



White Paper

Performance Benchmarks

Premier Banking Software on the IBM System i Platform

IBM System i Benchmark Center
Rochester, Minnesota

March 2007

As part of an ongoing commitment to ensure that our *Premier*[®] suite of banking software operates at the highest performance levels, ITI has conducted tests to measure performance on the IBM System i platform. This document details the objectives, configurations, methodology and results of the established benchmarks, and demonstrates the exceptional performance and scalability of *Premier* on this powerful IBM platform.

Table of Contents

Executive Summary	4
Objectives	4
Configurations	4
System Hardware	4
System Software.....	4
Database	5
Methodology.....	6
Application Software.....	6
Interactive Benchmarks.....	6
Interactive Workloads	7
Update Benchmarks	7
Update Workloads.....	8
Update Process Flow	8
Results.....	8
Interactive Benchmark Results.....	8
Isolated Premier Inquiry Interactive Benchmark Results.....	9
Isolated Connect ³ (Premiercom) Interactive Benchmark Results.....	10
Concurrent Interactive Benchmark Results.....	11
Update Benchmark Results	12
Conclusions.....	13
About the IBM System i Hardware Platform.....	13
About ITI's Premier Software and Services	13
About IBM and the IBM System i Benchmark Centers	14
About Information Technology, Inc.	14
For More Information	14
Notice.....	15

Executive Summary

Information Technology, Inc. (ITI) is committed to ensuring that *Premier*[®] software operates at the highest levels of performance for financial institutions. As part of this commitment, ITI recently conducted a number of tests at the IBM[®] System i Benchmark Center in Rochester, Minnesota. These tests measured *Premier*'s performance on IBM's popular System i platform. This document details the objectives, configurations, methodology and results of the established benchmarks, and demonstrates the exceptional performance and scalability of ITI's *Premier* software on IBM's newest System i platforms.

Objectives

Performance benchmarks for ITI's *Premier* software on IBM System i were established by ITI at the IBM Benchmark Center in March 2007. The project had three primary objectives:

- 1) Benchmark the performance and scalability of *Premier* update application software using multiple databases on multiple IBM System i configurations.
- 2) Benchmark the performance and scalability of *Premier* and *Connect*³ data tier application software, supporting *Premier* customer inquiries and *Premierecom* Internet banking activity on multiple IBM System i configurations.
- 3) Evaluate the performance and scalability of ITI's application software on IBM System i configurations and determine additional methods of gaining efficiencies.

Configurations

System Hardware

Benchmarks were established on three IBM System i configurations. The selected configurations offer a great range of processing resources and are representative of the wide variety of systems well-suited for use by ITI's client base. All IBM System i configurations described below include standard RAID-5 disk arrays.

System Configurations	IBM System i Model Number	Number of Processors	CPW Rating	Allocated Memory	Number of Disk Arms
A	520	1	3800	6 GB	20
B	550	2	7100	12 GB	24
C	550	4	14000	32 GB	36

System Software

Benchmarks were established on systems running IBM's newest System i operating system, i5/OS V5R4. IBM's "Expert Cache" feature was enabled for each benchmark, ensuring input/output contention was minimized for each program.

Database

Benchmarks were established with five different database configurations offering a wide range of processing requirements in terms of account volume and transaction posting activity.

Database A Configuration (One Physical Database)	Total Number of Accounts	Total Number of On-Us Items	Total Number of Transit Items
Demand Deposit	68,791	82,821	67,006
Savings	44,526	2,223	
Certificate of Deposit	6,713	10	
Loans	48,318	744	
General Ledger	11,250	8,829	
Totals	179,598	94,627	67,006

Database B Configuration (Two Physical Databases)	Total Number of Accounts	Total Number of On-Us Items	Total Number of Transit Items
Demand Deposit	137,582	165,642	134,012
Savings	89,052	4,446	
Certificate of Deposit	13,426	20	
Loans	96,636	1,488	
General Ledger	22,500	17,658	
Totals	359,196	189,254	134,012

Database C Configuration (Four Physical Databases)	Total Number of Accounts	Total Number of On-Us Items	Total Number of Transit Items
Demand Deposit	275,164	331,284	268,024
Savings	178,104	8,892	
Certificate of Deposit	26,852	40	
Loans	193,272	2,976	
General Ledger	45,000	35,316	
Totals	718,392	378,508	268,024

Database D Configuration (Two Physical Databases)	Total Number of Accounts	Total Number of On-Us Items	Total Number of Transit Items
Demand Deposit	482,270	454,996	190,720
Savings	305,914	26,728	
Certificate of Deposit	335,964	510	
Loans	433,620	13,114	
General Ledger	402,008	30,340	
Totals	1,959,768	525,688	190,720

Database E Configuration (Four Physical Databases)	Total Number of Accounts	Total Number of On-Us Items	Total Number of Transit Items
Demand Deposit	964,540	909,992	381,440
Savings	611,828	53,456	
Certificate of Deposit	671,928	1,020	
Loans	867,240	26,228	
General Ledger	804,016	60,680	
Totals	3,919,536	1,051,376	381,440

Methodology

Application Software

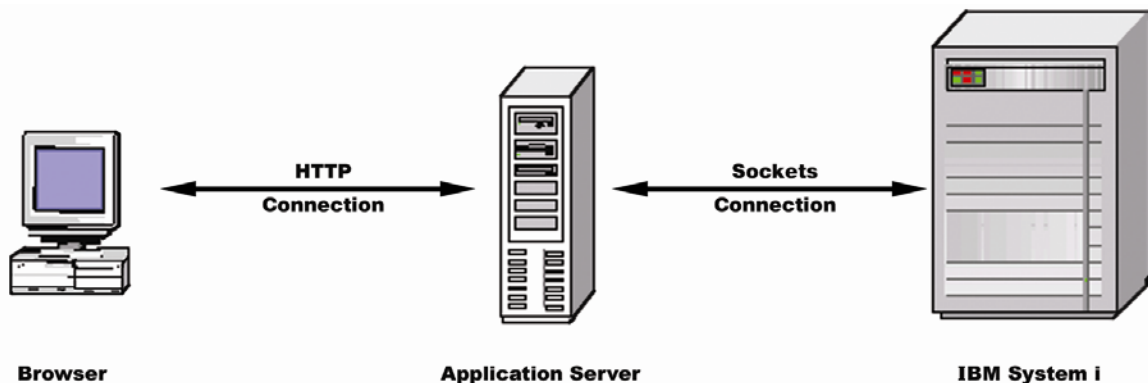
Benchmarks were conducted using *Premier* database release level 19 and the following application software versions:

<i>Premier</i>	5.1
<i>Connect³</i>	3.7
<i>ATM</i>	2.9

Applications also included performance improvements available for general release in subsequent software versions.

Interactive Benchmarks

Interactive benchmarks were conducted with ITI's *Premier*, *Connect³* and *ATM* application software. Interactive applications are structured using classic three-tier architecture consisting of data, business and presentation tiers. Standard TCP/IP connections accommodate the communications between the components of this architecture.



The data tier includes programs retrieving information from a banking customer database on an IBM System i. The business tier includes programs on Windows[®] application servers, applying business rules to user requests and formatting responses. The presentation tier resides on the application server, accepts user requests and presents responses to a browser (e.g., Microsoft[®] Internet Explorer[®]) on a workstation.

The interactive benchmarks for this project focused on the performance and scalability of the data tier within the structure of these applications. *Connect*³ middleware links an array of ITI electronic delivery systems with the ITI *Premier* and other customer databases in the data tier. A *Premierecom* Internet banking application server workload was used to benchmark *Connect*³.

Interactive Workloads

When benchmarking the performance of the data tier, the user requests and business rules were emulated to represent varying degrees of interactive workloads. The parameters used to emulate the application server workloads were based on transaction history reports from actual ITI clients.

Benchmarks were conducted for the following three types of interactive workloads, which typically represent the majority of online activity:

- 1) Isolated *Premier* customer and account inquiries
- 2) Isolated *Connect*³ (*Premierecom*) Internet banking activity
- 3) Concurrent *Premier* customer and account inquiries, *Connect*³ (*Premierecom*) Internet banking activity, and ATM activity

Standard *Premier* inquiry workloads, measured in terms of *Premier* users and their associated “transactions per hour,” were emulated to measure the data tier performance of the application. Only about 25% of user requests generate transactions to the data tier in standard *Premier* inquiry workloads. Most user requests are associated with more detailed presentation of information already retrieved from the customer database.

Standard *Connect*³ online workloads, measured in terms of *Premierecom* electronic banking customers and their associated “transactions per hour,” were emulated to measure the data tier performance of the application. About 75% of user requests generate transactions to the data tier in standard *Connect*³ online workloads, which is more characteristic of a maintenance application than an inquiry application.

Premier inquiry and *Connect*³ (*Premierecom*) online workloads were benchmarked in isolation and concurrently. Isolated benchmarks provide effective analysis of exclusive utilization of system resources by particular applications. Concurrent benchmarks are designed to demonstrate system resource utilization with multiple applications competing for system resources simultaneously. ATM activity was also added to the concurrent online benchmarks to enhance this effect.

Update Benchmarks

Update benchmarks were conducted with *Premier* software processing representative databases on IBM System i. Benchmarks were established by scaling the size of the database configurations to the processing capability/capacity of the system configurations, and they were designed to measure the performance of system and database configurations considered typical for current ITI clients.

Although an organized database contributes to optimal update performance, no explicit attempt was made to reorganize these databases using the ITI standard database reorganization program prior to benchmarks.

Rather, benchmarks were established by essentially updating these representative databases “as-is” in attempt to simulate real-world processing conditions.

Update Workloads

Update workloads consisted of standard update processing requirements including daily extract, sort, update and report generation programs. Standard update processing for the following ITI applications were included in all benchmarks:

- Demand Deposit Account (DDA)
- Loan Accounting System (LAS)
- Savings Account (SAV)
- Central Information System (CIS)
- Certificate of Deposit (COD)
- General Ledger/Financial Management System (FMS)

Standard update processing for the following ITI application was also included in benchmarks for databases D and E:

- Safe Deposit Box Accounting (SDB)

Benchmarks did not include additional processes generally regarded as daily requirements such as database backups, *Premier Prime* database population or *Premier Director* downloads.

Update Process Flow

Standard update process flows were used for all benchmarks, leveraging the multithreading capabilities of ITI software, while ensuring that application update programs ran in proper progression.

Results

Interactive Benchmark Results

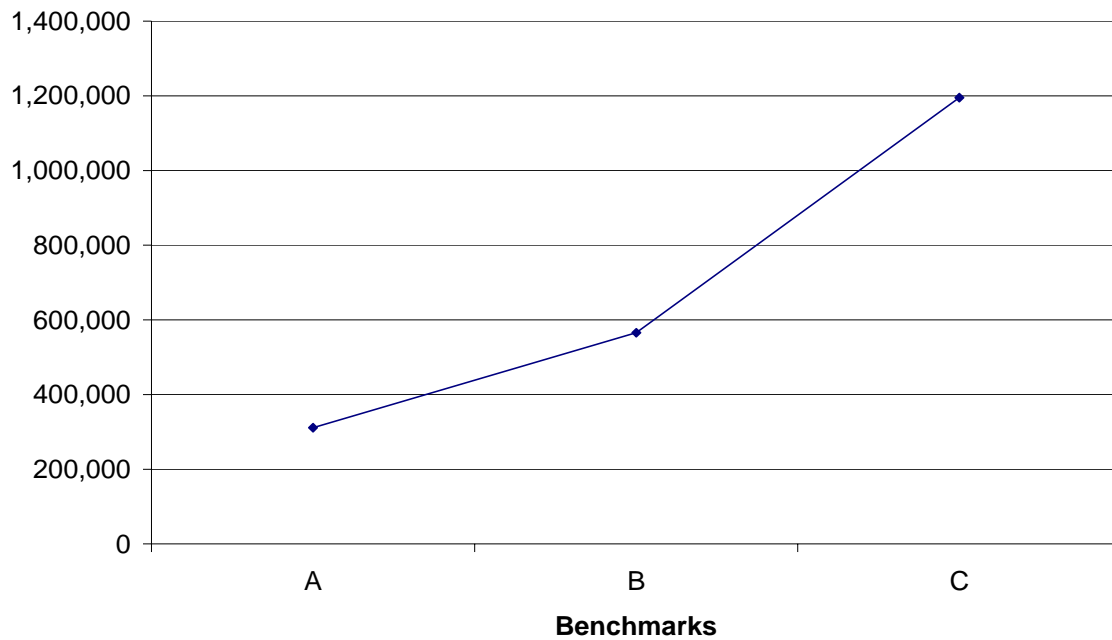
Interactive benchmark results were organized in terms of benchmark parameters (i.e., primarily by data tier system configuration, and secondarily by the number of supported online users and transactions per hour). The number of supported online users are estimated based on the number of transactions per hour achieved during each benchmark. Estimates were determined based on analysis of ITI client transaction history including the number of users authorized for online services, percentage of logins occurring at peak hours, average session length, and the percentage of traffic during peak hours.

Benchmarks were conducted on multiple IBM System i configurations considered possible solutions for *Premier* and *Connect*³ data tier processing requirements. Metrics used for interactive benchmark evaluation included the average data tier latency (response time per transaction from the IBM System i) and system resource utilization.

Isolated Premier Inquiry Interactive Benchmark Results

	System Configuration	Supported Users	Transactions Per Hour	Average Data Tier Latency (seconds)	Average CPU Utilization (%)	Average Disk Utilization (%)
Benchmark A	A	100,000	311,016	0.243	33.9	3.3
Benchmark B	B	200,000	566,220	0.048	25.4	5.9
Benchmark C	C	400,000	1,195,290	0.053	21.1	6.1

Premier Inquiry Transactions Per Hour



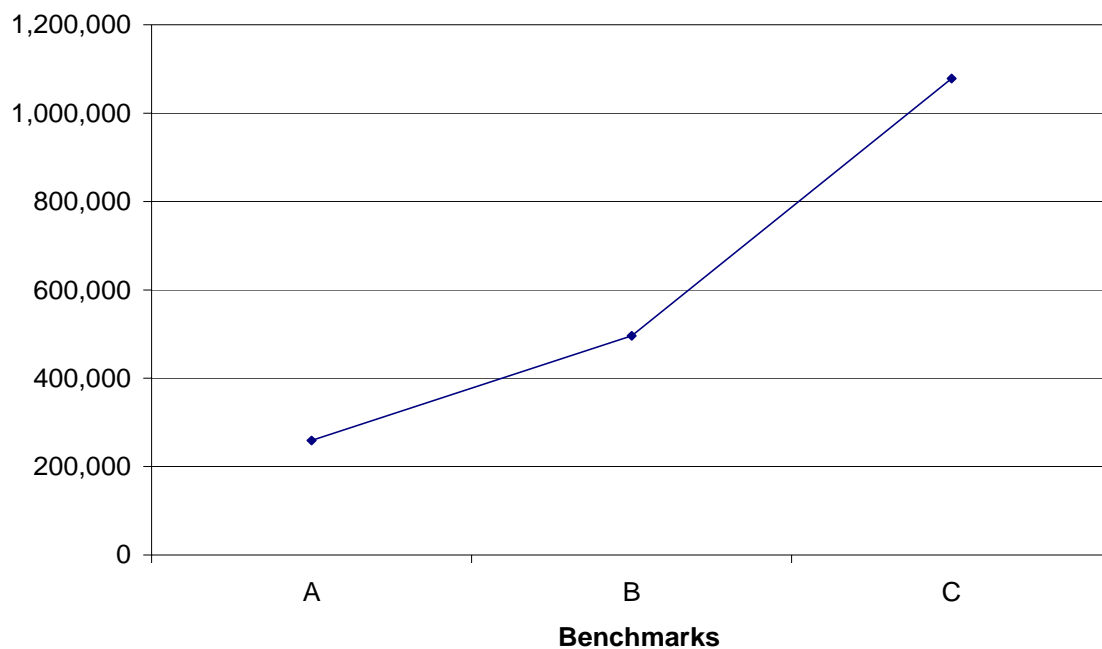
Observations:

- Throughput rates surpassed 1.1 million transactions per hour
- Average data tier latency did not surpass 0.243 seconds
- Relatively low average CPU utilization levels provide high capacity for processing additional online and update workloads

Isolated Connect³ (Premier@com) Interactive Benchmark Results

	System Configuration	Supported Users	Transactions Per Hour	Average Data Tier Latency (seconds)	Average CPU Utilization (%)	Average Disk Utilization (%)
Benchmark A	A	750,000	258,822	0.165	51.9	4.8
Benchmark B	B	1,500,000	492,030	0.553	55.4	6.6
Benchmark C	C	3,000,000	1,078,720	0.399	44.4	12.0

Connect³ (Premier@com) Transactions Per Hour



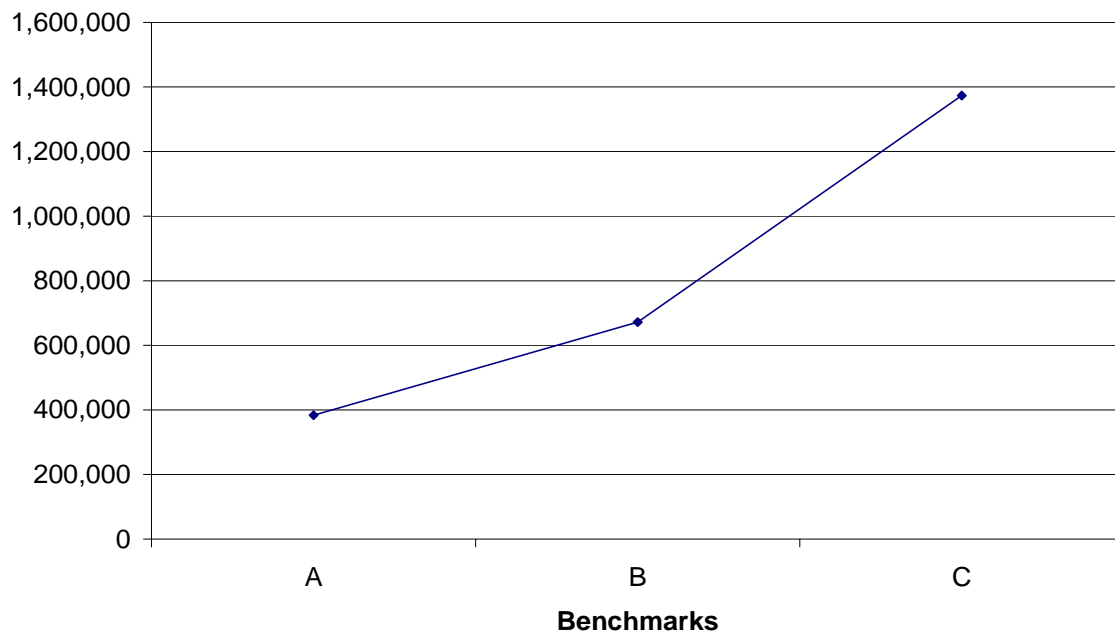
Observations:

- Throughput rates surpassed 1 million transactions per hour
- Average data tier latency did not surpass 0.553 seconds
- Average CPU utilization levels provide some capacity for processing additional online and update workloads

Concurrent Interactive Benchmark Results

	System Configuration	Premier Inquiry Transactions Per Hour	Connect ³ Transactions Per Hour	Average Data Tier Latency (seconds)	Average CPU Utilization (%)	Average Disk Utilization (%)
Benchmark A	A	199,608	184,212	0.110	55.2	5.3
Benchmark B	B	354,564	302,280	0.293	59.2	6.3
Benchmark C	C	738,204	621,930	0.249	51.9	17.2

Concurrent Transactions Per Hour



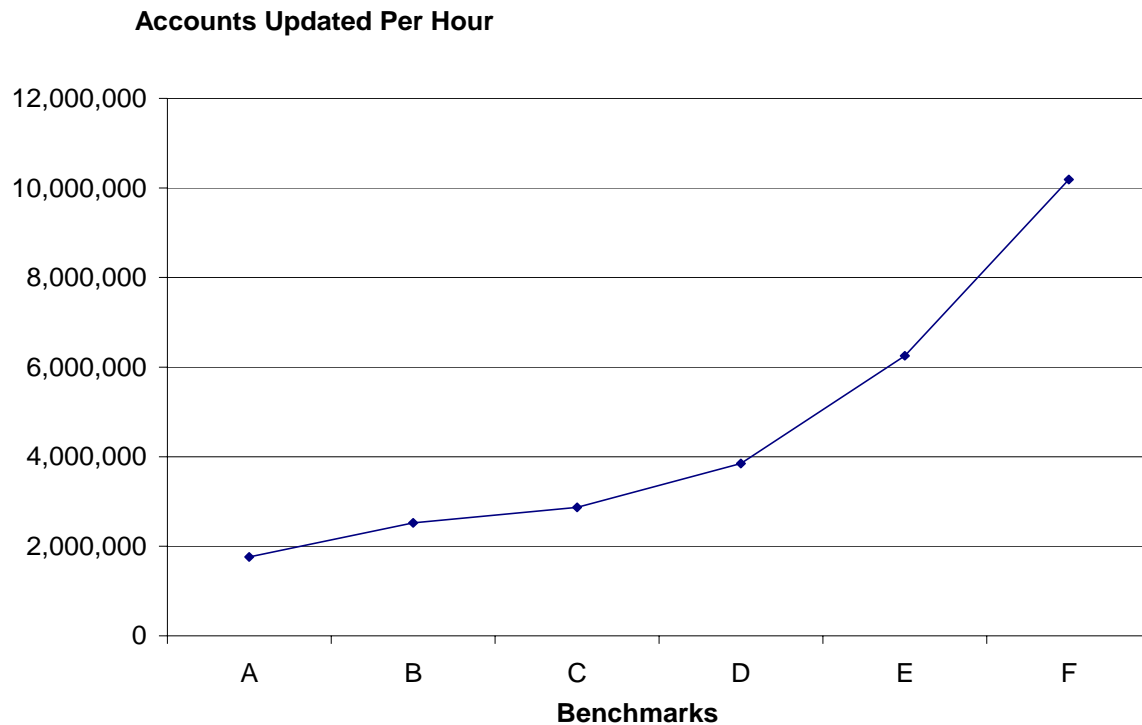
Observations:

- Throughput rates surpassed 1.3 million transactions per hour (including ATM activity not referenced in the Results table)
- Average data tier latency did not surpass 0.293 seconds
- Refer to the isolated *Premier Inquiry* and *Connect³ (Premierecom)* interactive benchmark results to determine approximate number of supported users for corresponding throughput (transactions per hour)
- Average CPU utilization levels provide some capacity for processing additional online and update workloads

Update Benchmark Results

Update benchmark results were organized in terms of system configuration. Benchmarks were conducted on a range of IBM System i configurations considered possible solutions for each representative database's update processing requirements. Metrics used for evaluation included the total elapsed time of the update run, overall throughput and system resource utilization.

	System Configuration	Database Configuration	Accounts Updated (Per Hour)	Elapsed Time	Average CPU Utilization (%)	Average Disk Utilization (%)
Benchmark A	A	A	1,760,656	00:06:06	29.2	7.0
Benchmark B	A	B	2,520,674	00:08:03	48.5	15.0
Benchmark C	A	C	2,870,379	00:15:01	67.4	31.0
Benchmark D	B	D	3,848,972	00:30:33	43.8	19.0
Benchmark E	C	D	6,254,579	00:18:48	13.4	7.0
Benchmark F	C	E	10,192,538	00:23:04	27.2	11.0



Observations:

- Throughput rates surpassed 10 million accounts per hour

Conclusions

These benchmark results solidly demonstrate that ITI's *Premier* and *Connect*³ application software, together with IBM's System i hardware, is more than capable of accommodating the processing requirements of virtually any financial institution in the nation, regardless of size. The interactive benchmark results demonstrate that 400,000 *Premier* users (financial institution employees performing inquiries) and 3 million active *Premierecom* Internet banking customers can be accommodated. The *Premier* update benchmark results demonstrate that 4 million accounts can be processed in 23 minutes – a rate of 10 million accounts per hour.

ITI clients who choose the IBM System i platform can expect outstanding performance. Benchmark results show that high levels of update throughput and online activity can be achieved with optimal levels of resource utilization for a wide range of processing requirements.

About the IBM System i Hardware Platform

The IBM System i is the next-generation System i, the industry's first POWER5™ processor-based server, able to run any combination of Linux, AIX and the i5/OS on a single system. IBM i5/OS is the next generation of OS/400®. IBM i5/OS V5R4 is a premier integrated operating system that builds on and extends the capabilities of OS/400. New IBM System i, i5/OS and the IBM Virtualization Engine™ combine to deliver an integrated infrastructure that's simpler, more productive, and more resilient. Whatever the size of your business, in this increasingly complex on-demand world, IBM System i technology can help you integrate to innovate, simplify your IT infrastructure and deliver without disruption.

About ITI's Premier Software and Services

Premier's comprehensive suite of software and services is the solution of choice at financial institutions nationwide, from de novos and community banks to those with many billions in assets. No matter where they can be found on the technology curve, *Premier* clients gain every opportunity to leverage their existing systems and processes to the greatest extent possible – with powerful results. A continuous cycle of research, development, implementation and feedback delivers the most advanced software on the market, available on the client's choice of two popular hardware platforms. Careful design delivers results that are sophisticated, yet easy to use. Expert service enhances your technology and fine-tunes your banking processes. The result is widespread recognition of *Premier* as the industry's finest and most flexible solution – one that helps clients compete and thrive in an always-changing financial services environment.

About IBM and the IBM System i Benchmark Centers

IBM is the world's largest information technology company, with 80 years of leadership in helping businesses innovate. Drawing on resources from across IBM and key IBM Business Partners, IBM offers a wide range of services, solutions and technologies that enable customers, large and small, to take full advantage of on-demand business. For more information about IBM, visit www.ibm.com.

The IBM Benchmark Centers provide benchmark capability worldwide for IBM server and storage technology, including proof of concept, scaling and performance services. At these centers, IBM business partners have access to IBM eServer technologies, including System z and zSeries[®], System p and pSeries, System x and xSeries, System i and iSeries, and Blue Gene equipment and IBM and storage devices. All IBM-supported operating systems are also available. IBM systems can be configured to specification in order to stress, tune and test an application or database, measure performance and determine workload capacity.

About Information Technology, Inc.

Serving more U.S. banks and savings institutions than any other software and services vendor, ITI offers several core solutions, including the service-oriented architecture-based *Premier*[®] and *PCS Vision*[™] suites, and a broad range of supporting products and services available on the nation's most popular IBM and Unisys hardware platforms for in-house and outsourced account processing. Founded in 1976, ITI works closely with some of the best-known technology companies in the world, and has grown to incorporate businesses and offices nationwide, including its Premier, Precision Computer Systems (PCS), Branch Automation, eSolutions, Digital Solutions, Decision Metrics and Professional Services operating units. ITI is a subsidiary of Fiserv, Inc.

Fiserv, Inc. (NASDAQ: FISV), a Fortune 500 company, provides information management systems and services to the financial and insurance industries. Leading services include transaction processing, outsourcing, business process outsourcing (BPO), software and systems solutions. The company serves more than 17,000 clients worldwide and is the leading provider of core processing solutions for U.S. banks, credit unions and thrifts. Fiserv was ranked the largest provider of information technology services to the financial services industry worldwide in the 2004, 2005 and 2006 FinTech 100 surveys. Headquartered in Brookfield, Wis., Fiserv reported more than \$4.5 billion in total revenue for 2006. For more information, visit www.fiserv.com.

For More Information

For more information about these tests or the *Premier* product suite, call ITI at 402.421.4207 or e-mail partner@iti.fiserv.com. ITI can also be found on the Internet at www.itinw.net.

Notice

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