



Fast Access to DB2/400

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Executive Summary - Fast Access to DB2/400

Harnessing the power and performance of DB2/400 has eluded many professionals trained in the use of SQL as the primary means to access data. This challenge often extends to C/C++/C# and VB programmers alike.

Enterprises experienced with iSeries systems and DB2/400 performance and security often seek ways to extend both their experience and confidence with the environment; suggesting DB2/400 become the database for online transactions from Microsoft Windows and from web applications running in IIS. However, programming professionals experienced in the use of SQL often do not understand how to extract the best performance from DB2/400 in these situations. ASNA has developed DataGate for the express purpose of providing unparalleled performance in these exacting situations.

DB2/400 is unlike SQL in many ways, yet those developers whose experience is limited to SQL insist on using ODBC, OLE/DB and ADO, which is quite natural; the technology and architecture has proven its worth in the world of MS SQL Server and Oracle.

However, the integrated nature of OS/400 and DB2/400 dictates that DB2/400 be different from traditional Relational Databases.

The ability to process SQL statements in DB2/400 has been available for many years. However, the performance achievable by client/server applications via this interface is poor compared to what is achievable via record-at-a-time access patterns.

Why?

Usage patterns

When IBM developed DB2/400, it served only RPG and COBOL programs. Today, the vast majority of programs using DB2 are still RPG and COBOL. These programs access data via a construct called a *'file.'* In relational database terminology, the concept of a file is the equivalent of a scrollable server cursor. A file (cursor) maintains a current position, when a record (row) is read the current position is moved to that record and the record is locked. The application can rely on the fact that the record is locked to perform its update operation, which affects the current record.

The application deals with one record at a time. To operate on sets of records, such as all the detail lines of a purchase order, the application contains a loop where each record in the set is dealt with individually. While these operations are being performed on the set, the database is unaware that the set exists; while processing an individual record, the database is only concerned with the individual record, not the set. The grouping of individual records into a set only exists in the logic of the business application.

In order to be efficient in supporting these kinds of applications, certain architectural decisions had to be made while designing DB2/400. These decisions affected the way records are locked, indices are built, disk is allocated etc. The resulting database is highly optimized for the vast majority of its users: RPG and COBOL applications.

These kinds of tradeoffs are very common in the software world. We find a very similar case within typical relational databases, though in reversed order. The documentation for relational databases warns against the use of scrollable server cursors. The performance of applications using cursors to access one row at a time is inferior to those using set operations, reflecting the underlying decisions made while designing the engines of these products.

It is this deep understanding and appreciation for the differences that enables ASNA to develop its DataGate product to perform so much better than those constructed with ADO. The access patterns employed by the application, one record at a time, align much better to the architecture of the database.

ASNA DataGate vs. IBM DB2 UDB

Introduction

A series of tests were devised to demonstrate the comparative performance of a number of data intensive scenarios with client/server access to the IBM iSeries i5 model 520. Two mechanisms are evaluated: ASNA DataGate .NET for iSeries and IBM DB2 UDB for iSeries .NET Provider (IBM.Data.DB2.iSeries).

iSeries Platforms

The tests results were run on an iSeries i5 model 520; OS/400 V5R3 over a 10-baseT intranet.

Client and Web Server Platforms

The client and web serving machines were single processor Dell OptiPlex GX150. The client machines ran with Windows XP Professional. The web-serving machine ran with IIS 6.0 on Windows 2000 Server.

The Files

Tests were conducted on data files of varying sizes, both in the record size (file width) and number of records in the member (file length). Interestingly, the test results were affected more by the files' width than length.

File Name	Nbr of Records	Nbr of Fields	Record Length	Key Length
File A	12,000	10	151	5
File B	10,000	79	484	16
File C	13,000	338	2109	6
File D	144,000	15	82	10
File E	144,000	94	566	10
File F	144,000	353	2191	10

See Appendix A for detailed descriptions of each file used in the tests.

Timing

All times, exclude database connection and file open/close times. Only the actual file processing time is notes. Unless otherwise noted, database connection and file open times were nominal.

The Single Client Tests (Test Suites 1 & 2)

These tests were run from a single dedicated client to a dedicated iSeries 520.

The Multiple Client Tests (Test Suite 3)

These tests were run from a multiple dedicated clients to a dedicated iSeries 520.

The Multiple Client Middle Tier Tests (Test Suite 4)

These tests were run from dedicated Windows 2000 Server running IIS to a dedicated iSeries 520.

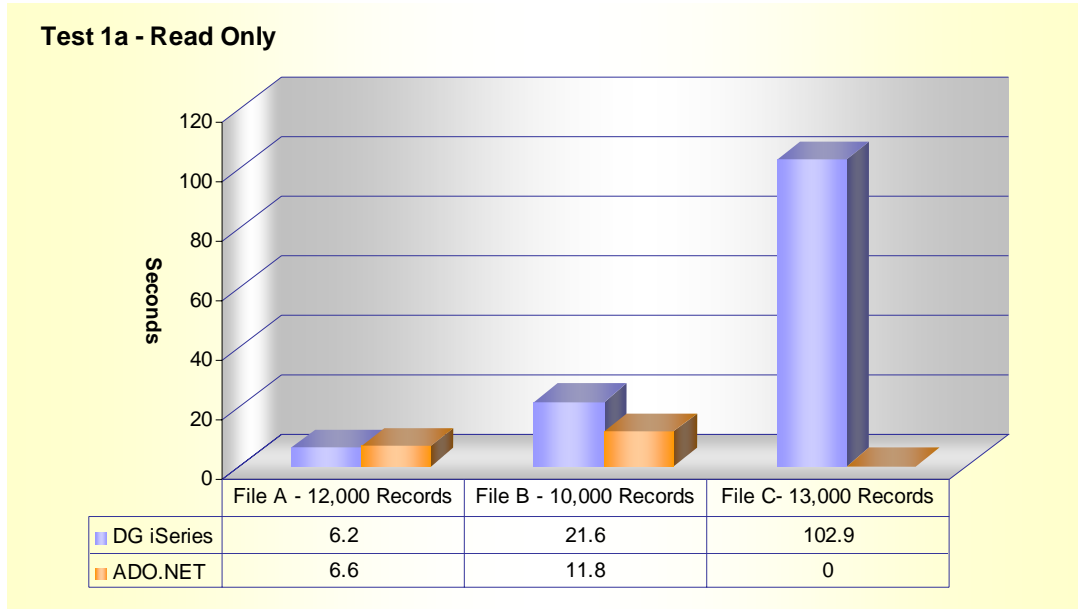
Single Client Tests

Test Suite 1

These tests demonstrate simple handling of large numbers of records.

Test 1a

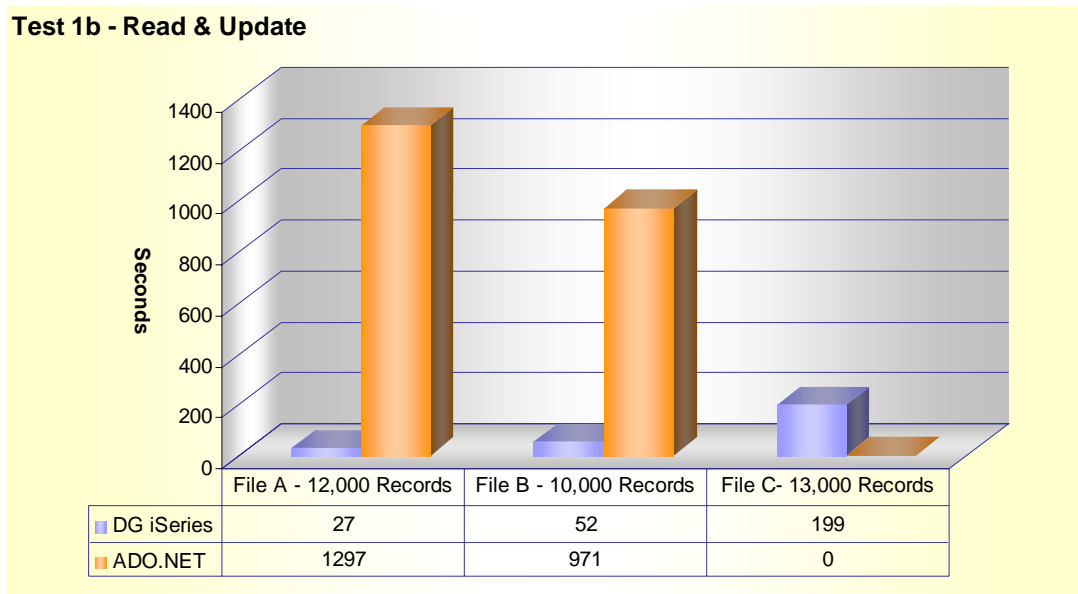
Simple indexed-sequential read of all records in the file.



- Results could not be obtained with FileC for DB2.NET test. File could not be read
- Results pending resolution from IBM

Test 1b

Update field(s) in each record in the file based upon indeterminate criteria (such as user data entry, etc.) where set processing is unavailable.

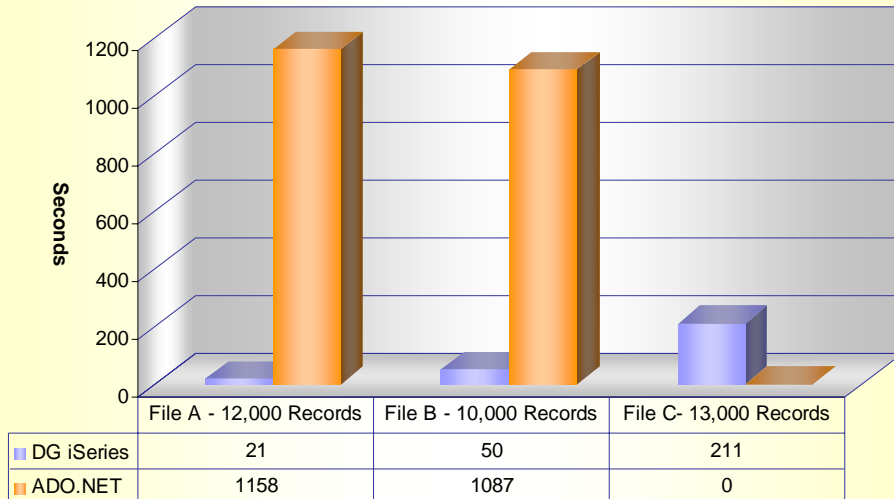


- Results could not be obtained with File C for DB2.NET test. File could not be read
- Results pending resolution from IBM

Test 1c

Write each record in the file to a new, but identical file.

Test 1c - Read & Update to New Member



- Results could not be obtained with FileC for DB2.NET test. File could not be read
- Results pending resolution from IBM

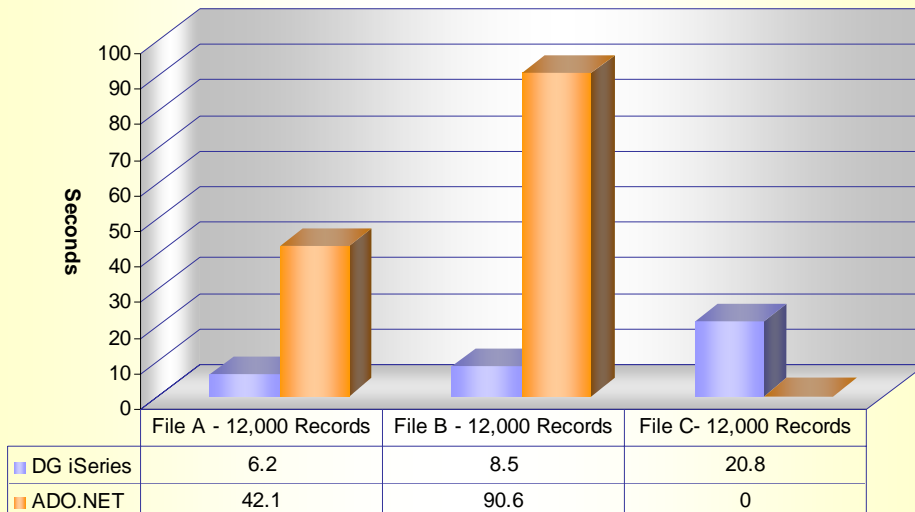
Test Suite 2

These tests demonstrate transaction-based usage. Like test Suite 1, these tests do not demonstrate scalability (see Test Suites 3 & 4). Rather, they show a simple relationship between the data access mechanisms.

Test 2a

This test randomly selects and reads individual records from the test files (as in a customer record, for example). The file's key is generated randomly and the record is retrieved. When a record is retrieved, another key is randomly generated and the process continues without hesitation until the test is completed. The elapsed times represent how long was required to execute the number of random reads as noted.

Test 2a - Random Read: 1000 Cycles

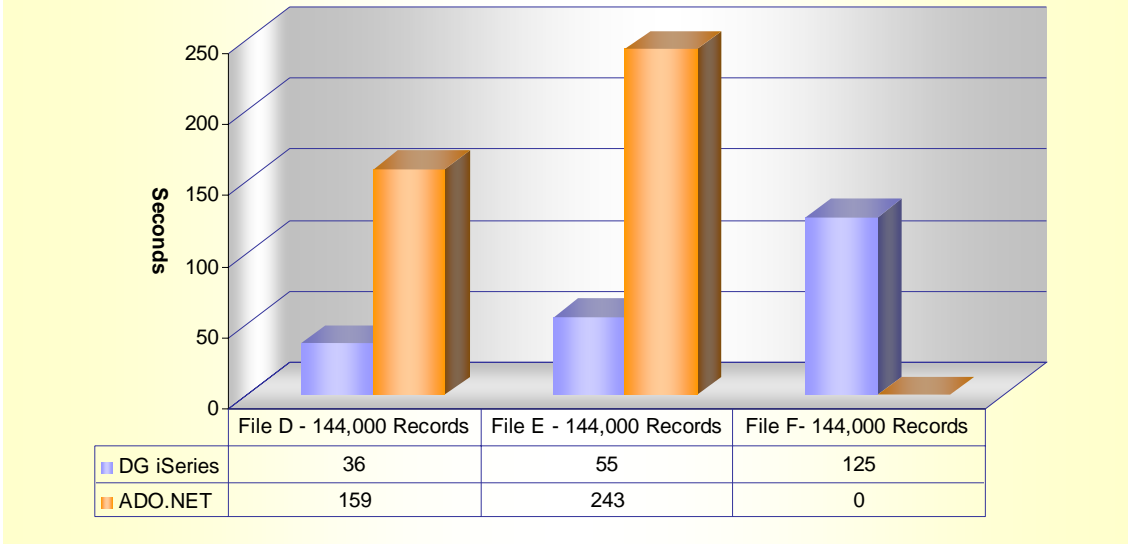


- Results could not be obtained with FileC for DB2.NET test. File could not be read.
- Results pending resolution from IBM

Test 2b

This test randomly selects and reads sets of records from the test files (as in order detail, for example). The file's major key is generated randomly and the record set is retrieved. When the set is retrieved, another key is randomly generated and the process continues without hesitation until the test is completed. The elapsed times represent how long was required to execute the number of random requests as noted.

Test 2b - Random Read Sets: 1000 Cycles



- Results could not be obtained with Files C & F for DB2.NET test. Files could not be read.
- Results pending resolution from IBM.

Multiple Client Tests

Test Suite 3 – Client/Server Scalability

These tests demonstrate the scalability of transaction-based database usage. The tests are run from multiple clients. The results of these tests are the average response times for the test's function.

These tests were conducted as “thick client,” client-server applications, where the application accessed and updated data directly from the iSeries database server. All applications were stateful, where database connections and files were kept open for the duration of the test.

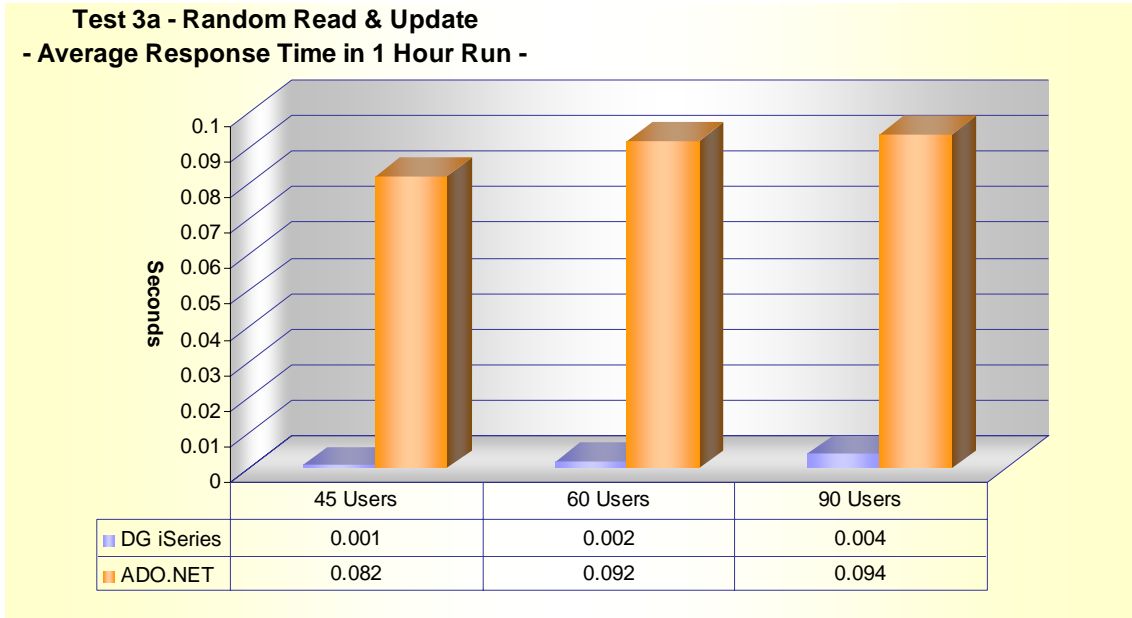
Test statistics were not accumulated until sufficient “warm up” time has passed for all “clients” to connect to the database, open files, and begin processing.

The pacing between transactions for each client is set by “keying time” and “think time.” This pacing is similar to the TPC-C testing criterion where the times randomly vary within defined boundaries.

See Appendix B - Testing notes for the details regarding keying and think times.

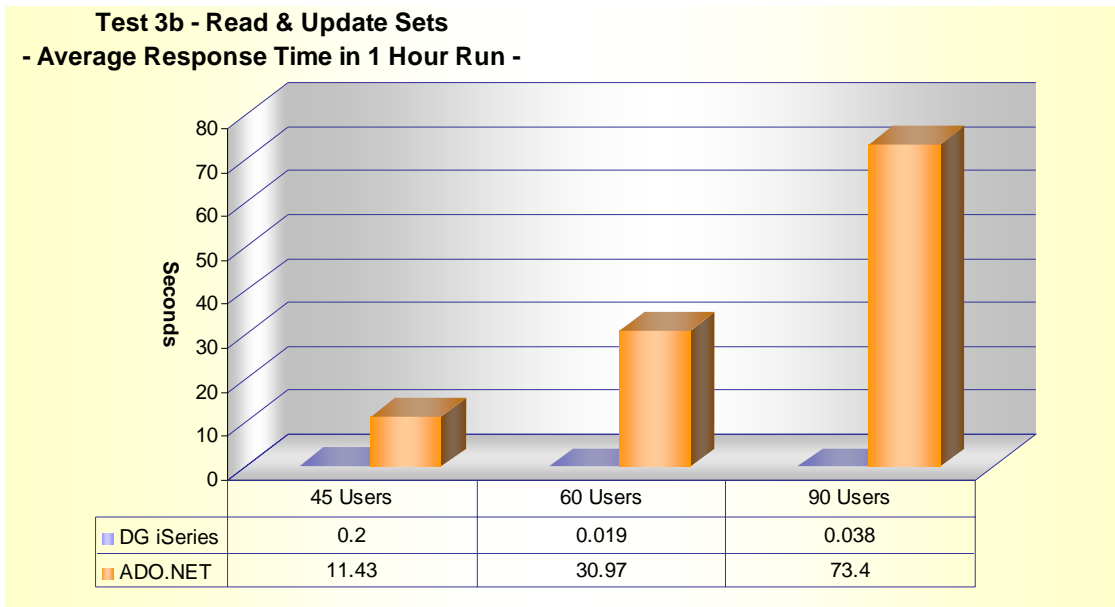
Test 3a

This test randomly selects and updates individual records from the test files. The file's key is generated randomly and the record is retrieved and updated (as in Customer maintenance).



Test 3b

This test randomly selects, reads and updates sets of records from the test files (as in order detail or sales detail). The file's major key is generated randomly and the record set is retrieved and updated (as in Order Fulfillment).



Multiple Client Middle – Tier Tests

Test Suite 4 - Web Server Scalability

These tests demonstrate the scalability of transaction-based database usage in a 3-tier environment. The tests are run from multiple clients. The results of these tests are the average response times for the test's function.

These tests were conducted as “thin client,” web-server applications, where the client is the presentation layer (e.g., Web browser or Web service consumer). The transaction logic is confined to the web server, which accessed and updated data directly from the iSeries database server. All transactions were stateless, where database connections and files were open only for the duration of the transaction. When a transaction was completed, the files were closed and database connection terminated.

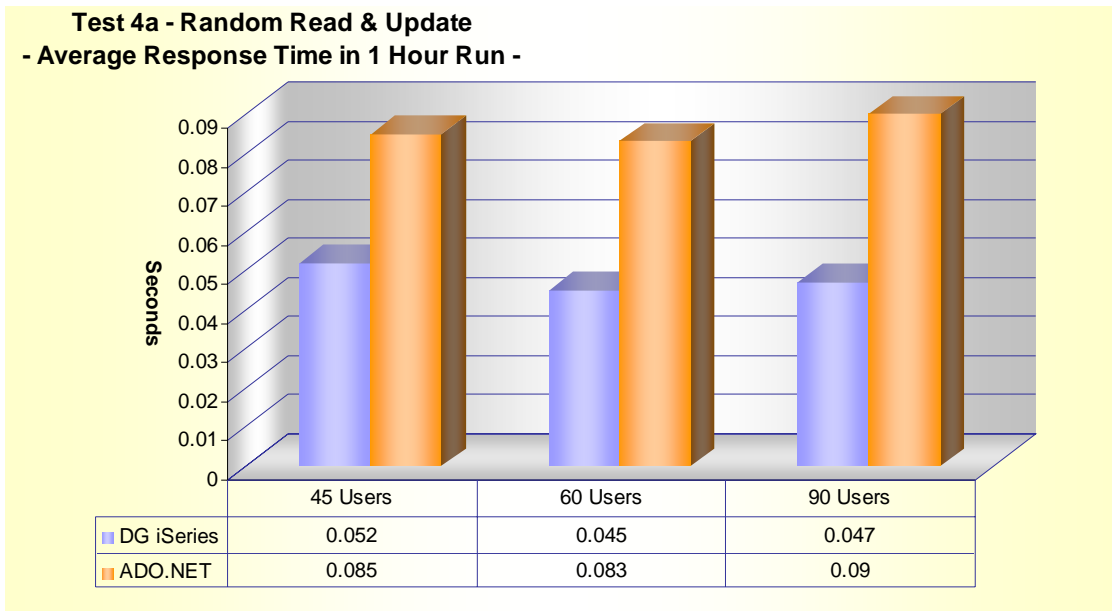
Test statistics were not accumulated until sufficient “warm up” time has passed for all “clients” to connect to the database, open files, and begin processing.

The pacing between transactions for each client is set by “keying time” and “think time.” This pacing is similar to the TPC-C testing criterion where the times randomly vary within defined boundaries.

See Appendix B - Testing notes for the details regarding keying and think times.

Test 4a

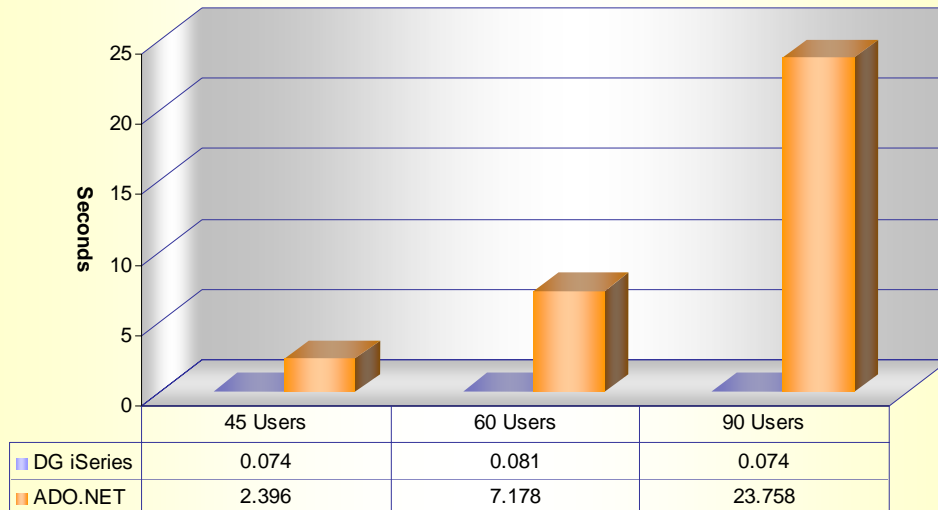
This test randomly selects and updates individual records from the test files. The file's key is generated randomly and the record is retrieved and updated (as in Customer maintenance).



Test 4b

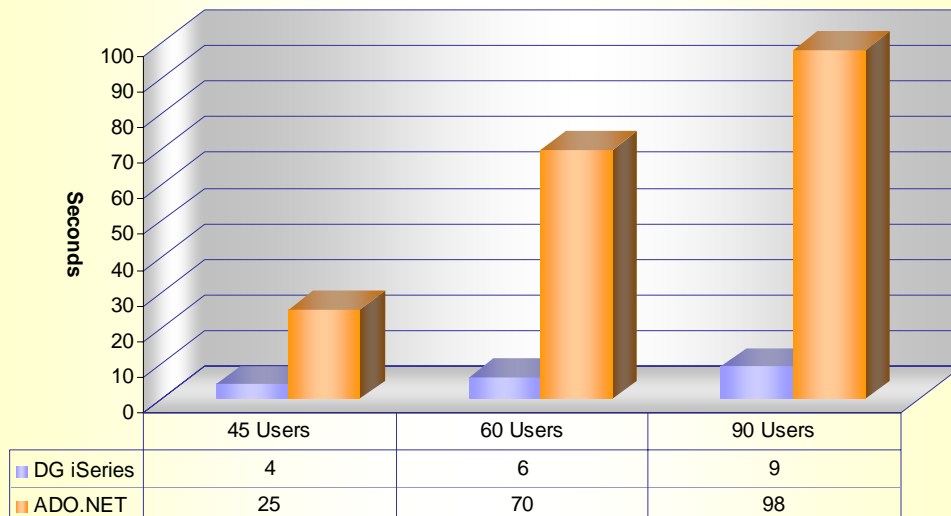
This test randomly selects, reads and updates sets of records from the test files (as in order detail or sales detail). The file's major key is generated randomly and the record set is retrieved and updated (as in Order Fulfillment).

Test 4b - Average Response Time

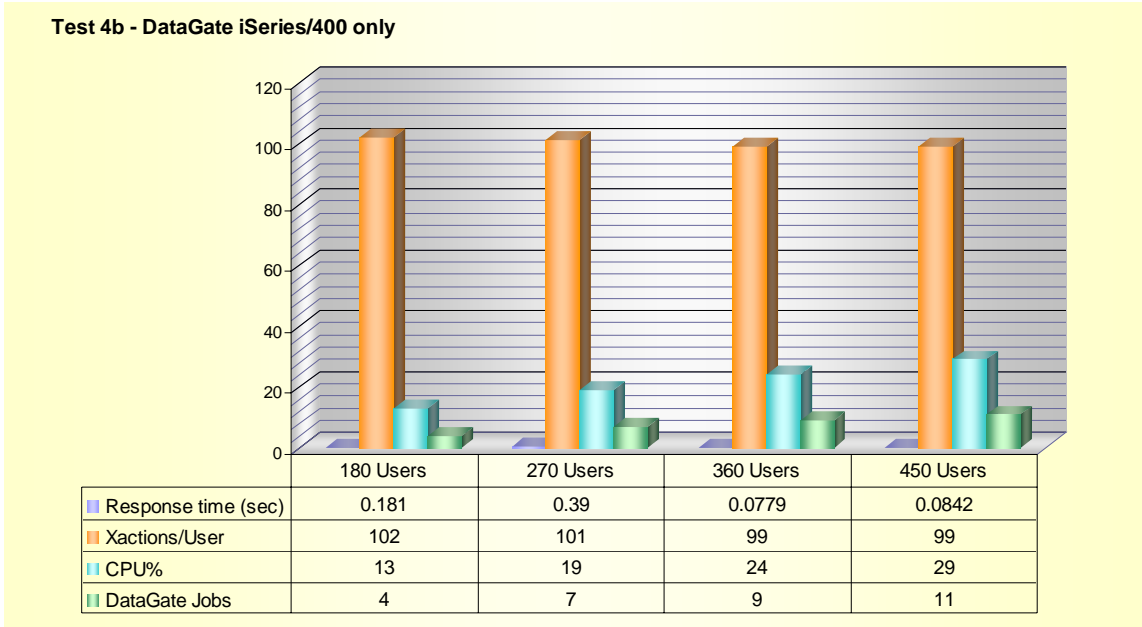


An interesting statistic is the load placed upon the iSeries by the process. ASNA DataGate for iSeries demonstrated superior integration with DB2 UDB database engine than did IBM.Data.DB2.iSeries.

Test 4b - iSeries CPU Load During Test



Essentially, the ADO .NET Test 4b maxed out at 90 users. Additional users were tested with DataGate for iSeries/400 with the following results. In all cases, the application transaction response times to the iSeries remained at sub-second timing.



Appendix A

File: File A

Type of file: Logical
Duplicates: Allowed
Database: BON_5047
Member count: 1
Format count: 1
Maximum file wait time: Immediate
Maximum record wait time: 60 seconds
Share Type: Share Update

Format: RCMMASTL1
Fields: 10
Record length: 151
Key length: 5

Field Name	Data Type
CMCUSTNO	Packed(9,0)
CMNAME	Char(40)
CMADDR1	Char(35)
CMCITY	Char(30)
CMSTATE	Char(2)
CMPOSTCODE	Char(10)
CMCNTRY	Char(2)
CMACTIVE	Char(1)
CMFAX	Packed(10,0)
CMPHONE	Char(20)

Key Order Usage:

CMCUSTNO Ascending Signed

File: File B

Type of file: Logical
Duplicates: Allowed
Database: BON_5047
Member count: 1
Format count: 1
Maximum file wait time: Immediate
Maximum record wait time: 60 seconds
Share Type: Share Update

Format: EXUSOL
Fields: 79
Record length: 484
Key length: 16

CHANGE	Zoned(6,0)	HISSTD	Char(1)	HIST2D	Char(10)
HIUPRM	Zoned(6,0)	HICSTD	Char(1)	HIST2T	Packed(3,0)
HIUUNT	Zoned(4,0)	HIDPOT	Char(3)	HIST2P	Packed(5,2)
HIUEXT	Char(5)	HIDBYR	Char(5)	HIST3D	Char(10)
HIUSYC	Char(9)	HIDRQB	Char(5)	HIST3T	Packed(3,0)
HIUCCD	Zoned(2,0)	HIDTYP	Char(1)	HIST3P	Packed(5,2)
HIUVND	Char(5)	HIDPCT	Zoned(3,1)	HIST4D	Char(10)
HIUCTR	Char(10)	HIDRTY	Char(1)	HIST4T	Packed(3,0)
HIUPON	Char(6)	HIPLAN	Char(11)	HIST4P	Packed(5,2)
HIUPOS	Packed(7,0)	HIELEV	Char(3)	HIST5D	Char(10)
HIULIN	Packed(5,0)	HIPHSE	Char(3)	HIST5T	Packed(3,0)
HIUDSC	Char(30)	HIITEM	Char(20)	HIST5P	Packed(5,2)
HIUAMT	Packed(11,2)	HISWO	Zoned(6,0)	HIRFLG	Char(1)
HIQNTY	Packed(11,4)	HIJOB2	Zoned(6,0)	HIDESC	Char(40)
HIUNMS	Char(3)	HITRAC	Char(8)	HISTCD	Char(1)
HIUNPR	Packed(11,4)	HIBLOK	Char(3)	HICMT1	Char(40)
HIUORM	Zoned(2,0)	HILOTR	Char(4)	HICMT2	Char(40)
HIUORD	Zoned(2,0)	HIBSEQ	Packed(3,0)	HICMT3	Char(40)
HIUORC	Zoned(2,0)	HIEXMM	Zoned(2,0)	HITCMM	Zoned(2,0)
HIUORY	Zoned(2,0)	HIEXDD	Zoned(2,0)	HITCDD	Zoned(2,0)
HIUOTM	Zoned(6,0)	HIEXCC	Zoned(2,0)	HITCCC	Zoned(2,0)
HIUPNM	Zoned(2,0)	HIEXYY	Zoned(2,0)	HITCYY	Zoned(2,0)
HIUPND	Zoned(2,0)	HI#STG	Packed(1,0)	HITASK	Packed(3,0)
HIUPNC	Zoned(2,0)	HIST1D	Char(10)	HILINE	Packed(3,0)
HIUPNY	Zoned(2,0)	HIST1T	Packed(3,0)	HISALN	Packed(3,0)
HIPSTD	Char(1)	HIST1P	Packed(5,2)	HIBCO	Packed(3,0)
				HIBGRP	Packed(3,0)

Key Order Usage:

HIUCTR Ascending Unsigned
HIUPON Ascending Unsigned

File: FILE C

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: 60 seconds
 Maximum record wait time: 60 seconds
 Share Type: Share Update
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds

Format: WQFMSTR
 Fields: 338
 Record length: 2109
 Key length: 6

WQQTE#	packed(11,0)	WQD1GS	Char(1)	WQD3GN	Char(1)
WQPRFX	Char(3)	WQD1DT	Char(1)	WQD3MS	Char(1)
WQPOL#	Packed(7,0)	WQD1RT	Char(2)	WQD3OL	Packed(4,0)
WQSUFX	Packed(2,0)	WQD1RS	Packed(8,0)	WQD3PT	Packed(2,0)
WQAGST	Packed(2,0)	WQD1MM	Char(1)	WQD322	Char(1)
WQAGNO	Packed(4,0)	WQD1CI	Char(1)	WQD3RL	Char(1)
WQINAM	Char(36)	WQD1SF	Char(1)	WQD3AP	Packed(8,0)
WQSNAM	Char(12)	WQD1OC	Char(3)	WQD3JS	Packed(8,0)
WQPROD	Char(5)	WQD2FN	Char(20)	WQD3GS	Char(1)
WQEFDT	Packed(8,0)	WQD2MN	Char(20)	WQD3DT	Char(1)
WQLSDT	Packed(8,0)	WQD2LN	Char(20)	WQD3RT	Char(2)
WQTDRV	Packed(2,0)	WQD2DOB	Packed(8,0)	WQD3RS	Packed(8,0)
WQTVEH	Packed(2,0)	WQD2GN	Char(1)	WQD3MM	Char(1)
WQTERM	Packed(2,0)	WQD2MS	Char(1)	WQD3CI	Char(1)
WQTIER	Char(4)	WQD2OL	Packed(4,0)	WQD3SF	Char(1)
WQBI		WQD2PT	Packed(2,0)	WQD3OC	Char(3)
WQPD		WQD222	Char(1)	WQD4FN	Char(20)
WQUMBI	Char(10)	WQD2RL	Char(1)	WQD4MN	Char(20)
WQMEDP	Char(10)	WQD2AP	Packed(8,0)	WQD4LN	Char(20)
WQRNWD	Packed(2,2)	WQD2JS	Packed(8,0)	WQD4DOB	Packed(8,0)
WQD1FN	Char(20)	WQD2GS	Char(1)	WQD4GN	Char(1)
WQD1MN	Char(20)	WQD2DT	Char(1)	WQD4MS	Char(1)
WQD1LN	Char(20)	WQD2RT	Char(2)	WQD4OL	Packed(4,0)
WQD1DOB	Packed(8,0)	WQD2RS	Packed(8,0)	WQD4PT	Packed(2,0)
WQD1GN	Char(1)	WQD2MM	Char(1)	WQD422	Char(1)
WQD1MS	Char(1)	WQD2CI	Char(1)	WQD4RL	Char(1)
WQD1OL	Packed(4,0)	WQD2SF	Char(1)	WQD4AP	Packed(8,0)
WQD1PT	Packed(2,0)	WQD2OC	Char(3)	WQD4JS	Packed(8,0)
WQD122	Char(1)	WQD3FN	Char(20)	WQD4GS	Char(1)
WQD1RL	Char(1)	WQD3MN	Char(20)	WQD4DT	Char(1)
WQD1AP	Packed(8,0)	WQD3LN	Char(20)	WQD4RT	Char(2)
WQD1JS	Packed(8,0)	WQD3DOB	Packed(8,0)	WQD4RS	Packed(8,0)
WQD3GN	Char(1)	WQD5FN	Char(20)	WQD6MM	Char(1)
WQD3MS	Char(1)	WQD5MN	Char(20)	WQD6CI	Char(1)
WQD3OL	Packed(4,0)	WQD5LN	Char(20)	WQD6SF	Char(1)
WQD3PT	Packed(2,0)	WQD5DOB	Packed(8,0)	WQD6OC	Char(3)
WQD322	Char(1)	WQD5GN	Char(1)	WQV1TP	Char(2)
WQD3RL	Char(1)	WQD5MS	Char(1)	WQV1VN	Char(17)

WQD3AP	Packed(8,0)	WQD5OL	Packed(4,0)	WQV1MD	Char(20)
WQD3JS	Packed(8,0)	WQD5PT	Packed(2,0)	WQV1YR	Packed(4,0)
WQD3GS	Char(1)	WQD522	Char(1)	WQV1MK	Char(20)
WQD3DT	Char(1)	WQD5RL	Char(1)	WQV1CS	Packed(6,0)
WQD3RT	Char(2)	WQD5AP	Packed(8,0)	WQV1SY	Packed(2,0)
WQD3RS	Packed(8,0)	WQD5JS	Packed(8,0)	WQV1PF	Char(1)
WQD3MM	Char(1)	WQD5GS	Char(1)	WQV1TH	Char(1)
WQD3CI	Char(1)	WQD5DT	Char(1)	WQV1US	Char(1)
WQD3SF	Char(1)	WQD5RT	Char(2)	WQV1ML	Packed(3,0)
WQD3OC	Char(3)	WQD5RS	Packed(8,0)	WQV1D#	Packed(2,0)
WQD4FN	Char(20)	WQD5MM	Char(1)	WQV1GZ	Packed(5,0)
WQD4MN	Char(20)	WQD5CI	Char(1)	WQV1CM	Char(10)
WQD4LN	Char(20)	WQD5SF	Char(1)	WQV1CL	Char(10)
WQD4DOB	Packed(8,0)	WQD5OC	Char(3)	WQV1SD	Packed(5,0)
WQD4GN	Char(1)	WQD6FN	Char(20)	WQV1CU	Packed(5,0)
WQD4MS	Char(1)	WQD6MN	Char(20)	WQV1RT	Char(1)
WQD4OL	Packed(4,0)	WQD6LN	Char(20)	WQV1TW	Char(10)
WQD4PT	Packed(2,0)	WQD6DOB	Packed(8,0)	WQV2TP	Char(2)
WQD422	Char(1)	WQD6GN	Char(1)	WQV2VN	Char(17)
WQD4RL	Char(1)	WQD6MS	Char(1)	WQV2MD	Char(20)
WQD4AP	Packed(8,0)	WQD6OL	Packed(4,0)	WQV2YR	Packed(4,0)
WQD4JS	Packed(8,0)	WQD6PT	Packed(2,0)	WQV2MK	Char(20)
WQD4GS	Char(1)	WQD622	Char(1)	WQV2CS	Packed(6,0)
WQD4DT	Char(1)	WQD6RL	Char(1)	WQV2SY	Packed(2,0)
WQD4RT	Char(2)	WQD6AP	Packed(8,0)	WQV2PF	Char(1)
WQD4RS	Packed(8,0)	WQD6JS	Packed(8,0)	WQV2TH	Char(1)
WQD4MM	Char(1)	WQD6GS	Char(1)	WQV2US	Char(1)
WQD4CI	Char(1)	WQD6DT	Char(1)	WQV2ML	Packed(3,0)
WQD4SF	Char(1)	WQD6RT	Char(2)	WQV2D#	Packed(2,0)
WQD4OC	Char(3)	WQD6RS	Packed(8,0)	WQV2GZ	Packed(5,0)
WQV2CM	Char(10)	WQV4SD	Packed(5,0)	WQV6RT	Char(1)
WQV2CL	Char(10)	WQV4CU	Packed(5,0)	WQV6TW	Char(10)
WQV2SD	Packed(5,0)	WQV4RT	Char(1)	WQV0AT	Char(1)
WQV2CU	Packed(5,0)	WQV4TW	Char(10)	WQV0AN	Char(36)
WQV2RT	Char(1)	WQV5TP	Char(2)	WQV0AA	Char(24)
WQV2TW	Char(10)	WQV5VN	Char(17)	WQV0AC	Char(16)
WQV3TP	Char(2)	WQV5MD	Char(20)	WQV0AS	Char(2)
WQV3VN	Char(17)	WQV5YR	Packed(4,0)	WQV0AZ	Packed(9,0)
WQV3MD	Char(20)	WQV5MK	Char(20)	WQV0AR	Packed(9,0)
WQV3YR	Packed(4,0)	WQV5CS	Packed(6,0)	WQV1AT	Char(1)
WQV3MK	Char(20)	WQV5SY	Packed(2,0)	WQV1AN	Char(36)
WQV3CS	Packed(6,0)	WQV5PF	Char(1)	WQV1AA	Char(24)
WQV3SY	Packed(2,0)	WQV5TH	Char(1)	WQV1AC	Char(16)
WQV3PF	Char(1)	WQV5US	Char(1)	WQV1AS	Char(2)
WQV3TH	Char(1)	WQV5ML	Packed(3,0)	WQV1AZ	Packed(9,0)
WQV3US	Char(1)	WQV5D#	Packed(2,0)	WQV1AR	Packed(9,0)
WQV3ML	Packed(3,0)	WQV5GZ	Packed(5,0)	WQV2AT	Char(1)
WQV3D#	Packed(2,0)	WQV5CM	Char(10)	WQV2AN	Char(36)
WQV3GZ	Packed(5,0)	WQV5CL	Char(10)	WQV2AA	Char(24)
WQV3CM	Char(10)	WQV5SD	Packed(5,0)	WQV2AC	Char(16)

WQV3CL	Char(10)	WQV5CU	Packed(5,0)	WQV2AS	Char(2)
WQV3SD	Packed(5,0)	WQV5RT	Char(1)	WQV2AZ	Packed(9,0)
WQV3CU	Packed(5,0)	WQV5TW	Char(10)	WQV2AR	Packed(9,0)
WQV3RT	Char(1)	WQV6TP	Char(2)	WQV3AT	Char(1)
WQV3TW	Char(10)	WQV6VN	Char(17)	WQV3AN	Char(36)
WQV4TP	Char(2)	WQV6MD	Char(20)	WQV3AA	Char(24)
WQV4VN	Char(17)	WQV6YR	Packed(4,0)	WQV3AC	Char(16)
WQV4MD	Char(20)	WQV6MK	Char(20)	WQV3AS	Char(2)
WQV4YR	Packed(4,0)	WQV6CS	Packed(6,0)	WQV3AZ	Packed(9,0)
WQV4MK	Char(20)	WQV6SY	Packed(2,0)	WQV3AR	Packed(9,0)
WQV4CS	Packed(6,0)	WQV6PF	Char(1)	WQV4AT	Char(1)
WQV4SY	Packed(2,0)	WQV6TH	Char(1)	WQV4AN	Char(36)
WQV4PF	Char(1)	WQV6US	Char(1)	WQV4AA	Char(24)
WQV4TH	Char(1)	WQV6ML	Packed(3,0)	WQV4AC	Char(16)
WQV4US	Char(1)	WQV6D#	Packed(2,0)	WQV4AS	Char(2)
WQV4ML	Packed(3,0)	WQV6GZ	Packed(5,0)	WQV4AZ	Packed(9,0)
WQV4D#	Packed(2,0)	WQV6CM	Char(10)	WQV4AR	Packed(9,0)r
WQV4GZ	Packed(5,0)	WQV6CL	Char(10)	WQV5AT	Char(1)
WQV4CM	Char(10)	WQV6SD	Packed(5,0)	WQV5AN	Char(36)
WQV4CL	Char(10)	WQV6CU	Packed(5,0)	WQV5AA	Char(24)
WQV5AC	Char(16)	WQD1US	Char(1)	WQD5AG	Char(1)
WQV5AS	Char(2)	WQD1ML	Packed(3,0)	WQV5AG	Char(1)
WQV5AZ	Packed(9,0)	WQD1AG	Char(1)	WQD6US	Char(1)
WQV5AR	Packed(9,0)	WQV1AG	Char(1)	WQD6ML	Packed(3,0)
WQV6AT	Char(1)	WQD2US	Char(1)	WQD6AG	Char(1)
WQV6AN	Char(36)	WQD2ML	Packed(3,0)	WQV6AG	Char(1)
WQV6AA	Char(24)	WQD2AG	Char(1)	WQEX01	Char(10)
WQV6AC	Char(16)	WQV2AG	Char(1)	WQEX02	Char(10)
WQV6AS	Char(2)	WQD3US	Char(1)	WQEX03	Packed(8,0)
WQV6AZ	Packed(9,0)	WQD3ML	Packed(3,0)	WQEX04	Packed(8,0)
WQV6AR	Packed(9,0)	WQD3AG	Char(1)		
WQV0V#	Packed(1,0)	WQV3AG	Char(1)		
WQV1V#	Packed(1,0)	WQD4US	Char(1)		
WQV2V#	Packed(1,0)	WQD4ML	Packed(3,0)		
WQV3V#	Packed(1,0)	WQD4AG	Char(1)		
WQV4V#	Packed(1,0)	WQV4AG	Char(1)		
WQV5V#	Packed(1,0)	WQD5US	Char(1)		
WQV6V#	Packed(1,0)	WQD5ML	Packed(3,0)		

Key Order Usage:

WQQTE# Ascending Signed

File: FILE D

Type of file: Logical
Duplicates: Not Allowed
Database: BON_5047
Member count: 1
Format count: 1
Maximum file wait time: 60 seconds
Maximum record wait time: 60 seconds
Share Type: Share Update

Format: RCSMASTL1
Fields: 15
Record length: 82
Key length: 10

Field Name	Data Type
CSCUSTNO	Packed(9,0)
CSYEAR	Zoned(4,0)
CSTYPE	Zoned(1,0)
CSSALES01	Packed(11,2)
CSSALES02	Packed(11,2)
CSSALES03	Packed(11,2)
CSSALES04	Packed(11,2)
CSSALES05	Packed(11,2)
CSSALES06	Packed(11,2)
CSSALES07	Packed(11,2)
CSSALES08	Packed(11,2)
CSSALES09	Packed(11,2)
CSSALES10	Packed(11,2)
CSSALES11	Packed(11,2)
CSSALES12	Packed(11,2)

Key Order Usage:

CSCUSTNO Ascending Signed
CSYEAR Ascending Signed
CSTYPE Ascending Signed

File: File E

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds
 Share Type: Share Update

Format: EXUSOL
 Fields: 94
 Record length: 566
 Key length: 10

CSCUSTNO	Packed(9,0)	HIPSTD	Char(1)	HIST2T	Packed(3,0)
CSYEAR	Zoned(4,0)	HISSTD	Char(1)	HIST2P	Packed(5,2)
CSTYPE	Zoned(1,0)	HICSTD	Char(1)	HIST3D	Char(10)
CHANGE	Zoned(6,0)	HIDPOT	Char(3)	HIST3T	Packed(3,0)
HIUPRM	Zoned(6,0)	HIDBYR	Char(5)	HIST3P	Packed(5,2)
HIUUNT	Zoned(4,0)	HIDRQB	Char(5)	HIST4D	Char(10)
HIUEXT	Char(5)	HIDTYP	Char(1)	HIST4T	Packed(3,0)
HIUSYC	Char(9)	HIDPCT	Zoned(3,1)	HIST4P	Packed(5,2)
HIUCCD	Zoned(2,0)	HIDRTY	Char(1)	HIST5D	Char(10)
HIUVND	Char(5)	HIPLAN	Char(11)	HIST5T	Packed(3,0)
HIUCTR	Char(10)	HIELEV	Char(3)	HIST5P	Packed(5,2)
HIUPON	Char(6)	HIPHSE	Char(3)	HIRFLG	Char(1)
HIUPOS	Packed(7,0)	HIITEM	Char(20)	HIDESC	Char(40)
HIULIN	Packed(5,0)	HISWO	Zoned(6,0)	HISTCD	Char(1)
HIUDSC	Char(30)	HIJOB2	Zoned(6,0)	HICMT1	Char(40)
HIUAMT	Packed(11,2)	HITRAC	Char(8)	HICMT2	Char(40)
HIQNTY	Packed(11,4)	HIBLOK	Char(3)	HICMT3	Char(40)
HIUNMS	Char(3)	HILOTR	Char(4)	HITCMM	Zoned(2,0)
HIUNPR	Packed(11,4)	HIBSEQ	Packed(3,0)	HITCDD	Zoned(2,0)
HIUORM	Zoned(2,0)	HIEXMM	Zoned(2,0)	HITCCC	Zoned(2,0)
HIUORD	Zoned(2,0)	HIEXDD	Zoned(2,0)	HITCYY	Zoned(2,0)
HIUORC	Zoned(2,0)	HIEXCC	Zoned(2,0)	HITASK	Packed(3,0)
HIUORY	Zoned(2,0)	HIEXYY	Zoned(2,0)	HILINE	Packed(3,0)
HIUOTM	Zoned(6,0)	HI#STG	Packed(1,0)	HISALN	Packed(3,0)
HIUPNM	Zoned(2,0)	HIST1D	Char(10)	HIBCO	Packed(3,0)
HIUPND	Zoned(2,0)	HIST1T	Packed(3,0)	HIBGRP	Packed(3,0)
HIUPNC	Zoned(2,0)	HIST1P	Packed(5,2)	CSSALES01	Packed(11,2)
HIUPNY	Zoned(2,0)	HIST2D	Char(10)	CSSALES02	Packed(11,2)
CSSALES03	Packed(11,2)				
CSSALES04	Packed(11,2)				
CSSALES05	Packed(11,2)				
CSSALES06	Packed(11,2)				
CSSALES07	Packed(11,2)				
CSSALES08	Packed(11,2)				
CSSALES09	Packed(11,2)				
CSSALES10	Packed(11,2)				
CSSALES11	Packed(11,2)				
CSSALES12	Packed(11,2)				

Key Order Usage:

CSCUSTNO Ascending Signed
 CSYEAR Ascending Signed
 CSTYPE Ascending Signed

File: File F

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: 60 seconds
 Maximum record wait time: 60 seconds
 Share Type: Share Update
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds

Format: WQFMSTR
 Fields: 353
 Record length: 2191
 Key length: 10

CSCUSTNO	Packed(9,0)	WQD1PT	Packed(2,0)	WQD2CI	Char(1)
CSYEAR	Zoned(4,0)	WQD122	Char(1)	WQD2SF	Char(1)
CSTYPE	Zoned(1,0)	WQD1RL	Char(1)	WQD2OC	Char(3)
WQQTE#	packed(11,0)	WQD1AP	Packed(8,0)	WQD3FN	Char(20)
WQPRFX	Char(3)	WQD1JS	Packed(8,0)	WQD3MN	Char(20)
WQPOL#	Packed(7,0)	WQD1GS	Char(1)	WQD3LN	Char(20)
WQSUFX	Packed(2,0)	WQD1DT	Char(1)	WQD3DOB	Packed(8,0)
WQAGST	Packed(2,0)	WQD1RT	Char(2)	WQD3GN	Char(1)
WQAGNO	Packed(4,0)	WQD1RS	Packed(8,0)	WQD3MS	Char(1)
WQINAM	Char(36)	WQD1MM	Char(1)	WQD3OL	Packed(4,0)
WQSNAM	Char(12)	WQD1CI	Char(1)	WQD3PT	Packed(2,0)
WQPROD	Char(5)	WQD1SF	Char(1)	WQD322	Char(1)
WQEFDT	Packed(8,0)	WQD1OC	Char(3)	WQD3RL	Char(1)
WQLSDT	Packed(8,0)	WQD2FN	Char(20)	WQD3AP	Packed(8,0)
WQTDRV	Packed(2,0)	WQD2MN	Char(20)	WQD3JS	Packed(8,0)
WQTVEH	Packed(2,0)	WQD2LN	Char(20)	WQD3GS	Char(1)
WQTERM	Packed(2,0)	WQD2DOB	Packed(8,0)	WQD3DT	Char(1)
WQTIER	Char(4)	WQD2GN	Char(1)	WQD3RT	Char(2)
WQBI		WQD2MS	Char(1)	WQD3RS	Packed(8,0)
WQPD		WQD2OL	Packed(4,0)	WQD3MM	Char(1)
WQUMBI	Char(10)	WQD2PT	Packed(2,0)	WQD3CI	Char(1)
WQMEDP	Char(10)	WQD222	Char(1)	WQD3SF	Char(1)
WQRNWD	Packed(2,2)	WQD2RL	Char(1)	WQD3OC	Char(3)
WQD1FN	Char(20)	WQD2AP	Packed(8,0)	WQD4FN	Char(20)
WQD1MN	Char(20)	WQD2JS	Packed(8,0)	WQD4MN	Char(20)
WQD1LN	Char(20)	WQD2GS	Char(1)	WQD4LN	Char(20)
WQD1DOB	Packed(8,0)	WQD2DT	Char(1)	WQD4DOB	Packed(8,0)
WQD1GN	Char(1)	WQD2RT	Char(2)	WQD4GN	Char(1)
WQD1MS	Char(1)	WQD2RS	Packed(8,0)	WQD4MS	Char(1)
WQD1OL	Packed(4,0)	WQD2MM	Char(1)	WQD4OL	Packed(4,0)
WQD4PT	Packed(2,0)	WQD6PT	Packed(2,0)	WQV2TH	Char(1)
WQD422	Char(1)	WQD622	Char(1)	WQV2US	Char(1)
WQD4RL	Char(1)	WQD6RL	Char(1)	WQV2ML	Packed(3,0)
WQD4AP	Packed(8,0)	WQD6AP	Packed(8,0)	WQV2D#	Packed(2,0)
WQD4JS	Packed(8,0)	WQD6JS	Packed(8,0)	WQV2GZ	Packed(5,0)
WQD4GS	Char(1)	WQD6GS	Char(1)	WQV2CM	Char(10)
WQD4DT	Char(1)	WQD6DT	Char(1)	WQV2CL	Char(10)

WQD4RT	Char(2)	WQD6RT	Char(2)	WQV2SD	Packed(5,0)
WQD4RS	Packed(8,0)	WQD6RS	Packed(8,0)	WQV2CU	Packed(5,0)
WQD4MM	Char(1)	WQD6MM	Char(1)	WQV2RT	Char(1)
WQD4CI	Char(1)	WQD6CI	Char(1)	WQV2TW	Char(10)
WQD4SF	Char(1)	WQD6SF	Char(1)	WQV3TP	Char(2)
WQD4OC	Char(3)	WQD6OC	Char(3)	WQV3VN	Char(17)
WQD5FN	Char(20)	WQV1TP	Char(2)	WQV3MD	Char(20)
WQD5MN	Char(20)	WQV1VN	Char(17)	WQV3YR	Packed(4,0)
WQD5LN	Char(20)	WQV1MD	Char(20)	WQV3MK	Char(20)
WQD5DOB	Packed(8,0)	WQV1YR	Packed(4,0)	WQV3CS	Packed(6,0)
WQD5GN	Char(1)	WQV1MK	Char(20)	WQV3SY	Packed(2,0)
WQD5MS	Char(1)	WQV1CS	Packed(6,0)	WQV3PF	Char(1)
WQD5OL	Packed(4,0)	WQV1SY	Packed(2,0)	WQV3TH	Char(1)
WQD5PT	Packed(2,0)	WQV1PF	Char(1)	WQV3US	Char(1)
WQD522	Char(1)	WQV1TH	Char(1)	WQV3ML	Packed(3,0)
WQD5RL	Char(1)	WQV1US	Char(1)	WQV3D#	Packed(2,0)
WQD5AP	Packed(8,0)	WQV1ML	Packed(3,0)	WQV3GZ	Packed(5,0)
WQD5JS	Packed(8,0)	WQV1D#	Packed(2,0)	WQV3CM	Char(10)
WQD5GS	Char(1)	WQV1GZ	Packed(5,0)	WQV3CL	Char(10)
WQD5DT	Char(1)	WQV1CM	Char(10)	WQV3SD	Packed(5,0)
WQD5RT	Char(2)	WQV1CL	Char(10)	WQV3CU	Packed(5,0)
WQD5RS	Packed(8,0)	WQV1SD	Packed(5,0)	WQV3RT	Char(1)
WQD5MM	Char(1)	WQV1CU	Packed(5,0)	WQV3TW	Char(10)
WQD5CI	Char(1)	WQV1RT	Char(1)	WQV4TP	Char(2)
WQD5SF	Char(1)	WQV1TW	Char(10)	WQV4VN	Char(17)
WQD5OC	Char(3)	WQV2TP	Char(2)	WQV4MD	Char(20)
WQD6FN	Char(20)	WQV2VN	Char(17)	WQV4YR	Packed(4,0)
WQD6MN	Char(20)	WQV2MD	Char(20)	WQV4MK	Char(20)
WQD6LN	Char(20)	WQV2YR	Packed(4,0)	WQV4CS	Packed(6,0)
WQD6DOB	Packed(8,0)	WQV2MK	Char(20)	WQV4SY	Packed(2,0)
WQD6GN	Char(1)	WQV2CS	Packed(6,0)	WQV4PF	Char(1)
WQD6MS	Char(1)	WQV2SY	Packed(2,0)	WQV4TH	Char(1)
WQD6OL	Packed(4,0)	WQV2PF	Char(1)	WQV4US	Char(1)
WQV4ML	Packed(3,0)	WQV6GZ	Packed(5,0)	WQV4AZ	Packed(9,0)
WQV4D#	Packed(2,0)	WQV6CM	Char(10)	WQV4AR	Packed(9,0)r
WQV4GZ	Packed(5,0)	WQV6CL	Char(10)	WQV5AT	Char(1)
WQV4CM	Char(10)	WQV6SD	Packed(5,0)	WQV5AN	Char(36)
WQV4CL	Char(10)	WQV6CU	Packed(5,0)	WQV5AA	Char(24)
WQV4SD	Packed(5,0)	WQV6RT	Char(1)	WQV5AC	Char(16)
WQV4CU	Packed(5,0)	WQV6TW	Char(10)	WQV5AS	Char(2)
WQV4RT	Char(1)	WQV0AT	Char(1)	WQV5AZ	Packed(9,0)
WQV4TW	Char(10)	WQV0AN	Char(36)	WQV5AR	Packed(9,0)
WQV5TP	Char(2)	WQV0AA	Char(24)	WQV6AT	Char(1)
WQV5VN	Char(17)	WQV0AC	Char(16)	WQV6AN	Char(36)
WQV5MD	Char(20)	WQV0AS	Char(2)	WQV6AA	Char(24)
WQV5YR	Packed(4,0)	WQV0AZ	Packed(9,0)	WQV6AC	Char(16)
WQV5MK	Char(20)	WQV0AR	Packed(9,0)	WQV6AS	Char(2)
WQV5CS	Packed(6,0)	WQV1AT	Char(1)	WQV6AZ	Packed(9,0)

WQV5SY	Packed(2,0)	WQV1AN	Char(36)	WQV6AR	Packed(9,0)
WQV5PF	Char(1)	WQV1AA	Char(24)	WQV0V#	Packed(1,0)
WQV5TH	Char(1)	WQV1AC	Char(16)	WQV1V#	Packed(1,0)
WQV5US	Char(1)	WQV1AS	Char(2)	WQV2V#	Packed(1,0)
WQV5ML	Packed(3,0)	WQV1AZ	Packed(9,0)	WQV3V#	Packed(1,0)
WQV5D#	Packed(2,0)	WQV1AR	Packed(9,0)	WQV4V#	Packed(1,0)
WQV5GZ	Packed(5,0)	WQV2AT	Char(1)	WQV5V#	Packed(1,0)
WQV5CM	Char(10)	WQV2AN	Char(36)	WQV6V#	Packed(1,0)
WQV5CL	Char(10)	WQV2AA	Char(24)	WQD1US	Char(1)
WQV5SD	Packed(5,0)	WQV2AC	Char(16)	WQD1ML	Packed(3,0)
WQV5CU	Packed(5,0)	WQV2AS	Char(2)	WQD1AG	Char(1)
WQV5RT	Char(1)	WQV2AZ	Packed(9,0)	WQV1AG	Char(1)
WQV5TW	Char(10)	WQV2AR	Packed(9,0)	WQD2US	Char(1)
WQV6TP	Char(2)	WQV3AT	Char(1)	WQD2ML	Packed(3,0)
WQV6VN	Char(17)	WQV3AN	Char(36)	WQD2AG	Char(1)
WQV6MD	Char(20)	WQV3AA	Char(24)	WQV2AG	Char(1)
WQV6YR	Packed(4,0)	WQV3AC	Char(16)	WQD3US	Char(1)
WQV6MK	Char(20)	WQV3AS	Char(2)	WQD3ML	Packed(3,0)
WQV6CS	Packed(6,0)	WQV3AZ	Packed(9,0)	WQD3AG	Char(1)
WQV6SY	Packed(2,0)	WQV3AR	Packed(9,0)	WQV3AG	Char(1)
WQV6PF	Char(1)	WQV4AT	Char(1)	WQD4US	Char(1)
WQV6TH	Char(1)	WQV4AN	Char(36)	WQD4ML	Packed(3,0)
WQV6US	Char(1)	WQV4AA	Char(24)	WQD4AG	Char(1)
WQV6ML	Packed(3,0)	WQV4AC	Char(16)	WQV4AG	Char(1)
WQV6D#	Packed(2,0)	WQV4AS	Char(2)	WQD5US	Char(1)
WQD5ML	Packed(3,0)	WQEX04	Packed(8,0)	CSSALES10	Packed(11,2)
WQD5AG	Char(1)	CSSALES01	Packed(11,2)	CSSALES11	Packed(11,2)
WQV5AG	Char(1)	CSSALES02	Packed(11,2)	CSSALES12	Packed(11,2)
WQD6US	Char(1)	CSSALES03	Packed(11,2)		
WQD6ML	Packed(3,0)	CSSALES04	Packed(11,2)		
WQD6AG	Char(1)	CSSALES05	Packed(11,2)		
WQV6AG	Char(1)	CSSALES06	Packed(11,2)		
WQEX01	Char(10)	CSSALES07	Packed(11,2)		
WQEX02	Char(10)	CSSALES08	Packed(11,2)		
WQEX03	Packed(8,0)	CSSALES09	Packed(11,2)		

Key Order Usage:

CSCUSTNO	Ascending Signed
CSYEAR	Ascending Signed
CSTYPE	Ascending Signed

Appendix B - Testing notes

Tests 3a, 3b, 4a and 4b

All clients were allowed to start and run for a minimum of 15 minutes before statistics were gathered (“warm-up”). The warm-up was needed to get the ADO jobs to stabilize. Without the warm-up, the ADO tests would have performed more poorly.

Keying time is a random number of seconds ranging between 18 and 25.

Think time is a mean of 12 seconds. It is taken from a negative exponential distribution and computed from the following equation. It was not allowed to be less than 8 seconds nor more than 120 seconds.

$$T_t = -\log(r) * \mu$$

where: log = natural log (base e)

T_t = think time

r = random number uniformly distributed between 0 and 1

μ = mean think time

Test 3b & 4b

The number of records processed in the secondary “detail” file ranged between 10 and 14 records for each transaction.

ASNA DataGate .NET vs. ADO (OLEDB)

Introduction

A series of tests were devised to demonstrate the comparative performance of a number of data intensive scenarios with client/server access to the IBM iSeries/400 platform. Two mechanisms are evaluated: ASNA DataGate .NET for iSeries/400 and IBM iSeries Access for Windows ADO Provider (IBMDA400).

iSeries Platforms

The tests results were run on an iSeries model 270; OS/400 V5R2 over a 10-baseT intranet. The client machines were a single processor Dell OptiPlex GX150 running Windows 2000 Professional.

The Files

Tests were conducted on data files of varying sizes, both in the record size (file width) and number of records in the member (file length). Interestingly, the test results were affected more by the files' width than length.

File Name	Nbr of Records	Nbr of Fields	Record Length	Key Length
File A	12,000	10	151	5
File B	10,000	79	484	16
File C	13,000	338	2109	6
File D	144,000	15	82	10
File E	144,000	94	566	10
File F	144,000	353	2191	10

See Appendix A for detailed descriptions of each file used in the tests.

Timing

All times, exclude database connection and file open/close times. Only the actual file processing time is notes. Unless otherwise noted, database connection and file open times were nominal.

The Single Client Tests (Test Suites 1 & 2)

These tests were run from a single dedicated client to a dedicated iSeries 270.

The Multiple Client Tests (Test Suite 3)

These tests were run from a multiple dedicated clients to a dedicated iSeries 270.

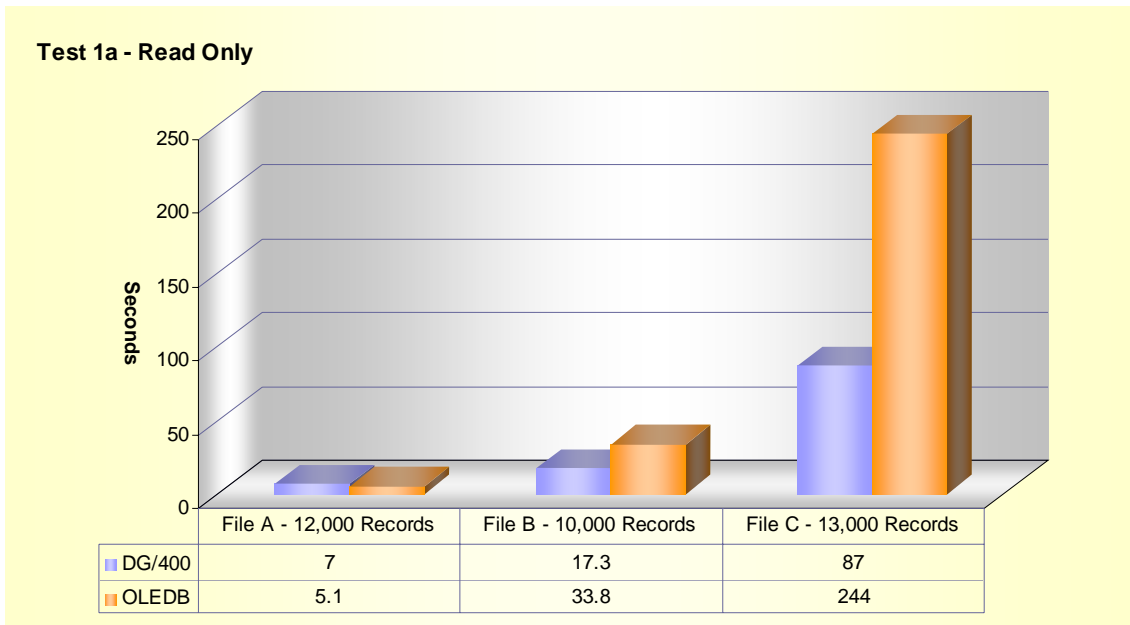
Single Client Tests

Test Suite 1

These tests demonstrate simple handling of large numbers of records.

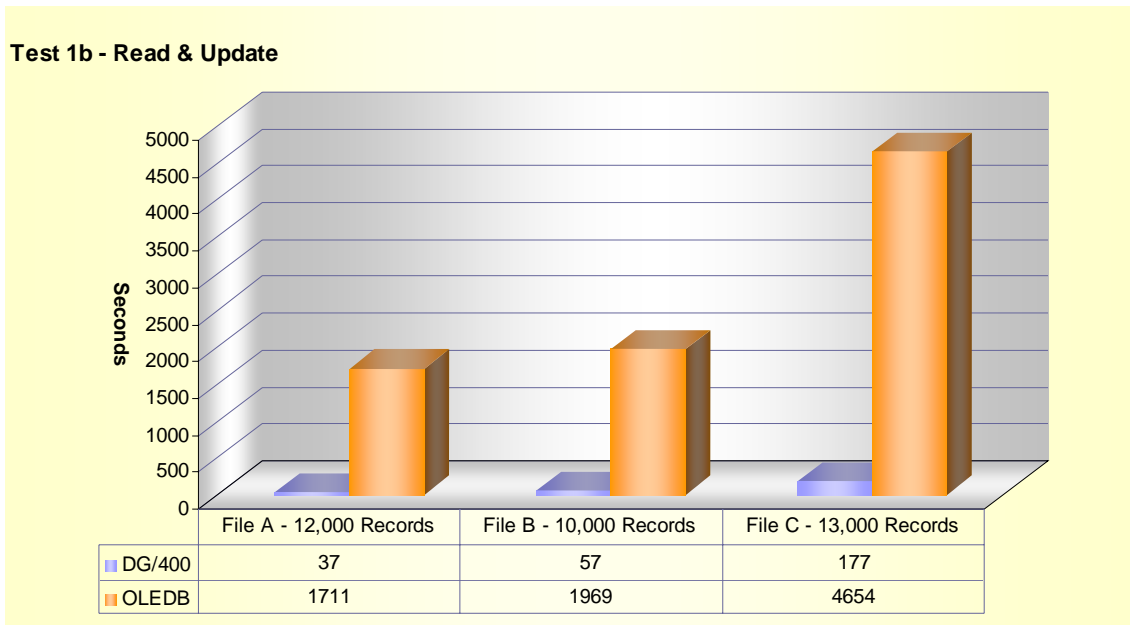
Test 1a

Simple indexed-sequential read of all records in the file.



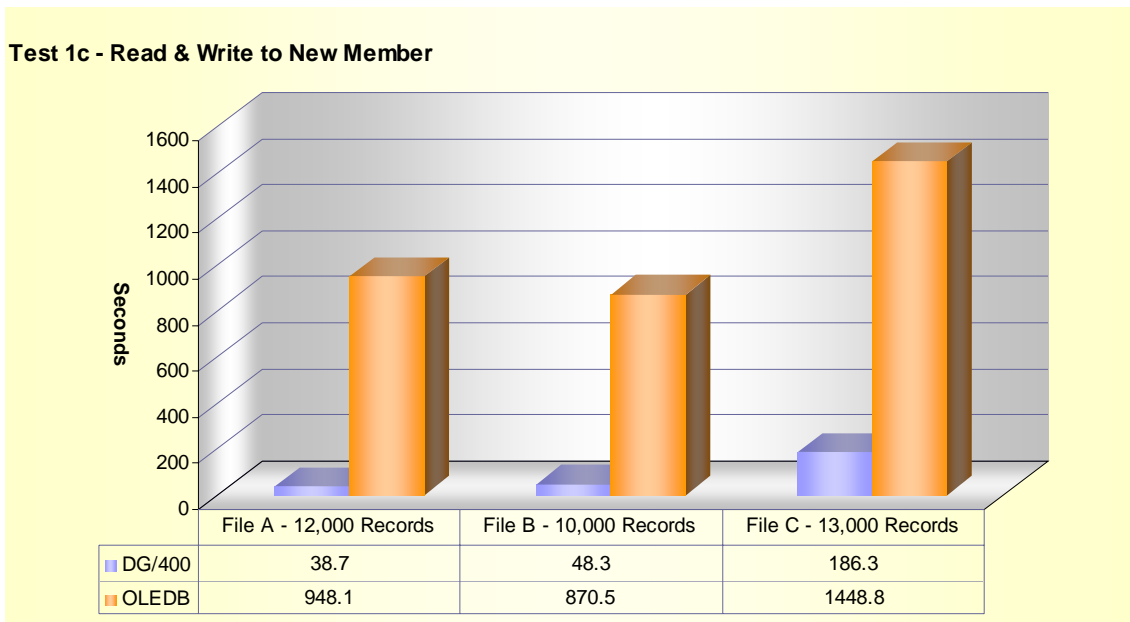
Test 1b

Update field(s) in each record in the file based upon indeterminate criteria (such as user data entry, etc.) where set processing is unavailable.



Test 1c

Write each record in the file to a new, but identical file.

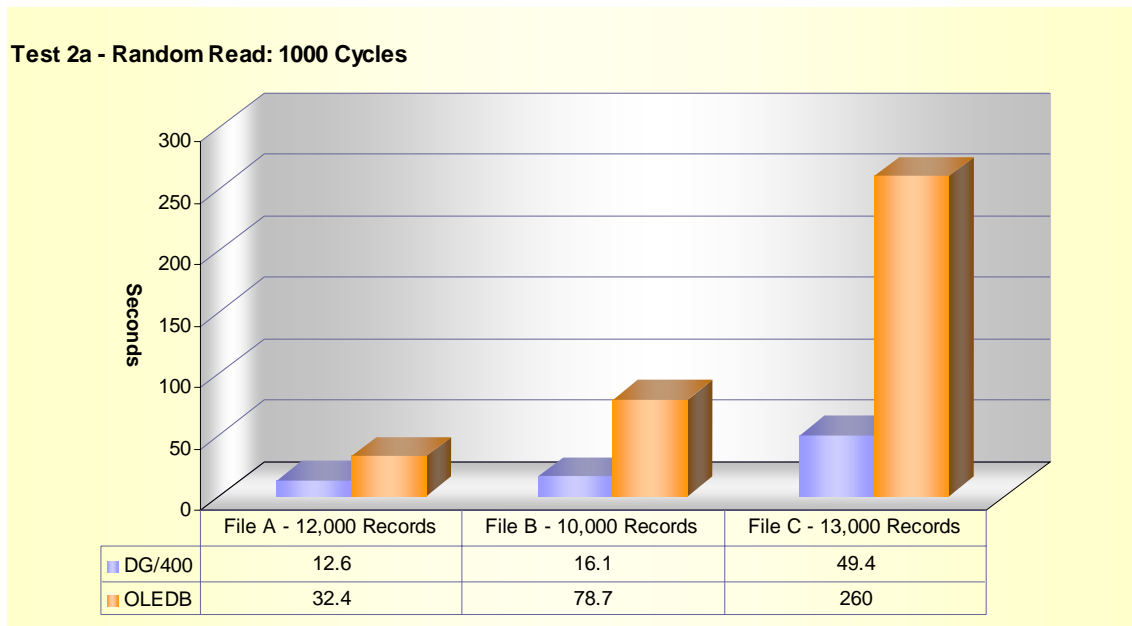


Test Suite 2

These tests demonstrate transaction-based usage. Like test Suite 1, these tests do not demonstrate scalability (see Test Suite 3). Rather, they show a simple relationship between the data access mechanisms.

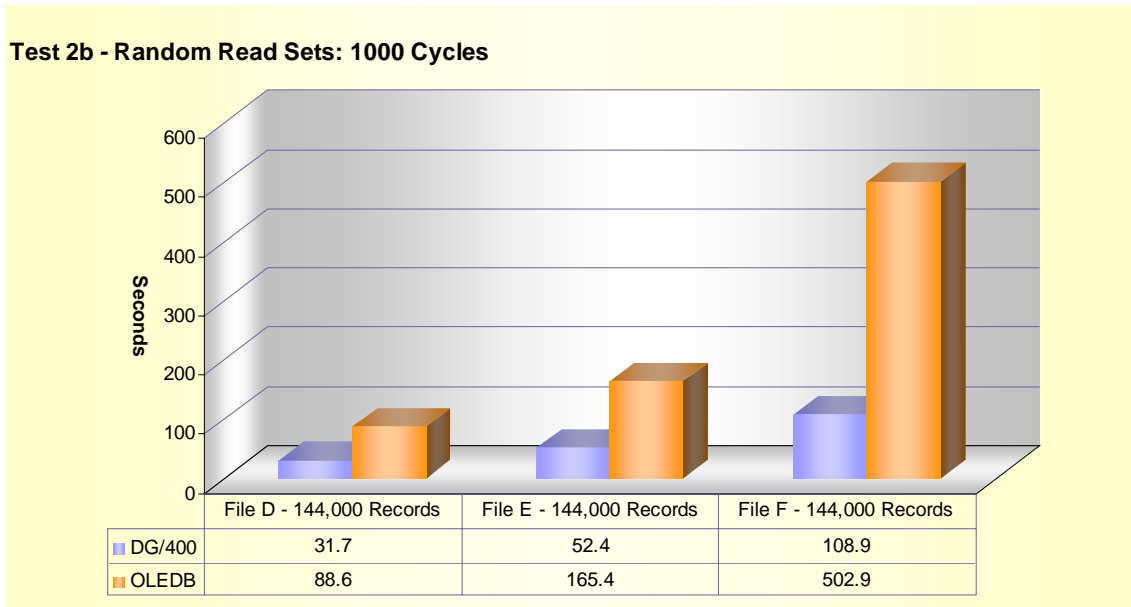
Test 2a

This test randomly selects and reads individual records from the test files (as in a customer record, for example). The file's key is generated randomly and the record is retrieved. When a record is retrieved, another key is randomly generated and the process continues without hesitation until the test is completed. The elapsed times represent how long was required to execute the number of random reads as noted.



Test 2b

This test randomly selects and reads sets of records from the test files (as in order detail, for example). The file's major key is generated randomly and the record set is retrieved. When the set is retrieved, another key is randomly generated and the process continues without hesitation until the test is completed. The elapsed times represent how long was required to execute the number of random requests as noted.



Multiple Client Tests

Test Suite 3 – Client/Server Scalability

These tests demonstrate the scalability of transaction-based database usage. The tests are run from multiple clients. The results of these tests are the average response times for the test's function.

These tests were conducted as “thick client,” client-server applications, where the application accessed and updated data directly from the iSeries database server. All applications were stateful, where database connections and files were kept open for the duration of the test.

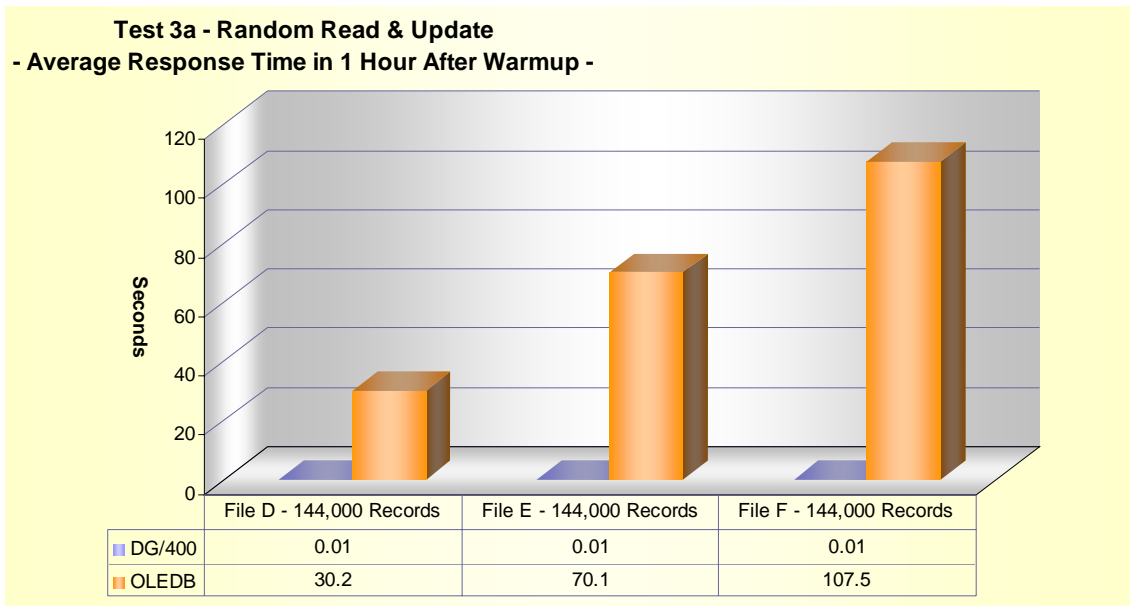
Test statistics were not accumulated until sufficient “warm up” time has passed for all “clients” to connect to the database, open files and begin processing.

The pacing between transactions for each client is set by “keying time” and “think time.” This pacing is similar to the TPC-C testing criterion where the times randomly vary within defined boundaries.

See Appendix B - Testing **notes** for the details regarding keying and think times.

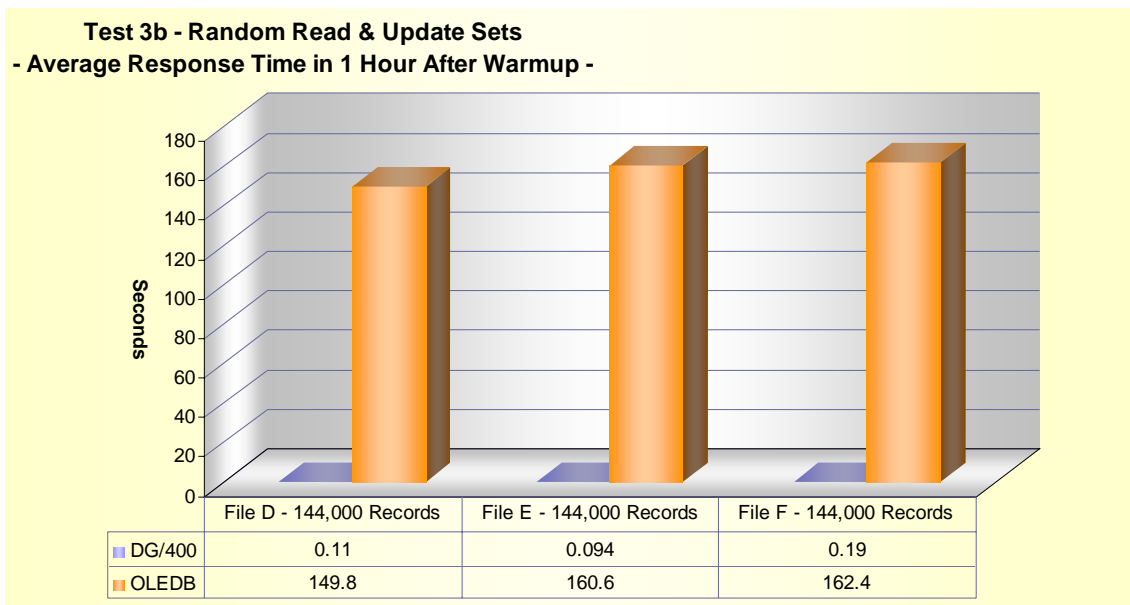
Test 3a

This test randomly selects and updates individual records from the test files. The file's key is generated randomly and the record is retrieved and updated (as in Customer maintenance).



Test 3b

This test randomly selects, reads and updates sets of records from the test files (as in order detail or sales detail). The file's major key is generated randomly and the record set is retrieved and updated (as in Order Fulfillment).



Test Suite 4 - Web Server Scalability

These tests demonstrate the scalability of transaction-based database usage in a 3-tier environment. The tests are run from multiple clients. The results of these tests are the average response times for the test's function.

These tests were conducted as “thin client,” web-server applications, where the client is the presentation layer (e.g., Web browser or Web service consumer). The transaction logic is confined to the web server, which accessed and updated data directly from the iSeries database server. All transactions were stateless, where database connections and files were open only for the duration of the transaction. When a transaction was completed, the files were closed and database connection terminated.

Test statistics were not accumulated until sufficient “warm up” time has passed for all “clients” to connect to the database, open files and begin processing. Transaction failures (e.g., unable to connect to database, record lock time out) were not contemplated in the average response time statistic.

However, such failures would be reflected as a reduction of transaction throughput, overall. This is reflected in the “Throughput Coefficient” which is a result of dividing total transactions by the average response time. The greater the coefficient, the better the transaction throughput.

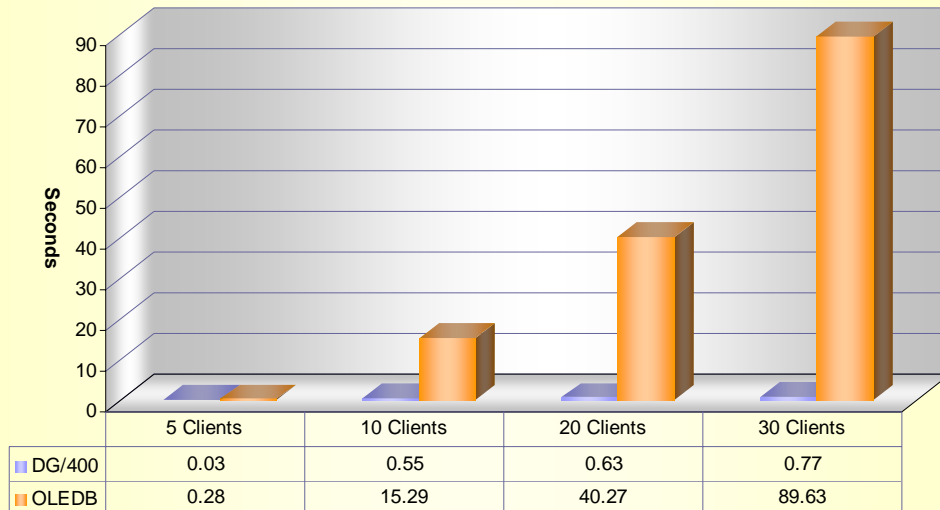
The pacing between transactions for each client is set by “keying time” and “think time.” This pacing is similar to the TPC-C testing criterion where the times randomly vary within defined boundaries.

See Appendix B - Testing **notes** for the details regarding keying and think times.

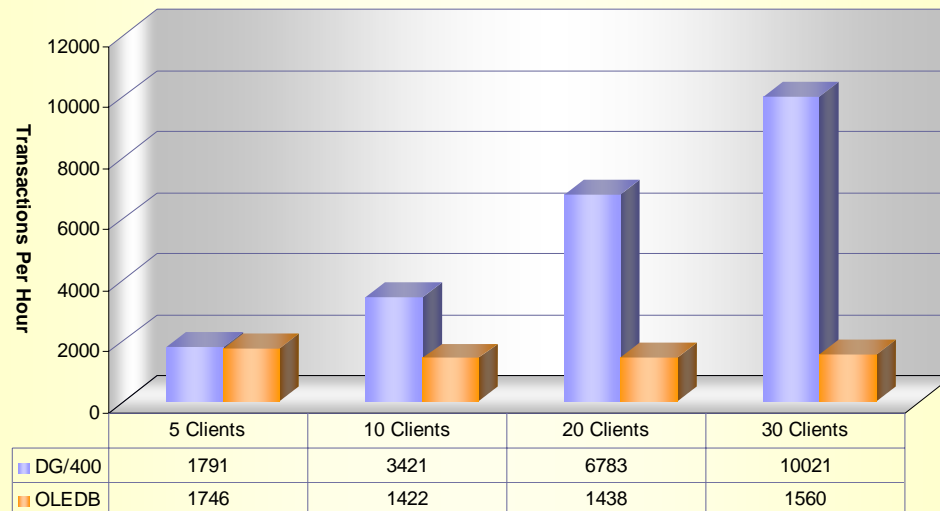
Test 4a

This test randomly selects and updates individual records from the test files. The file's key is generated randomly and the record is retrieved and updated (as in Customer maintenance).

Test 4a - Average Response Time



Test 4a - Completed Transaction

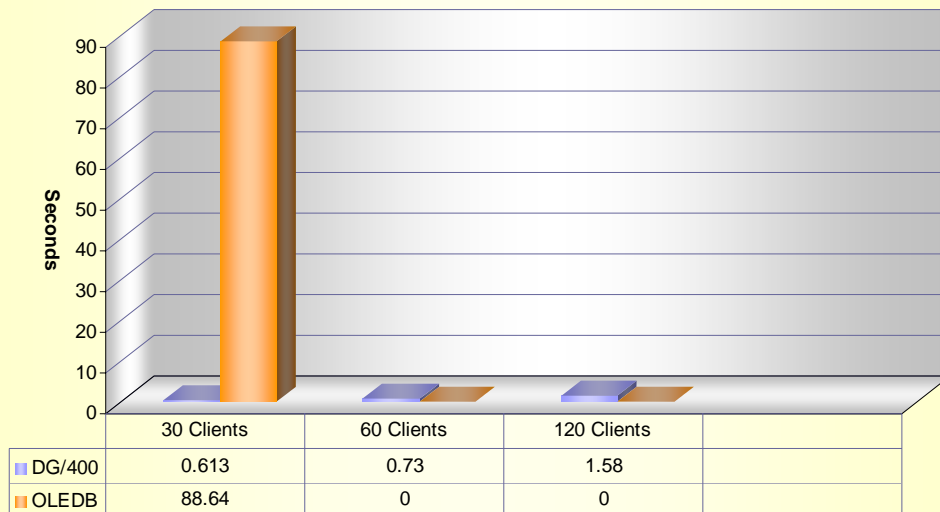


Test 4b

This test randomly selects, reads and updates sets of records from the test files (as in order detail or sales detail). The file's major key is generated randomly and the record set is retrieved and updated (as in Order Fulfillment).

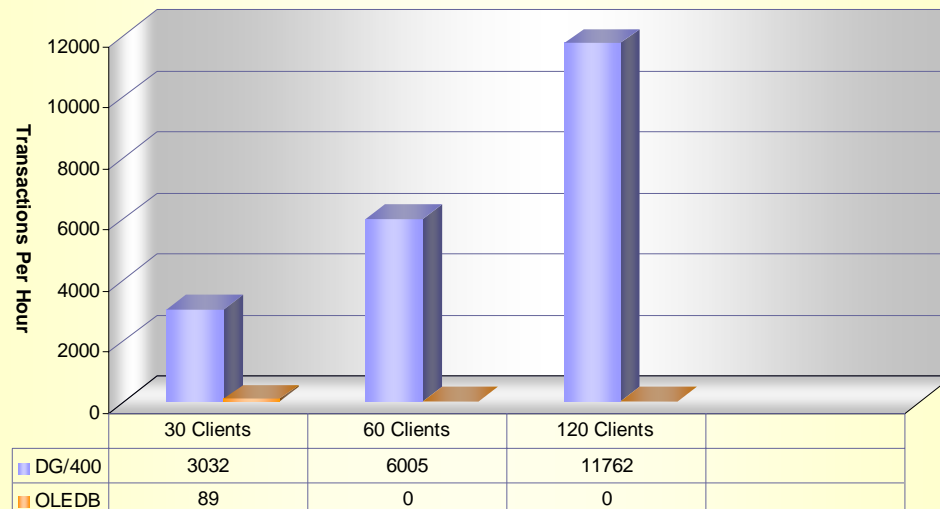
ADO testing could not be completed for more than 60 or more clients due to failure to establish connections.

Test 4b - Average Response Time



- *ADO tests could not be completed for 60 or 120 clients*

Test 4b - Completed Transaction



- *ADO tests could not be completed for 60 or 120 clients*

Appendix A

File: File A

Type of file:	Logical
Duplicates:	Allowed
Database:	BON_5047
Member count:	1
Format count:	1
Maximum file wait time:	Immediate
Maximum record wait time:	60 seconds
Share Type:	Share Update
Format:	RCMMASTL1
Fields:	10
Record length:	151
Key length:	5

Field Name	Data Type
CMCUSTNO	Packed(9,0)
CMNAME	Char(40)
CMADDR1	Char(35)
CMCITY	Char(30)
CMSTATE	Char(2)
CMPOSTCODE	Char(10)
CMCNTRY	Char(2)
CMACTIVE	Char(1)
CMFAX	Packed(10,0)
CMPHONE	Char(20)

Key Order Usage:

CMCUSTNO Ascending Signed

File: File B

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds
 Share Type: Share Update

Format: EXUSOL
 Fields: 79
 Record length: 484
 Key length: 16

CHANGE	Zoned(6,0)	HISSTD	Char(1)	HIST1P	Packed(5,2)
HIUPRM	Zoned(6,0)	HICSTD	Char(1)	HIST2D	Char(10)
HIUUNT	Zoned(4,0)	HIDPOT	Char(3)	HIST2P	Packed(5,2)
HIUEXT	Char(5)	HIDBYR	Char(5)	HIST3D	Char(10)
HIUSYC	Char(9)	HIDRQB	Char(5)	HIST3T	Packed(3,0)
HIUCCD	Zoned(2,0)	HIDTYP	Char(1)	HIST3P	Packed(5,2)
HIUVND	Char(5)	HIDPCT	Zoned(3,1)	HIST4D	Char(10)
HIUCTR	Char(10)	HIDRTY	Char(1)	HIST4T	Packed(3,0)
HIUPON	Char(6)	HIPLAN	Char(11)	HIST4P	Packed(5,2)
HIUPOS	Packed(7,0)	HIELEV	Char(3)	HIST5D	Char(10)
HIULIN	Packed(5,0)	HIPHSE	Char(3)	HIST5T	Packed(3,0)
HIUDSC	Char(30)	HIITEM	Char(20)	HIST5P	Packed(5,2)
HIUAMT	Packed(11,2)	HISWO	Zoned(6,0)	HIRFLG	Char(1)
HIQNTY	Packed(11,4)	HIJOB2	Zoned(6,0)	HIDESC	Char(40)
HIUNMS	Char(3)	HITRAC	Char(8)	HISTCD	Char(1)
HIUNPR	Packed(11,4)	HIBLOK	Char(3)	HICMT1	Char(40)
HIUORM	Zoned(2,0)	HILOTR	Char(4)	HICMT2	Char(40)
HIUORD	Zoned(2,0)	HIBSEQ	Packed(3,0)	HICMT3	Char(40)
HIUORC	Zoned(2,0)	HIEXMM	Zoned(2,0)	HITCMM	Zoned(2,0)
HIUORY	Zoned(2,0)	HIEXDD	Zoned(2,0)	HITCDD	Zoned(2,0)
HIUOTM	Zoned(6,0)	HIEXCC	Zoned(2,0)	HITCCC	Zoned(2,0)
HIUPNM	Zoned(2,0)	HIEXYY	Zoned(2,0)	HITCYY	Zoned(2,0)
HIUPND	Zoned(2,0)	HI#STG	Packed(1,0)	HITASK	Packed(3,0)
HIUPNC	Zoned(2,0)	HIST1D	Char(10)	HILINE	Packed(3,0)
HIUPNY	Zoned(2,0)	HIST2T	Packed(3,0)	HISALN	Packed(3,0)
HIPSTD	Char(1)	HIST1T	Packed(3,0)	HIBCO	Packed(3,0)
				HIBGRP	Packed(3,0)

Key Order Usage:

HIUCTR Ascending Unsigned
 HIUPON Ascending Unsigned

File: File C

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: 60 seconds
 Maximum record wait time: 60 seconds
 Share Type: Share Update
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds

Format: WQFMSTR
 Fields: 338
 Record length: 2109
 Key length: 6

WQQTE#	packed(11,0)	WQD1AP	Packed(8,0)	WQD3FN	Char(20)
WQPRFX	Char(3)	WQD1JS	Packed(8,0)	WQD3MN	Char(20)
WQPOL#	Packed(7,0)	WQD1GS	Char(1)	WQD3LN	Char(20)
WQSUFX	Packed(2,0)	WQD1DT	Char(1)	WQD3DOB	Packed(8,0)
WQAGST	Packed(2,0)	WQD1RT	Char(2)	WQD3GN	Char(1)
WQAGNO	Packed(4,0)	WQD1RS	Packed(8,0)	WQD3MS	Char(1)
WQINAM	Char(36)	WQD1MM	Char(1)	WQD3OL	Packed(4,0)
WQSNAM	Char(12)	WQD1CI	Char(1)	WQD3PT	Packed(2,0)
WQPROD	Char(5)	WQD1SF	Char(1)	WQD322	Char(1)
WQEFDT	Packed(8,0)	WQD1OC	Char(3)	WQD3RL	Char(1)
WQLSDT	Packed(8,0)	WQD2FN	Char(20)	WQD3AP	Packed(8,0)
WQTDRV	Packed(2,0)	WQD2MN	Char(20)	WQD3JS	Packed(8,0)
WQTVEH	Packed(2,0)	WQD2LN	Char(20)	WQD3GS	Char(1)
WQTERM	Packed(2,0)	WQD2DOB	Packed(8,0)	WQD3DT	Char(1)
WQTIER	Char(4)	WQD2GN	Char(1)	WQD3RT	Char(2)
WQBI		WQD2MS	Char(1)	WQD3RS	Packed(8,0)
WQPD		WQD2OL	Packed(4,0)	WQD3MM	Char(1)
WQUMBI	Char(10)	WQD2PT	Packed(2,0)	WQD3CI	Char(1)
WQMEDP	Char(10)	WQD222	Char(1)	WQD3SF	Char(1)
WQRNWD	Packed(2,2)	WQD2RL	Char(1)	WQD3OC	Char(3)
WQD1FN	Char(20)	WQD2AP	Packed(8,0)	WQD4FN	Char(20)
WQD1MN	Char(20)	WQD2JS	Packed(8,0)	WQD4MN	Char(20)
WQD1LN	Char(20)	WQD2GS	Char(1)	WQD4LN	Char(20)
WQD1DOB	Packed(8,0)	WQD2DT	Char(1)	WQD4DOB	Packed(8,0)
WQD1GN	Char(1)	WQD2RT	Char(2)	WQD4GN	Char(1)
WQD1MS	Char(1)	WQD2RS	Packed(8,0)	WQD4MS	Char(1)
WQD1OL	Packed(4,0)	WQD2MM	Char(1)	WQD4OL	Packed(4,0)
WQD1PT	Packed(2,0)	WQD2CI	Char(1)	WQD4PT	Packed(2,0)
WQD122	Char(1)	WQD2SF	Char(1)	WQD422	Char(1)
WQD1RL	Char(1)	WQD2OC	Char(3)	WQD4RL	Char(1)
WQD4AP	Packed(8,0)	WQD6AP	Packed(8,0)	WQV2D#	Packed(2,0)
WQD4JS	Packed(8,0)	WQD6JS	Packed(8,0)	WQV2GZ	Packed(5,0)
WQD4GS	Char(1)	WQD6GS	Char(1)	WQV2CM	Char(10)
WQD4DT	Char(1)	WQD6DT	Char(1)	WQV2CL	Char(10)
WQD4RT	Char(2)	WQD6RT	Char(2)	WQV2SD	Packed(5,0)
WQD4RS	Packed(8,0)	WQD6RS	Packed(8,0)	WQV2CU	Packed(5,0)

WQD4MM	Char(1)	WQD6MM	Char(1)	WQV2RT	Char(1)
WQD4CI	Char(1)	WQD6CI	Char(1)	WQV2TW	Char(10)
WQD4SF	Char(1)	WQD6SF	Char(1)	WQV3TP	Char(2)
WQD4OC	Char(3)	WQD6OC	Char(3)	WQV3VN	Char(17)
WQD5FN	Char(20)	WQV1TP	Char(2)	WQV3MD	Char(20)
WQD5MN	Char(20)	WQV1VN	Char(17)	WQV3YR	Packed(4,0)
WQD5LN	Char(20)	WQV1MD	Char(20)	WQV3MK	Char(20)
WQD5DOB	Packed(8,0)	WQV1YR	Packed(4,0)	WQV3CS	Packed(6,0)
WQD5GN	Char(1)	WQV1MK	Char(20)	WQV3SY	Packed(2,0)
WQD5MS	Char(1)	WQV1CS	Packed(6,0)	WQV3PF	Char(1)
WQD5OL	Packed(4,0)	WQV1SY	Packed(2,0)	WQV3TH	Char(1)
WQD5PT	Packed(2,0)	WQV1PF	Char(1)	WQV3US	Char(1)
WQD522	Char(1)	WQV1TH	Char(1)	WQV3ML	Packed(3,0)
WQD5RL	Char(1)	WQV1US	Char(1)	WQV3D#	Packed(2,0)
WQD5AP	Packed(8,0)	WQV1ML	Packed(3,0)	WQV3GZ	Packed(5,0)
WQD5JS	Packed(8,0)	WQV1D#	Packed(2,0)	WQV3CM	Char(10)
WQD5GS	Char(1)	WQV1GZ	Packed(5,0)	WQV3CL	Char(10)
WQD5DT	Char(1)	WQV1CM	Char(10)	WQV3SD	Packed(5,0)
WQD5RT	Char(2)	WQV1CL	Char(10)	WQV3CU	Packed(5,0)
WQD5RS	Packed(8,0)	WQV1SD	Packed(5,0)	WQV3RT	Char(1)
WQD5MM	Char(1)	WQV1CU	Packed(5,0)	WQV3TW	Char(10)
WQD5CI	Char(1)	WQV1RT	Char(1)	WQV4TP	Char(2)
WQD5SF	Char(1)	WQV1TW	Char(10)	WQV4VN	Char(17)
WQD5OC	Char(3)	WQV2TP	Char(2)	WQV4MD	Char(20)
WQD6FN	Char(20)	WQV2VN	Char(17)	WQV4YR	Packed(4,0)
WQD6MN	Char(20)	WQV2MD	Char(20)	WQV4MK	Char(20)
WQD6LN	Char(20)	WQV2YR	Packed(4,0)	WQV4CS	Packed(6,0)
WQD6DOB	Packed(8,0)	WQV2MK	Char(20)	WQV4SY	Packed(2,0)
WQD6GN	Char(1)	WQV2CS	Packed(6,0)	WQV4PF	Char(1)
WQD6MS	Char(1)	WQV2SY	Packed(2,0)	WQV4TH	Char(1)
WQD6OL	Packed(4,0)	WQV2PF	Char(1)	WQV4US	Char(1)
WQD6PT	Packed(2,0)	WQV2TH	Char(1)	WQV4ML	Packed(3,0)
WQD622	Char(1)	WQV2US	Char(1)	WQV4D#	Packed(2,0)
WQD6RL	Char(1)	WQV2ML	Packed(3,0)	WQV4GZ	Packed(5,0)
WQV4CM	Char(10)	WQV6SD	Packed(5,0)	WQV5AN	Char(36)
WQV4CL	Char(10)	WQV6CU	Packed(5,0)	WQV5AA	Char(24)
WQV4SD	Packed(5,0)	WQV6RT	Char(1)	WQV5AC	Char(16)
WQV4CU	Packed(5,0)	WQV6TW	Char(10)	WQV5AS	Char(2)
WQV4RT	Char(1)	WQV0AT	Char(1)	WQV5AZ	Packed(9,0)
WQV4TW	Char(10)	WQV0AN	Char(36)	WQV5AR	Packed(9,0)
WQV5TP	Char(2)	WQV0AA	Char(24)	WQV6AT	Char(1)
WQV5VN	Char(17)	WQV0AC	Char(16)	WQV6AN	Char(36)
WQV5MD	Char(20)	WQV0AS	Char(2)	WQV6AA	Char(24)
WQV5YR	Packed(4,0)	WQV0AZ	Packed(9,0)	WQV6AC	Char(16)
WQV5MK	Char(20)	WQV0AR	Packed(9,0)	WQV6AS	Char(2)
WQV5CS	Packed(6,0)	WQV1AT	Char(1)	WQV6AZ	Packed(9,0)
WQV5SY	Packed(2,0)	WQV1AN	Char(36)	WQV6AR	Packed(9,0)
WQV5PF	Char(1)	WQV1AA	Char(24)	WQV0V#	Packed(1,0)

WQV5TH	Char(1)	WQV1AC	Char(16)	WQV1V#	Packed(1,0)
WQV5US	Char(1)	WQV1AS	Char(2)	WQV2V#	Packed(1,0)
WQV5ML	Packed(3,0)	WQV1AZ	Packed(9,0)	WQV3V#	Packed(1,0)
WQV5D#	Packed(2,0)	WQV1AR	Packed(9,0)	WQV4V#	Packed(1,0)
WQV5GZ	Packed(5,0)	WQV2AT	Char(1)	WQV5V#	Packed(1,0)
WQV5CM	Char(10)	WQV2AN	Char(36)	WQV6V#	Packed(1,0)
WQV5CL	Char(10)	WQV2AA	Char(24)	WQD1US	Char(1)
WQV5SD	Packed(5,0)	WQV2AC	Char(16)	WQD1ML	Packed(3,0)
WQV5CU	Packed(5,0)	WQV2AS	Char(2)	WQD1AG	Char(1)
WQV5RT	Char(1)	WQV2AZ	Packed(9,0)	WQV1AG	Char(1)
WQV5TW	Char(10)	WQV2AR	Packed(9,0)	WQD2US	Char(1)
WQV6TP	Char(2)	WQV3AT	Char(1)	WQD2ML	Packed(3,0)
WQV6VN	Char(17)	WQV3AN	Char(36)	WQD2AG	Char(1)
WQV6MD	Char(20)	WQV3AA	Char(24)	WQV2AG	Char(1)
WQV6YR	Packed(4,0)	WQV3AC	Char(16)	WQD3US	Char(1)
WQV6MK	Char(20)	WQV3AS	Char(2)	WQD3ML	Packed(3,0)
WQV6CS	Packed(6,0)	WQV3AZ	Packed(9,0)	WQD3AG	Char(1)
WQV6SY	Packed(2,0)	WQV3AR	Packed(9,0)	WQV3AG	Char(1)
WQV6PF	Char(1)	WQV4AT	Char(1)	WQD4US	Char(1)
WQV6TH	Char(1)	WQV4AN	Char(36)	WQD4ML	Packed(3,0)
WQV6US	Char(1)	WQV4AA	Char(24)	WQD4AG	Char(1)
WQV6ML	Packed(3,0)	WQV4AC	Char(16)	WQV4AG	Char(1)
WQV6D#	Packed(2,0)	WQV4AS	Char(2)	WQD5US	Char(1)
WQV6GZ	Packed(5,0)	WQV4AZ	Packed(9,0)	WQD5ML	Packed(3,0)
WQV6CM	Char(10)	WQV4AR	Packed(9,0)r	WQD5AG	Char(1)
WQV6CL	Char(10)	WQV5AT	Char(1)	WQV5AG	Char(1)
WQD6US	Char(1)				
WQD6ML	Packed(3,0)				
WQD6AG	Char(1)				
WQV6AG	Char(1)				
WQEX01	Char(10)				
WQEX02	Char(10)				
WQEX03	Packed(8,0)				
WQEX04	Packed(8,0)				

Key Order Usage:

WQQTE# Ascending Signed

File: FILE D

Type of file: Logical
Duplicates: Not Allowed
Database: BON_5047
Member count: 1
Format count: 1
Maximum file wait time: 60 seconds
Maximum record wait time: 60 seconds
Share Type: Share Update

Format: RCSMASTL1
Fields: 15
Record length: 82
Key length: 10

Field Name	Data Type
CSCUSTNO	Packed(9,0)
CSYEAR	Zoned(4,0)
CSTYPE	Zoned(1,0)
CSSALES01	Packed(11,2)
CSSALES02	Packed(11,2)
CSSALES03	Packed(11,2)
CSSALES04	Packed(11,2)
CSSALES05	Packed(11,2)
CSSALES06	Packed(11,2)
CSSALES07	Packed(11,2)
CSSALES08	Packed(11,2)
CSSALES09	Packed(11,2)
CSSALES10	Packed(11,2)
CSSALES11	Packed(11,2)
CSSALES12	Packed(11,2)

Key Order Usage:

CSCUSTNO Ascending Signed
CSYEAR Ascending Signed
CSTYPE Ascending Signed

File: File E

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds
 Share Type: Share Update

Format: EXUSOL
 Fields: 94
 Record length: 566
 Key length: 10

CSCUSTNO	Packed(9,0)	HIDBYR	Char(5)	HIST5D	Char(10)
CSYEAR	Zoned(4,0)	HIDRQB	Char(5)	HIST5T	Packed(3,0)
CSTYPE	Zoned(1,0)	HIDTYP	Char(1)	HIST5P	Packed(5,2)
CHANGE	Zoned(6,0)	HIDPCT	Zoned(3,1)	HIRFLG	Char(1)
HIUPRM	Zoned(6,0)	HIDRTY	Char(1)	HIDESC	Char(40)
HIUUNT	Zoned(4,0)	HIPLAN	Char(11)	HISTCD	Char(1)
HIUEXT	Char(5)	HIELEV	Char(3)	HICMT1	Char(40)
HIUSYC	Char(9)	HIPHSE	Char(3)	HICMT2	Char(40)
HIUCCD	Zoned(2,0)	HIITEM	Char(20)	HICMT3	Char(40)
HIUVND	Char(5)	HISWO	Zoned(6,0)	HITCMM	Zoned(2,0)
HIUCTR	Char(10)	HIJOB2	Zoned(6,0)	HITCDD	Zoned(2,0)
HIUPON	Char(6)	HITRAC	Char(8)	HITCCC	Zoned(2,0)
HIUPOS	Packed(7,0)	HIBLOK	Char(3)	HITCYY	Zoned(2,0)
HIULIN	Packed(5,0)	HILOTR	Char(4)	HITASK	Packed(3,0)
HIUDSC	Char(30)	HIBSEQ	Packed(3,0)	HILINE	Packed(3,0)
HIUAMT	Packed(11,2)	HIEXMM	Zoned(2,0)	HISALN	Packed(3,0)
HIQNTY	Packed(11,4)	HIEXDD	Zoned(2,0)	HIBCO	Packed(3,0)
HIUNMS	Char(3)	HIEXCC	Zoned(2,0)	HIBGRP	Packed(3,0)
HIUNPR	Packed(11,4)	HIEXYY	Zoned(2,0)	CSSALES01	Packed(11,2)
HIUORM	Zoned(2,0)	HI#STG	Packed(1,0)	CSSALES02	Packed(11,2)
HIUORD	Zoned(2,0)	HIST1D	Char(10)	CSSALES03	Packed(11,2)
HIUORC	Zoned(2,0)	HIST1T	Packed(3,0)	CSSALES04	Packed(11,2)
HIUORY	Zoned(2,0)	HIST1P	Packed(5,2)	CSSALES05	Packed(11,2)
HIUOTM	Zoned(6,0)	HIST2D	Char(10)	CSSALES06	Packed(11,2)
HIUPNM	Zoned(2,0)	HIST2T	Packed(3,0)	CSSALES07	Packed(11,2)
HIUPND	Zoned(2,0)	HIST2P	Packed(5,2)	CSSALES08	Packed(11,2)
HIUPNC	Zoned(2,0)	HIST3D	Char(10)	CSSALES09	Packed(11,2)
HIUPNY	Zoned(2,0)	HIST3T	Packed(3,0)	CSSALES10	Packed(11,2)
HIPSTD	Char(1)	HIST3P	Packed(5,2)	CSSALES11	Packed(11,2)
HISSTD	Char(1)	HIST4D	Char(10)	CSSALES12	Packed(11,2)
HICSTD	Char(1)	HIST4T	Packed(3,0)		
HIDPOT	Char(3)	HIST4P	Packed(5,2)		

Key Order Usage:

CSCUSTNO Ascending Signed CSYEAR Ascending Signed CSTYPE Ascending Signed

File: File F

Type of file: Logical
 Duplicates: Allowed
 Database: BON_5047
 Member count: 1
 Format count: 1
 Maximum file wait time: 60 seconds
 Maximum record wait time: 60 seconds
 Share Type: Share Update
 Maximum file wait time: Immediate
 Maximum record wait time: 60 seconds

Format: WQFMSTR
 Fields: 353
 Record length: 2191
 Key length: 10

CSCUSTNO	Packed(9,0)	WQD1CI	Char(1)	WQD3CI	Char(1)
CSYEAR	Zoned(4,0)	WQD1SF	Char(1)	WQD3SF	Char(1)
CSTYPE	Zoned(1,0)	WQD1OC	Char(3)	WQD3OC	Char(3)
WQQTE#	packed(11,0)	WQD2FN	Char(20)	WQD4FN	Char(20)
WQPRFX	Char(3)	WQD2MN	Char(20)	WQD4MN	Char(20)
WQPOL#	Packed(7,0)	WQD2LN	Char(20)	WQD4LN	Char(20)
WQSUFX	Packed(2,0)	WQD2DOB	Packed(8,0)	WQD4DOB	Packed(8,0)
WQAGST	Packed(2,0)	WQD2GN	Char(1)	WQD4GN	Char(1)
WQAGNO	Packed(4,0)	WQD2MS	Char(1)	WQD4MS	Char(1)
WQINAM	Char(36)	WQD2OL	Packed(4,0)	WQD4OL	Packed(4,0)
WQSNAM	Char(12)	WQD2PT	Packed(2,0)	WQD4PT	Packed(2,0)
WQPROD	Char(5)	WQD222	Char(1)	WQD422	Char(1)
WQEFDT	Packed(8,0)	WQD2RL	Char(1)	WQD4RL	Char(1)
WQLSDT	Packed(8,0)	WQD2AP	Packed(8,0)	WQD4AP	Packed(8,0)
WQTDRV	Packed(2,0)	WQD2JS	Packed(8,0)	WQD4JS	Packed(8,0)
WQTVEH	Packed(2,0)	WQD2GS	Char(1)	WQD4GS	Char(1)
WQTERM	Packed(2,0)	WQD2DT	Char(1)	WQD4DT	Char(1)
WQTIER	Char(4)	WQD2RT	Char(2)	WQD4RT	Char(2)
WQBI		WQD2RS	Packed(8,0)	WQD4RS	Packed(8,0)
WQPD		WQD2MM	Char(1)	WQD4MM	Char(1)
WQUMBI	Char(10)	WQD2CI	Char(1)	WQD4CI	Char(1)
WQMEDP	Char(10)	WQD2SF	Char(1)	WQD4SF	Char(1)
WQRNWD	Packed(2,2)	WQD2OC	Char(3)	WQD4OC	Char(3)
WQD1FN	Char(20)	WQD3FN	Char(20)	WQD5FN	Char(20)
WQD1MN	Char(20)	WQD3MN	Char(20)	WQD5MN	Char(20)
WQD1LN	Char(20)	WQD3LN	Char(20)	WQD5LN	Char(20)
WQD1DOB	Packed(8,0)	WQD3DOB	Packed(8,0)	WQD5DOB	Packed(8,0)
WQD1GN	Char(1)	WQD3GN	Char(1)	WQD5GN	Char(1)
WQD1MS	Char(1)	WQD3MS	Char(1)	WQD5MS	Char(1)
WQD1OL	Packed(4,0)	WQD3OL	Packed(4,0)	WQD5OL	Packed(4,0)

WQD1PT	Packed(2,0)	WQD3PT	Packed(2,0)	WQD5PT	Packed(2,0)
WQD122	Char(1)	WQD322	Char(1)	WQD522	Char(1)
WQD1RL	Char(1)	WQD3RL	Char(1)	WQD5RL	Char(1)
WQD1AP	Packed(8,0)	WQD3AP	Packed(8,0)	WQD5AP	Packed(8,0)
WQD1JS	Packed(8,0)	WQD3JS	Packed(8,0)	WQD5JS	Packed(8,0)
WQD1GS	Char(1)	WQD3GS	Char(1)	WQD5GS	Char(1)
WQD1DT	Char(1)	WQD3DT	Char(1)	WQD5DT	Char(1)
WQD1RT	Char(2)	WQD3RT	Char(2)	WQD5RT	Char(2)
WQD1RS	Packed(8,0)	WQD3RS	Packed(8,0)	WQD5RS	Packed(8,0)
WQD1MM	Char(1)	WQD3MM	Char(1)	WQD5MM	Char(1)
WQD5CI	Char(1)	WQV1RT	Char(1)	WQV4TP	Char(2)
WQD5SF	Char(1)	WQV1TW	Char(10)	WQV4VN	Char(17)
WQD5OC	Char(3)	WQV2TP	Char(2)	WQV4MD	Char(20)
WQD6FN	Char(20)	WQV2VN	Char(17)	WQV4YR	Packed(4,0)
WQD6MN	Char(20)	WQV2MD	Char(20)	WQV4MK	Char(20)
WQD6LN	Char(20)	WQV2YR	Packed(4,0)	WQV4CS	Packed(6,0)
WQD6DOB	Packed(8,0)	WQV2MK	Char(20)	WQV4SY	Packed(2,0)
WQD6GN	Char(1)	WQV2CS	Packed(6,0)	WQV4PF	Char(1)
WQD6MS	Char(1)	WQV2SY	Packed(2,0)	WQV4TH	Char(1)
WQD6OL	Packed(4,0)	WQV2PF	Char(1)	WQV4US	Char(1)
WQD6PT	Packed(2,0)	WQV2TH	Char(1)	WQV4ML	Packed(3,0)
WQD622	Char(1)	WQV2US	Char(1)	WQV4D#	Packed(2,0)
WQD6RL	Char(1)	WQV2ML	Packed(3,0)	WQV4GZ	Packed(5,0)
WQD6AP	Packed(8,0)	WQV2D#	Packed(2,0)	WQV4CM	Char(10)
WQD6JS	Packed(8,0)	WQV2GZ	Packed(5,0)	WQV4CL	Char(10)
WQD6GS	Char(1)	WQV2CM	Char(10)	WQV4SD	Packed(5,0)
WQD6DT	Char(1)	WQV2CL	Char(10)	WQV4CU	Packed(5,0)
WQD6RT	Char(2)	WQV2SD	Packed(5,0)	WQV4RT	Char(1)
WQD6RS	Packed(8,0)	WQV2CU	Packed(5,0)	WQV4TW	Char(10)
WQD6MM	Char(1)	WQV2RT	Char(1)	WQV5TP	Char(2)
WQD6CI	Char(1)	WQV2TW	Char(10)	WQV5VN	Char(17)
WQD6SF	Char(1)	WQV3TP	Char(2)	WQV5MD	Char(20)
WQD6OC	Char(3)	WQV3VN	Char(17)	WQV5YR	Packed(4,0)
WQV1TP	Char(2)	WQV3MD	Char(20)	WQV5MK	Char(20)
WQV1VN	Char(17)	WQV3YR	Packed(4,0)	WQV5CS	Packed(6,0)
WQV1MD	Char(20)	WQV3MK	Char(20)	WQV5SY	Packed(2,0)
WQV1YR	Packed(4,0)	WQV3CS	Packed(6,0)	WQV5PF	Char(1)
WQV1MK	Char(20)	WQV3SY	Packed(2,0)	WQV5TH	Char(1)
WQV1CS	Packed(6,0)	WQV3PF	Char(1)	WQV5US	Char(1)
WQV1SY	Packed(2,0)	WQV3TH	Char(1)	WQV5ML	Packed(3,0)
WQV1PF	Char(1)	WQV3US	Char(1)	WQV5D#	Packed(2,0)
WQV1TH	Char(1)	WQV3ML	Packed(3,0)	WQV5GZ	Packed(5,0)
WQV1US	Char(1)	WQV3D#	Packed(2,0)	WQV5CM	Char(10)
WQV1ML	Packed(3,0)	WQV3GZ	Packed(5,0)	WQV5CL	Char(10)
WQV1D#	Packed(2,0)	WQV3CM	Char(10)	WQV5SD	Packed(5,0)

WQV1GZ	Packed(5,0)	WQV3CL	Char(10)	WQV5CU	Packed(5,0)
WQV1CM	Char(10)	WQV3SD	Packed(5,0)	WQV5RT	Char(1)
WQV1CL	Char(10)	WQV3CU	Packed(5,0)	WQV5TW	Char(10)
WQV1SD	Packed(5,0)	WQV3RT	Char(1)	WQV6TP	Char(2)
WQV1CU	Packed(5,0)	WQV3TW	Char(10)	WQV6VN	Char(17)
WQV6MD	Char(20)	WQV3AA	Char(24)	WQV2AG	Char(1)
WQV6YR	Packed(4,0)	WQV3AC	Char(16)	WQD3US	Char(1)
WQV6MK	Char(20)	WQV3AS	Char(2)	WQD3ML	Packed(3,0)
WQV6CS	Packed(6,0)	WQV3AZ	Packed(9,0)	WQD3AG	Char(1)
WQV6SY	Packed(2,0)	WQV3AR	Packed(9,0)	WQV3AG	Char(1)
WQV6PF	Char(1)	WQV4AT	Char(1)	WQD4US	Char(1)
WQV6TH	Char(1)	WQV4AN	Char(36)	WQD4ML	Packed(3,0)
WQV6US	Char(1)	WQV4AA	Char(24)	WQD4AG	Char(1)
WQV6ML	Packed(3,0)	WQV4AC	Char(16)	WQV4AG	Char(1)
WQV6D#	Packed(2,0)	WQV4AS	Char(2)	WQD5US	Char(1)
WQV6GZ	Packed(5,0)	WQV4AZ	Packed(9,0)	WQD5ML	Packed(3,0)
WQV6CM	Char(10)	WQV4AR	Packed(9,0)r	WQD5AG	Char(1)
WQV6CL	Char(10)	WQV5AT	Char(1)	WQV5AG	Char(1)
WQV6SD	Packed(5,0)	WQV5AN	Char(36)	WQD6US	Char(1)
WQV6CU	Packed(5,0)	WQV5AA	Char(24)	WQD6ML	Packed(3,0)
WQV6RT	Char(1)	WQV5AC	Char(16)	WQD6AG	Char(1)
WQV6TW	Char(10)	WQV5AS	Char(2)	WQV6AG	Char(1)
WQV0AT	Char(1)	WQV5AZ	Packed(9,0)	WQEX01	Char(10)
WQV0AN	Char(36)	WQV5AR	Packed(9,0)	WQEX02	Char(10)
WQV0AA	Char(24)	WQV6AT	Char(1)	WQEX03	Packed(8,0)
WQV0AC	Char(16)	WQV6AN	Char(36)	WQEX04	Packed(8,0)
WQV0AS	Char(2)	WQV6AA	Char(24)	CSSALES01	Packed(11,2)
WQV0AZ	Packed(9,0)	WQV6AC	Char(16)	CSSALES02	Packed(11,2)
WQV0AR	Packed(9,0)	WQV6AS	Char(2)	CSSALES03	Packed(11,2)
WQV1AT	Char(1)	WQV6AZ	Packed(9,0)	CSSALES04	Packed(11,2)
WQV1AN	Char(36)	WQV6AR	Packed(9,0)	CSSALES05	Packed(11,2)
WQV1AA	Char(24)	WQV0V#	Packed(1,0)	CSSALES06	Packed(11,2)
WQV1AC	Char(16)	WQV1V#	Packed(1,0)	CSSALES07	Packed(11,2)
WQV1AS	Char(2)	WQV2V#	Packed(1,0)	CSSALES08	Packed(11,2)
WQV1AZ	Packed(9,0)	WQV3V#	Packed(1,0)	CSSALES09	Packed(11,2)
WQV1AR	Packed(9,0)	WQV4V#	Packed(1,0)	CSSALES10	Packed(11,2)
WQV2AT	Char(1)	WQV5V#	Packed(1,0)	CSSALES11	Packed(11,2)
WQV2AN	Char(36)	WQV6V#	Packed(1,0)	CSSALES12	Packed(11,2)
WQV2AA	Char(24)	WQD1US	Char(1)		
WQV2AC	Char(16)	WQD1ML	Packed(3,0)		
WQV2AS	Char(2)	WQD1AG	Char(1)		
WQV2AZ	Packed(9,0)	WQV1AG	Char(1)		
WQV2AR	Packed(9,0)	WQD2US	Char(1)		
WQV3AT	Char(1)	WQD2ML	Packed(3,0)		
WQV3AN	Char(36)	WQD2AG	Char(1)		

Key Order Usage

CSCUSTNO Ascending Signed
CSYEAR Ascending Signed
CSTYPE Ascending Signed

Appendix B – Testing Notes

Tests 3a, 3b, 4a and 4b

All clients were allowed to start and run for a minimum of 15 minutes before statistics were gathered (“warm-up”). The warm-up was needed to get the ADO jobs to stabilize. Without the warm-up, the ADO tests would have performed more poorly.

Keying time is a random number of seconds ranging between 18 and 25.

Think time is a mean of 12 seconds. It is taken from a negative exponential distribution and computed from the following equation. It was not allowed to be less than 8 seconds nor more than 120 seconds.

$$T_t = -\log(r) * \mu$$

where: log = natural log (base e)

T_t = think time

r = random number uniformly distributed between 0 and 1

μ = mean think time

Test 3b & 4b

The number of records processed in the secondary “detail” file ranged between 10 and 14 records for each transaction.

Results

Using an IBM NetFinity 3500 as the web application server and an iSeries Model 270 as the database server, this test demonstrates the expected response times and transaction volumes for a lightweight web application.

Test methodology

Two Visual RPG for .NET Web Forms were employed, each being requested alternatively with 1 to 5 second (random) delay. Both web forms request data from, and post data to the database server. Transaction time is measured between the page Request and server Response.

Statistic

Simulated Browsers	140
Test period	3 hours
Application Server	NetFinity 3500 ¹
Database server	iSeries 270 ²
Average response time each page	2.5 seconds
Number of 2-page transactions processed per browser	1015
2-Page Transactions per Hour	47,367
.NET language	ASNA Visual RPG for .NET
iSeries Connectivity Middleware	ASNA DataGate .NET for iSeries/400
Connection Pooling to iSeries?	Yes
Average number of DataGate/400 jobs	14

Analysis

The number of 2-page transactions processed per hour is the significant number. Although 140 browser sessions were employed to simulate the web activity, the hourly user activity can be expressed as:

47,367 web users each executing the 2-form application once within an hour

23,683 web users each executing the 2-form application twice within an hour

11,841 web users each executing the 2-form application 4 times within an hour

5,921 web users each executing the 2-form application 8 times within an hour

2,960 web users each executing the 2-form application 16 times within an hour

This test was conducted on dedicated, though very small application and database servers. One could expect better results on larger, faster machines.

About ASNA

San Antonio-based ASNA (Amalgamated Software of North America) was established in 1982 and develops and markets unique software products that evolve IBM AS/400 and iSeries systems. Aligned with Microsoft's .NET initiative, ASNA is the only company to offer a thoroughly conceived, standards-based extension and migration path that solves its customers' business challenges. For more information about ASNA: <http://www.asna.com/>

¹ 2 CPU @ 732 MHz; 256 MB RAM; Windows 2003 running IIS 6

² 128MB RAM