Microsoft Business Solutions

Performance Troubleshooting Guide for Microsoft® Business Solutions–Navision®

MICROSOFT BUSINESS SOLUTIONS–NAVISION

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PREFACE

This document is designed to be used as a stand-alone reference book or as part of a training course.

When this document is used as part of a training course, it should be supplied with its companion book of exercises as well as the fob files that contain the tools and the fob files that are used in the exercises.

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Chapter 1

Performance Problems – An Introduction

This chapter introduces you to the basic elements that are covered in this guide.

This chapter contains the following sections:

- Introduction
- The Test Environment
- Client Performance Indicators
- Common Performance Problems

1.1 INTRODUCTION

This material is designed to help you identify performance problems in a Microsoft Business Solutions–Navision application. It describes how to troubleshoot on both server options and describes and explains how to use the debugging tools that exist in Navision to identify performance problems. It also describes how to use the troubleshooting tools that come with this guide. Furthermore, it contains a brief description of some of the Microsoft SQL Server tools that you can use.

This document describes some of the most common performance problems and the reasons that can cause them. The topics covered include:

- The Client Monitor and the Code Coverage tool
- The new performance trouble shooting tools
- Hardware setup and performance
- Setting up the test environment
- Identifying the clients that cause performance problems
- Profiling a task with the Client Monitor
- Identifying the worst server calls and the keys and filters that cause them
- Identifying the tasks that cause deadlocks on Microsoft Business Solutions–Navision Database Server
- Using the SQL Error Log to identify the clients involved in deadlocks on SQL Server
- How to identify locking problems
- How to set up locking order rules and check whether or not your application follows these rules
- Identifying index problems on SQL Server
- How to identify bad C/AL NEXT statements on SQL Server
- How to use Excel pivot tables to get an overview of the data in the Client Monitor.

Performance problems can be caused by bottlenecks in the hardware setup or by problems within Navision. Performance problems in Navision can be caused by, for example, the way that keys are designed, by the way that keys are used together with filters, or by the way that tables or records are locked.

This guide is mainly concerned with identifying performance problems that exist within Navision, even though poor performance can be caused by inadequate or badly configured hardware. For more information about hardware considerations, see the section "Hardware Setup" on page 34.

Database Servers

The two database server options for Navision, Navision Database Server and SQL Server, behave differently both with regard to performance and locking. However, the methodology and the tools that you can use to identify these bottlenecks are almost the same.

1.2 THE TEST ENVIRONMENT

You will generally need to set up a separate test environment before you can start troubleshooting and solving the performance problems that exist in a working installation.

Setting up a test environment means:

1 Setting up a separate database server.

The test server should be set up on a separate computer and not on the computer that is used by the production system. Using a separate test environment gives you complete control over the system and over who has access to it. It also means that the customer can continue to use the production system.

2 Copying the production system database to the test server.

If you are running on SQL Server, use the backup/restore functions in Enterprise Manager to make a fast copy of the database to the test server. If you are running on Navision Database Server, you can use the server-based backup program HotCopy.

3 Warming up the server, to ensure that you get realistic measurements.

You must warm up the test server regardless of which server option you are using.

Warming Up SQL Server

If you have just turned SQL Server on or if you have just created the database or company, you must warm up SQL Server by using the database and the company. This ensures that the system resembles the actual customer installation and means that you can generate realistic performance measurements.

You only need to run an initial test to warm up SQL Server. When SQL Server is warmed up, the execution plans for most queries have already been generated and are ready for use. Furthermore, the most frequently used data is now available in memory.

When SQL Server is not warmed up, you will, for example, see that inserting, modifying or deleting the first record in a table that contain keys that have SumIndexFields associated with them can take up to several seconds to finish. This would normally be done much faster in a working installation.

Warming Up Navision Database Server

If you have just started Navision or if you have just opened the database and company in Navision, you must warm up Navision Database Server before you can generate realistic performance measurements. Running an initial test will warm up Navision by ensuring that all the objects you need are available on the client.

Debugging Tools

To ensure that you have the most recent version of the debugging tools, install the newest version of the Navision client on the computers that you are going to use to test the installation.

Note

The earlier version of Navision, Navision Financials does not have a Client Monitor for the SQL Server Option. The Client Monitor is an essential element in the troubleshooting procedures described in this training material.

If you develop corrections in Navision that you would like to implement in Navision Financials, you can use the REMID feature from the Navision Upgrade Toolkit to change the Navision objects before importing them into Navision Financials.

1.3 CLIENT PERFORMANCE INDICATORS

When you connect a client to Navision Database Server, you can see status information about server calls that take two or more seconds in the status bar.

Typical server calls that generate status information are:

- Server calls that modify or delete sets of records.
- Server calls that scan an index or an entire table to find some data.
- Server calls that need to lock a record or a table can be forced to wait until other transactions are committed and release the locks that they placed.

Therefore, you should keep an eye on the indicator in the status bar when you are trying to identify problematic tasks because this information might be all you need to break down a performance problem.

However, if you are using the Microsoft SQL Server Option for Microsoft Business Solutions–Navision, the client’s user interface has no indicators to tell you how much time is spent on long running tasks. You therefore need some other procedures to break down a performance problem on SQL Server. However, when clients are waiting for locks to be released by other clients, you can see this information by using the session monitor as described in the section "Using the Session Monitor to Locate the Clients that Cause Performance Problems on SQL Server" on page 11.

1.4 Common Performance Problems

Many things can cause poor performance but some of the most common causes are:

- The way that keys are defined combined with the way that they are used in filters or queries when you want to read data.
- The way keys are defined with SumIndexFields combined with the way that summing FlowFields are defined.
- The number of keys that are defined with SumIndexFields when running on SQL Server.

The procedures described in this material will help you identify the places where these problems occur.

If you are running on SQL Server, you must also be aware of a very specific performance problem that applies to forms:

- Setting the *SourceTablePlacement* property to the default value (*Saved*) will often make opening forms that display data from tables that contain many records (1,000,000 or more), for example G/L entries, very slow. To fix this problem, set the *SourceTablePlacement* property to *First* in these forms.

Performance and Locking

Performance problems that are related to specific tasks should always be tested in the test environment, when no other users are logged on to the database server. This will help you determine whether the performance problem is related to the task itself, or if the problem only occurs when the task is executed in combination with other tasks on the same server.

Performance problems that are caused by a specific task are described in the section The Client Monitor on page 17. Performance problems that are caused by clients spending time waiting for other clients to release locks on resources that the client in question wants to place exclusive locks on are described in the section "Locking" on page 25.

Deadlocks occur when concurrent transactions try to lock the same resources but don't lock them in the same order. This can either be solved by always using the same locking order or by using a "locking semaphore" that will prevent these transactions from running concurrently. You can find out which resources are causing deadlocks by following the procedure described in the section "Locking" on page 25.

Hardware

When you are trying to identify any bottlenecks that exist in an installation you must also check the hardware that the installation is running on. You should check the hardware that is being used by both the server and the client computers. See the section "Hardware Setup" on page 34.

Getting Some Assistance

Depending on your expertise in the technical areas that are essential for troubleshooting performance problems, you can choose to follow all the steps described in this troubleshooting guide or you can stop at some point and give your results to other experts.

For example, the data that you get by using the Client Monitor (as described in the next chapter) can easily be transferred to other experts. They will then be able to identify performance problems solely on the basis of this data, before looking at the objects from the database and before having access to the data in the database.

Chapter 2
Identifying Performance Problems

This chapter explains how to identify performance problems in Navision.

This chapter contains the following sections:

- Using the Session Monitor to Locate the Clients that Cause Performance Problems on Navision Database Server
- Using the Session Monitor to Locate the Clients that Cause Performance Problems on SQL Server
- Time Measurements
- The Client Monitor
- Locking

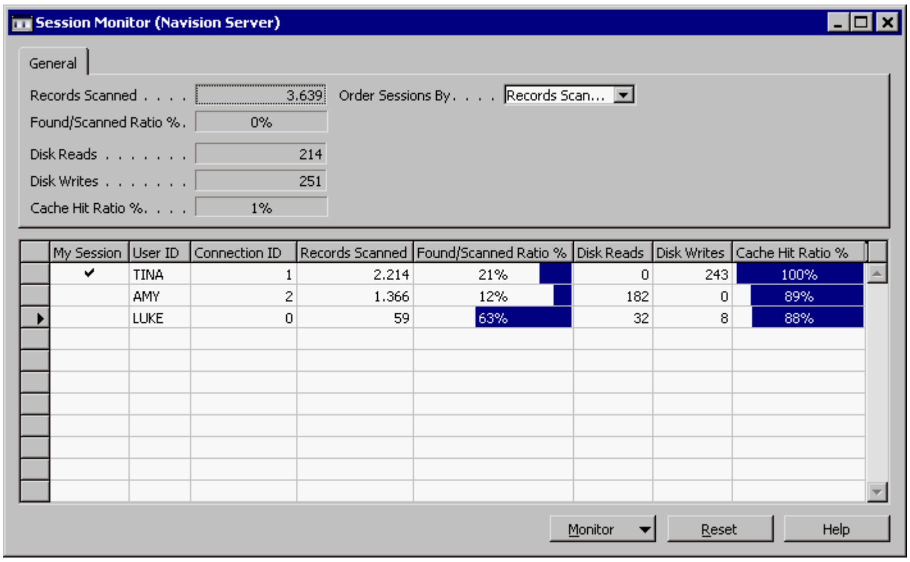
2.1 Using the Session Monitor to Locate the Clients that Cause Performance Problems on Navision Database Server

You use the Session Monitor (Navision Database Server) to identify the clients that cause performance problems on Navision Database Server.

You must import some helper objects before you can start to identify the clients that are causing performance problems:

1. Import the `Session Monitor (Navision Server).fob` file. The objects imported include form 150010, ***Session Monitor (Navision Srv)***.

2. Run form 150010, ***Session Monitor (Navision Srv)***.



The ***Session Monitor (Navision Server)*** window displays updated information from the ***Session*** table. The information is refreshed every second by default, but you can change this setting by clicking Monitor, Setup.

By default, the most active sessions in terms of the amount of records scanned are shown at the top of the list. The **Records Scanned** field tells you how many records the database server has scanned in order to find the records that this session wanted.

The sessions with the largest number of scanned records are the ones that should be investigated first. Follow the guidelines in the other sections to investigate these sessions.

Note

In the ***Session Monitor (Navision Server)*** window, if the value in the **Found/Scanned Ratio** field is high, this indicates that the indexes and queries match. A value of 30-50% is normal, while 3% is low.

2.2 Using the Session Monitor to Locate the Clients that Cause Performance Problems on SQL Server

You use the Session Monitor (SQL Server) to locate the clients that cause performance problems when you are using the SQL Server Option for Navision.

You must import some helper objects before you can start to identify the clients that are causing performance problems:

1 Ensure that you have installed the client components for SQL Server from the Microsoft SQL Server CD.

2 Open the Query Analyzer tool and click File, Open. Browse to the folder where you have stored the session monitor tools and open the `Session Monitor (SQL Server).sql` file.

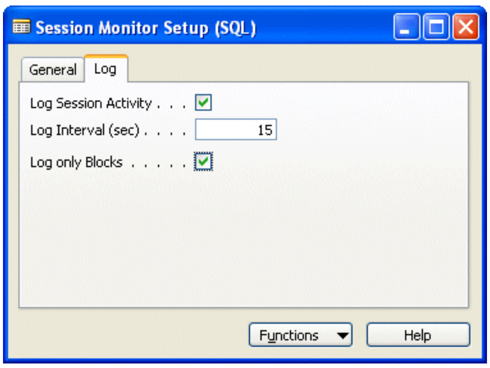
3 Click Query, Change Database and select the Navision database that you want to monitor.

4 Click Query, Execute. The `Session Monitor (SQL Server).sql` drops the current Session (SQL) view and creates a new view to replace it.

5 In Navision, open the ***Object Designer*** and import the `Session Monitor (SQL Server).fob` file.

6 Run form 150014, ***Session Monitor (SQL Server)*** window and click Monitor, Setup and the ***Session Monitor Setup (SQL)*** window opens.

7 Click the ***Log*** tab:



8 Enter a check mark in the **Log Session Activity** check box. Specify a time interval in the **Log Interval (sec)** field. If you are only interested in identifying any blocks that occur, enter a check mark in the **Log only Blocks** check box.

You must enter a value in the **Log Interval (sec)** field, for example 15 seconds. Navision will now log the current level of activity once every 15 seconds. When Navision logs the activity, it runs through the active sessions and creates one entry per session. These entries are logged to the ***Session Information History*** table.

If you select the **Log only Blocks** option, Navision only logs the sessions that are involved in blocking. This includes the sessions that are blocked and the sessions that are blocking others.

Finding the correct setting for the **Log Interval (sec)** option is a matter of achieving the right balance between how accurately you want Navision to log activity, and how large a performance overhead you are ready to accept. 15 seconds would seem to give a reasonable balance.

The Session Monitor creates a log entry every time the specified interval has elapsed and therefore any blocks that occur within the specified interval are not logged. If you want to make sure, that the Session Monitor catches as many blocks as possible, you can decrease the interval to, for example, 5 seconds or lower. To simultaneously decrease the performace overhead, select the **Log only Blocks** option so that only those sessions involved in a block are logged.

9 In the ***Session Monitor Setup (SQL)*** window, click Functions, Start Logging.

The Log Session Activity codeunit runs as a single instance codeunit. This means that the only way to stop the codeunit is to close and re-open the company. However, you can suspend it by removing the check mark from the **Log Session Activity** option. The codeunit will still keep running in the background, but it will not log anything. To resume logging, you must restart the session and start logging again.

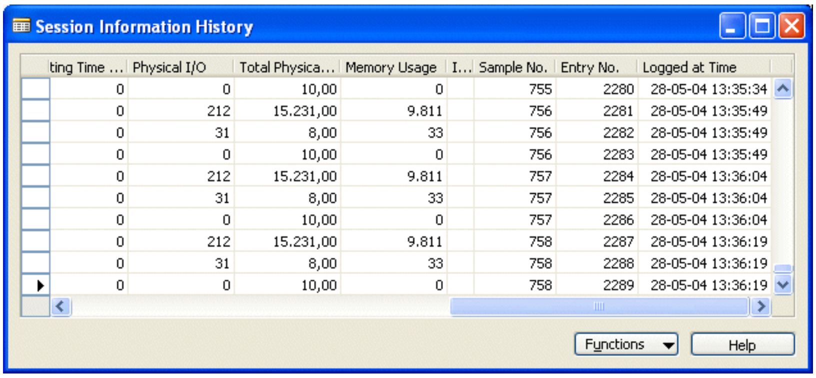
Viewing the Log

As mentioned earlier, the information gathered by the Session Monitor is inserted into the ***Session Information History*** table. You use the ***Session Information History*** window to view this data.

The ***Session Information History*** window shows you all the entries that have been logged. You can analyze this information in Navision or export it to a `.csv` file and analyze it in Excel.

To export the log to Excel:

1 Open the Object Designer and open the ***Session Information History*** window:



ting Time ...	Physical I/O	Total Physica...	Memory Usage	I...	Sample No.	Entry No.	Logged at Time
0	0	10,00	0		755	2280	28-05-04 13:35:34
0	212	15.231,00	9.811		756	2281	28-05-04 13:35:49
0	31	8,00	33		756	2282	28-05-04 13:35:49
0	0	10,00	0		756	2283	28-05-04 13:35:49
0	212	15.231,00	9.811		757	2284	28-05-04 13:36:04
0	31	8,00	33		757	2285	28-05-04 13:36:04
0	0	10,00	0		757	2286	28-05-04 13:36:04
0	212	15.231,00	9.811		758	2287	28-05-04 13:36:19
0	31	8,00	33		758	2288	28-05-04 13:36:19
0	0	10,00	0		758	2289	28-05-04 13:36:19

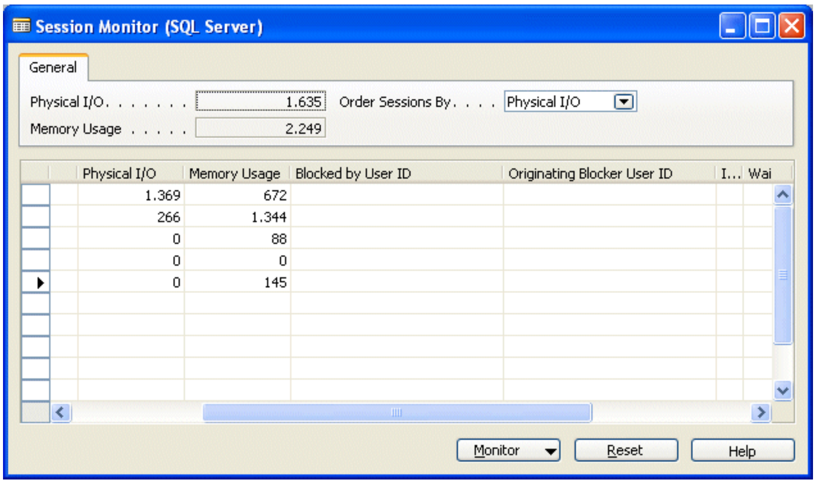
2 Click Functions, Export Log and specify a file name.

Remember to use the extension `.csv`, for example, `Log.csv`.

3 Double click the file, and it opens in Excel.

Excel has a limitation of 65,536 rows. If the log contains more entries that this, you will not be able to open the file in Excel. You can get around this by applying a filter and only exporting some of the entries. Alternatively, you can delete some of the entries and then export the remainder. If you think that you are close to the limit of 65,536 records, click Functions, Count to find out how many entries are within the current filter.

You can also view the information gathered by the Session Monitor in the ***Session Monitor (SQL Server)*** window:



The ***Session Monitor (SQL Server)*** window displays updated information from a view. This view is similar to the one that lies behind the ***Session*** table. The ***Session Monitor (SQL Server)*** window tells you which clients are currently connected to the server as well as the current load on the server. The information is refreshed every second by default, but you can change this setting by clicking Monitor, Setup.

By default, the most active sessions in terms of physical I/O are listed at the top of the ***Session Monitor (SQL Server)*** window. These are the sessions that should be investigated first. You can also list the sessions according to their memory usage, because this is also is a good indicator of activity. SQL Server can also give you information about the CPU usage, but unfortunately this information is not very reliable on SQL Server 2000.

To investigate these sessions, follow the guidelines described in the following sections.

The ***Session Monitor (SQL Server)*** window also lists information about the clients that are waiting for locks held by other clients to be released, as well as the identity of the clients that placed the locks. If you want to concentrate on this area only, look at and/or filter the fields starting with Blocked (**Blocked**, **Blocked by Connection ID**, **Blocked by User ID**, **Blocked by Host Name**).

Deleting Entries

To delete entries from the ***Session Information History*** table:

1 Open the Object Designer and open the ***Session Information History*** window.

2 Click Functions, Delete Log Entries.

This deletes all the entries within the current filter. If you have not placed a filter, all the entries are deleted.

2.3 Time Measurements

When you are working with performance problems, it is recommended that you make accurate measurements of the amount of time it takes to perform the tasks in question.

You can monitor and measure the time a task takes by using a stopwatch or preferably by using some helper objects.

The `ActivityLog.fob` file contains some objects that enable you to measure precisely the time spent on a particular task. These measurements are stored in a table enabling you to review the amount of time spent on the task at a later date.

To measure the time spent on a task:

1 Import the `ActivityLog.fob` file and compile the objects that are imported.

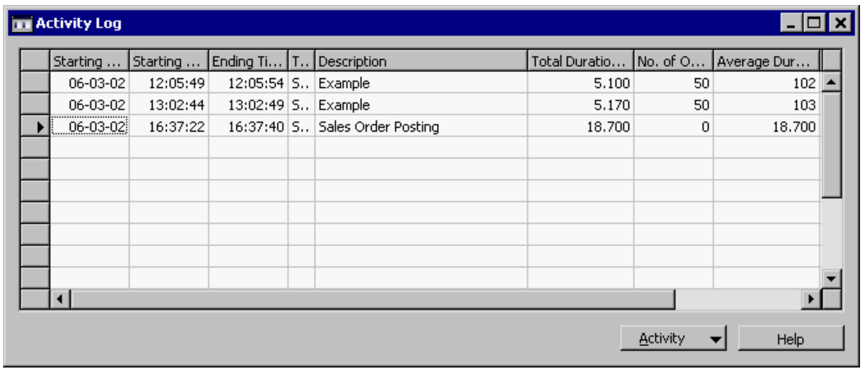
2 Use the objects in the same way as they are used in the codeunit contained in `Sample use of Activity Log.fob`.

To see how this codeunit works:

1 Import the `Sample use of Activity Log.fob` file and open codeunit 150000, Sample use of Activity Log in the editor to see how the Activity Log is used to monitor the task in the codeunit.

2 Run codeunit 150000, Sample use of Activity Log. This creates a new line in the Activity Log.

3 Run form 150000, Activity Log to open the Activity Log.



The **Activity Log** window contains the following information:

- The date and time at which the activity was started.
- The date and time at which the activity finished.
- The status of the activity.
- The total time in milliseconds that the activity took.
- The number of operations that the activity involved.
- The average time that each operation took.

- A check mark indicating which session was yours.
- The connection ID of the session that carried out the activity.

Details of the Activity

To see the changes, if any, that an activity made to the database, you must enable this feature. Codeunit 150000, Sample use of Activity Log shows you how to enable this feature.

After you have enabled the feature and carried out the activity that you are interested in monitoring, select the activity and click Activity, Table Size Changes to see the changes that were made to the database.

The **Table Size Changes** window appears:

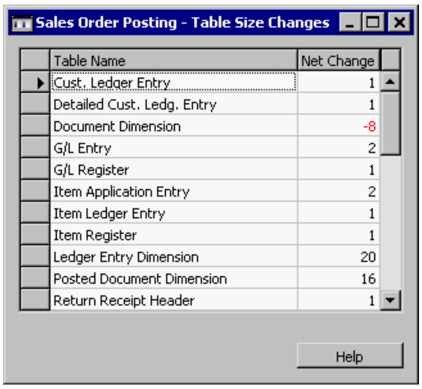

Sales Order Posting - Table Size Changes

Table Name	Net Change
Cust. Ledger Entry	1
Detailed Cust. Ledg. Entry	1
Document Dimension	-8
G/L Entry	2
G/L Register	1
Item Application Entry	2
Item Ledger Entry	1
Item Register	1
Ledger Entry Dimension	20
Posted Document Dimension	16
Return Receipt Header	1

Help

This window contains information about the net amount of records that were entered into or deleted from the tables in the database during the activity. Knowing the amount of changes that an activity involves helps you understand the amount of time used by a particular task.

2.4 The Client Monitor

The Client Monitor is an important tool for troubleshooting performance and locking problems. You can also use it to identify the worst server calls and to identify index and filter problems in the SQL Server Option. The Client Monitor and the Code Coverage tool now work closely together allowing you to easily identify, for example, the code that generated a particular server call.

Using the Client Monitor to Profile a Task

The Client Monitor displays all the details of the server calls made by the current client, including the time spent on each server call. This makes it an invaluable tool when you want to analyze a particular task and study the server calls that the task makes as well as the code that initiates the server calls.

To profile and analyze a given task in Navision using the Client Monitor, you must have some Client Monitor helper objects:

1. Import the `Client Monitor.fob` file, including Form 150020, Client Monitor.
2. Compile all of the objects that are imported. This must be done because some of the field definitions are different on the two database server options.
3. Click Tools, Debugger, Code Coverage to open the ***Code Coverage*** window. Start the Code Coverage tool and then start the Client Monitor just before you are ready to perform the task that you want to investigate.
4. Perform the task that you want to test.
5. When you have finished the task, stop the Client Monitor and then stop the Code Coverage tool. The Client Monitor uses many lines to describe a single server call, and this makes it difficult to use for data analysis.
6. Run form 150020 Client Monitor. This processes the data from the Client Monitor and displays it in a new window.

The **Client Monitor** window displays and formats the data that has been gathered by the Client Monitor so that it can be more easily analyzed. It carries out a kind of cross tabulation of the operations and parameters and uses one line per server call.

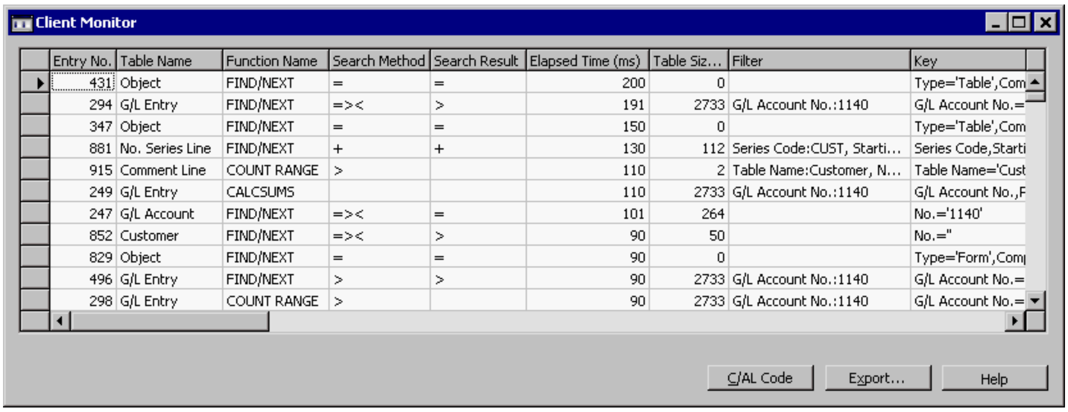
Important

When you use these tools, make sure that your test tasks are focused on the area that you are interested in testing. If you spend time doing other tasks, both the Client Monitor and the Code Coverage tool will fill up with irrelevant information.

You can analyze the Client Monitor data within Navision, or you can perform a more detailed analysis by importing the data into pivot tables in Excel.

If you are analyzing a lengthy task that takes an hour or more to run, you should consider restricting the scope of the task. You can limit the task by applying filters that will make the task handle less data, or by stopping the task after several minutes. You can then use the Client Monitor data from the part of the task that was performed as the basis for your analysis.

Here is an example of the kind of data that you can see in the Client Monitor (taken from SQL Server):



Entry No.	Table Name	Function Name	Search Method	Search Result	Elapsed Time (ms)	Table Siz...	Filter	Key
431	Object	FIND/NEXT	=	=	200	0		Type='Table',Com
294	G/L Entry	FIND/NEXT	=><	>	191	2733	G/L Account No.:1140	G/L Account No.=
347	Object	FIND/NEXT	=	=	150	0		Type='Table',Com
881	No. Series Line	FIND/NEXT	+	+	130	112	Series Code:CUST, Starti...	Series Code,Starti
915	Comment Line	COUNT RANGE	>		110	2	Table Name:Customer, N...	Table Name='Cust
249	G/L Entry	CALCSUMS			110	2733	G/L Account No.:1140	G/L Account No.,F
247	G/L Account	FIND/NEXT	=><	=	101	264		No.='1140'
852	Customer	FIND/NEXT	=><	>	90	50		No.=''
829	Object	FIND/NEXT	=	=	90	0		Type='Form',Com
496	G/L Entry	FIND/NEXT	>	>	90	2733	G/L Account No.:1140	G/L Account No.=
298	G/L Entry	COUNT RANGE	>		90	2733	G/L Account No.:1140	G/L Account No.=

The Client Monitor displays the database function calls that are made by the C/AL code as follows:

Function call in C/AL:	**Function Name (+ Search Method) shown in the Client Monitor:**
GET	FIND/NEXT('=')
FIND('-')	FIND/NEXT('-')
NEXT	FIND/NEXT('>')
ISEMPTY	ISEMPTY (as long as no MARKEDONLY filter is used)
CALCSUMS	CALCSUMS
CALCFIELDS	If the FlowField is of type sum: CALCSUMS If the FlowField is of type lookup: FIND/NEXT('-')
LOCKTABLE	LOCKTABLE
INSERT	If the table is not locked already: LOCKTABLE INSERT
MODIFY	If the table is not locked already: LOCKTABLE Often on SQL Server: FIND/NEXT('=') MODIFY
DELETE	If the table is not locked already: LOCKTABLE DELETE
MODIFYALL	If the table is not locked already: LOCKTABLE MODIFYALL (as long as validation code isn't executed)
DELETEALL	If the table is not locked already: LOCKTABLE DELETEALL (as long as validation code isn't executed)

Generally, the `FIND/NEXT` function in the Client Monitor means:

Function Name:	**Search Method:**	**Means:**
FIND/NEXT	–	FIND('-') or find the first record (within the current filter using the current key).
FIND/NEXT	+	FIND('+') or find the last record (within the current filter using the current key).
FIND/NEXT	>	NEXT or find the record with key values greater than the current key values (within the current filter using the current key).
FIND/NEXT	<	NEXT(-1) or find the record with key values less than the current key values (within the current filter using the current key).
FIND/NEXT	=	GET or find one record with key values equal to the current key values (within the current filter).

In the Client Monitor:

- For each `FIND/NEXT`, the **Search Method** field tells you what kind of `FIND/NEXT` server call it is (see the previous table).
- For each `FIND/NEXT`, the **Search Result** field contains a value (the same as the **Search Method** field) if data was found. Otherwise, it is blank.
- For each `COMMIT`, the **Commit** field normally contains the value 1, indicating that the transaction was committed. If the transaction was rolled back and not committed, the value is 0.
- The **Elapsed Time (ms)** field shows the amount of time that elapsed between the start and the end of a server call. This means that it gives you the total time spent on the client, the network and the server.

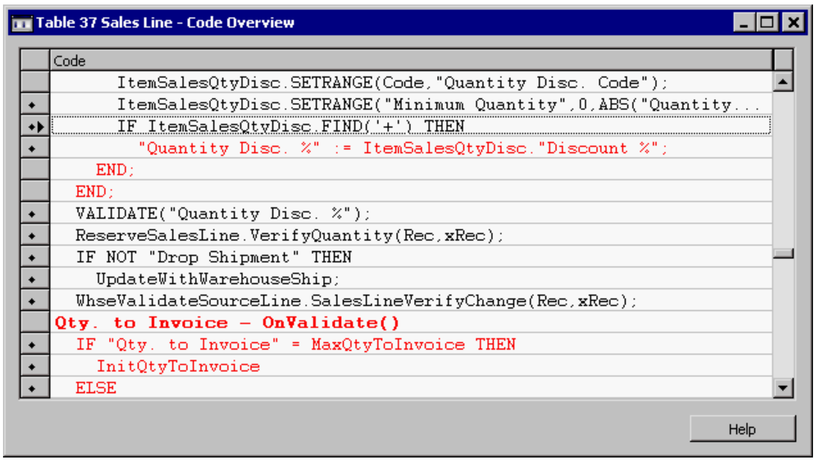
Note that the information in the **Elapsed Time (ms)** field tends to be slightly inaccurate for fast server calls. If a server call takes 1 ms, then the average **Elapsed Time (ms)** is 1 ms. However, 90% of the server calls will have 0 in the **Elapsed Time (ms)** field, while 10% of the server calls will have 10 in the **Elapsed Time (ms)** field.

- The **Table Size (Current)** field tells you the amount of records that were in the table when you started the Client Monitor. This information can help explain why server calls to a particular table can take such a long time (that is, when the Elapsed Time (ms) values are high).
- The **SQL Status** field tells you whether the data was read from the server or from the client cache.
- A check mark in the **Locking** field indicates that the server call has locked data. To focus on locking issues you can place a filter on this field.

The Client Monitor cannot be used to analyze temporary tables because they are stored on the client and inserts into temporary tables do not involve server calls.

The Client Monitor gathers and displays all the database function calls that are made by the C/AL code, as well as the server calls that are made indirectly by, for example, opening a form. The C/AL code that initiates a database function call can be seen in the **Source Object** and **Source Text** fields (these fields are not shown in the previous picture).

However, this is not the most informative way of viewing the code. To get a more detailed overview of the code that made a particular database call, select the line in question in the Client Monitor and click C/AL Code. The ***Code Overview*** window opens displaying the code that made the database function call. This gives you a quick way of locating the relevant piece of code.



The focus of the ***Code Overview*** window is the line in the code that made the database call. If C/SIDE made the database call, the ***Code Overview*** window will point to the last C/AL code that was executed before

made the database call.

Note

When the code contains an `IF..THEN ..ELSE` statement, the break point that is displayed in the ***Code Overview*** window will often be slightly inaccurate.

You can also specify that the information collected by the Code Coverage tool is stored permanently in a table. This means that the data is always available and you will not have to profile the task every time you need to see this data. However, permanently storing this information makes the Client Monitor and the Code Coverage tool work more slowly.

To store the code coverage information in a table:

1 Run form 150021, Client Monitor Setup.

2 Enter a check mark in the **Save Code Coverage Info.** field.

The Most Problematic Server Calls

To identify the most problematic server calls:

1 Profile your task as described in “Using the Client Monitor to Profile a Task”.

2 Run form 150020, Client Monitor.

3 Click View, Sort to sort the data in the ***Client Monitor*** window. Sorting by Elapsed Time (ms) in descending order is one of the more useful ways of viewing the data. The server calls that took the longest time will then be listed at the top. This will help you identify the most problematic server calls.

After you have identified the problematic server calls, you can optimize the slow queries that are caused by filters and keys that don’t match (especially on SQL Server) by using the appropriate keys in the queries or possibly by changing the existing keys.

Note

Rearranging the fields in a key, for example, by moving the first field in a key to the end and by changing the references to the key (both in the code and in the properties), can solve a performance problem. Furthermore, any FlowFields in the key that are calculating sums are guaranteed to work as long as all the original fields are left in the key. If you remove some of the fields from a key, you can cause some FlowFields that are calculating sums to produce run time errors.

When you are developing an application, you will not encounter problems like the one described above, unless you enter some pseudo-realistic amounts of data into the database.

Carefully read the information about performance in the section "Keys, Queries and Performance" on page 39.

The Overall Picture

You can use the Client Monitor together with Microsoft Excel to analyze the time spent by tasks that make many server calls (that is, 100+). You must begin by profiling the task as described in the section "Using the Client Monitor to Profile a Task" on page 17. The data must then be transferred into Excel.

To transfer the data into Excel:

1 Run form 150020, Client Monitor.

2 Click Export and save as a `.txt` file.

3 In Excel, import the `.txt` file that you have just saved.

You now have a spreadsheet containing the basic Client Monitor data.

You use the pivot tables in Excel to generate a sorted list of the tables that take the most time. The pivot table must also list the functions that are used as well as the search method and the search result for each table. You must also check the server calls that generated the sums to see the average amount of elapsed time for each server call.

You can also create new spreadsheets that summarize different operations on various tables by using the Pivot Table feature.

To create a pivot table:

1 Click Data, PivotTable, PivotChart Report and click Finish in the wizard that appears.

You can now choose which breakdown of the Client Monitor elements you would like to analyze. This example uses the typical elements.

2 In the ***PivotTable*** window, select the Table Name button and drag it over to the range that says "Drop Row Fields Here".

3 Repeat this procedure for Function Name, Search Method and Search Result placing each field to the right of the previous field.

4 Drag Elapsed Time (ms) over to the range that says "Drop Data Items Here".

You can now see the breakdown of timings per table/function etc, summed up.

To list the most important tables first:

1 Double-click the **Table Name** field heading.

2 Select Advanced.

3 In the **AutoSort** options, select Descending. In the **Using** drop-down list select Sum of Elapsed Time (ms).

To list the most important functions per table first, repeat this procedure for the **Function Name** field.

If there are any totals that you do not want to see, right-click the field that contains the word Total and click Hide.

For more information about pivot tables, see the online help in Excel.

Here is a snapshot of an analysis of elapsed time:

Analysis at Table and Function Level – Sum of Elapsed Time (ms)				
Sum of Elapsed Time (ms)				
Table Name	Function Name	Search Method	Search Result	Total
Reservation Entry	`CALCSUMS`	(blank)	(blank)	380
	`DELETE`	(blank)	(blank)	1382
	`FIND/NEXT`	-	-	630
			(blank)	361
		+	+	0
			(blank)	30
		=	=	140
			(blank)	0
		>	>	40
			(blank)	1851
	`INSERT`	(blank)	(blank)	20
	`LOCKTABLE`	(blank)	(blank)	0
	`MODIFY`	(blank)	(blank)	1673
Reservation Entry Total				6507
Calendar Entry	`FIND/NEXT`	+	+	490
		<	(blank)	1792
Calendar Entry Total				2282

These pivot tables contain information about the amount of time that was spent performing certain operations. The table contains a table-by-table breakdown of the time spent on each of the tables that were involved in the operations as well as the total time used. The tables are listed in ascending order of time spent. The table also lists the functions that were called on each table and the time it took to perform each operation.

The first table listed is the ***Reservation Entry*** table. You can see that a total of 380 milliseconds were spent calculating sums and 1382 milliseconds were spent performing deletions. A list of the `FIND` operations follows, which details the operations that were performed and the amount of time that each operation took.

A total of 20 milliseconds were spent performing inserts into the ***Reservation Entry*** table. A total of 1673 milliseconds were spent modifying data in the ***Reservation Entry*** table.

If time is spent on modifications (`INSERT`, `MODIFY`, `DELETE`, `MODIFYALL`, `DELETEALL`) and the average time spent on modification server calls is high, you should check the keys in the table. The number and length of the keys greatly influence the time it takes to make modifications on both database servers. On SQL Server, if the average time spent on modification server calls is extremely long, check whether or not there are SumIndexFields in the keys and whether or not the *MaintainSIFTIndex* property is set to *Yes* for these keys. Setting the *MaintainSIFTIndex* property to *No* for these keys can greatly improve the speed of modification server calls, but there will be some loss of performance for those tasks that generate sums using these keys.

2.5 Locking

You can also use the Client Monitor to see whether or not locking prevents concurrent tasks from being executed at the same time and to identify where deadlocks occur in a specific multi-user scenario. Before using the Client Monitor to identify potential locking problems you must import some Client Monitor helper objects:

1 Import the `Client Monitor.fob` file, including the following forms:

Form 150020, Client Monitor

Form 150024, Client Monitor (Multi-User)

2 Compile all the objects that are imported. This must be done because some of the field definitions are different on the two database server options.

To identify locking problems:

1 Before trying to identify any locking problems, you must make sure the clocks are synchronized on all the client machines. You can set up computers running most Windows operating systems so that their clocks are automatically synchronized with the time on a server when they log on by using the following command: “`net time \\computername /SET`”.

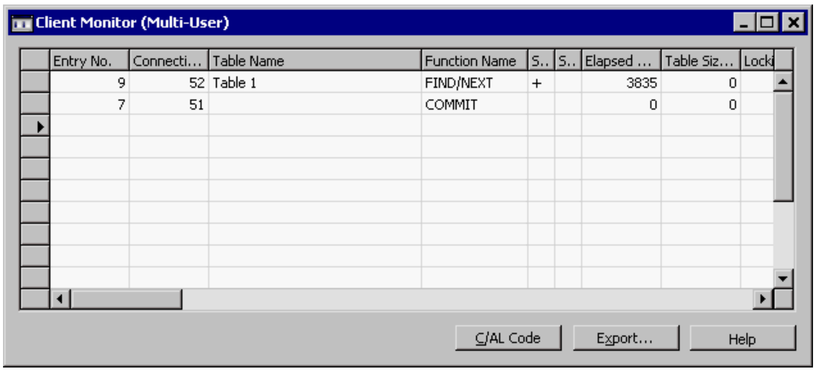
2 Start the Client Monitor on all the computers that are involved in the multi-user test.

3 Perform the tasks that you want to test.

4 Stop the Client Monitor on all the computers.

5 On each client computer, process the common client monitor data by running form 150020, Client Monitor.

6 Run form 150024, Client Monitor (Multi-User) on one of the client computers.



The ***Client Monitor (Multi-User)*** window contains information about the transactions that might have blocked other clients. The `COMMIT` in the transactions that might have blocked other clients is shown together with the server calls made by the clients that are potentially waiting for the `COMMIT` to be completed. The other server calls are listed before the `COMMIT`.

For example, in the window shown here, you can see that the client with Connection ID 52 has waited almost 4 seconds. This indicates that there might have been a block.

7 Check the values in the **Elapsed Time (ms)** field to see if there are any server calls that are taking longer than normal.

A high value in the **Elapsed Time (ms)** field indicates that a server call is waiting for locks to be released. Use the filtering features in Navision to see all the details of the locking scenarios. The value in the **Locking** field is *Yes* when a server call locks data. You should put a filter on this field to limit the data.

8 If a deadlock has occurred on SQL Server, the **SQL Error** field in the **Client Monitor (Multi-User)** window will show the error message generated by SQL Server. To see all these lines, set the filter “SQL Error<>’’. These lines are marked red and bold.

For more information about locking, see the section "Locking in Navision – A Comparison of Navision Database Server and SQL Server" on page 41.

- You can “optimize” locking by checking whether a set is empty or not. If it is not empty, you can continue locking and reading through the set. If a table is empty, it should not be used at all, and this will remove all the locking problems that are caused by that table. Such a solution can, for example, be acceptable for the comment lines on a sales order during posting.
- You can limit the locking on SQL Server by setting the *MaintainSIFTIndex* property on a key with SumIndexFields to *No*.
- In Navision, you can use the *SIFTLevelsToMaintain* property to more precisely control the level of performance and locking on SQL Server.

Locating the Tasks That Cause Deadlock Problems on Navision Database Server

Two transactions can only cause a deadlock if they both lock some of the same tables. However, if both of the transactions are defined so that the first lock they place is on the same table, no deadlock will occur. In other words, a deadlock occurs when two or more transactions have a conflicting locking order.

When you want to identify potential locking problems, you only need to use one client. You run the tasks on the client that you think might cause locking problems and gather all of the relevant data in the Client Monitor and then open a special form to see if there are any potential deadlocks.

To find potential deadlocks on Navision Database Server:

1 Import the `Client Monitor.fob` file, if you have not already imported it.

2 Compile all the objects that are imported. This must be done because some of the field definitions are different on the two database server options.

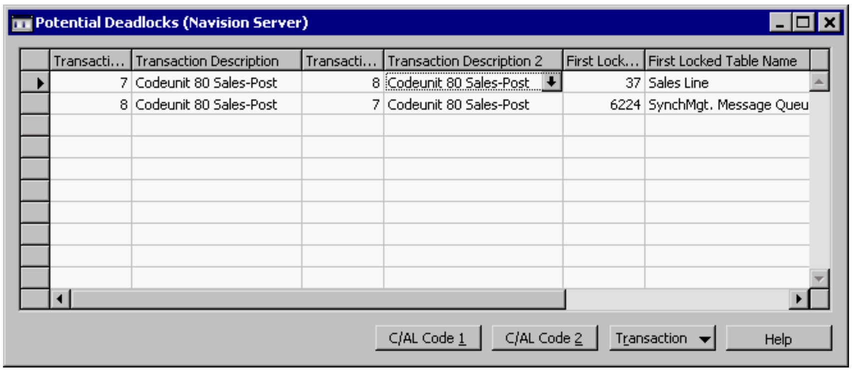
3 Prepare the tasks that you want to run concurrently without any deadlocks occurring.

4 Open and start the Code Coverage tool and then open and start the Client Monitor.

5 Perform the tasks.

6 Stop the Client Monitor and then stop the Code Coverage tool.

7 Run form 150030, Potential Deadlocks (Navision).



The ***Potential Deadlocks (Navision Server)*** window lists all the potential deadlocks or locking order conflicts that occurred during the tasks that you performed and is based on an analysis of the locking order that is used in each write transaction that was carried out. Each line in the window contains information about two transactions that represent a potential deadlock. These transactions represent a potential deadlock because they both lock some of the same tables but lock them in a different order. Sets of transactions that do not contain a potential deadlock are not displayed.

Each line in the window contains the following information:

Field:	**Contains:**
Transaction No.	The number of the first of the two transactions that represent a potential deadlock.
Transaction Description	By default, this field contains the name of the object that initiated the first transaction.
Transaction No. 2	The number of the second transaction.
Transaction Description 2	By default, this field contains the name of the object that initiated the second transaction.
First Locked Table ID First Locked Table Name	The ID and the name of the first table that is common to both transactions and is locked by the first transaction.
First Locked Table ID 2 First Locked Table Name 2	The ID and the name of the first table that is common to both transactions and is locked by the second transaction.

From this form, you can access more detailed information about the locks that were placed by each transaction, as well as the code that was used.

- To see the details about one of the transactions, select a line in the ***Potential Deadlocks (Navision Server)*** window and click Transaction, Client Monitor, Transaction 1 or 2. The details are displayed in the Client Monitor.
- To see the locking operations that were performed by one of the transactions, select a line in the ***Potential Deadlocks (Navision Server)*** window and click Transaction, Client Monitor (Locking Operations Only), Transaction 1 or 2. The locking operations are displayed in the Client Monitor.
- To see the locking order used by one of the transactions, select a line in the ***Potential Deadlocks (Navision Server)*** window and click Transaction, Locking Order, Transaction 1 or 2. The locking order used by the transaction you select is displayed in the ***Transaction Locking Order*** window.
- To see the code that made the first server call in the first transaction, select the appropriate line in the ***Potential Deadlocks (Navision Server)*** window and click C/AL Code 1. The code is displayed in the ***Code Overview*** window.

Locking Order Rules on Navision Database Server

As stated in the previous section a deadlock occurs when two or more transactions have a conflicting locking order and no deadlock can occur if the first lock the transactions place is on the same table.

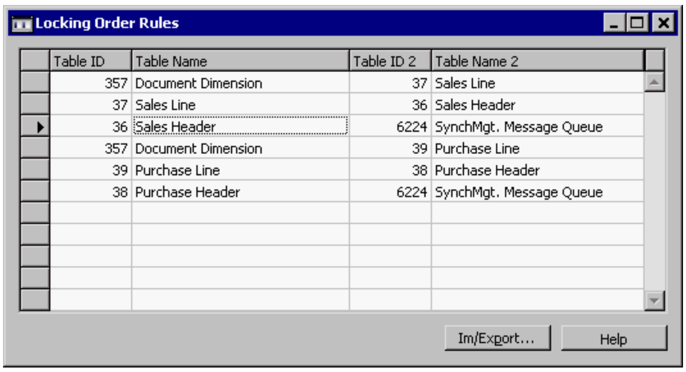
From this we can deduce that if you have an agreed set of rules that determine the locking order that must be used in your application then no deadlocks will occur. The problem is that agreeing to a set of rules is one thing, adhering to the rules is another thing entirely. Remembering the rules isn't as easy as it sounds – there could be a large number of them.

There is now a tool that can help you see whether or not your application follows the locking rules that you have specified.

This involves determining which rules must apply in your application, entering them into the system and then checking your application to see if it violates the rules or not.

After you have determined the rules that must govern locking order in your application, you can enter them into the system:

1 Run form 150029, Locking Order Rules and the ***Locking Order Rules*** window appears:



2 Enter the rules that you want your application to follow. Each entry represents a rule and you can enter as many rules as you need.

Each rule specifies that one table must be locked before another table. Needless to say your rules must not contain any conflicts. The consistency of the rules is checked when you test your application to see if it follows the rules. If the rules contain a conflict you will receive an error message.

After you have entered the rules, you can test whether or not your application follows the rules.

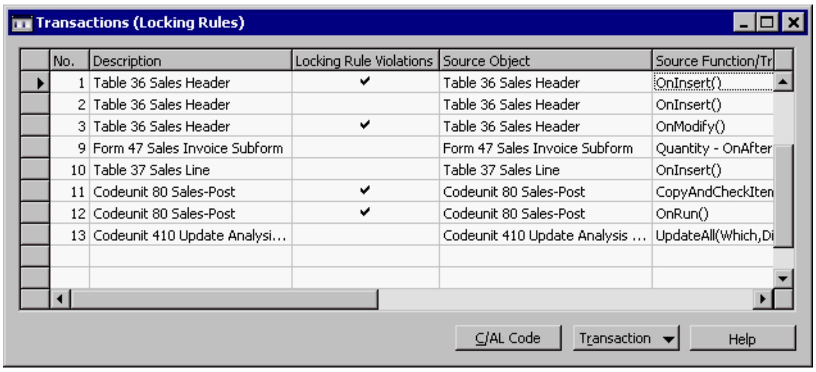
1 Open and start the Code Coverage tool and then open and start the Client Monitor.

2 Perform the tasks that you want to test.

3 Stop the Client Monitor and then stop the Code Coverage tool.

4 Run form 150027,Transactions (Locking Rules).

5 The ***Transactions (Locking Rules)*** window appears listing the transactions that you performed:



No.	Description	Locking Rule Violations	Source Object	Source Function/Tr
1	Table 36 Sales Header	✔	Table 36 Sales Header	OnInsert()
2	Table 36 Sales Header		Table 36 Sales Header	OnInsert()
3	Table 36 Sales Header	✔	Table 36 Sales Header	OnModify()
9	Form 47 Sales Invoice Subform		Form 47 Sales Invoice Subform	Quantity - OnAfter
10	Table 37 Sales Line		Table 37 Sales Line	OnInsert()
11	Codeunit 80 Sales-Post	✔	Codeunit 80 Sales-Post	CopyAndCheckIten
12	Codeunit 80 Sales-Post	✔	Codeunit 80 Sales-Post	OnRun()
13	Codeunit 410 Update Analysi...		Codeunit 410 Update Analysis ...	UpdateAll(Which,Di

- If any of the transactions violated the rules that you specified earlier a check mark is displayed in the **Locking Rule Violations** field.
- To see the C/AL code that broke the locking rule, select the transaction in question and click C/AL Code. The ***C/AL Code – Code Coverage*** window appears displaying the relevant code.
- To see all the operations and tables that were involved in a particular transaction, select the transaction and click Transaction, Client Monitor.
- To see only the locking operations and the tables that were locked in a particular transaction, select the transaction and click Transaction, Client Monitor (Locking Operations Only).
- To see the order in which tables were locked by a particular transaction, select the transaction and click Transaction, Locking Order.
- To see the locking rules that were violated by a particular transaction, select the transaction and click Transaction, Locking Rules Violated.

Locating the Clients That Cause Deadlock Problems on SQL Server

When a deadlock occurs, one transaction continues, while the others are aborted. To find out which clients are involved in a deadlock on SQL Server and which clients are not stopped, see the section "SQL Server Error Log" on page 37.

Identifying the Keys That Cause Problems on SQL Server

When you are using the SQL Server Option, it is important that any customizations that you develop contain keys and filters that are designed to run optimally on SQL Server. We have therefore developed a tool that helps you test your keys and filters in a development environment and ensure that they conform to the demands made by SQL Server

When you want to see if an application contains any keys that might cause problems, you only need a demonstration database and not a copy of the customer's database. Inserting, modifying and deleting records will take a similar amount of time in both large and small databases. However, the amount of time that it takes to read will be very different, especially for tables that become very large in the customer's database. This means that an analysis based on the **Elapsed Time (ms)** field in the Client Monitor is not enough when you are troubleshooting performance problems in a small database.

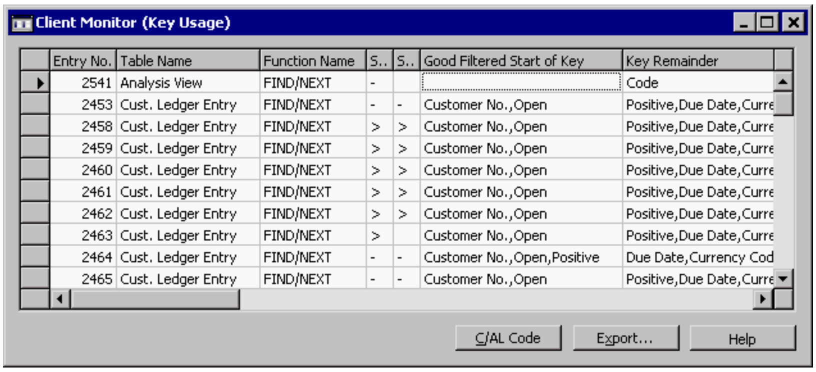
To check whether the keys and filters are designed correctly:

1 Open and start the Code Coverage tool and then open and start the Client Monitor.

2 Perform the task that you want to test.

3 Stop the Client Monitor and then stop the Code Coverage tool.

4 Open form 150022, Client Monitor (Key Usage).



Entry No.	Table Name	Function Name	S..	S..	Good Filtered Start of Key	Key Remainder
2541	Analysis View	FIND/NEXT	-			Code
2453	Cust. Ledger Entry	FIND/NEXT	-	-	Customer No.,Open	Positive,Due Date,Curre
2458	Cust. Ledger Entry	FIND/NEXT	>	>	Customer No.,Open	Positive,Due Date,Curre
2459	Cust. Ledger Entry	FIND/NEXT	>	>	Customer No.,Open	Positive,Due Date,Curre
2460	Cust. Ledger Entry	FIND/NEXT	>	>	Customer No.,Open	Positive,Due Date,Curre
2461	Cust. Ledger Entry	FIND/NEXT	>	>	Customer No.,Open	Positive,Due Date,Curre
2462	Cust. Ledger Entry	FIND/NEXT	>	>	Customer No.,Open	Positive,Due Date,Curre
2463	Cust. Ledger Entry	FIND/NEXT	>		Customer No.,Open	Positive,Due Date,Curre
2464	Cust. Ledger Entry	FIND/NEXT	-	-	Customer No.,Open,Positive	Due Date,Currency Cod
2465	Cust. Ledger Entry	FIND/NEXT	-	-	Customer No.,Open	Positive,Due Date,Curre

Queries with filters that do not use the keys appropriately are shown in this window. The key that is being used is split into two fields: **Good Filtered Start of Key** and **Key Remainder**. Those fields that are filtered to a single value, but are not used efficiently on SQL Server because of the selection and ordering of fields in the key that is used, are shown in the **Key Candidate Fields** field.

Remember, SQL Server always wants a single-value field as the filter or as the first field in the filter. For more information about keys and filters, see the section "Keys, Queries and Performance" on page 39.

The information in the ***Client Monitor (Key Usage)*** window is sorted by table name and only displays the queries with filters that can potentially cause problems. You will therefore have to use your knowledge of the application that you are developing and the theory behind the design of keys for SQL Server to decide which of the queries you can ignore and which you will have to modify.

In general, you should:

- Ignore those queries that use small tables that will not grow very large in the customer's database. An example of a small table that you can readily ignore is table 95, ***G/L Budget Name***.
- Focus on the large tables and the tables that will grow rapidly in the customer's database.
- Focus on the **Key Candidate Fields** and the **Good Filtered Start of Key** fields.
- As mentioned earlier you should look at the **Good Filtered Start of Key** field. If this field is empty, check the **Key Candidate Fields** field and decide whether the fields shown here would have made a difference if they had been used efficiently. This is where your understanding of the application will help you.

You need to decide whether the suggested key will make the query run more efficiently or not. If the suggested filter is a field that contains many different values, it will probably help.

If you really understand the theory behind the design of efficient queries, you will know whether or not it makes sense to change the application.

However, if you are uncertain about the theory you will have to test the suggested query. This means that you must use a database that contains a realistic amount of data and then test the existing filter and the suggested new filter to see which one works more efficiently.

Note

The ***Client Monitor (Key Usage)*** window also gives you information about how a key works on Navision Database Server. Some keys will give problems on both servers and others will only be a problem on SQL Server.

Reading Problems on SQL Server

When you are running on SQL Server and are reading data, some `NEXT` function calls can generate separate SQL statements instead of using the data that is stored in cache, and this can cause performance problems. The Client Monitor also contains a tool that can help you locate the C/AL code that generated these problematic SQL `NEXT` statements.

To locate this C/AL code, you must perform the tasks in question, identify the problematic `NEXT` statements and then locate the C/AL code that generated these statements.

1 Import the `Client Monitor.fob` file, if you have not already imported it.

2 Compile all the objects that are imported. This must be done because some of the field definitions are different on the two database server options.

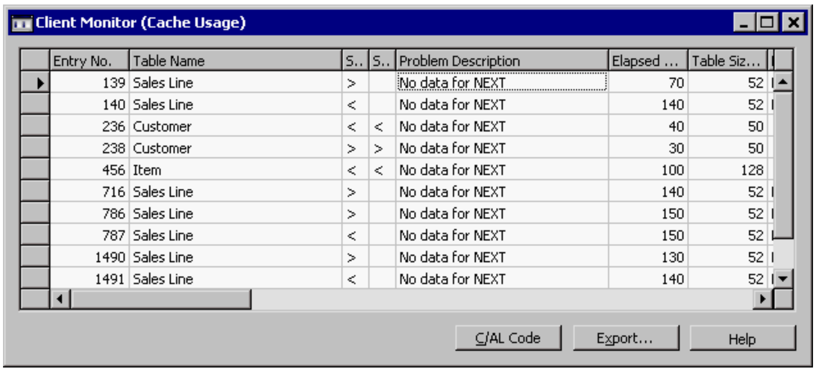
3 Prepare the tasks that you want to perform.

4 Open and start the Code Coverage tool and then open and start the Client Monitor.

5 Perform the tasks that you want to test.

6 Stop the Client Monitor and then stop the Code Coverage tool.

7 Run form 150023, Client Monitor (Cache Usage).



Entry No.	Table Name	S..	S..	Problem Description	Elapsed ...	Table Siz...
139	Sales Line	>		No data for NEXT	70	52
140	Sales Line	<		No data for NEXT	140	52
236	Customer	<	<	No data for NEXT	40	50
238	Customer	>	>	No data for NEXT	30	50
456	Item	<	<	No data for NEXT	100	128
716	Sales Line	>		No data for NEXT	140	52
786	Sales Line	>		No data for NEXT	150	52
787	Sales Line	<		No data for NEXT	150	52
1490	Sales Line	>		No data for NEXT	130	52
1491	Sales Line	<		No data for NEXT	140	52

The ***Client Monitor (Cache Usage)*** window lists the problematic `NEXT` statements that were generated by the tasks that you performed. All of the normal `NEXT` statements are ignored.

These `NEXT` statements are problematic because they generate their own SQL statement and database call to retrieve data from the server and do not use the data that is already cached on the client. It is difficult to know with certainty why these `NEXT` statements behave like this. It might be:

- because C/SIDE is unable to optimize this function.
- a result of the way that the code is written.

However these `NEXT` statements only cause problems if they are run repeatedly as part of a long-running batch job and generate a large number of extra server calls.

To see the C/AL code that generated the SQL `NEXT` statements, select the line you are interested in and click C/AL Code. The code that generated the statement is displayed in the ***Code Overview*** window.

To export the data in this window as a text file, click Export.

Chapter 3
Other Issues

This chapter discusses some of the other issues that you must take into consideration when you are trying to identify and solve performance problems.

This chapter contains the following sections:

- Hardware Setup
- SQL Server Error Log
- Keys, Queries and Performance
- Locking in Navision – A Comparison of Navision Database Server and Microsoft SQL Server
- Configuration Parameters

3.1 Hardware Setup

It is also possible that poor performance is caused by the hardware that you are using. There are three aspects of the hardware that you should consider: the server, the clients and the network.

Hardware Setup for the Database Server

To identify any hardware bottlenecks that may exist on a server use the Windows Performance Monitor. You should check the time usage for the both the disks and the CPU.

If the disks cause the bottleneck, you can lessen the problem and improve performance by:

- Adding more RAM to decrease disk activity, such as swapping.
- Spreading the SQL Server database and log files across more disks.
- Adding one disk controller per disk.
- Installing faster disks.
- If the bottleneck is caused by the CPUs, you can improve performance by installing faster CPUs.

On SQL Server, if the performance problems are only significant when multiple users are working simultaneously, adding more CPUs will lessen the problem. If the bottleneck is not caused by the hard disks or the CPUs, it is outside the server and lies either in the network or on the client computers.

It is always a good idea to expand the search for bottlenecks beyond the server hardware and try to identify the reasons behind the unacceptable usage of resources.

You can use the Windows Performance Monitor to monitor the following server performance counters:

Object Name	Counter Name	Instances	Best Values	Recommendation (Best Values not met)
Memory	Available Mbytes	SQL Server TS Servers	5MB	Add more memory Reserve less memory for SQL Server
	Pages/sec	SQL Server TS Servers	<25	Add more memory Reserve less memory for SQL Server
Physical Disk	Avg Disk Read Queue length	SQL Server Disks	<2	Change disk system
	Avg Disk Write Queue length	SQL Server Disks	<2	Change disk system

Object Name	**Counter Name**	**Instances**	**Best Values**	**Recommendation (Best Values not met)**
Processor	% Processor time	SQL Server TS Servers	0-80	Add more CPUs
System	Processor Queue Length	SQL Server TS Servers	<2	Add more CPUs
	Context Switches/sec SQL Server	SQL Server TS Servers (Multi-processor)	<8000	Set Affinity Mask
Network Interface	Output queue length	SQL Server TS Servers	<2	Increase network capacity
SQL Server Access Methods	Full Scans/sec	SQL Server		Review Navision C/AL Code
	Page Splits/sec	SQL Server	0	Defrag SQL Server Indexes, Review Navision C/AL Keys
SQL Server Buffer Manager	Buffer Cache Hit Ratio	SQL Server	>90	Add more memory
SQL Server Databases	Log Growths	SQL Server	0 (during peak times)	Increase and set the size of the transaction log
SQL Server General Statistics	User Connections	SQL Server		
SQL Server Locks	Lock Requests/sec	SQL Server		Review Navision C/AL Code
	Lock Wait/sec	SQL Server		Review Navision C/AL Code

Hardware Setup for Clients

To identify any hardware bottlenecks that may exist on a client computer use the Windows Performance Monitor. You should check the time usage for both the disks and the CPU.

If the disks on the client computer cause the bottleneck, you can lessen the problem and improve performance by:

- Adding more RAM to decrease disk activity such as swapping.
- Installing faster disks.

If the bottleneck is the CPU, you can improve performance by changing to a faster CPU.

If it isn't the hard disks or the CPU that are causing the bottleneck, the problem (if it is a hardware problem) is located outside the client and lies either in the network or on the server.

Network

If neither the database server nor the clients seem to be the bottleneck in a system, look at the network. To find out if a critical task runs slowly because the network is slow, run the same task directly on the database server. The difference in speed tells you the maximum improvement you can hope to achieve by having an optimal network. You can also create a form based on the ***Performance*** virtual table to see some measurements for the network you are using.

The good thing about hardware problems is that the solution is always hardware. It will always be possible to improve performance by adding new hardware. The improvement may only be slight, but it is still an improvement. Unfortunately, this can give you a false sense of security. Your installation may have some serious problems, the symptoms of which you are only alleviating by adding new hardware, while the real source of the problem remains unaltered.

3.2 SQL Server Error Log

To monitor deadlocks on SQL Server, enable trace flags 1204 and 3605 (if you are running SQL Server 2000 and have not upgraded to Service Pack 3) in the Startup Parameters of SQL Server, and then restart the server. This will generate diagnostic messages in the SQL Server Error Log.

Trace Flag 1204 – returns the type of locks that are participating in the deadlock and the current command affected.

Trace Flag 3605 – sends the trace output to the error log. This is always done when you are running SQL Server 2000 Service Pack 3 or later. (If you start SQL Server from the command prompt, the output also appears on the screen.)

Secondly you should implement a SQL Server alert to notify an operator when a deadlock occurs so that an investigation of the deadlock scenario can start immediately.

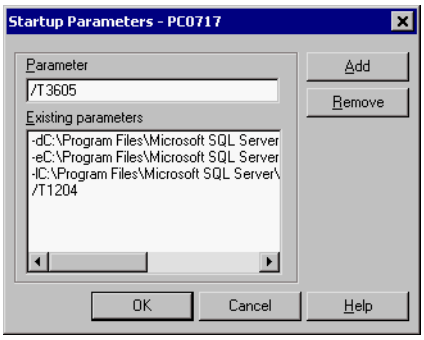
To enable a trace flag:

1 Open Enterprise Manager.

2 Expand Microsoft SQL Servers and expand SQL Server Group.

3 Right-click the server for which you want to enable the trace flags and select Properties.

4 In the ***SQL Server Properties (Configure)*** window, click Startup Parameters and the ***Startup Parameters*** window appears:



5 Enter the name of the trace flag in the **Parameter** field and click Add and then click OK.

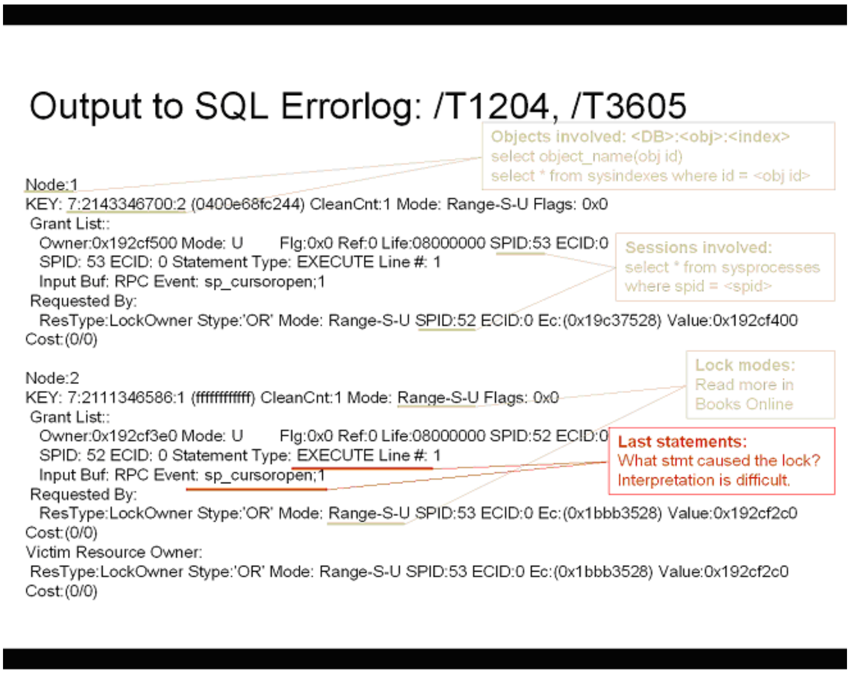
If your application experiences some locking problems you can open the SQL error log and see the types of locks that were placed and the clients that were involved.

To open the SQL error log:

1 Open the ***Startup Parameters*** window as described earlier.

2 Use the scroll bar in the **Existing Parameters** field to see which of the parameters is the error log. This also tells you the path to where the error log is stored. This is normally `C:\Program Files\Microsoft SQL Server\MSSQL\log\ERRORLOG`.

3 Locate the error log and open it in Notepad.



3.3 KEYS, QUERIES AND PERFORMANCE

When you write a query that searches through a subset of the records in a table, you should always carefully define the keys both in the table and in the query so that Navision can quickly identify this subset. For example, the entries for a specific customer will normally be a small subset of a table containing entries for all the customers.

If Navision can locate and read the subset efficiently, the time it will take to complete the query will only depend on the size of the subset. If Navision cannot locate and read the subset efficiently, performance will deteriorate. In the worst-case scenario, Navision will read through the entire table and not just the relevant subset. In a table containing 100,000 records, this could mean taking either a few milliseconds or several seconds to answer the query.

To maximize performance, you must define the keys in the table so that they facilitate the queries that you will have to run. These keys must then be specified correctly in the queries.

For example, you would like to retrieve the entries for a specific customer. To do this, you apply a filter to the **Customer No.** field in the ***Cust. Ledger Entry*** table. In order to run the query efficiently on SQL Server, you must have defined a key in the table that has **Customer No.** as the first field. You must also specify this key in the query.

The table could have these keys:

```
Entry No.
Customer No.,Posting Date
```

The query could look like this:

```
SETCURRENTKEY("Customer No.");
SETRANGE("Customer No.",'1000');
IF FIND('-') THEN
  REPEAT
  UNTIL NEXT = 0;
```

You should define keys and queries in the same way when you are using Navision Database Server. However, Navision Database Server can run the same query almost as efficiently if **Customer No.** is not the first field in the key. For example, if you have defined a key that contains **Country Code** as the first field and **Customer No.** as the second field and if there are only a few different country codes used in the entries, it will only take a little longer to run the query.

The table could have these keys:

```
Entry No.
Country Code, Customer No.,Posting Date
```

The query could look like this:

```
SETCURRENTKEY("Country Code","Customer No.");
SETRANGE("Customer No.",'1000');
IF FIND('-') THEN
```

```
REPEAT
UNTIL NEXT = 0;
```

But SQL Server will not be able to answer this query efficiently and will read through the entire table.

In conclusion, SQL Server makes stricter demands than Navision Database Server on the way that keys are defined in tables and on the way they are used in queries.

This section has been copied from the *Application Designer's Guide*.

3.4 Locking in Navision – A Comparison of Navision Database Server and SQL Server

The following information explains the differences and similarities in the way that locking is carried out in the two database options for Navision, Navision Database Server and SQL Server.

Important

The following information only covers the default transaction type UpdateNoLocks for the SQL Server Option for Navision. For information about the other transaction types, see the *C/SIDE Reference Guide* online Help.

Both Server Options

In the beginning of a transaction, the data that you read will not be locked. This means that reading data will not conflict with transactions that modify the same data. If you want to ensure that you are reading the latest data from a table, you must lock the table before you read it.

Locking Single Records

Normally, you must not lock a record before you read it even though you may want to modify or delete it afterwards. When you try to modify or delete the record, you will get an error message if another transaction has modified or deleted the record in the meantime. You receive this error message because C/SIDE checks the timestamp that it keeps on all of the records in a database and detects that the timestamp on the copy you have read is different from the timestamp on the modified record in the database.

Locking Record Sets

Normally, you lock a table before reading a set of records in that table if you want to read these records again later to modify or delete them. You must lock the table to ensure that another transaction does not modify these records in the meantime.

You will not receive an error message if you do not lock the table even though the records have been modified as a result of other transactions being carried out while you were reading them.

Minimizing Deadlocks

To minimize the amount of deadlocks that occur, you must lock records and tables in the same order for all transactions. You can also try to locate areas where you lock more records and tables than you actually need, and then diminish the extent of these locks or remove them completely. This can prevent conflicts on these records and tables.

If this does not prevent deadlocks, you can, as a last resort, lock more records and tables to prevent transactions from running concurrently.

If you cannot prevent the occurrence of deadlocks by programming, you must run the deadlocking transactions separately.

Locking in Navision Database Server

Data that is not locked will be read from the same snapshot (version) of the database.

If you call `LOCKTABLE` or a modifying function (for example, `INSERT`, `MODIFY` or `DELETE`), on a table, the whole table will be locked.

Locking Record Sets

As mentioned previously, you will normally lock a table before reading a set of records in that table if you want to read these records again later to modify or delete them. With Navision Database Server you can choose to lock the table with `LOCKTABLE(TRUE,TRUE)` after reading the records for the first time instead of locking with `LOCKTABLE` before reading the records for the first time.

When you try to modify or delete the records, you will receive an error message if another transaction has modified the records in the meantime.

You will also receive an error message if another transaction has inserted a record into the record set in the meantime. However, if another transaction has deleted a record from the record set in the meantime, you will not be able to notice this change. The purpose of locking with `LOCKTABLE(TRUE,TRUE)` after reading the records for the first time is to postpone the table lock that Navision Database Server puts on the table. This improves concurrency.

Locking in SQL Server

When data is read without locking, you will get the latest (possibly uncommitted) data from the database.

If you call `Rec.LOCKTABLE`, nothing will happen right away. However, when data is read from the table after `LOCKTABLE` has been called, the data will be locked.

If you call `INSERT`, `MODIFY` or `DELETE`, the specified record will be locked immediately. This means that two transactions, which insert, modify or delete separate records in the same table will not conflict. Furthermore, locks will also be placed whenever data is read from the table after the modifying function has been called.

It is also important to note that even though SQL Server initially puts locks on single records, it can also choose to escalate a single record lock to a table lock. It will do so if it determines that the overall performance will be improved by not having to set locks on individual records. The improvement in performance must outweigh the loss in concurrency that this excessive locking causes.

If you specify what record to read, for example, by calling `Rec.GET`, that record will be locked. This means that two transactions, which read specific, but separate, records in a table will not cause conflicts.

If you browse a record set (that is, read sequentially through a set of records), for example, by calling `Rec.FIND('-')` or `Rec.NEXT`, the record set (including the empty space) will be locked as you browse through it. However, the locking implementation used in SQL Server will also cause the record before and the record after this record set to be locked. This means that two transactions, which just read separate sets of records in a table, will cause a conflict if there are no records between these two record sets. When locks are placed on a record set, other transactions cannot put locks on any record within the set.

Note that C/SIDE decides how many records to retrieve from the server when you ask for the first or the next record within a set. C/SIDE then handles subsequent reads with no additional effort, and fewer calls to the server will give better performance. In addition to improving performance, this means that you cannot precisely predict when locks are set when you browse.

Note

Navision tables that have keys defined for SumIndexFields cause additional tables to be created in SQL Server to support SIFT functionality. One table is created for each key that contains SumIndexFields. When you modify a Navision table that has keys defined for SumIndexFields, modifications can be made to these SQL Server tables. When this happens, there is no guarantee that two transactions can modify different records in the Navision table without causing conflicts.

Locking Differences in the Code

A typical use of `LOCKTABLE(TRUE,TRUE)` in Navision Database Server is shown in the first column of the table below. The equivalent code for the SQL Server Option is shown in the second column. The code that works on both servers is shown in the third column.

The `RECORDLEVELLOCKING` property is used to detect whether record level locking is being used. If this is the case, then you are using the SQL Server Option for Navision. This is currently the only server that supports record level locking.This section has been copied from the *Application Designer's Guide*.

Navision Database Server

```
IF Rec.FIND('-') THEN
  REPEAT
  UNTIL Rec.NEXT = 0;
Rec.LOCKTABLE(TRUE,TRUE);
IF Rec.FIND('-') THEN
  REPEAT
    Rec.MODIFY;
  UNTIL Rec.NEXT = 0;
```

SQL Server

```
Rec.LOCKTABLE;
IF Rec.FIND('-') THEN
  REPEAT
  UNTIL Rec.NEXT = 0;
IF Rec.FIND('-') THEN
  REPEAT
    Rec.MODIFY;
  UNTIL Rec.NEXT = 0;
```

Both Server Types

```
IF Rec.RECORDLEVELLOCKING THEN
 Rec.LOCKTABLE;
IF Rec.FIND('-') THEN
  REPEAT
  UNTIL Rec.NEXT = 0;
IF NOT Rec.RECORDLEVELLOCKING THEN
 Rec.LOCKTABLE(TRUE,TRUE);
IF Rec.FIND('-') THEN
  REPEAT
    Rec.MODIFY;
  UNTIL Rec.NEXT = 0;
```

3.5 Configuration Parameters

You can configure a Navision database by creating a SQL Server table configuration parameter table and entering parameters into the table that will determine some of the behavior of Navision when it is using this database.

In the database create a table, owned by dbo:

```
CREATE TABLE [$ndo$dbconfig] (config VARCHAR(512) NOT NULL)

GRANT SELECT ON [$ndo$dbconfig] TO public
```

(You can add additional columns to this table, if necessary. The length of the *config* column should be large enough to contain the necessary configuration values, as explained below, but need not be 512.)

There is one record in this table for each parameter that is required.

The following sections describe the parameters that you can enter into this table.

Index Hinting

It is possible to force SQL Server to use a particular index when executing queries for `FIND('-')`, `FIND('+')`, `FIND('=')` and `GET` statements. This can be used as a workaround when SQL Server's Query Optimizer picks the wrong index for a query.

Index hinting can help avoid situations where SQL Server's Query Optimizer chooses an index access method that requires many page reads and generates long-running queries with response times that vary from seconds to several minutes. Selecting an alternative index can give instant 'correct' query executions with response times of milliseconds. This problem usually occurs only for particular tables and indexes that contain certain data spreads and index statistics.

In the rare situations where it is necessary, you can direct Navision to use index hinting for such problematic queries. When you use index hinting, Navision adds commands to the SQL queries that are sent to the server. These commands bypass the normal decision making of SQL Server's Query Optimizer and force the server to choose a particular index access method.

Note

This feature should only be used after all the other possibilities have been exhausted, for example, updating statistics, optimizing indexes or re-organizing column order in indexes.

The index hint syntax is:

```
IndexHint=<Yes,No>;Company=<company name>;Table=<table
name>;Key=<keyfield1,keyfield2,...>; Search Method=<search method
list>;Index=<index id>
```

Each parameter keyword can be localized in the "Driver configuration parameters" section of the `.stx` file.

The guidelines for interpreting the index hint are:

- If `IndexHint=No`, the entry is ignored.
- All the keywords must be present or the entry is ignored.
- If a given keyword value cannot be matched the entry is ignored.
- The values for the company, table, key fields and search method must be surrounded by double-quotes to delimit names that contain spaces, commas etc.
- The table name corresponds to the name supplied in the Object Designer (not the Caption name).
- The key must contain all the key fields that match the required key in the ***Keys*** window in the Table Designer.

4 The search method contains a list of search methods used in `FIND` statements, that must be one of '`-`', '`+`', '`=`', or '`!`' (for the C/AL `GET` function).

The index ID corresponds to a SQL Server index for the table: 0 represents the primary key; all other IDs follow the number included in the index name for all the secondary keys. Use the SQL Server command `sp_helpindex` to get information about the index ID associated with indexes on a given table. In this example we are looking for index information about the ***Item Ledger Entry*** table:

```
sp_helpindex 'CRONUS International Ltd_$Item Ledger Entry'
```

When Navision executes a query, it checks whether or not the query is for the company, table, current key and search method listed in one of the IndexHint entries. If it is, it will hint the index for the supplied index ID in that entry.

Note that:

- If the company is not supplied, the entry will match all the companies.
- If the search method is not supplied, the entry will match all the search methods.
- If the index ID is not supplied, the index hinted is the one that corresponds to the supplied key. This is probably the desired behavior in most cases.
- If the company/table/fields are renamed or the table's keys redesigned, the IndexHint entries must be modified manually.

Here are a few examples that illustrate how to add an index hint to the table by executing a statement in Query Analyzer:

EXAMPLE 1

```
INSERT INTO [$ndo$dbconfig] VALUES

('IndexHint=Yes;Company="CRONUS International Ltd.";Table="Item
Ledger Entry";Key="Item No.","Variant Code";Search Method="-
+";Index=3')
```

This will hint the use of the $3 index of the ***CRONUS International Ltd_$Item Ledger Entry*** table for `FIND('-')` and `FIND('+')` statements when the *Item No.*,*Variant Code* key is set as the current key for the ***Item Ledger Entry*** table in the CRONUS International Ltd. company.

EXAMPLE 2

```
INSERT INTO [$ndo$dbconfig] VALUES

('IndexHint=No;Company="CRONUS International Ltd.";Table="Item
Ledger Entry";Key="Item No.","Variant Code";Search Method="-
+";Index=3')
```

The index hint entry is disabled.

EXAMPLE 3

```
INSERT INTO [$ndo$dbconfig] VALUES

('IndexHint=Yes;Company="CRONUS International Ltd.";Table="Item
Ledger Entry";Key="Item No.","Variant Code";Search Method="-
+";Index=')
```

This will hint the use of the *Item No.*,*Variant Code* index of the ***CRONUS International Ltd_$Item Ledger Entry*** table for `FIND('-')` and `FIND('+')` statements when the *Item No.*,*Variant Code* key is set as the current key for the ***Item Ledger Entry*** table in the CRONUS International Ltd. company. This is probably the way that the index-hinting feature is most commonly used.

EXAMPLE 4

```
INSERT INTO [$ndo$dbconfig] VALUES

('IndexHint=Yes;Company=;Table="Item Ledger Entry";Key="Item
No.","Variant Code";Search Method="-+";Index=3')
```

This will hint the use of the $3 index of the ***CRONUS International Ltd_$Item Ledger Entry*** table for `FIND('-')` and `FIND('+')` statements when the *Item No.*,*Variant Code* key is set as the current key for the ***Item Ledger Entry*** table for all the companies (including a non-company table with this name) in the database.

EXAMPLE 5

```
INSERT INTO [$ndo$dbconfig] VALUES

('IndexHint=Yes;Company="CRONUS International Ltd.";Table="Item
Ledger Entry";Key="Item No.","Variant Code";Search Method=;Index=3')
```

This will hint the use of the $3 index of the ***CRONUS International Ltd_$Item Ledger Entry*** table for every search method when the *Item No.*,*Variant Code* key is set as the current key for the ***Item Ledger Entry*** table in the CRONUS International Ltd. company.

Lock Granularity

When Navision is reading data from tables it places forced `ROWLOCK` hints, by default. These rowlock hints prevent SQL Server from automatically determining the granularity (row, page or table) of the locks that it places. This can lead to a high locking overhead on the server, even though concurrency is optimum.

To allow SQL Server to determine the granularity of the locks that it places, the `DefaultLockGranularity` parameter can be used in the database configuration table.

The syntax of the `DefaultLockGranularity` parameter is:

```
DefaultLockGranularity=<Yes,No>
```

When the parameter is `Yes`, SQL Server will choose the granularity of the locks that it places. When the parameter is `No`, Navision will override SQL Server and place `ROWLOCK`s.

This section has been copied from the *Application Designer's Guide*.

Appendix A
Object List

This appendix contains a list of all the objects in the fob files described in the Performance Troubleshooting Guide.

A.1 Performance Troubleshooting Object List

The following tables list all the objects contained in the `.fob` files described in this document:

Session Monitor (Navision Server).fob		
Table	150010	Session Monitor Setup
Table	150011	Session Information
Form	150010	Session Monitor (Navision Server)
Form	150011	Session Monitor Lines
Form	150012	Session Monitor Setup (SQL)
Form	150013	Sessions
Codeunit	150010	Session Monitor Mgt.

Session Monitor (SQL Server).fob		
Table	150012	Session Monitor Setup (SQL)
Table	150013	Session Information (SQL)
Table	150014	Session (SQL)
Form	150014	Session Monitor (SQL Server)
Form	150015	Session Monitor Lines (SQL)
Form	150016	Session Monitor Setup (SQL)
Form	150017	Sessions (SQL Server)
Codeunit	150011	Session Monitor Mgt. (SQL Server)

ActivityLog.fob		
Table	150000	Activity Log Entry
Table	150001	Table Size Change
Form	150000	Activity Log
Form	150001	Table Size Changes

Sample Use of Activity Log.fob		
Codeunit	150000	Sample Use of Activity Log

Client Monitor.fob		
Table	150020	Client Monitor
Table	150021	Client Monitor Setup
Table	150022	Code Coverage Line

Table	150023	Transaction
Table	150024	Transaction Lock
Table	150025	Locking Rule
Table	150026	Potential Deadlock
Table	150027	Locking Rule Violation
Form	150020	Client Monitor
Form	150021	Client Monitor Setup
Form	150022	Client Monitor (Key Usage)
Form	150023	Client Monitor (Cache Usage)
Form	150024	Client Monitor (Multi-User)
Form	150025	Transactions
Form	150026	Transaction Locking Order
Form	150027	Transactions (Locking Rules)
Form	150028	Locking Rule Violations
Form	150029	Locking Order Rules
Form	150030	Potential Deadlocks (Navision)
Form	150031	C/AL Code – Code Coverage
Form	150032	C/AL Code – Adv. Code Coverage
Report	150020	Code Coverage
Dataport	150020	Export Client Monitor
Dataport	150021	Export/Import Code Coverage
Dataport	150022	Import/Export Locking Rules
Codeunit	150020	Client Monitor Mgt.
Codeunit	150021	Client Monitor to C/AL Code
Codeunit	150022	Transaction Mgt.
Codeunit	150023	Transaction to C/AL Code
Codeunit	150024	Transaction Lock to C/AL Code
Codeunit	150025	Locking Order Rules Mgt.
Codeunit	150027	Deadlock to C/AL Code
Codeunit	150028	Deadlock to C/AL Code 2

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