile dialog to recover the space immediately.

Additionally, you can clear all of the data in the repository. This is a much faster method of recovering disk space and ‘starting over’ than deleting each profile or collection individually. This can be done from the usage tracker toolbar or via the CLRREP command in the *{PROGRAM LIBRARY}* library. If you choose to clear the data repository, all profiles that are not scheduled will also be removed since the data associated with them has been deleted.

See the following window for an explanation of each option:


insure/SQL - MAGIC - MAGIC
File Profile Data collection Tools Window Help
Usage tracking - Database profiles
Maximum size setting: Use this icon to set the maximum amount of DASD to consume.
Compress files used by the usage tracker.
Clear all data in the repository.

Profile	Status	Type of data collection
test	Not active	Interactive job start
test2	Not active	Job-based activity
D56A	Not active	Imported data
Scott's Test	Not active	Job-based activity
Newtest	Not active	All database activity
ll	Not active	Job-based activity

Status	Collection Start Date	Collection Start Time	Collection End Date	Collection End Time
Completed, data available	03/21/01	09:10:05	03/21/01	09:12:36

3.4.4 Importing SQL activity information

insure/INDEX and insure/ANALYSIS also allow you to work with database performance information that has been collected without the Usage Tracker.

Imported data must have been collected with the IBM System i™ database monitor, using the command STRDBMON. Data can be imported into the HomeRun toolset either from the same IBM System i™ system that has HomeRun installed, or from a remote IBM System i™. However, if you import from a remote system, you will need an additional license for HomeRun.

To import database monitor data into HomeRun:

1. Contact Centerfield Technology to ensure you have the proper license, if you will be importing data from a remote system.
2. Collect the data using the STRDBMON and ENDDBMON commands. Note the file name and library the database monitor data is stored in.
3. If data is collected on a remote system, move it to the system which has the HomeRun license.
4. Use the IMPPRFDTA command in the HomeRun library to import the data into HomeRun. At this time, you will be able to give this collection profile a name.
5. When IMPPRFDTA has completed, your collection profile will be visible under the new name you gave it when you use insure/INDEX or insure/ANALYSIS.

Note the following restrictions regarding imported collection profiles:

- If the data has been modified or trimmed down after collection, the trimming should be done using date and time as the criteria

- Real user profile resolution cannot be performed.
- If the source data came from a different system, file long name resolution cannot be performed

3.5 Using the insure/ANALYSIS interface

After you have successfully captured activity information and it has been prepared for analysis, you are ready to begin working with your database activity.

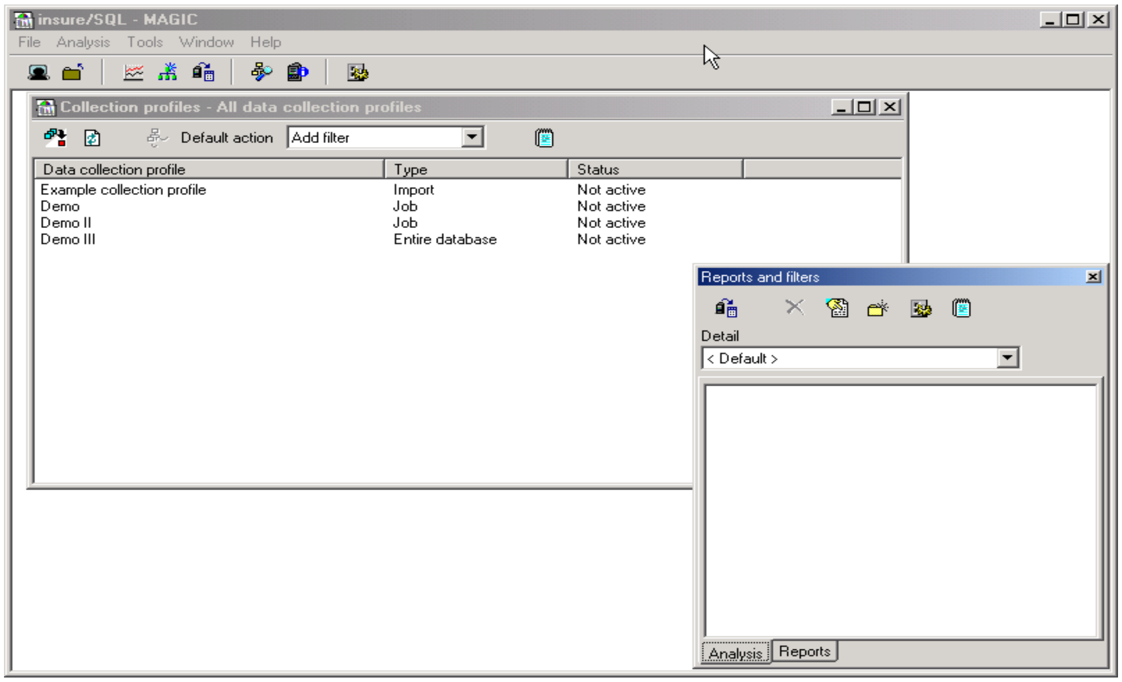
The insure/ANALYSIS interface uses two windows to separate your analysis requests and the information that is presented to you.

1. The *Reports and filters* window allows you to control your options and the type of analysis that you want to do.
2. The analysis detail window shows the output data you have requested for analysis, and lets you choose all or a portion of that data as a filter for your next request. This output window is initially populated with your list of database collection profiles, and will be labeled *Collection profiles – All data collection profiles*.

3.5.1 Example analysis

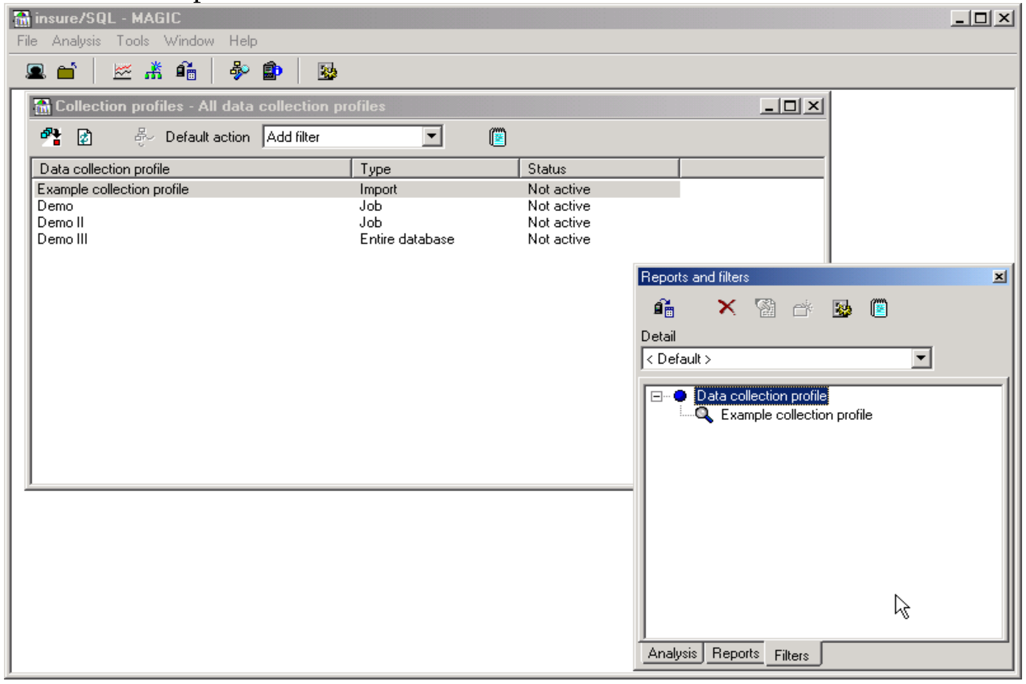
A simple example of an analysis session is given here to show the basic process of filtering and running reports. Detailed descriptions of the options available during analysis are in the sections following this one.

This screen shows the beginning of an analysis session after 4 collection profiles have been collected.



Data collection profile	Type	Status
Example collection profile	Import	Not active
Demo	Job	Not active
Demo II	Job	Not active
Demo III	Entire database	Not active

Suppose the data that you are interested in analyzing is in the collection profile named *Example collection profile*. To have this analysis apply only to the *Example collection profile*, highlight it and then click the Add as filter button on the toolbar. You will then see that collection profile name appear on the Filters tab of the Reports and Filters window, as shown here. This means that any reports you run will show data only from this collection profile.


insure/SQL - MAGIC
File Analysis Tools Window Help
Collection profiles - All data collection profiles
Default action
Reports and filters
Analysis
Reports
Filters

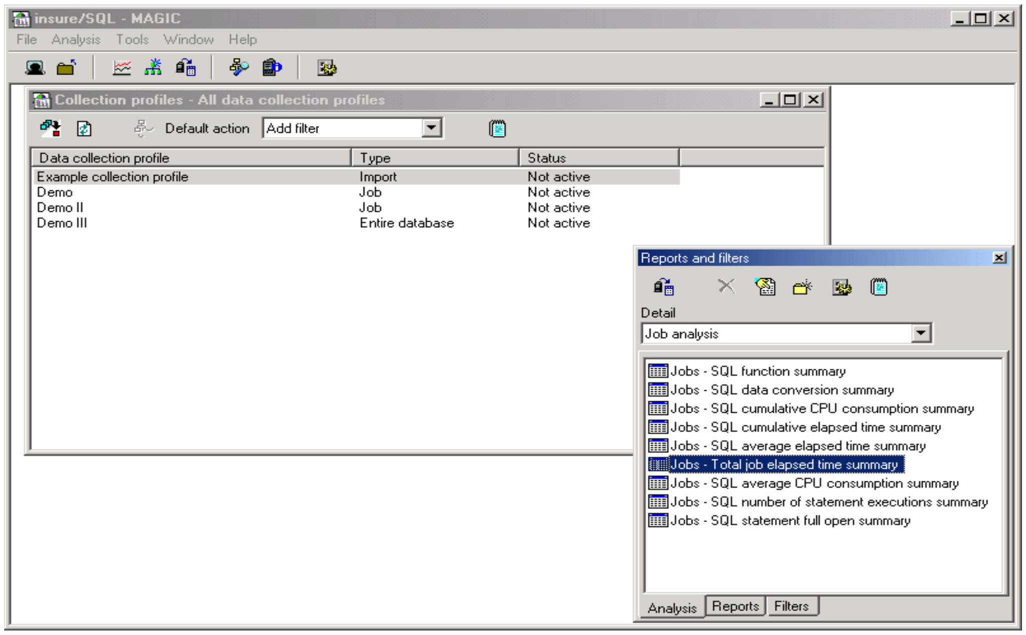
Default action: Add filter

Data collection profile	Type	Status
Example collection profile	Import	Not active
Demo	Job	Not active
Demo II	Job	Not active
Demo III	Entire database	Not active

Detail: < Default >

Data collection profile
Example collection profile

Now that you have selected your first filter, by a collection profile, you are ready to run some analysis. It is common to start an analysis session by looking at job statistics. In the Reports and Filters window, click on the Analysis tab. Then from the dropdown box labeled *Detail*, choose Job analysis. You will see a list of available reports for job statistics.

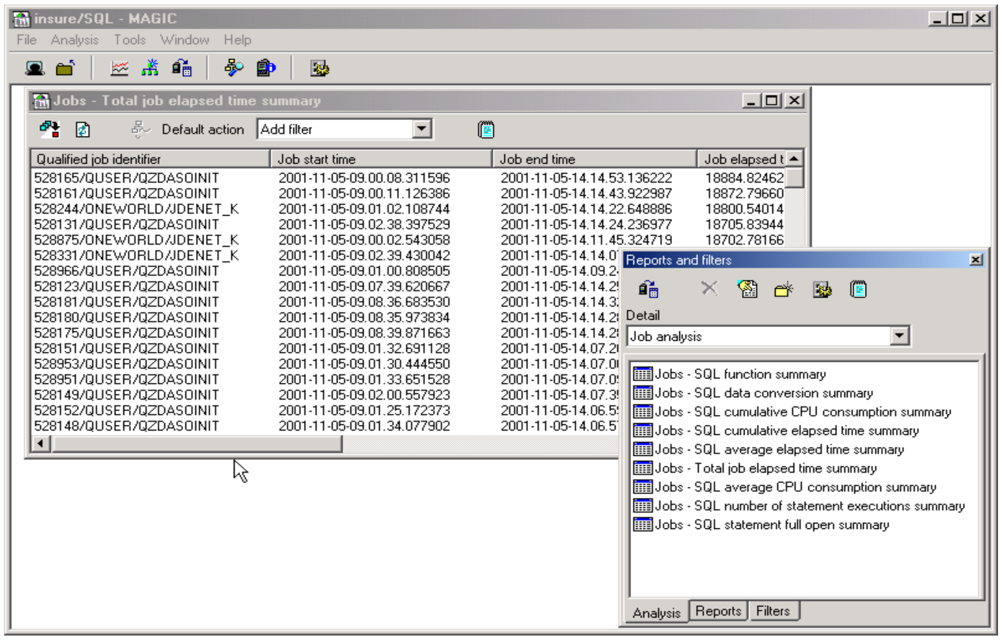


Data collection profile	Type	Status
Example collection profile	Import	Not active
Demo	Job	Not active
Demo II	Job	Not active
Demo III	Entire database	Not active

Detail: Job analysis

- Jobs - SQL function summary
- Jobs - SQL data conversion summary
- Jobs - SQL cumulative CPU consumption summary
- Jobs - SQL cumulative elapsed time summary
- Jobs - SQL average elapsed time summary
- Jobs - Total job elapsed time summary
- Jobs - SQL average CPU consumption summary
- Jobs - SQL number of statement executions summary
- Jobs - SQL statement full open summary

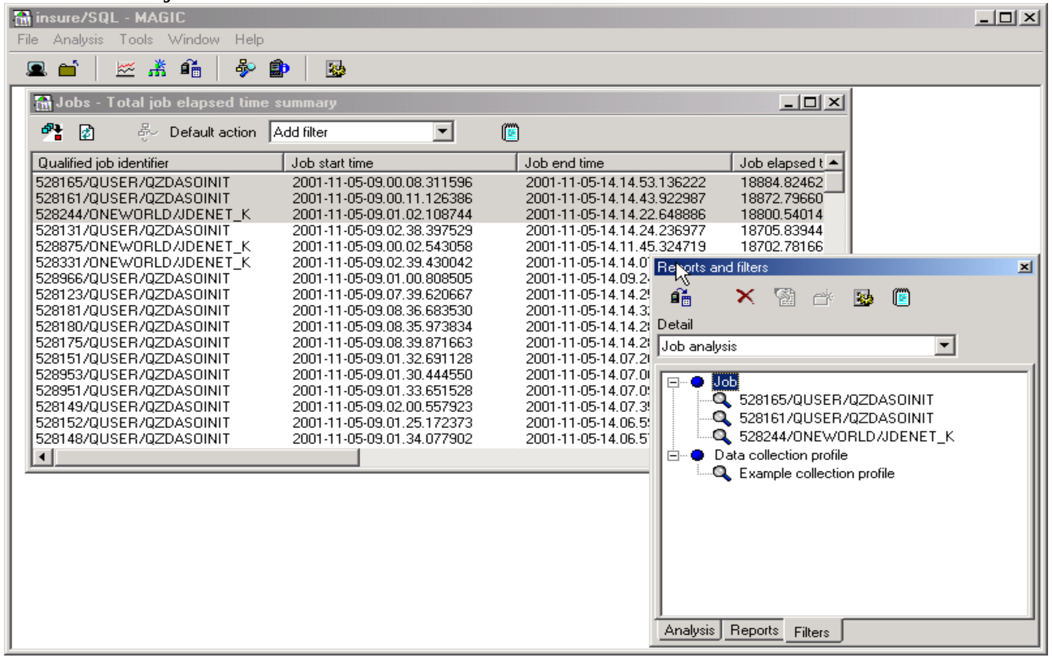
Highlight the analysis you want to run, and click the Run button on the toolbar of the Reports and filters window. In the example, *Jobs – Total job elapsed time summary* was chosen. You will see output in the analysis detail window similar to the following. Note the change in the title of the analysis detail window to reflect the analysis you ran.



Qualified job identifier	Job start time	Job end time	Job elapsed t
528165/QUSER/QZDASOINIT	2001-11-05-09.00.08.311596	2001-11-05-14.14.53.136222	18884.82462
528161/QUSER/QZDASOINIT	2001-11-05-09.00.11.126386	2001-11-05-14.14.43.922987	18872.79660
528244/ONEWORLD/JDENET_K	2001-11-05-09.01.02.108744	2001-11-05-14.14.22.648886	18800.54014
528131/QUSER/QZDASOINIT	2001-11-05-09.02.38.397529	2001-11-05-14.14.24.236977	18705.83944
528875/ONEWORLD/JDENET_K	2001-11-05-09.00.02.543058	2001-11-05-14.11.45.324719	18702.78166
528331/ONEWORLD/JDENET_K	2001-11-05-09.02.39.430042	2001-11-05-14.14.0	
528966/QUSER/QZDASOINIT	2001-11-05-09.01.00.808505	2001-11-05-14.09.2	
528123/QUSER/QZDASOINIT	2001-11-05-09.07.39.620667	2001-11-05-14.14.2	
528181/QUSER/QZDASOINIT	2001-11-05-09.08.36.683530	2001-11-05-14.14.3	
528180/QUSER/QZDASOINIT	2001-11-05-09.08.35.973834	2001-11-05-14.14.2	
528175/QUSER/QZDASOINIT	2001-11-05-09.08.39.871663	2001-11-05-14.14.2	
528151/QUSER/QZDASOINIT	2001-11-05-09.01.32.691128	2001-11-05-14.07.2	
528953/QUSER/QZDASOINIT	2001-11-05-09.01.30.444550	2001-11-05-14.07.0	
528951/QUSER/QZDASOINIT	2001-11-05-09.01.33.651528	2001-11-05-14.07.0	
528149/QUSER/QZDASOINIT	2001-11-05-09.02.00.557923	2001-11-05-14.07.3	
528152/QUSER/QZDASOINIT	2001-11-05-09.01.25.172373	2001-11-05-14.06.5	
528148/QUSER/QZDASOINIT	2001-11-05-09.01.34.077902	2001-11-05-14.06.5	

- Jobs - SQL function summary
- Jobs - SQL data conversion summary
- Jobs - SQL cumulative CPU consumption summary
- Jobs - SQL cumulative elapsed time summary
- Jobs - SQL average elapsed time summary
- Jobs - Total job elapsed time summary
- Jobs - SQL average CPU consumption summary
- Jobs - SQL number of statement executions summary
- Jobs - SQL statement full open summary

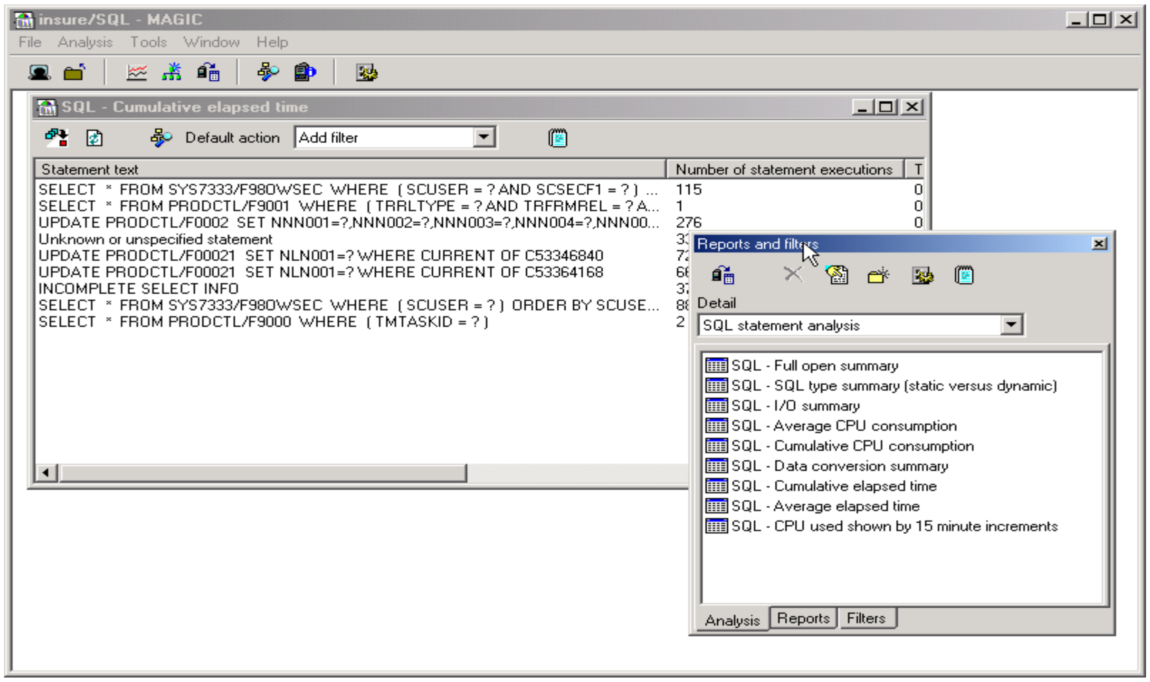
Now suppose you are interested in further analysis on some of these jobs. You can highlight one or more jobs, add them as filters, and run further analysis. This screen shows three jobs added as filters:



Qualified job identifier	Job start time	Job end time	Job elapsed t
528165/QUSER/QZDASOINIT	2001-11-05-09.00.08.311596	2001-11-05-14.14.53.136222	18884.82462
528161/QUSER/QZDASOINIT	2001-11-05-09.00.11.126386	2001-11-05-14.14.43.922987	18872.79660
528244/ONEWORLD/JDENET_K	2001-11-05-09.01.02.108744	2001-11-05-14.14.22.648886	18800.54014
528131/QUSER/QZDASOINIT	2001-11-05-09.02.38.397529	2001-11-05-14.14.24.236977	18705.83944
528875/ONEWORLD/JDENET_K	2001-11-05-09.00.02.543058	2001-11-05-14.11.45.324719	18702.78166
528331/ONEWORLD/JDENET_K	2001-11-05-09.02.39.430042	2001-11-05-14.14.0	
528966/QUSER/QZDASOINIT	2001-11-05-09.01.00.808505	2001-11-05-14.09.2	
528123/QUSER/QZDASOINIT	2001-11-05-09.07.39.620667	2001-11-05-14.14.2	
528181/QUSER/QZDASOINIT	2001-11-05-09.08.36.683530	2001-11-05-14.14.3	
528180/QUSER/QZDASOINIT	2001-11-05-09.08.35.973834	2001-11-05-14.14.2	
528175/QUSER/QZDASOINIT	2001-11-05-09.08.39.871663	2001-11-05-14.14.2	
528151/QUSER/QZDASOINIT	2001-11-05-09.01.32.691128	2001-11-05-14.07.2	
528953/QUSER/QZDASOINIT	2001-11-05-09.01.30.444550	2001-11-05-14.07.0	
528951/QUSER/QZDASOINIT	2001-11-05-09.01.33.651528	2001-11-05-14.07.0	
528149/QUSER/QZDASOINIT	2001-11-05-09.02.00.557923	2001-11-05-14.07.3	
528152/QUSER/QZDASOINIT	2001-11-05-09.01.25.172373	2001-11-05-14.06.5	
528148/QUSER/QZDASOINIT	2001-11-05-09.01.34.077902	2001-11-05-14.06.5	

- Job
  - 528165/QUSER/QZDASOINIT
  - 528161/QUSER/QZDASOINIT
  - 528244/ONEWORLD/JDENET_K
- Data collection profile
  - Example collection profile

Any subsequent report you run will show only the data from those three jobs, rather than from all jobs in your collection period. In the example shown, the *SQL – Cumulative elapsed time* analysis is run from the SQL statement analysis category. The SQL statements shown in the analysis detail window are only those run by the three jobs chosen as filters.



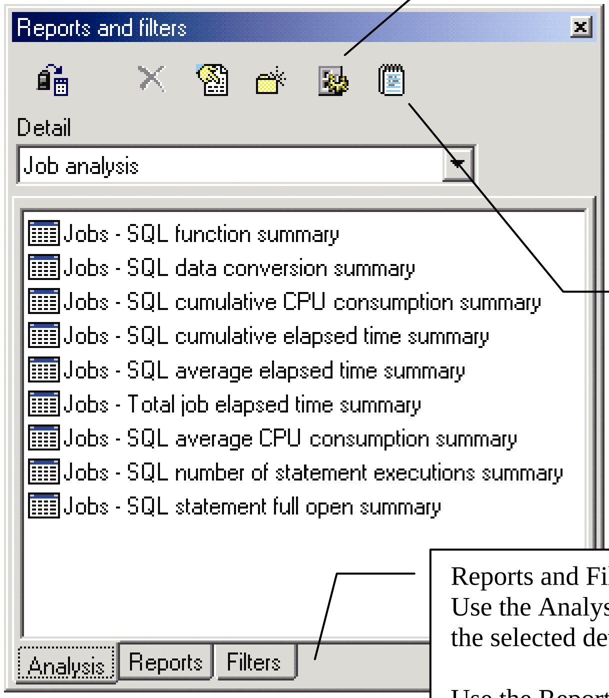
Statement text	Number of statement executions	T
SELECT * FROM SYS7333/F980WSEC WHERE (SCUSER = ? AND SCSECF1 = ?) ...	115	0
SELECT * FROM PRODCTL/F9001 WHERE (TRRLTYPE = ? AND TRFRMREL = ? A...	1	0
UPDATE PRODCTL/F0002 SET NNN001=?,NNN002=?,NNN003=?,NNN004=?,NNN00...	276	0
Unknown or unspecified statement	33	
UPDATE PRODCTL/F00021 SET NLN001=? WHERE CURRENT OF C53346840	72	
UPDATE PRODCTL/F00021 SET NLN001=? WHERE CURRENT OF C53364168	66	
INCOMPLETE SELECT INFO	37	
SELECT * FROM SYS7333/F980WSEC WHERE (SCUSER = ?) ORDER BY SCUSE...	88	
SELECT * FROM PRODCTL/F9000 WHERE (TMTASKID = ?)	2	

- SQL - Full open summary
- SQL - SQL type summary (static versus dynamic)
- SQL - I/O summary
- SQL - Average CPU consumption
- SQL - Cumulative CPU consumption
- SQL - Data conversion summary
- SQL - Cumulative elapsed time
- SQL - Average elapsed time
- SQL - CPU used shown by 15 minute increments

Now that you have worked through an example of an analysis session, see the following sections for details on the options available to you during analysis.

3.5.2 insure/ANALYSIS common options

Some of the buttons and features of the *Reports and filters* window are available regardless of which tab is selected. The following window shows some of the options and their descriptions.



Jobs - SQL function summary
Jobs - SQL data conversion summary
Jobs - SQL cumulative CPU consumption summary
Jobs - SQL cumulative elapsed time summary
Jobs - SQL average elapsed time summary
Jobs - Total job elapsed time summary
Jobs - SQL average CPU consumption summary
Jobs - SQL number of statement executions summary
Jobs - SQL statement full open summary

Toolbar – Preferences

The Preferences button allows you to customize your analysis environment to better suit your personal style. You can choose whether you want to receive confirmation messages as you add and remove filter conditions. You can also specify the default number of rows to be returned in the Analysis Options window.

Toolbar – Hide the Reports and Filters window

The Reports and Filters window, by default, remains on top of all other windows while the feature is active. This button allows you to hide the window while you are doing analysis or using a different feature.

Reports and Filters tabs
Use the Analysis tab to view the list of items that you can analyze within the selected detail type.

Use the Reports tab to generate printed reports based on the same data presented in the Analysis window.

Use the Filter tab to see any sub-setting criteria that you have specified. As you add filters, all future analysis that you do after adding the filter will be scoped to only information matching the new filtered criteria.

3.5.3 Reports and Filters - Analysis tab

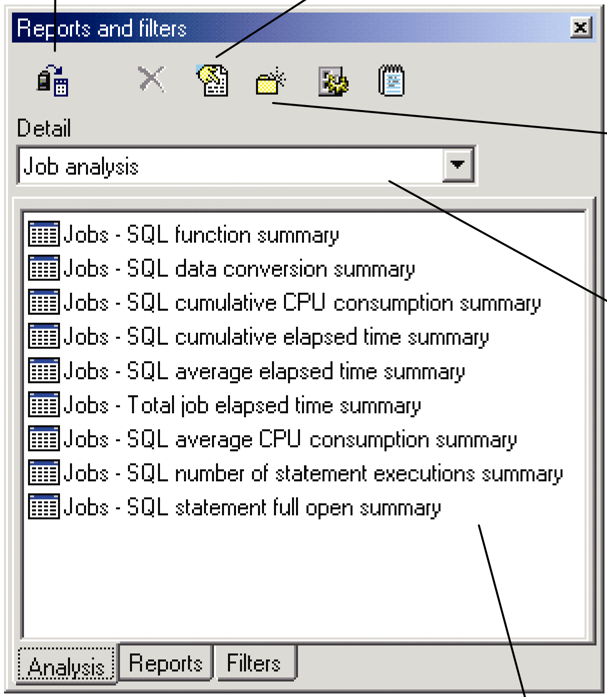
The Analysis tab shows you the individual types of analysis that you can perform.

Toolbar - Run

The Run button runs the highlighted report and displays the results in the Analysis Detail window.

Toolbar – Properties

The Properties button allows you to view or modify an analysis item definition. The features that are provided by the Properties button should only be used by experienced users who understand the underlying data.



Jobs - SQL function summary
Jobs - SQL data conversion summary
Jobs - SQL cumulative CPU consumption summary
Jobs - SQL cumulative elapsed time summary
Jobs - SQL average elapsed time summary
Jobs - Total job elapsed time summary
Jobs - SQL average CPU consumption summary
Jobs - SQL number of statement executions summary
Jobs - SQL statement full open summary

Toolbar – New

The New button allows you to add new analysis items to the list.

Detail dropdown

The Detail dropdown selects the type of detail that you want to analyze. The most common types of analysis are predefined. They include job, user, program/package, file, index, statement, and individual execution analysis.

Analysis/Reports tab

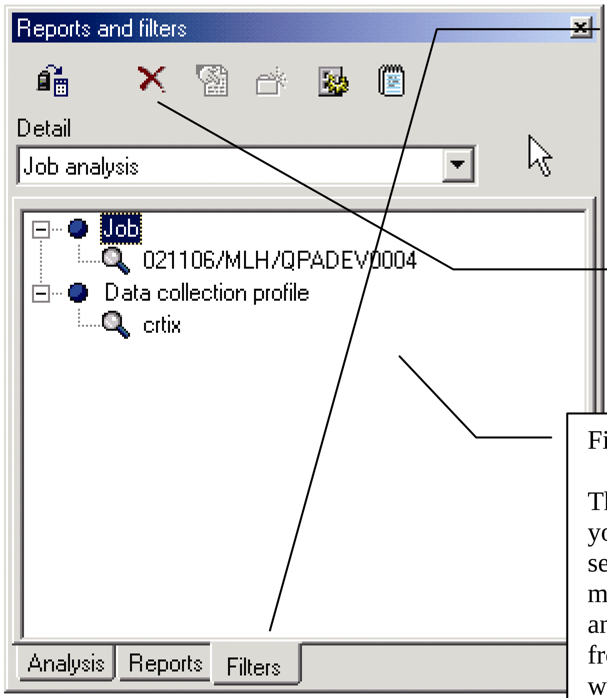
Use the Analysis tab to view the list of items that you can analyze within the selected detail type.

Analysis reports

The analysis reports show you important details about your collected data. The list of reports changes based on the Detail dropdown selection. To run a report you can double click the report item, or you can highlight the report and select the run report option from the menu or toolbar.

3.5.4 Reports and Filters - Filters tab

The *Filters* tab allows you to view and modify your filter criteria.



Filters tab

The *Filters* tab shows you the current filter criteria that you have defined for your analysis session. Options for removing selected filters become available when the filter tab is selected.

Toolbar – Delete
The *Delete* button will remove the selected filter or filters.

Filter list

The Filter list contains all of the filters currently specified for your analysis session. To remove a filter you must first select the filter and then use the *Delete* toolbar button or menu option to remove it. To add a filter, you choose your analysis criteria and then select the filter you want to add from the Analysis Detail window by double clicking the item within the Analysis Detail window.

3.5.5 Analysis detail window

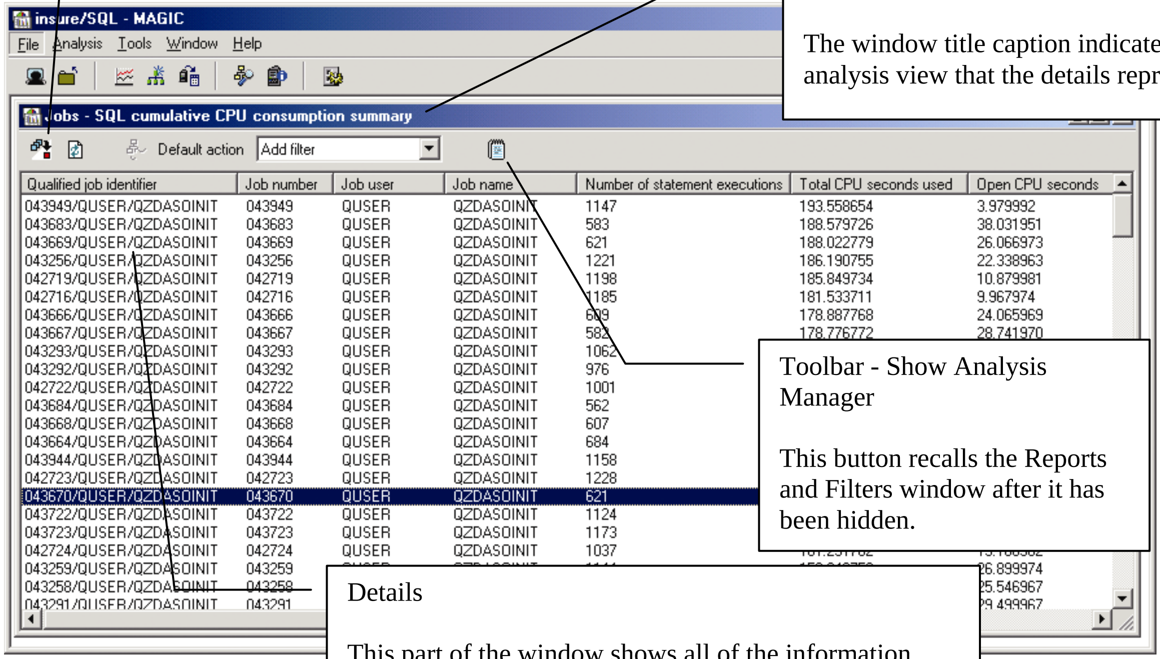
insure/ANALYSIS has a separate window where the details of your analysis request are presented after each selection. The title shown on this window will change throughout your analysis to reflect your last selection. This detail window will be referred to as the a*nalysis detail* window throughout the documentation. The most important features of the window are explained below.

Toolbar - Add filter

The *Add filter* button allows you to highlight one or more data items displayed in the analysis detail window and add them as additional filter criteria for future analysis. The *Filter* tab on the Reports and Filters window lets you view all of the filters that you currently have defined.

Window title

The window title caption indicates the analysis view that the details represent.


insure/SQL - MAGIC
File Analysis Tools Window Help
Jobs - SQL cumulative CPU consumption summary
Default action
Add filter

Qualified job identifier	Job number	Job user	Job name	Number of statement executions	Total CPU seconds used	Open CPU seconds
043949/QUSER/QZDASOINIT	043949	QUSER	QZDASOINIT	1147	193.558654	3.979992
043683/QUSER/QZDASOINIT	043683	QUSER	QZDASOINIT	583	188.579726	38.031951
043669/QUSER/QZDASOINIT	043669	QUSER	QZDASOINIT	621	188.022779	26.066973
043256/QUSER/QZDASOINIT	043256	QUSER	QZDASOINIT	1221	186.190755	22.338963
042719/QUSER/QZDASOINIT	042719	QUSER	QZDASOINIT	1198	185.849734	10.879981
042716/QUSER/QZDASOINIT	042716	QUSER	QZDASOINIT	1185	181.533711	9.967974
043666/QUSER/QZDASOINIT	043666	QUSER	QZDASOINIT	609	178.887768	24.065969
043667/QUSER/QZDASOINIT	043667	QUSER	QZDASOINIT	582	178.776772	28.741970
043293/QUSER/QZDASOINIT	043293	QUSER	QZDASOINIT	1062		
043292/QUSER/QZDASOINIT	043292	QUSER	QZDASOINIT	976		
042722/QUSER/QZDASOINIT	042722	QUSER	QZDASOINIT	1001		
043684/QUSER/QZDASOINIT	043684	QUSER	QZDASOINIT	562		
043668/QUSER/QZDASOINIT	043668	QUSER	QZDASOINIT	607		
043664/QUSER/QZDASOINIT	043664	QUSER	QZDASOINIT	684		
043944/QUSER/QZDASOINIT	043944	QUSER	QZDASOINIT	1158		
042723/QUSER/QZDASOINIT	042723	QUSER	QZDASOINIT	1228		
043670/QUSER/QZDASOINIT	043670	QUSER	QZDASOINIT	621		
043722/QUSER/QZDASOINIT	043722	QUSER	QZDASOINIT	1124		
043723/QUSER/QZDASOINIT	043723	QUSER	QZDASOINIT	1173		
042724/QUSER/QZDASOINIT	042724	QUSER	QZDASOINIT	1037		
043259/QUSER/QZDASOINIT	043259					26.899974
043258/QUSER/QZDASOINIT	043258					25.546967
043291/QUSER/QZDASOINIT	043291					29.499967

Toolbar - Show Analysis Manager

This button recalls the Reports and Filters window after it has been hidden.

Details

This part of the window shows all of the information based on the analysis view you have selected and is limited by the filters that you currently have in place.

4 Advanced Topics

4.1 Customizing the analysis detail output

The data that is provided within the analysis detail window for each analysis item has been predefined to show the most useful information, given the analysis item that it is associated with. However, you may want to look at the output information in a different format than the predefined layout provides. The *Customize* feature within the analysis detail window provides flexibility to allow you to:

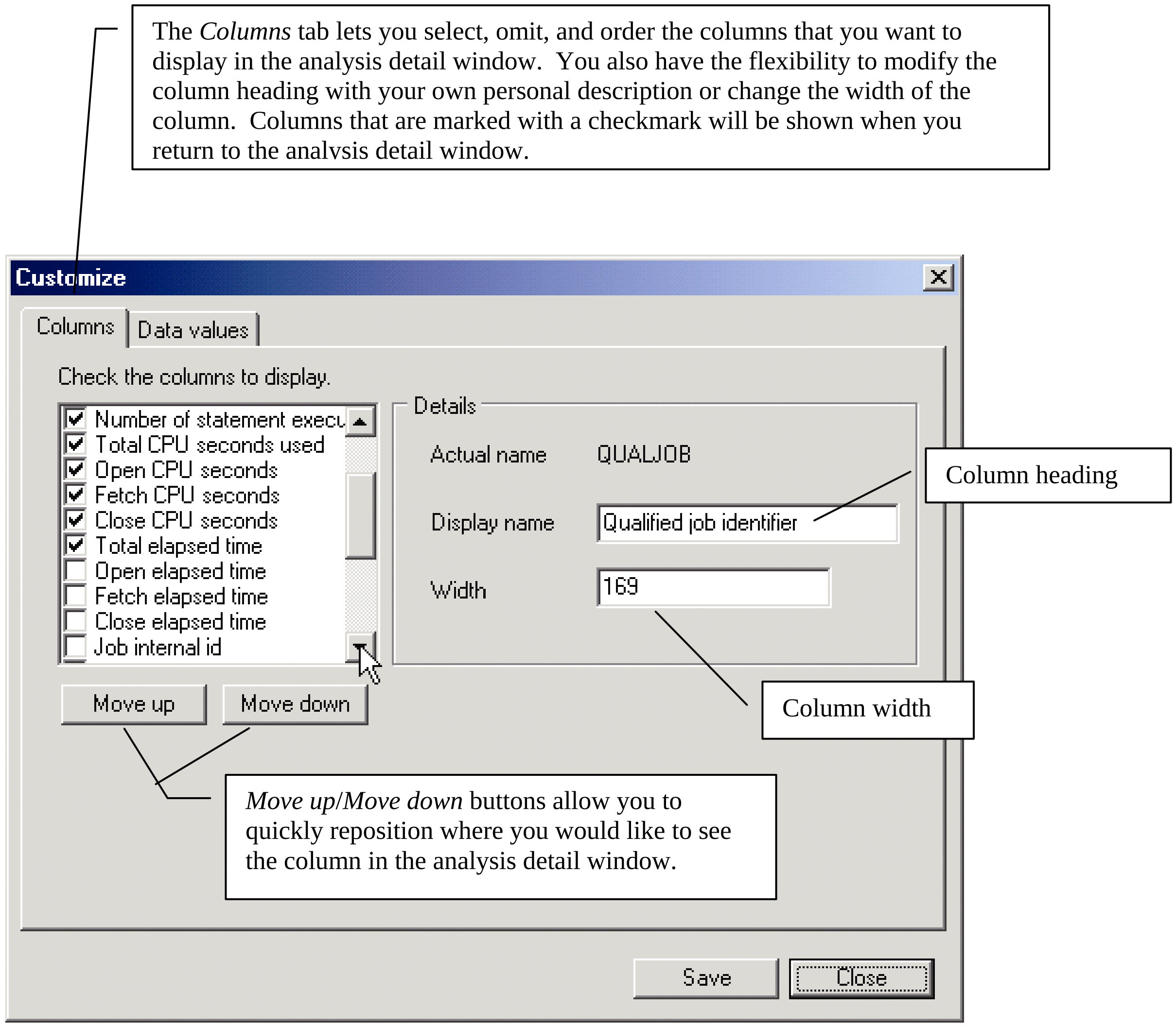
- Reorder columns
- Select additional columns
- Change column headings and sizes
- Make data value viewing substitutions

To begin customizing the output of a certain analysis item:

1. Run the analysis item that you want to customize to populate the analysis detail window
2. Within the details portion of the analysis detail window, right click the mouse and select customize

4.1.1 Using the columns tab

The Customize *Columns* tab allows you to quickly specify which fields you want to display within the analysis detail window and the description text that you would like displayed as the column heading. You can also set the column width and easily reorder the columns.



The *Columns* tab lets you select, omit, and order the columns that you want to display in the analysis detail window. You also have the flexibility to modify the column heading with your own personal description or change the width of the column. Columns that are marked with a checkmark will be shown when you return to the analysis detail window.

Customize

Check the columns to display.

- [x] Number of statement execu
- [x] Total CPU seconds used
- [x] Open CPU seconds
- [x] Fetch CPU seconds
- [x] Close CPU seconds
- [x] Total elapsed time
- [ ] Open elapsed time
- [ ] Fetch elapsed time
- [ ] Close elapsed time
- [ ] Job internal id

Details

Actual name	QUALJOB
Display name	Qualified job identifier
Width	169

Column heading

Column width

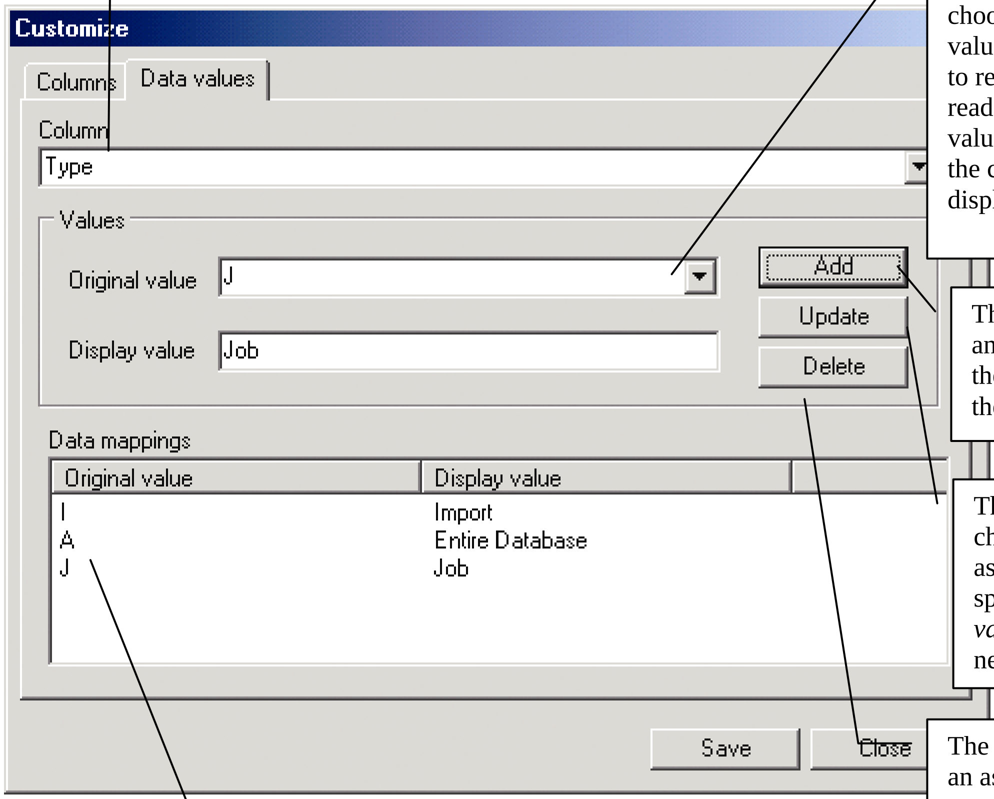
Move up/*Move down* buttons allow you to quickly reposition where you would like to see the column in the analysis detail window.

4.1.2 Using the data values tab

The Customize *Data values* tab allows you to quickly define substitution values to appear in the columns you choose.

The *Column* dropdown specifies the heading of the column which contains values that you would like to make substitutions for.

The *Original value* dropdown allows you to choose or type a data value that you would like to replace with a more readable or intuitive value. In this example, the character "I" will be displayed as "Import".



Column: Type

Values

Original value: J

Display value: Job

Data mappings

Original value	Display value
I	Import
A	Entire Database
J	Job

The *Add* button makes an association between the *Original value* and the *Display value*.

The *Update* button changes the association of the specified *Original value* to map to the new *Display value*.

The *Delete* button removes an association for the specified *Original value*.

The *Data Mappings* area shows the substitution definitions that already exist.

5 Scenarios for product use

5.1 Understanding SQL activity on your system

You normally start all analysis within insure/ANALYSIS on a per-collection-profile basis. A collection profile is created within the Usage Tracking collection facility or as part of an import request. The profile normally has one or more data collections of SQL information that are related by activity type or time. The first screen of detail in insure/ANALYSIS shows a list of collection profiles and their current status. While analysis can be performed without using a collection profile as a filter, it can make understanding the information more difficult. It is recommended that you always start by using a profile filter as your first filter.

There are two general approaches to understanding SQL activity within a profile, a "top down" or a "bottom up" approach. A top down methodology begins with doing high-level analysis of jobs, users, or programs/packages. As you identify the jobs, users, or programs/packages of interest to you, you establish more selective filters and continue by doing more detailed analysis at the statement and implementation levels. This type of analysis allows you to identify and focus on the most expensive activity on the system based on the criteria that you choose. Top down analysis is generally the fastest method for analyzing data because you begin by analyzing summarized data and selectively focus on more detailed information.

The bottom up approach begins with looking at reoccurring and system-wide expensive statements within the profile, independent of any other criteria. As you find statements of interest you establish statement level filters and analyze which jobs, users, or programs/packages ran the statements. You also analyze the implementation of the statements to determine if something can be changed to improve the statement. The bottom up analysis can be slow and resource intensive based on the amount of data associated with the profile. The nature of the bottom up analysis is to process a lot of data in an attempt to find common occurrences of inefficient operations that can be tuned to provide the most benefit system-wide.

5.2 Identifying high impact jobs

Job analysis is the most common starting point for analyzing SQL activity. It allows you to identify which SQL based jobs on the system have the largest impact on other system activity. You can also determine which jobs ran slowly that may not be a direct result of SQL problems.

For any job analysis item that you run you should follow the steps below:

1) Use the mouse to double click the collection profile that you would like to analyze. This sets a filter on the profile that you selected and limits your session's analysis to only data associated with that profile. If the list of collection profiles is not displayed when you enter insure/ANALYSIS, or if you have already performed other types of analysis, you may need to select *Collection profiles analysis* from the Reports and Filters *Detail* dropdown and re-run the *All data collection profiles* item. The *All data collection profiles* item allows you to see the list of available collection profiles and their associated status in the Analysis Detail window.
2) From the Reports and Filters *Detail* dropdown, select *Job analysis*. Use the mouse to double click the job analysis item for the type of information that you want to see.

6 Support

Centerfield Technology Inc. is committed to providing our customers with support as problems or questions arise. Support includes minor enhancement releases and upgrades which might be necessary as OS/400 and i5/OS releases become available.

6.1 Contact Information

Internet
Web support pages are maintained at www.centerfieldtechnology.com. Updated documentation, how-to's, FAQs, and a list of known problems will become available as needed.
E-mail
To contact technical support by email, send email requests to support@centerfieldtechnology.com.
Fax
To contact technical support by fax, send your request to **(888) 908-3073**.
Phone
You can call 507-287-8119 for technical support. Telephone support is available from 8:00 AM to 5:00 PM CST.

6.2 Additional Information

- Visit Centerfield Technology's HomeRun web site www.centerfieldtechnology.com to find the latest software patches for HomeRun. Follow the support link from the home page.
  PTFs listed in this document are current as of the date this document was released. There are times where IBM releases PTFs applicable to the functions our software uses after the document release date. Accordingly, we strongly recommend you visit our website periodically and verify that all listed PTFs are applied on your system.

7 Built-in Tools

7.1 Using Visual SQL Explain

Visual SQL Explain allows you to quickly understand the implementation of an SQL statement. It makes statement tuning easier by visually showing the actions that the System i query optimizer will use to implement a particular statement and by putting all of the influencing controls at your fingertips. It provides access to the standard SQL debug messages provided by the optimizer and it exposes important statistics related to the implementation path.

7.1.1 Visual SQL Explain plan constructs

The following plan constructs are used when implementing an SQL statement.

7.1.1.1 Sequential (arrival) file access methods

Table scan – Reads all records selecting the ones that match the selection criteria.

Parallel pre-fetch – Reads all of the records in parallel using 2 or more tasks.

Skip sequential processing – Uses a bitmap to selectively read the matching record, reading records in the physical order.

Parallel skip sequential processing – Uses a bitmap and 2 or more tasks to selectively read the matching records.

Encoded vector index load – Processes an EVI index while creating a bitmap.

Parallel encoded vector index load – Processes an EVI index using 2 or more tasks while creating a bitmap.

7.1.1.2 Key field (index based) access methods

Key row positioning – Use an index to selectively read records from a physical file returning the records in order.

Key row selection – Use an index to read all records from a physical file in order.

Index only positioning – Use an index to return the fields selected by the query.

Index only selection – Read the entire index to return the fields selected by the query.

7.1.1.3 Record processing methods

Group by – Process the GROUP BY clause record grouping.

Hash group by – Process the GROUP BY clause using a hashing algorithm.

Sort processing – Process the ORDER BY clause using a memory based sort algorithm.

Distinct processing – Process the DISTINCT clause, returning only unique records.

Record selection – Apply the WHERE clause selection after reading a record.

Union – Combine the results of two or more SELECT statements.

7.1.1.4 Join algorithms

Nested loop join – Join records by reading a record from the first file then finding a matching record in a second file until all matching records are processed in the first file.

Hash join – Join records by first reading all records and organizing them into subsets. Then join matching rows within each subset.

7.1.1.5 Intermediate result processing

Temporary index build – Build an index because an index is required and a suitable index does not exist.

Temporary results file – Build an intermediate file that contains the results up to this point. The rest of the query can operate against these results.

Temporary file – Build a temporary file to hold the results of a view or other complex source file.

Bitmap creation – Build a bitmap to selectively process records.

7.1.1.6 Visual SQL Explain plan constructs reference

Encoded vector index load

Processes an EVI index while creating a bitmap.

This is a good alternative if you do not have SMP capabilities on your system. To influence encoded vector index loading:

Specify the level of parallel processing that is allowed using either the QQRYDEGREE system value, HomeRun, or the CHGQRYA command.

Index only positioning

Index only positioning returns a row or set of rows ordered by a key field. Index only positioning only reads part of an index in a manner similar to a program that uses keys to find a particular record.

Unlike ***key row positioning***, it does not do random I/O to access the record in the physical file.

This makes index only positioning the fastest method for accessing an index. This method has the benefits of table scan processing and the benefits of index processing.

See ***key row positioning*** for implementation tips.

Index only selection

The entire index is read and any selection criteria that references the key columns of the index are applied using the information in the index.

Unlike ***key row selection***, it does not do random I/O to access the record in the physical file.

This makes index only selection the fastest method for accessing an index when the entire index must be processed. This method has the benefits of table scan processing and the benefits of index processing.

See ***key row selection*** for implementation tips.

Key row positioning

Key row positioning returns a row or set of rows ordered by a key field reading. Key row positioning only reads part of an index in a manner similar to program that use keys to find a particular records.

Key row positioning requires a traditional binary radix index.

It is a good alternative for the following cases.

- When a small number of rows will be returned from a file
- When the physical ordering of the records in the file are ordered using the same or a similar order as the key fields in the index.
- When the positioning can be used for join processing and either ORDER BY or GROUP BY processing.
- An existing index can be used instead of a dynamic index build over a large file.

Optimizing index access

- Index access is most efficient when it can do ***index only*** processing. Criteria for index only processing:
  - All selected fields from the file are contained in the index
  - None of the fields are null-capable

- Specify OPTIMIZE FOR n Rows. If a small number is specified for 'n', the query optimizer will tend to choose a keyed access method more often. If a large number is chosen for 'n', the optimizer will attempt to use a arrival sequence access method if possible. In general it is best to choose a value for 'n' that matches the number of rows you actually expect to be returned from the SQL statement.

- Create an encoded vector index (EVI) for each of the fields used in the WHERE clause for this file. This will allow bitmap based-processing and give the iSeries better statistics about data in the file.

- Remove or modify an ORDER BY clause.

- Change the availability of hash join processing.

- Use the command RGZPFM to organize the physical file to match this index.

Key row selection

This access method requires an index. The entire index is read and any selection criteria that references the key columns of the index is applied against the index.

The advantage of this method is that the table is only accessed to retrieve rows that satisfy the selection criteria applied against the index. Any additional selection not performed through the key selection method is performed at the table level.

The key selection access method can be very expensive if the search condition applies to a large number of rows because:

- The whole index is processed.
- For every key selected from the index, a random I/O to the table occurs.

This is better than key row positioning if every record in the index matches the selection criteria.

Normally, the optimizer will choose to use table scan processing when a search condition applies to a large number of rows. The optimizer only chooses the key selection method if less than 20% of the keys are selected or if an operation forces the use of an index. Options that might force the use of an index include:

- Ordering
- Grouping
- Joining

In these cases, the optimizer may choose to create a temporary index rather than use an existing index. When the optimizer creates a temporary index it uses a 32K page size. An index created using a CREATE INDEX statement normally uses only a 4K page size. The optimizer also processes as much of the selection as possible while building the temporary index. Nearly all temporary indexes built by the optimizer are select/omit or sparse indexes. Finally, the optimizer can use multiple parallel tasks when creating the index. The page size difference, corresponding performance improvement from swapping fewer pages, and the ability to use parallel tasks to create the index may be enough to overcome the overhead of creating an index. Table scans used for building of temporary keyed access paths.

If key selection access method is used because the query specified ordering (an index was required) the query performance might be improved by using one of the following combinations of pre-compiler parameters to allow the ordering to be done with the query sort.

ALWCPYDTA(*OPTIMIZE), ALWBLK(*ALLREAD), and COMMIT(*CHG or *CS)

ALWCPYDTA(*OPTIMIZE) and COMMIT(*NONE)

Optimizing index access

- Index access is most efficient when it can do ***index only*** processing. Criteria for index only processing

  - All selected fields from the file are contained in the index
  - None of the fields are null-capable

- Specify OPTIMIZE FOR n Rows. If a small number is specified for 'n', the query optimizer will tend to choose a keyed access method more often. If a large number is chosen for 'n', the optimizer will attempt to use a arrival sequence access method if possible. In general it is best to choose a value for 'n' that matches the number of rows you actually expect to be returned from the SQL statement.

- Create an encoded vector index (EVI) for each of the fields used in the WHERE clause for this file. This will allow bitmap based-processing and give the iSeries better statistics about data in the file.

- Remove or modify an ORDER BY clause.

- Change the availability of hash join processing.

- Use the command RGZPFM to organize the physical file to match this index.

Parallel pre-fetch

Read, using multiple I/O tasks, all of the records from the source table optimizing disk and memory utilization.

If the percentage of rows selected is greater than 20%, this method is more efficient than index processing. On the other hand, if a small percentage of data is selected and the file is large, this access method is not optimal.

Parallel pre-fetch is a good alternative for the following cases.

- A majority of the records in the file will be selected
- There is sufficient main memory with limited contention available for a larger portion of the file in memory at any given time
- The file is distributed across multiple physical disk units. If the file is distributed across multiple disk units the system can perform many physical disk I/O's at the same time which will reduce overall elapse time of the query.

See ***Table scan*** for information on how to influence parallel pre-fetch implementation.

Parallel skip sequential processing

Uses a bitmap and 2 or more tasks to process records in the order they physically reside in the file, eliminating records that will not be used in the result set as they are read. This approach is preferred to a table scan as it is more efficient.

Parallel skip sequential processing is a good alternative for the following cases.

- A majority of the records in the file will be selected
- The file contains a small number of records
- You have enough main memory available to allow all of the tasks to run efficiently

Influencing Parallel skip sequential processing

- Create an encoded vector index (EVI) for each of the fields use in the WHERE clause for this file. This will improve skip sequential processing efficiency and give the iSeries better statistics about data in the file.

- Specify the level of parallel processing allowed using either the QQRYDEGREE system value, HomeRun, or the CHGQRYA command.

- See ***Table scan*** for information more techniques.

Parallel encoded vector index load

Processes an EVI index while creating a bitmap using 2 or more tasks.

This is a good alternative if you have SMP capabilities on your system. To influence encoded vector index loading:

- Specify the level of parallel processing allowed using either the QQRYDEGREE system value, HomeRun, or the CHGQRYA command.

Skip sequential processing

Read records from a file in the order they physically reside in the file eliminating records that will not be used in the result set as they are read. This approach is preferred to a table scan as it is more efficient.

Skip sequential processing is a good alternative for the following cases.

- A majority of the records in the file will be selected
- The file contains a small number of records

Influencing skip sequential processing

- Create an encoded vector index (EVI) for each of the fields use in the WHERE clause for this file. This will improve skip sequential processing efficiency and give the iSeries better statistics about data in the file.

- See ***Table scan*** for information more techniques.

Table scan

Reads the entire file using the physical order of the records. This optimizes disk access as it minimizes random I/O.

If the percentage of rows selected is greater than 20%, this method is more efficient than index processing. On the other hand, if a small percentage of data is selected and the file is large, this access method is not optimal.

Optimizing table scan

- A table scan is most efficient if the optimizer can implement data space selection. This is the lowest level of selection the system can perform and can greatly minimize the CPU requirements to select or reject rows. The following situations allow the optimizer to use data space selection:

- the fields referenced in the WHERE clause should come directly from the table
- literal values in the WHERE clause should have the length and precision of the data in the table
- comparisons with packed decimal or other numeric types can only take advantage of data space selection if the table was created with an SQL CREATE TABLE statement
- character fields cannot be variable length

- Specify OPTIMIZE FOR n Rows. If a large number is specified for 'n', the query optimizer will tend to choose arrival sequence more often. If a small number is chosen for 'n', the optimizer will attempt to use a keyed access method if possible. In general it is best to choose a value for 'n' that matches the number of rows you actually expect to be returned from the SQL statement.

- Create an encoded vector index (EVI) for each of the fields used in the WHERE clause for this file. This will improve table scan efficiency and give the iSeries better statistics about data in the file.

- Create a traditional binary radix index for key fields used for ORDER BY, GROUP BY, or WHERE clause conditions. This will give the iSeries an index based option to access the file instead of a table scan. This should be done in cases where less than 20% of the rows in the file will be used in the result set or if these key fields are used often in several queries.

- Add or modify an ORDER BY clause.

- Specify a field from that has an index to bias the optimizer toward index based access.

- Specify a field from another file in the query to bias index access for that file and table scan for this file.

- Specify a field from several files to bias the iSeries to use a sort rather than index access for ordered access to the data.

- Allow I/O or CPU parallel processing. Table scan processing benefits from both I/O and CPU parallel processing.

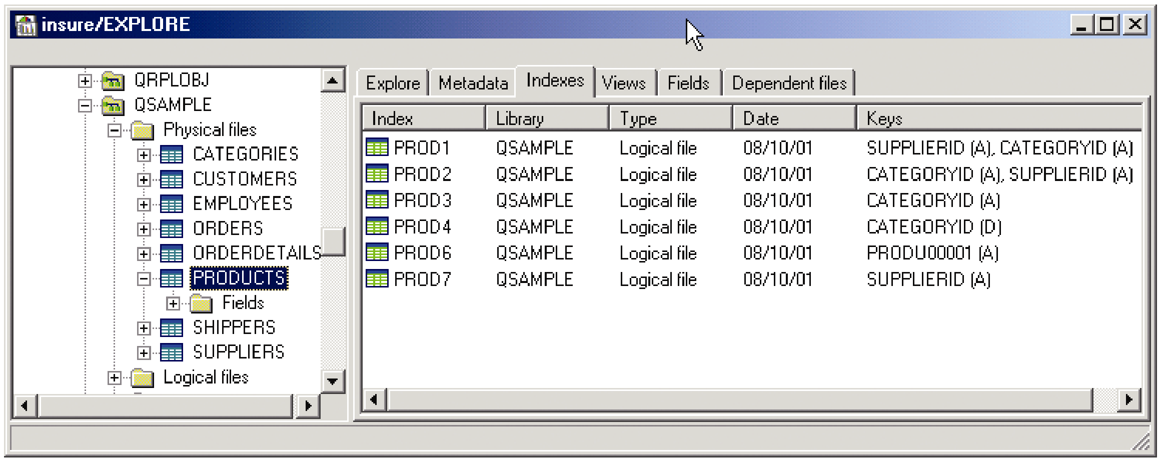
- Change the availability of hash join processing.

7.2 Using Database Explorer

Database Explorer provides access to database information so you can quickly browse for needed information:

- Browse System i libraries, files, views, indexes
- Browse metadata associated with these objects.
- View field definition information.
- View relationships between files and fields.
- Sort columns in ascending/descending order by clicking the column heading

Database Explorer gives you a familiar, hierarchical tree interface in its left pane, and displays details in the right pane. Navigating through the tree on the left gives you access to details about each item. In this example, the user has navigated to the file PRODUCTS in library QSAMPLE, allowing details to be shown about the file, such as which indexes are built over it:



Index	Library	Type	Date	Keys
PROD1	QSAMPLE	Logical file	08/10/01	SUPPLIERID (A), CATEGORYID (A)
PROD2	QSAMPLE	Logical file	08/10/01	CATEGORYID (A), SUPPLIERID (A)
PROD3	QSAMPLE	Logical file	08/10/01	CATEGORYID (A)
PROD4	QSAMPLE	Logical file	08/10/01	CATEGORYID (D)
PROD6	QSAMPLE	Logical file	08/10/01	PRODU00001 (A)
PROD7	QSAMPLE	Logical file	08/10/01	SUPPLIERID (A)

To access Database Explorer, choose the *Database Explorer* option from the *Tools* menu.

8 Appendixes

8.1 Introduction to database performance management

This section introduces database performance management for query and SQL activity and gives you a basis for the methodology and supporting software provided by the HomeRun toolset. It is intended to give you the basic information you need to optimize your database for SQL and query activity.

The HomeRun tools address database optimization and performance management above and beyond traditional system level performance management. As such, the performance information in this section complements traditional system performance tuning information. In some cases, your database usage and tuning will influence system level performance, such as the use of SMP.

This information applies to you if you have any type of SQL or query activity on your system. Some common environments are:

- Data warehouse or decision support environments
- Query/400 environments
- OPNQRYF environments
- ERP and application environments where embedded and dynamic SQL is used in System i programs
- ODBC and client/server environments or applications
- Internet environments and applications which access System i data using SQL

HomeRun:

1. Enables very straightforward process for managing performance.
2. Identify how your database is being used
3. Provide and maintain the optimal set of resources to support its usage.

8.1.1 Effective performance management

The following items are important to know in order to implement effective performance management. Read through the topics that follow and keep them in mind when designing, optimizing, or diagnosing your database and associated applications.

SQL and query activity

All SQL and query activity on the System i uses a feature of the operating system called the query optimizer. As the name suggests, it is responsible for optimizing access to your database data.

The types of activity that use the query optimizer include:

- Any application that uses SQL
- Query/400
- OPNQRYF
- Data analysis, data warehousing tools
- Client/server applications
- Internet access to System i data
- Client Access
- STRSQL, RUNSQLSTM
- DRDA
- ODBC (IBM, HiT, StarQuest, Wall Data, others)
- JDBC
- CLI

The query optimizer takes your query or SQL statement and determines the optimal way to perform that query based on the resources and information it has available.

To optimize your database and resolve performance issues you will normally do one or more of the following:

- Give the optimizer additional resources it needs (indexes, implementation options, data layout, storage, etc.)
- Eliminate unneeded resources that get in the way (indexes)
- Give the optimizer additional information
- Modify the SQL or query to a form that is more suitable for the optimizer

The System i optimizer will adapt to its environment

The query optimizer on the System i will adapt to its environment. Influencing factors are:

- hardware (main storage, # disk drives, CPU)
- system activity (configured and actual)
- amount of data in the file
- query specific conditions
- release/PTF level of the System i
- SMP and parallel processing

- Available indexes
- Each system must be tuned for its unique environment
- What's good for one system can be bad for another

This means:

- Every environment is different and should be tuned for its unique configuration and usage.

- Test and production systems differ. This means you need to manage performance in a production environment and need to make changes and manage these changes effectively. HomeRun has many built-in features to help.

- What's good for one environment may not be good for another and may actually cause problems.

- You want to tune for the activity that is occurring in the environment. You do not want to tune for all activity that could occur, only the activity that is actually occurring.

- You want to maintain the proper set of resources for your environment. Too many resources, such as indexes, can cause problems. Not enough resources, such as indexes and memory, can cause problems. You need to identify the optimal set of resources for your environment and its usage.

- As your database grows, your activity changes, or your hardware configuration changes, it is necessary to re-optimize your database for this new environment.

HomeRun makes it easy to identify, analyze, and tune for your unique activity.

8.1.2 Understanding an SQL statement's implementation

SQL and most query products let you specify what data you want, how you want it formatted, etc. However, the way the data is actually retrieved is taken care of by the query optimizer, and is hidden from the user.

In order to diagnose performance problems and fine-tune your environment, it sometimes becomes necessary to look "*under the covers*" to see what is happening.

This requires:

1. The ability to look inside the black box
2. The ability to understand what you see
3. The ability to take a corrective action

HomeRun helps you with all three of these requirements. The Visual SQL Explain tool and its associated documentation are primarily available for this purpose.

8.1.3 Managing change in a production environment

It is very important to manage any changes you make to your database in a production environment. As you add, delete, and change indexes and file attributes, you need the ability to track those changes and the ability to apply and remove those changes easily.

Some of the important reasons for tracking these changes are:

- Application modifications - Periodically you will need to install newer versions of applications and other software you use on your system. During this process, you will want to remove any indexes you have created to ensure the changes install properly.

- Operations - Your operations staff perform routine maintenance and backups. You want to make sure your changes are tracked and properly managed.

- Disaster recovery - You will want to keep a record of changes in order to recover from a disaster or system failure without starting over from scratch.

HomeRun has several features to help you manage change:

- Built-in change history management
- Integration with source control
- Security to control who can make changes to your system

8.1.4 Understanding side effects

Sometimes side effects occur. For example, say you have two SQL statements. You create an index for the first statement and it runs 20% faster. You then create an index for the second statement. It runs 30% faster, but has the side effect of slowing the first statement down by 50%.

This is a case where the second index was a good resource for the second statement but was a bad resource for the first statement.

To help avoid the problem, there are a few things that you can do.

- Tune the entire database, not individual SQL and queries, as much as possible.

- Tune only high impact individual SQL statements. Do not create every index that might ever be needed.

- Take advantage of the database and program level controls such as “allow copy data” (ALWCPYDTA) and blocking parameters to help the optimizer choose the right alternative.

- Take advantage of SQL syntax such as ‘OPTIMIZE FOR n ROWS’ to give the optimizer additional information it needs.

8.2 System-wide installation impacts

HomeRun changes some settings on your IBM System i™ system at installation time that can affect your current system configuration and activity. The HomeRun modifications that may have system-wide impacts are limited to:

- Changing system values
- Ending currently active Centerfield servers, jobs, and monitors
- Configuring network attributes
- Modifying subsystem configurations
- Adding exit points

This section also details information on HomeRun's use of the following IBM System i™ features:

- TCP/IP usage
- Job scheduler usage
- Authorities on installed libraries
- CL Commands and APIs used
- Programs which adopt authority

8.2.1 System Values

The HomeRun toolset helps you handle issues like performance, security, and usage tracking which requires special system privileges. Because the product installs software that performs privileged operations, it requires certain system values that control authority and application privileges to be set to certain values. The following table shows the list of system values and a description of the HomeRun installation requirements.

QALWUSRDMN	This system value is checked at installation to ensure that the value is either *ALL or that it contains the *{PROGRAM LIBRARY}* library as one of the libraries that allows user domain objects. HomeRun requires this setting because it stores and directly accesses user space objects in the *{PROGRAM LIBRARY}* library. If the system value is not set properly for HomeRun, the installation support modifies the setting to include the *{PROGRAM LIBRARY}* library.
QALWOBJRST	This system value is checked at installation to ensure that the value is either *ALL, or that it at least allows system state objects (*ALWSYSSTT) and objects that adopt owner authority (*ALWPGMADP) to be restored. HomeRun requires this setting because it restores objects with these attributes into the *{PROGRAM LIBRARY}* and *{DATA LIBRARY}* library. If the system value is not set properly for HomeRun, the installation will fail.

QUSEADPAUT	This system value is checked at installation time to ensure that the system does not restrict the list of user profiles that are allowed to modify programs to use adopted authority. HomeRun requires this because depending on the system program temporary fix (PTF) level, this system value can also control users that are allowed to run programs that adopt *OWNER authority. If the system value is not set properly for HomeRun, the installation will fail.

HomeRun references several other system values at run time to determine information about your system configuration. The following are other system values that are referenced at run time:

- QACGLVL
- QDATE
- QDAY
- QYEAR
- QMONTH
- QSRLNBR

8.2.2 Servers, Jobs, and Monitors

You need to ensure that the objects that will be replaced by the HomeRun installation and the resources that are being modified by the installation are not used or locked by other jobs on the system prior to starting the product installation. HomeRun creates and replaces objects in the *{PROGRAM LIBRARY}* and *{DATA LIBRARY}* libraries. You should ensure that there are no objects locked in these libraries prior to installing the software. However, even if you do not check these libraries before you start the installation, the HomeRun installation checks that some of the common jobs that can hold critical locks or cause other problems are always ended before letting the installation continue.

8.2.3 Database Monitor and HomeRun

Several features within HomeRun build on top of the IBM System i™ database monitor support (STRDBMON command). The HomeRun installation ends the database monitor if it is actively collecting system-wide activity. It ends the monitor to help ensure that there are no locks on files within the *{DATA LIBRARY}* library.

8.2.4 Subsystems and Work Management

The HomeRun server software handles:

- Managing and processing incoming requests from the administrative console software
- Enforcing user access policies configured by the administrative console software
- Scheduling of any activity requested by the administrative console
- Maintaining data collection information

The HomeRun server uses its own work management configuration to control how

HomeRun client jobs are started. At installation time or using the HomeRun CFGSVR IBM System i™ command, you define the subsystem that HomeRun activity should run in. By default the Centerfield server will run in its own subsystem defined by the XCSBS80 subsystem description in the program library. It is highly encouraged that you use this subsystem to isolate the Centerfield server from other system work. At installation time, an autostart job entry is put into the QUSRWRK subsystem. This autostart entry will automatically start the Centerfield subsystem and server so you do not normally have to start the server manually after an IPL. **If you use the default subsystem (XCSBS80) you can skip the rest of this section.**

The job queue is used as the starting point for starting new HomeRun client jobs. The job queue entry that is added is for the XCTCP job queue that is found in the *{PROGRAM LIBRARY}* library. If you are changing an existing configuration or installing over a previous version of a HomeRun server, the existing job queue entry is first removed and then the new entry is added to the specified subsystem. The command that HomeRun uses to add the job queue entry is similar to the following. The default subsystem is XCSBS80, and the sequence number begins at 50. If 50 is not available, the number is automatically incremented by the HomeRun configuration support until an unused sequence number is found.

> ADDJOBQE SBSD(**subsystem description**) JOBQ(*{PROGRAM LIBRARY}*/XCTCP) MAXACT(*NOMAX) SEQNBR(50)

A secondary job queue entry, XCAUTODBA, is used to schedule background work for HomeRun’s AutoDBA feature. By default it is placed at SEQNBR(60).

The routing entry that HomeRun installs controls the routing of the HomeRun client jobs. It must be added to the same subsystem that has the XCTCP job queue entry. The routing entry uses the XCTCP routing data for comparison and calls the QCMD program. The XCTCP job class is specified as the job class for the routing entry. The command that HomeRun uses to add the routing entry is similar to the following. The default subsystem is XCSBS80, and the sequence number begins at 170. If 170 is not available, the number is automatically incremented by the HomeRun configuration support until an unused sequence number is found. The second routing entry is added for work that should be run at a lower priority level and therefore uses a different class than the rest of the server jobs.

> ADDRTGE SBSD(**subsystem description**) SEQNBR(170) CMPVAL(***varies by release***) PGM(QSYS/QCMD) CLS(*{PROGRAM LIBRARY}*/XCTCP)

> ADDRTGE SBSD(**subsystem description**) SEQNBR(180) CMPVAL(***varies by release***) PGM(QSYS/QCMD) CLS(*{PROGRAM LIBRARY}*/XCTCPBJ)

If you are changing an existing configuration or installing over a previous version of HomeRun, the existing routing entry is not removed. It should not cause any harm to your existing application environment to leave it installed in a subsystem that is no longer used by HomeRun.   If you want to remove it, you need to remove it using standard work management support available on the IBM System i™.   You can use a command similar to following. Before issuing the command, you need to make sure that the sequence number used on the remove routing entry command is the sequence number for the HomeRun routing entry. You can check the routing entries by using the WRKSBSD command and displaying the routing entries for the subsystem that you want to change. For more information about performing work management activities, see IBM System i™ work management documentation.

RMVRTGE SBSD(**subsystem description**) SEQNBR(170)

RMVRTGE SBSD(**subsystem description**) SEQNBR(180)

The HomeRun installation creates objects within the *{PROGRAM LIBRARY}* installation library to support these and other work management changes on your system. The following are objects that are created by the HomeRun installation support that can be used for work management control.

Object Name	**Object Type**	**Description**
XCTCP	Job description	Job description used to set job properties for HomeRun administration client jobs
XCTCP	Job class	Job class used to set job properties for HomeRun administration client jobs
XCTCPBJ	Job class	Jobs class used to run jobs that may run long- running operations and should execute at a lower priority than other work.
XCTCP	Job queue	Job queue used to start HomeRun administration client jobs
XCHLP	Job description	Used by the XCHELPER background job
XCIAFINDER	Job description	Used by the XCIAFINDER background job (V5R4 and higher)
XCPC	Job description	Used by the XCPC background job
XCSTRSVR	Job description	Used by the autostart job entry
XCSCRUBBER	Job description	Job description used to set job properties for the HomeRun Collection Scrubber job

{PROGRAM LIBRARY}	Output queue	Output queue used for upcoming product enhancements

You can modify the objects used for controlling work management, but your changes will not be preserved when you upgrade to the next version of HomeRun.

8.2.5 Exit points

The following exit point is added during HomeRun product installation:

Exit Point	HomeRun Program Name
QIBM_QWT_JOBNOTIFY	XCDTAQ

This exit point is used by the Usage Tracker for insure/INDEX and insure/ANALYSIS. At installation time, no jobs are ended and no subsystems are ended. However, if you want to have the Usage Tracker monitor for specific new jobs that start (that is, if you choose the ***Filtered jobs*** Profile type), you will need to end and restart any subsystems in which those jobs might start before your monitor will take affect. This only needs to be done once after the installation of HomeRun.

Three other exit points are optionally added at installation time. A prompt will appear that asks if these exit points should be added so that additional types of data collection can be done by HomeRun. By default they are installed, but they can be bypassed if so desired. The three exit points are:

Exit Point	HomeRun Program Name
QIBM_QSQ_CLI_CONNECT	XCCLIINIT
QIBM_QZDA_INIT	XCODBCINIT
DDM exit point (DSPNETA)	XCDDM

8.2.6 TCP/IP Usage

The HomeRun server uses TCP/IP to communicate with the HomeRun clients. The server and client applications communicate almost exclusively using a TCP application. The application is written to use proprietary application data flows to give fast and efficient performance.

The IBM System i™ and personal computer sockets applications communicate with each other through TCP ports. Ports are used by the TCP protocol to identify a unique origin or destination of communication with a TCP application. TCP ports can be any numeric value from 1 to 65535. TCP applications that are commonly used, like ftp and telnet, use pre-assigned port numbers. Pre-assigned port numbers are called well-known TCP ports.

The well-known TCP port numbers range between 1 and 1023 and should not be used when you configure HomeRun. If you specify one of these ports, it can affect the operation of the application that normally uses the well-known port. When you install HomeRun, a port and associated application service is configured. The service name for HomeRun is CENTERFIELD_SERVER_80 and the port by default is **{default port}**. If the **{default port}** port is already used by another application, the port number is incremented until a free port is found. The command that HomeRun uses to add the service and port configuration is similar to the following. You can check the port and service configuration after you install by using the WRKSRVTBLE command and locating the CENTERFIELD_SERVER_80 in the service list.

ADDSRVTBLE SERVICE(CENTERFIELD_SERVER_80) PORT(**{default port}**) PROTOCOL('tcp') TEXT('Centerfield Technology Server')

In addition to the proprietary communications method, HomeRun uses an ODBC connection to handle report requests made by the administration client. HomeRun requires an iSeries Navigator ODBC connection. When the HomeRun client is installed, the auto-configuration support will attempt to configure an ODBC data source if the supported ODBC driver can be detected.

8.2.7 Job Scheduler Usage

The IBM System i™ built-in job scheduler is used by several components of HomeRun. Events that can cause jobs to be placed on the job scheduler are:

- Scheduling a Database Profiler data collection
- Scheduling Index Create requests using insure/INDEX or Visual SQL Explain
- Cleaning database collections using the Collection Scrubber
- Autonomic Database Assistant (AutoDBA) analysis and actions

8.2.8 Default public authority of libraries

The *{PROGRAM LIBRARY}* and *{DATA LIBRARY}* libraries are created with the default create authority set to *CHANGE.

8.2.9 Command Language (CL) Commands Used by HomeRun

HomeRun is continually being enhanced and modified, so the list of CL commands used by HomeRun also continues to change. The following is a list of CL commands that are used by HomeRun. If you have modified command defaults or installed an application that either replaces or changes any of the following commands, you should contact Centerfield Technology to discuss the impacts that the changes may have on HomeRun. **NOTE: This list may change without notice and is not guaranteed to be complete for the most current version of software.**

ADDPFTRG	CHKTAP	DLTJRN	IF	RTVMBRD
ADDMON*	CLOF	DLTJRNRCV	GOTO	RTVMSG
ADDEXITPGM	CPROBJ	DLTOVR	MONMSG	RTVNETA
ADDJOBQE	CPYF	DLTPGM	MOVOBJ	RTVOBJD
ADDJOBSCDE	CPYSPLF	DLTSP*	OPNDBF	RTVSYSVAL
ADDMSGD	CRTDTAARA	DLTSPLF	OVRDBF	SAVOBJ
ADDRTGE	CRTDUPOBJ	DLTUSRSPC	OVRPRTF	SBMJOB
ADDSRVTBLE	CRTJRN	DO	PASSWORD*	SNDPGMMSG
ALCOBJ	CRTJRNRCV	DSPDBR	PGM	SNDRCVF
CALL	CRTLF	DSPFD	PRTSQLINF	STRDBG
CALLPRC	CRTLIB	DSPJOB	RETURN	STRDBMON
CFGSVR*	CRTOUTQ	DSPJOBLOG	RCVF	STRHOSTSVR
CHGACGCDE	CRTPF	ENDDBG	RCVMSG	STRJRNPF
CHGJOB	CRTSAVF	ENDDBMON	RMVJOBQE	STRSVR*
CHGLIBL	CRTSP*	ENDDO	RMVJOBSCDE	STRTCPSVR
CHGNETA	CRTSRCPF	ENDHOSTSVR	RMVMSGD	
CHGOBJOWN	CRTUSRPRF	ENDJOB	RMVPFTRG	
CHGQRYA	DCL	ENDJRNPF	RMVMON*	
CHGSYSLIBL	DCLF	ENDPGM	RNMOBJ	
CHGSYSVAL	DLCOBJ	ENDPJ	RSTOBJ	
CHGVAR	DLTDTAARA	ENDSVR*	RTVDTAARA	
CHKOBJ	DLTF	ENDTCPSVR	RTVJOBA	

* Indicates Centerfield Technology command

8.2.10 OS/400 System APIs Used by HomeRun

HomeRun is continually being enhanced and modified so the list of system application interfaces (APIs) used by HomeRun also continues to change. The following is a list of system APIs and header files that contain API interfaces that are used by HomeRun. If you have installed programs that either replace or change any of the following APIs, you should contact Centerfield Technology to discuss the impacts that the changes may have on HomeRun.

NOTE: This list may change without notice and is not guaranteed to be complete for the most current version of software. This list may not include every API that is used if the API name does not match the included source member (i.e. the name of the API is in the source file and used by Centerfield but not explicitly listed here).

CEELOCT	QUSDLTUS	QWTSETP
QCMDEXC	QUSGEN	QWCRSVAL
QDBRTVFD	QUSLJOB	QUSRTVEI

QDBLDBR	QUSLMBR	QUSMBRD
QLICHGLL	QUSLOBJ	QUSRTVFD
QMHRTVM	QUSPTRUS	QUSCHGPA
QMHSNDPM	QUSRJOBI	QDBBRCDS
QSYGETPH	QUSRMBRD	QTNADDCR
QSYRLSPH	QUSRTVUS	QUSMIAPI
QUSCHGUS	QWCRJBST	QDMLOPNF
QTNRMVCR	QWCRSSTS	QMHRSNEM
QUSEC	QWCLOBJL	QPMWKCOL
QJOURNAL	QMHRCVPM	QWDLSJBQ
QTOCNETSTS	QPMLPFRD	QWCLSCDE
QWCCHGTN	QWDLSBSE	
QPMLPMGT	QUSCUSAT	

8.2.11 Programs Adopting *OWNER Authority

The following programs adopt *OWNER authority. All HomeRun programs are compiled to use adopted authority.

Program Name	**Description**
XCACTODBC	Retrieve actively connected user access jobs
XCADDJE	Add job notify exit point
XCADDJOBCFG	Add job configuration command processor
XCADDUAE	Add the remote monitoring support
XCADVIX	Advise indexes
XCAUDOPR	Audit a client request
XCJBCFGPOP	Change job history prompt override processor
XCCFGMONHS	Configure monitor history auditing
XCCFGMONHP	Configure monitor history prompt override program
XCCHGODBCA	Change run time attributes of a user access job
XCCHKCMTCTL	Check commitment control driver program
XCCMD	Internally used by client software to run a Command Language (CL) command
XCCMT (service program)	Commitment control API interfaces
XCDSPLICINF	Display system license information
XCENDHLPCP	End helper command processing program
XCENDSCRBR	End scrubber job command processor
XCHELPER	Background job reading job notify data queue
XCHLP	Main helper job program

XCIAFINDER	Read journal to retrieve recommended indexes
XCIP	Capture IP address for job
XCJOBUTIL (service program)	Job APIs that require job control authority
XCJDELOG	Look at JDE logs
XCJDEINI	Edit JDE.INI file
XCJOBPRF	Start a database monitor collection for a job
XCLOCKCF	Lock APIs
XCLSTJOB	List jobs APIs
XCMONHST	Monitor job history to audit table
XCMTXWAIT	Mutex APIs
XCPASS	License entry and verification
XCPERFCOLL	Performance collector APIs
XCPMSUB	Dynamically substitute parameters for a parameterized SQL SELECT statement
XCPRFCRT	Create a database collection profile
XCPRFDTL	Delete a database collection profile
XCPRFEND	End a Database Profiler collection
XCPRFENDAP	End all active Database Profiler collections
XCPRFRNM	Rename a database collection profile
XCPRFSTR	Start a Database Profiler collection
XCOWCFG	Configure server for OneWorld environment
XCREPBLD	Build Database Profiler repository
XCREPDLT	Delete repository
XCRTVCFGVAL	Retrieve configuration value
XCRMVJBCFG	Remove job configuration
XCRMVUAE	Remove the remote monitoring support
XCSCDTRG	Schedule requested work (used as trigger program for XCSCD file)
XCSCRUB	Remove unneeded collection data
XCSEMWAIT	Semaphore APIs
XCSIGNON	Check password at sign on time and swap user profile to signed in user
XCSPDSPCMD	Internally used by client software to run an OS/400 command and return spool file output
XCSQLEXEC	Internally used by client software to run non-SELECT SQL statement with commitment control
XCSQLEXEC0	Internally used by client software to run non-SELECT SQL statement without commitment control

XCSQLSEL	Internally used by client software to run SQL SELECT statement with system naming
XCSQLSEL2	Internally used by client software to run SQL SELECT statement with SQL naming
XCSTRHLPCP	Start helper command processing program
XCSTRSVR	Start the Centerfield server
XCSYSUTIL (service program)	System information APIs
XCTRIGGER	Trigger program for configuration files
XCTRIGGERM	Trigger program for job monitor configuration files
XCDBGUTIL (service program)	Debug utilities

8.3 HomeRun Tuning Methodology FAQ

The HomeRun toolset employs a tuning methodology that allows you to maximize the overall performance of your database by helping you focus your time and energy on the data access activities that matter most on your system. Whether you are planning for data warehousing projects, debugging existing performance problems, or just trying to get the most out of your system, the methodology employed by HomeRun can help you.

This FAQ employs a whole-toolset approach to SQL tuning. That is, there are suggestions for using each of the tools in the HomeRun toolset. If the FAQ discusses a tool you do not have a license for or are not familiar with, you can find out more from the tool’s manual, included on your product CD.

8.3.1 Why tune your database and queries?

If your end users can gather more critical information faster than your competitors can with little or no additional cost to your company, you have a competitive advantage. Business intelligence and data warehousing initiatives are taking companies into an era where, if done right, business analysts can make faster and more precise decisions. Tuning access to your data can give you an additional advantage if you have already deployed a data warehousing solution, or help level the playing field if you have not.

8.3.2 What types of data access tuning can you do?

Data access tuning really involves two types of work, system-wide and individual query tuning. Individual query tuning is done by analyzing each implementation step of a single query and only taking action when you can identify a step that you can improve. On the System i, this has typically been done by running a query under debug and interpreting the query optimizer debug messages in the System i job log or by using output created by the System i database monitor.

System-wide query tuning is tuning by:

- Sampling all query activity on the system
- Ranking the activity on the system by some criteria (typically, either impact to the system or using end user response time)
- Individually tuning highly ranked activities
- Repeating the process

Historically on the System i, we have done virtually all tuning using the individual query tuning methods. Why? It is easy to identify the single long running queries because our users complain about them. Another reason we have always individually tuned our queries is because the tools that are available for doing system-wide query tuning have either been unavailable or have been difficult to use. While system-wide tuning is seldom used, it provides the most benefit to your environment, if the tools are available to facilitate the analysis.

8.3.3 How do you know what to tune?

The most effective tuning requires tools that help you do both system-wide and individual query tuning. The tools should help you identify what data access activities need to be focused on, and either provide you with insight as to what should be done to improve the access, or take some predefined actions to improve it for you.

At a minimum, the tools used for tuning should help you identify:

- What queries provide the longest delays for your end users
- What queries have the largest impact on your system
- What data is accessed most often within your system and when
- Which users or groups of users are accessing your data most frequently
- How are users are getting the information that they want to see

Given these pieces of information, you can focus on the queries, objects, and users that will give the most return for the changes that you make.

8.3.4 What types of things can I do to improve my data access performance?

The actions that you take to improve your data access performance vary based on:

- The transactional uses of your data that is being queried
- The tools being used to run queries on your system
- The level of control you have over the queries being run on your system
- The priority that query activity should have on your system
- The amount of disk resource you have available

On the System i, the activities that have traditionally had largest positive effects on data access performance are:

- Creating a new index that provides a needed access path for the System i Query Optimizer to implement a query in the most optimal way
- Deleting one or more existing indexes that prevent the System i Query Optimizer from examining better access paths and selecting the most optimal implementation of a query
- Changing the query to a form that allows the System i Query Optimizer to better determine the most optimal implementation of a query
- Making program compilation changes to influence the System i Query Optimizer's implementation of a query
- Making program or system changes to influence the operating system's caching and parallel execution algorithms
- Creating a periodically refreshed summary table to simplify and optimize access to the same information
- Preventing estimated long running queries from being run

8.3.5 Specifically, how does HomeRun help me?

HomeRun on the System i gives you the ability to develop, deploy, and manage query activity on your System i with far less effort from you than any methods used in the past. The product has many features that can be used for several purposes depending on your need.

8.3.5.1 For the Programmer

SQL PROGRAM DESIGN AND IMPLEMENTATION:
For programmers writing SQL programs to generate and retrieve new data on the System i, the programmer will start by designing the layout of their program and possibly new database files. While the programmer is doing their design work, they should consider how the System i Query Optimizer will implement their queries. In a best case scenario, the programmer should experiment with the Visual SQL Explain feature to understand how each query will be implemented and understand its impact before finalizing the program design. The information that the feature provides can give valuable insight about needed indexes or may influence some design choices that otherwise may not have been considered.

SYSTEM-WIDE TESTING, DEPLOYMENT, AND PERFORMANCE TUNING:
Once the programmer has completed the design and implementation of the project, system-wide tuning should be performed with either mock system loads or early in the deployment phase. To use HomeRun for system-wide tuning:

1) You start by using the usage tracking feature of insure/INDEX or insure/ANALYSIS to sample representative time periods of activity on your system. The usage tracking feature allows you to sample activity either ad hoc or on a scheduled basis. If you choose to track on a scheduled basis, you can sample at specific times of the day, month, or year.
2) After you have gathered enough data to be representative of a normal workload, you should run insure/INDEX to identify and create recommended indexes. As you gather more data the indexes recommendations and their associated weights become statistically more accurate. Before acting on the index recommendations, you should consider the impact that your changes will have on your transactional workload. insure/INDEX records which indexes were created using the tool, for easy removal or integration into a source control system.
3) You should perform more sampling into a new profile after each set of changes to understand the impact that your previous changes had and find new improvements that can be made.
4) After you have created the most beneficial indexes and understand their impact, you can use the reports within insure/ANALYSIS to:
    a) Identify queries that have the longest delays for your end users
    b) Identify queries that have the greatest impact on your system
    c) Identify the most commonly run queries ranked by their cumulative impact

    d) Identify queries that may have selected a poor implementation because the System i Query Optimizer timed out choosing an implementation
    e) Identify the users generating the most query activity
5) The reports within insure/ANALYSIS can take you down several paths. You may choose to analyze individual SQL statements, using Visual SQL Explain to fine-tune specific high impact statements. You may choose to create summary tables for commonly run queries. You may use the Database Explorer feature to help you understand why specific queries are timing out. You may choose to use insure/RESOURCES policies to limit the impact of certain users or groups of users.

8.3.5.2 For the SQL Query Designer

QUERY DESIGN AND IMPLEMENTATION:

Query designers writing new queries to retrieve data on the System i will start by understanding the database and the data they intend to access. Typically, the query designer would use the DSPFD, DSPFFD, DSPDBR operating system commands to understand characteristics and relationships within their database. Database Explorer will help the query designer by showing programmer-specified creation detail associated with the different components of the database as well as relationships between the files and indexes within the database. Database Explorer allows the designer to see index search order, data types of fields, and existing logical files and SQL views using a quick and easy, point and click interface. The designer will use the information from Database Explorer to assist coding their SQL in the Visual SQL Explain editor or other favorite tool.

Visual SQL Explain provides all the functionality the query designer needs to design optimized SQL queries. Visual SQL Explain can import SQL query information from the most common applications that query designers may use like Query/400, Query Manager/400, source files, or simply from a PC text file. It will help the query designer understand performance characteristics of an individual SELECT statement by displaying the System i query optimizer's implementation of the statement in a graphical, easy to understand way. The traditional query optimizer debug messages that query designers have used in the past are also provided for those power designers that like the traditional methods. The feature is designed to allow the query designer to quickly iterate through the query design process while continually providing easy to understand implementation feedback. As changes are made to the query, the immediate implementation feedback allows the designer to proactively see how their changes affect the query optimizer's implementation. In the past, the query designer needed to analyze the query's implementation as a separate step that would often be forgotten or bypassed until end users complained about performance.

Visual SQL Explain surfaces the System i settings that affect the query optimizer's choices. The settings are easy to manipulate allowing the designer to quickly experiment with different settings, again using a quick and easy, point and click interface. By experimenting with the available settings, the query designer can learn how the System i settings affect a query in their environment. It allows the query designer to ensure that the settings are optimal for each query and each environment.

Many times the query optimizer will choose to build one or more temporary indexes to implement a query. If the query requires a temporary index, the time required to build the index is a majority of the overall time needed to run the query. By creating a permanent index to replace an index that the query optimizer chose to build temporarily, the time that was required to build the temporary index when the query was run can almost always be eliminated. Visual SQL Explain graphically surfaces the temporary indexes that the query optimizer believes are needed. If the query designer determines that temporary indexes that query optimizer needs should be created permanently, the wizard for creating indexes makes creating the index a simple process.   The wizard starts the query designer in the right direction by defaulting the creation information using information gathered from the query optimizer. It also allows the create index request to be done interactively, submitted for batch processing immediately, or scheduled at a specific time. The index create options give the query designer the flexibility to create the index with as small of an impact on the system as is appropriate for the environment and time of day.

QUERY ONGOING MAINTENANCE:
Once the query designer has designed and tuned the query, insure/RESOURCES can help the query designer understand the query usage and can be valuable for trouble-shooting any problems.