

IMS Version 10 Performance Summary

October 2007

Author: Hiram K. Neal

Contributors: Bovorit Pibulsongram, Mike Gonzales, Hsiung Tang

IMS Performance Test Team (IBM Silicon Valley Laboratory)

David Viguers Software Performance Analyst

Abstract

IMS Version 10 offers features that enhance the availability, performance, integration, manageability, and scalability of IMS and IMS data. This paper illustrates the performance characteristics of the new IMS Version 10.

The information provided in this paper was obtained at the IBM Silicon Valley Laboratory and is intended for migration and capacity planning purposes.

© IBM 2007

Software Group

San Jose

	Page
1 Introduction	4
2 Executive Overview	5
3 Base Performance	6
3.1 Introduction	6
3.2 Base Test Environment	6
3.3 Base Performance Results	7
3.4 Base Performance Summary	10
4 MSC Bandwidth	11
4.1 Introduction	11
4.2 MSC Bandwidth Test Environment	11
4.3 MSC Bandwidth Results	12
4.4 MSC Bandwidth Summary	15
5 Fast Path EMH Enhancements	16
5.1 Introduction	16
5.2 Fast Path EMH Enhancements Test Environment	16
5.3 Fast Path EMH Enhancements Results	17
5.4 Fast Path EMH Enhancements Summary	21
6 Fast Path Serviceability / Usability	22
6.1 Introduction	22
6.2 Fast Path Serviceability / Usability Environment	22
6.3 Fast Path Serviceability / Usability Results	23
6.4 Fast Path Serviceability / Usability Summary	23
7 HALDB Index/ILDS Rebuild Utility Free Space Enhancements	24
7.1 Introduction	24
7.2 HALDB Index/ILDS Rebuild Utility Free Space Environment	24
7.3 HALDB Index/ILDS Rebuild Utility Free Space Results	25
7.4 HALDB Index/ILDS Rebuild Utility Free Space Summary	26
8 Fast Path High Stress	27
8.1 Introduction	27
8.2 Fast Path High Stress Test Environment	27
8.3 Fast Path High Stress Results	28
8.4 Fast Path High Stress Summary	28
9 Image Copy 2 FlashCopy Support	29
9.1 Introduction	29
9.2 Image Copy 2 FlashCopy Support Test Environment	29
9.3 Image Copy 2 FlashCopy Support Results	30
9.4 Image Copy 2 FlashCopy Support Summary	30

	Page
10 OTMA Performance	31
10.1 Introduction	31
10.2 OTMA Performance Test Environment	31
10.3 OTMA Performance Results	32
10.4 OTMA Performance Summary	32
11 IMS Connect with Shared Queues	33
11.1 Introduction	33
11.2 IMS Connect with Shared Queues Test Environment	33
11.3 IMS Connect with Shared Queues Results	34
11.4 IMS Connect with Shared Queues Summary	35
12 IMS Connect with Data Sharing	36
12.1 Introduction	36
12.2 IMS Connect with Data Sharing Test Environment	36
12.3 IMS Connect with Data Sharing Results	37
12.4 IMS Connect with Data Sharing Summary	37
13 IMS Connect V10 Benchmark	38
13.1 Introduction	38
13.2 IMS Connect V10 Benchmark Test Environment	38
13.3 IMS Connect V10 Benchmark Results	39
13.4 IMS Connect V10 Benchmark Summary	39
14 Transaction Level Statistics	40
14.1 Introduction	40
14.2 Transaction Level Statistics Test Environment	40
14.3 Transaction Level Statistics Results	41
14.4 Transaction Level Statistics Summary	42
15 ACBLIB Member Online Change	43
15.1 Introduction	43
15.2 ACBLIB Member Online Change Test Environment	43
15.3 ACBLIB Member Online Change Results	44
15.4 ACBLIB Member Online Change Summary	45
Addendum 1 Parallel Recon Access	46
A1.1 Introduction	46
A1.2 PRA Test Environment	46
A1.3 PRA Results	47
A1.4 PRA Summary	50
16 Testing Methodology	51
16.1 Disclaimer	52
16.2 Trademarks	52

1 Introduction

The IBM IMS Version 10 release offers a large variety of enhancements providing improved performance, availability, scalability, and manageability to an unsurpassed data and transaction management product. The IBM SVL performance test team traditionally conducts performance test evaluations and release to release comparisons to insure optimal performance and to provide this document as a source of information about the current product and it's performance enhancement characteristics. This paper illustrates the performance characteristics of the IBM IMS Version 10 release as observed by the IBM SVL performance test team's evaluations. Documented in this paper are the results and performance characteristics observed during the evaluations and IMS Version 9 vs IMS Version 10 comparisons for the following areas:

- Full Function with shared queues
- Full Function with HALDB
- Fast Path base measurements
- BMP base measurements
- IMS Connect with shared queues
- IMS Connect with data sharing
- IMS Connect benchmark measurement
- Image Copy 2 (IC2) with FlashCopy support
- ACBLIB Member Online Change (OLC)
- Multiple Systems Coupling (MSC) Bandwidth
- Support Large Sequential Data Sets
- Transaction Level Statistics (TLS)
- Fast Path S/U enhancements
- Fast Path EMH enhancements
- OTMA enhancements
- Dynamic Resource Definition (DRD) Restart
- ILDS Rebuild Utility Free Space
- Fast Path high stress benchmark
- CSA VSCR

It should be noted, while the same workload and processor configuration was used for any given IMS Version 9 to IMS Version 10 comparison, there were variations in the workload and processor configurations for each measurement evaluation therefore direct comparisons of one measurement evaluation to another should be avoided. Please refer to the disclaimers section for additional considerations.

The CSA Virtual Storage Constraint Relief (VSCR) evaluations of the CSA usage contain measurements for each of the base and enhancement function areas and are documented within each respective base or enhanced function section of this document. All references to CSA in this document are references to 24 bit CSA unless otherwise specified.

2 Executive Overview

IMS Version 10 observations highlight the performance characteristics of this release in comparison to the IMS Version 9 product and in some cases IMS Version 10 compared to itself with and without certain enhancements activated. Some of these observations are:

- Multiple Systems Coupling Bandwidth - MSC Bandwidth enhancements are currently demonstrating significant improvements for MTM, CTC, and VTAM configurations. A peak performance improvement of up to 41% was observed for total elapsed time required for the enhanced MSC MTM environment, improvements of up to 66% for the enhanced MSC CTC environment were observed, and a peak performance improvement of 56% for the enhanced MSC VTAM environment was observed.
- IMS Connect - IMS Version 10 IMS Connect is currently demonstrating a 2.5% ITR improvement over the previous release.
- IMS Connect Benchmark - With IMS Version 10 IMS Connect achieves the high transaction rate of 11,300 transactions per second.
- Fast Path, Full Function with High Availability Large Data Base (HALDB), and Full Function Shared Message Queue Base measurements - Comparisons between IMS Version 9 and IMS Version 10 environments all demonstrate less than 3% degradation in ITR for the IMS Version 10 environments.
- Fast Path High Stress - With IMS Version 10 transaction rates of 22,300 transactions per second (tps), within a single IMS control region executing in a Fast Path environment on a single 8 engine LPAR of an IBM System z9 Enterprise Model S54 Mainframe (Type 2094, Model S54), were observed with just 55.54% CPU busy.
- Fast Path EMH enhancements - Improvements in ITR ranging from .4% to 15.5% were observed for environments ranging in the number of IMS dependent regions from 20 - 80 for the IMS Version 10 FP EMH enhancement in comparison to IMS Version 9 FP EMH.

3 Base Performance

3.1 Introduction

During the testing cycle for every IMS release the core functions, also referred to as the base functions, of the product are tested under high stress and evaluated against the previous release. For the IMS Version 10 release the testing scenarios involved in the base testing included workloads that evaluated the Fast Path, Full Function with HALDB, Full Function with Shared Message Queues, and Batch Message Processing (BMP) base characteristics.

3.2 Environment

The base performance measurements were conducted on configurations of the hardware and software shown in Table 1. The workloads for each of the base evaluations are documented in Table 2.

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs. For specific number of processors used for the IMS LPARs are described in each of the specific evaluations.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM System Storage DS8000 Turbo (2107-9B2, 8300 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R7 & V1R8, z/OS DFSMS V1R4, IMS V9R1, IMS V10R1, TPNS V3R5

Table 1: IMS Version 10 base performance test hardware & software environment.

Base Measurement	Workload Description
Fast Path:	Fast Path workload with credit card processing characteristics and DEDB databases.
Full Function with HALDB:	Full Function data sharing workload with sample industry transactions (such as hotel and inventory transactions) with a variety of OSAM & VSAM Full Function and HALDB partition data bases.
Full Function with Shared Message Queues	Data Sharing Full Function workload performs updates to a variety of OSAM & VSAM Full Function databases and uses the IRLM address space for the datasharing lock manager.
BMP:	Banking BMP workload performs extensive sequential updates to Fast Path databases simulating end-of-day account reconciliation.

Table 2: IMS Version 10 base performance test workloads.

3.3 Results

For each of the base measurement evaluations comparisons between IMS Version 9 and IMS Version 10 were performed with emphasis on the Internal Throughput Rate (ITR) and the Common System Area (CSA) usage. The Banking BMP base measurements focus is on the total elapsed time required to execute the BMP's. The following charts demonstrate the results of these comparisons.

3.3.1 Fast Path Base Results

Chart 1 below demonstrates the results of ITR comparisons for the Fast Path Base measurement comparisons between IMS Version 9 and IMS Version 10.

Observations:

- Internal Throughput Rate (ITR) comparison of IMS Version 9 and IMS Version 10 Fast Path base measurement demonstrating 1.1% degradation for the IMS Version 10 release.
- Workload executing at approximately 80% of the available processing power.
- No change in CSA usage was observed.

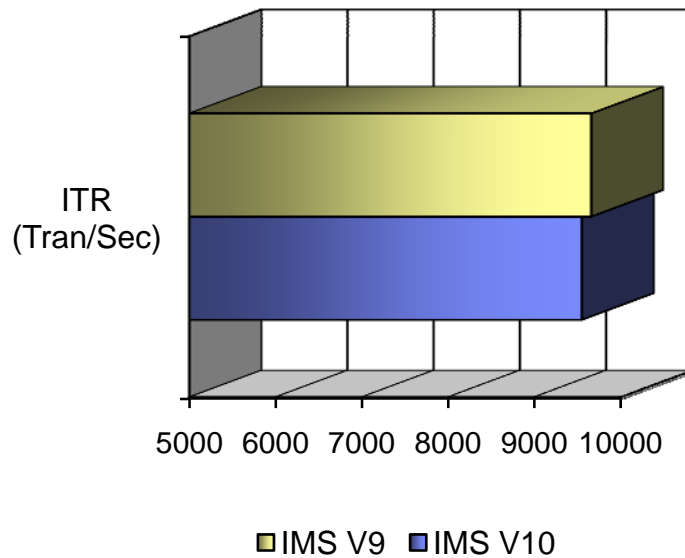


Chart 1: IMS Fast Path ITR comparison.

Values:

IMS Version 9 maintained an External Throughput Rate (ETR) of 7,795 transactions per second at a CPU busy percentage of 80.7% yielding an ITR of 9,659 with approximately 804K bytes of CSA usage. The IMS Version 10 ETR results were 7,774 transactions per second at 81.4% CPU busy percentage yielding an ITR of 9,550 with approximately 804K bytes of CSA usage. IMS was executing on a single three engine Logical Partition (LPAR) with TPNS driving the workload from a second three engine LPAR.

3.3.2 Full Function with HALDB Results

Chart 2 below demonstrates the ITR in transactions per second and CSA usage in kilobytes of the results of the comparisons between IMS Version 9 and IMS Version 10 for the Full Function with HALDB environment.

Observations:

- ITR comparison of the IMS Version 9 and IMS Version 10 Full Function with HALDB base demonstrating less than 1% degradation.
- Workload executing at approximately 85% of the available processing power.
- Approximately 3%, (24K) reduction in CSA usage for IMS Version 10 was observed.

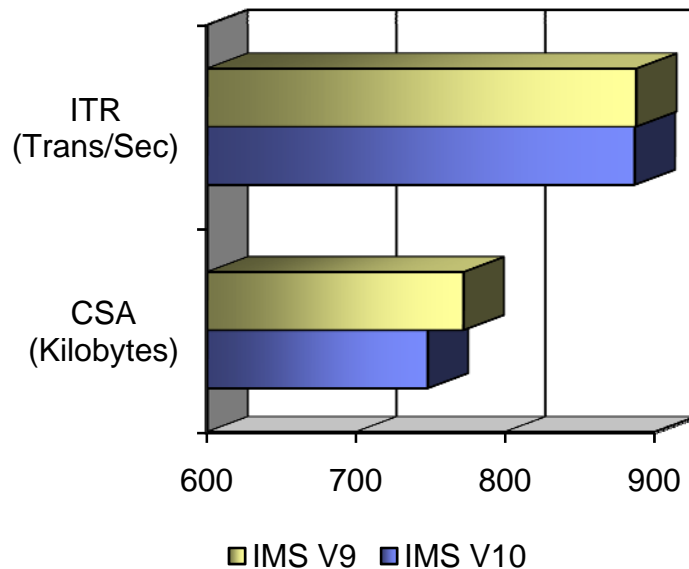


Chart 2: IMS Full Function with HALDB ITR (top) and CSA usage (bottom).

Values:

This measurement was conducted using an IMS Full Function workload with an equal mix of OSAM & VSAM data bases and a 4 partition HALDB data base. IMS Version 9 maintained an ETR of 752 transactions per second at a CPU busy percentage of 84.6% yielding an ITR of 888 with approximately 772K bytes of CSA usage. The IMS Version 10 results demonstrated an ETR of 753 transactions per second at 84.92% CPU busy percentage yielding an ITR of 887 with approximately 748K bytes of CSA usage. The IMS during this evaluation was executing on a 2 engine LPAR of the IBM eServer zSeries 990.

3.3.3 Full Function Shared Message Queues Results

Chart 3 below demonstrates the results of ITR and CSA usage comparisons for the Full Function Shared Message Queues (SMQ) measurement comparisons between IMS Version 9 and IMS Version 10.

Observations:

- ITR comparison of the IMS Version 9 and IMS Version 10 Full Function SMQ base demonstrating less than 3% degradation.
- Workload executing at approximately 86% of the available processing power.
- No change in CSA usage was observed.

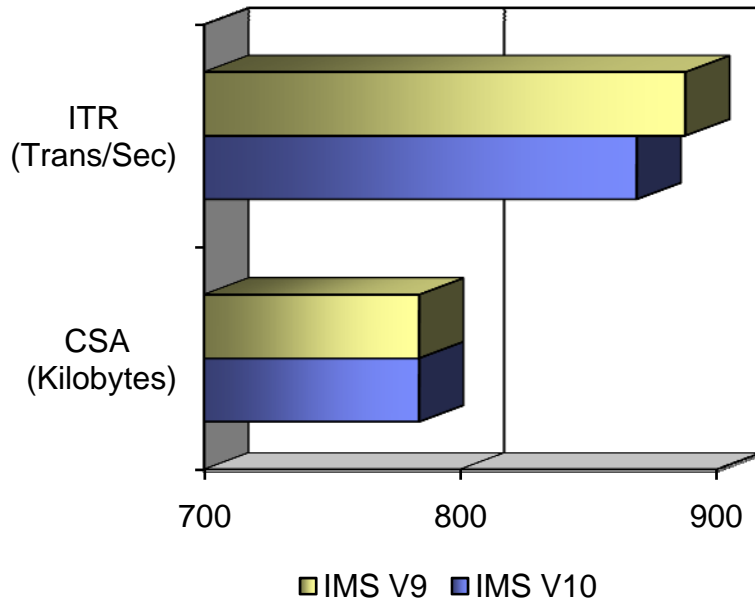


Chart 3: IMS Full Function SMQ ITR (top) and CSA usage (bottom).

Values:

IMS Version 9 maintained an ETR of 759 transactions per second at a CPU busy percentage of 85.4% yielding an ITR of 888. The IMS Version 10 results demonstrated an ETR of 757 transactions per second at 87.1% CPU usage yielding an ITR of 869. This measurement was conducted with a single IMS executing in shared queues mode on a 3 engine LPAR with TPNS driving the workload on a second 3 engine LPAR.

	IMS V9	IMS V10
ETR (tx per sec)	759	757
CPU Busy (%)	85.4	87.1
IO Rate (per sec)	7,083	7,220
ITR (tx per sec)	888	869
SMQ structure		
• Access/Sec	7,820	7,619
• Sync	100% (11.7)	100% (11.8)
• Async	0% (0)	0% (0)
Logger structure		
• Access/Sec	3,501	3,712
• Sync	93.9% (13.9)	92.5% (13.6)
• Async	6.1% (665.9)	7.2% (809.7)

Table 3: IMS Full Function Shared Message Queues comparison values.

3.3.4 Banking BMP Base Results

Chart 4 below demonstrates the results for the Banking BMP base measurement comparisons between IMS Version 9 and IMS Version 10.

Observations:

- A significant reduction, approximately 11%, in CSA usage was observed for IMS Version 10 in comparison to IMS Version 9.
- Total elapsed time in seconds of the IMS Version 9 and of the IMS Version 10 single Banking BMP base measurements demonstrating no degradation.
- Workloads executing at approximately 10% of the available processing power.

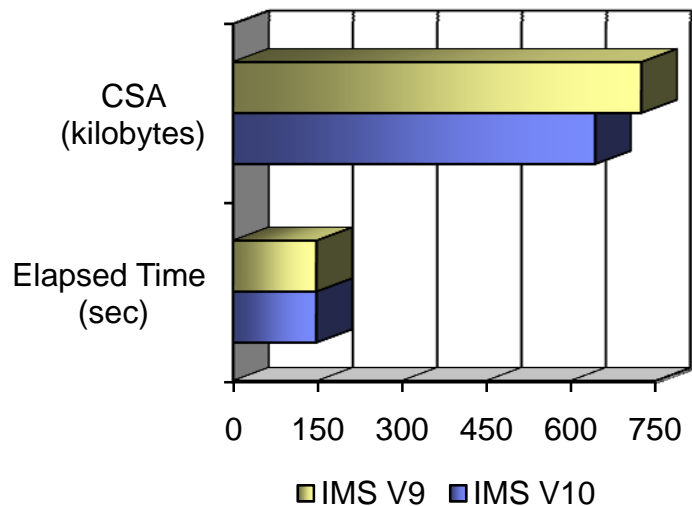


Chart 4: Banking BMP total elapsed time comparison.

Values:

IMS Version 9 executed the BMP with a total elapsed time of 148 seconds at a 9.8% CPU busy rate with 726K bytes of CSA usage. This was compared against a total elapsed time of 148 seconds at 9.8% CPU busy and 644K bytes of CSA usage for IMS Version 10.

3.4 Base Performance Summary

The ITR and Elapsed times variance in degradation for IMS Version 10 is targeted at or below 3 percent in any base function. IMS Version 10 demonstrates the following performance characteristics when compared to IMS Version 9.

- Full Function with HALDB transaction processing : ITR degradation is within 1.0 percent
- Full Function with Shared Message Queues: ITR degradation is less than 3.0 percent
- Fast Path transaction processing: ITR degradation is within 1.5 percent
- Batch Message Processing: No increase in Elapsed time or CPU usage was observed.
- Reduction in CSA usage of 11 percent was observed for IMS Version 10 BMP environment.

4 MSC Bandwidth

4.1 Introduction

The IBM IMS Version 10 release offers significant enhancements to the Multiple Systems Coupling function providing scalability and workload balancing capabilities. Illustrated below in the following tables are measurement results which demonstrate the performance benefits gained from increased link buffer sizes in Channel to Channel (CTC), Memory to Memory (MTM), and MSC VTAM workload scenarios.

4.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs. 2 IMS LPARS with 3 processors per LPAR.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 4: IMS Version 10 MSC Bandwidth enhancement test hardware & software environment.

Testing Scenarios:

Using DFSDDLTO 9,999 messages were sent across an MSC link from a “Front End” IMS to a “Back End” IMS and allowed to queue up. These messages were then released by starting the appropriate dependent message regions. The transit and processing times for the released transactions were measured.

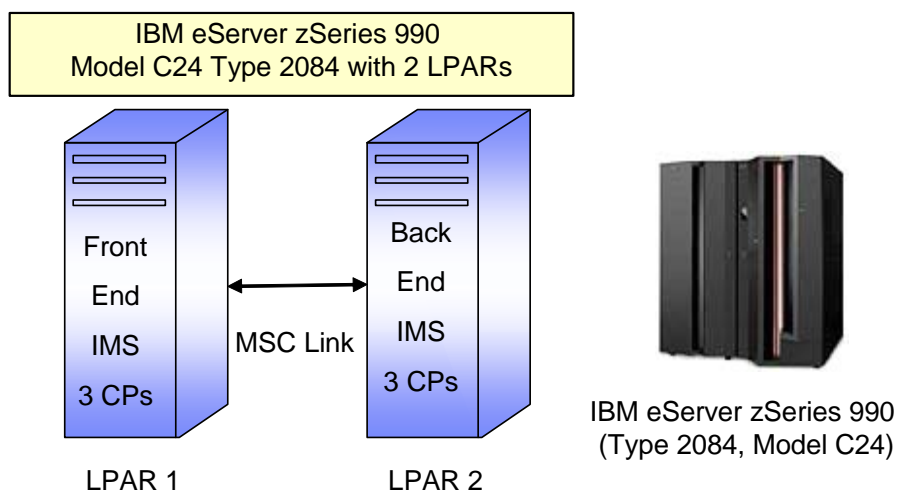


Figure 1: MSC Environment configuration.

4.3.1 MSC Bandwidth CTC Results

Chart 5 & Table 5 below demonstrate the performance improvements observed in a MSC Channel to Channel (CTC) workload environment when sending messages via the IMS Version 10 MSC bandwidth enhanced version and the performance improvements gained by scaling up to larger link buffer sizes.

Observations:

- Improvements such as the inclusion of message responses in the buffers and improved blocking technology for transaction message throughput times results in approximately 56% improvement in total message send and receive elapsed time by just switching on the MSC Bandwidth enhancements.

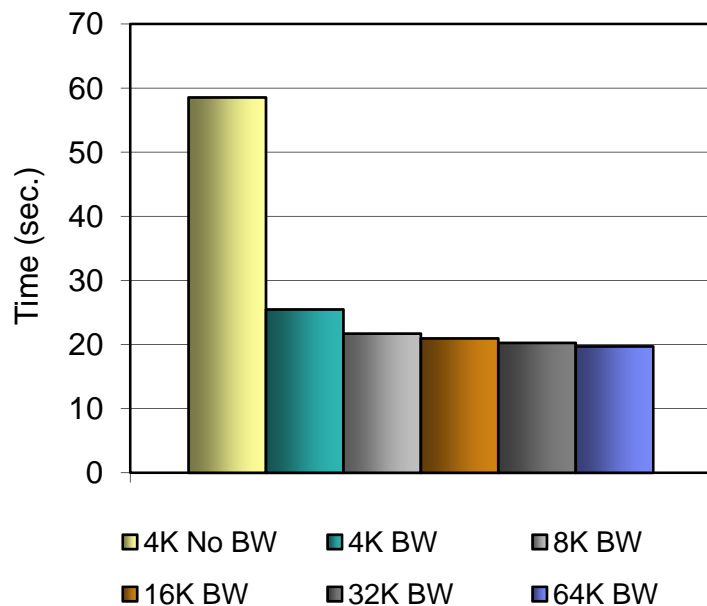


Chart 5: MSC CTC message total send and receive times (seconds).

Values:

The improvement percentage documented in Table 5 represents the improvement of total elapsed time, or percentage of time saved, for the message receive time. This is the time the message response spends on the MSC link returning to the originating IMS.

Buffer Size	Send Msg. Time (sec)	Receive Msg. Time (sec)	Improvement over 4K buffer no BW
4K	29.277	29.271	–
4K BW	12.748	12.740	56.46%
8K BW	10.857	10.850	62.92%
16K BW	10.488	10.480	64.18%
32K BW	10.137	10.127	65.38%
64K BW	9.865	9.853	66.31%

Table 5: MSC CTC message send and receive time observations.

4.3.2 MSC Bandwidth MTM Results

Chart 6 and Table 6 below demonstrate the performance improvements observed in MSC Memory to Memory (MTM) workload environment when sending messages via the MSC bandwidth enhanced version and the performance improvements gained by scaling up to larger link buffer sizes.

Observations:

- Roughly 32% improvement in total message send and receive elapsed time was observed by just switching to MSC Bandwidth enhancements in the MTM environment
- BW = With IMS V10 Bandwidth enhancements

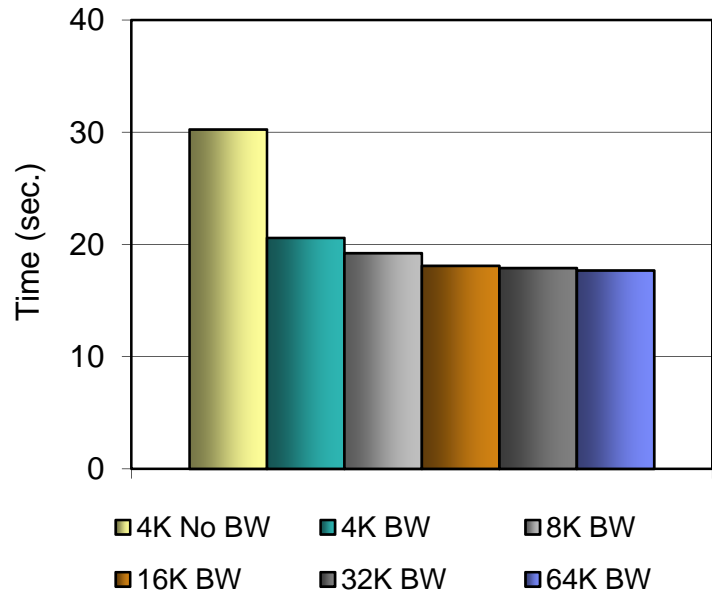


Chart 6: MSC MTM message total send and receive times (seconds).

Values:

The improvement percentage documented in Table 6 represents the improvement of total elapsed time, or percentage of time saved, for the message receive time. This is the time the message response spends on the MSC link returning to the originating IMS.

Buffer Size	Send Msg. Time (sec)	Receive Msg. Time (sec)	Improvement over 4K buffer no BW
4K	15.121	15.118	–
4K BW	10.290	10.288	31.94%
8K BW	9.607	9.605	36.46%
16K BW	9.045	9.043	40.18%
32K BW	8.948	8.946	40.82%
64K BW	8.839	8.835	41.54%

Table 6: MSC MTM message send and receive time observations.

4.3.3 MSC Bandwidth VTAM Results

Chart 7 and Table 7 below demonstrate the performance improvements observed in MSC VTAM workload environment when sending messages via the MSC bandwidth enhanced version and the performance improvements gained by scaling up to larger link buffer sizes.

Observations:

- Roughly 44% improvement in total message send and receive elapsed time was observed by just switching to MSC Bandwidth enhancements in the VTAM environment
- BW = With IMS V10 Bandwidth enhancements

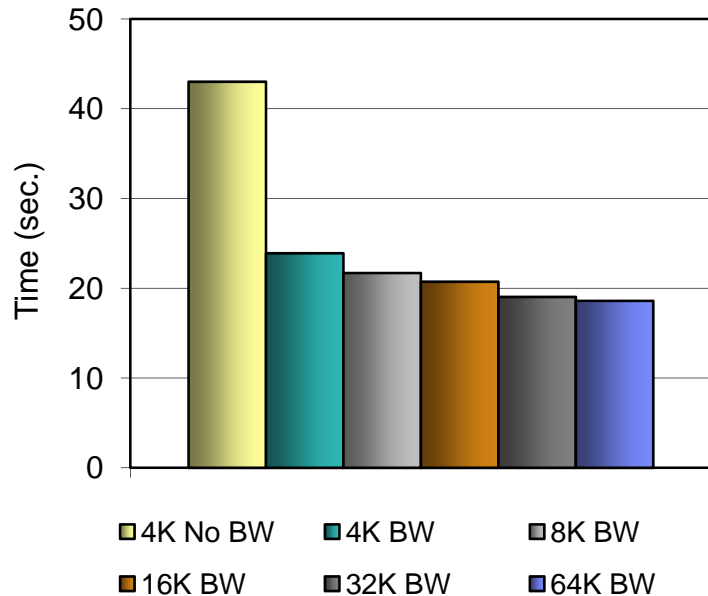


Chart 7: MSC VTAM message total send and receive times

Values:

The improvement percentage documented in Table 7 represents the improvement of total elapsed time, or percentage of time saved, for the message receive time. This is the time the message response spends on the MSC link returning to the originating IMS.

Buffer Size	Send MSG Time (sec)	Receive MSG Time (sec)	Improvement over 4K buffer no BW
4K	21.509	21.503	–
4K BW	11.955	11.949	44.42%
8K BW	10.856	10.849	49.53%
16K BW	10.373	10.365	51.77%
32K BW	9.522	9.512	55.73%
64K BW	9.309	9.296	56.72%

Table 7: MSC VTAM message send and receive time observations.

4.4 MSC Bandwidth Summary

Improvements across the board for all of the MSC environments tested, Channel to Channel (CTC), Memory to Memory (MTM), and MSC VTAM were observed as a result of switching to the MSC Bandwidth enhancements and by scaling up the MSC link buffer sizes.

- An average of roughly 56% improvement was observed with the enhanced MSC CTC environment with bandwidth turned on versus the traditional MSC CTC environments.
- A peak performance improvement of up to 66% was observed with the enhanced MSC CTC environment with bandwidth on and an MSC link buffer size of 64K versus the traditional MSC CTC environment.
- An average of roughly 32% improvement was observed with the enhanced MSC MTM environment with bandwidth turned on versus the traditional MSC MTM environments.
- A peak performance improvement of up to 41% was observed with the enhanced MSC MTM environment with bandwidth on and an MSC link buffer size of 64K versus the traditional MSC MTM environment.
- An average of roughly 44% improvement was observed with the enhanced MSC VTAM environment with bandwidth turned on versus the traditional MSC VTAM environments.
- A peak performance improvement of up to 56% was observed with the enhanced MSC VTAM environment with bandwidth on and an MSC link buffer size of 64K versus the traditional MSC VTAM environment.

Note: The average message size for the MSC Bandwidth measurements was 564 bytes in length. Further documentation with measurement evaluations using larger message sizes is pending.

5 Fast Path Shared EMH Enhancements

5.1 Introduction

Along with providing command support to reset Fast Path response mode for static nodes and dynamic users, the IMS Version 10 Fast Path Shared Expedited Message Handling (EMH) enhancement provides improved Shared EMHQ performance through an improved message queuing algorithm for balancing groups (BALGs). This algorithm change is based on a percent of active IFP regions. The number of transactions allowed to queue locally before triggering global processing has changed. In IMS Version 9 and prior releases IMS would trigger global processing when the number of messages queued would exceed 25 percent of the active IFP regions (or a minimum of 5). Now with IMS Version 10 IMS will not trigger global processing until the queue count exceeds 100 percent of the IFP regions. This change allows more transactions to be processed locally without any Coupling Facility structure access.

5.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, 2 IMS LPARS with 3 CPs per LPAR
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V9R1, IMS V10R1, TPNS V3R5

Table 8: IMS Version 10 Shared EMH enhancement test hardware & software environment.

Testing Scenarios:

Using a Fast Path workload, the performance characteristics of IMS Version 10 Shared EMH enhancements and the characteristics of IMS Version 9 Shared EMH function were measured and compared at CPU utilization of 70 percent or higher. Terminal network activity was simulated using TPNS executing on separate processors. The testing involved the following:

- Execution of a Fast Path workload in an IMS sysplex environment with:
 - 20, 40, 60, & 80 active IMS Fast Path (IFP) regions
 - 4000 terminals/LPAR in a 2-way sysplex environment
 - (Terminal Network is simulated by executing TPNS using SNA protocol on separate processors)

5.3.1 Fast Path Shared EMH 20 IFP Regions Results

The following table and chart demonstrate the performance characteristics observed by comparing the IMS Version 10 Shared EMH enhancements to the IMS Version 9 Shared EMH function. Chart 8 below illustrates the ITR performance improvement gained by the use of IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 with 20 active IFPs present.

Observations:

- An improvement in ITR of approximately 15.5% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 20 IFP regions are active.
- ITR values represent the total ITR across all IMS systems in the sysplex.

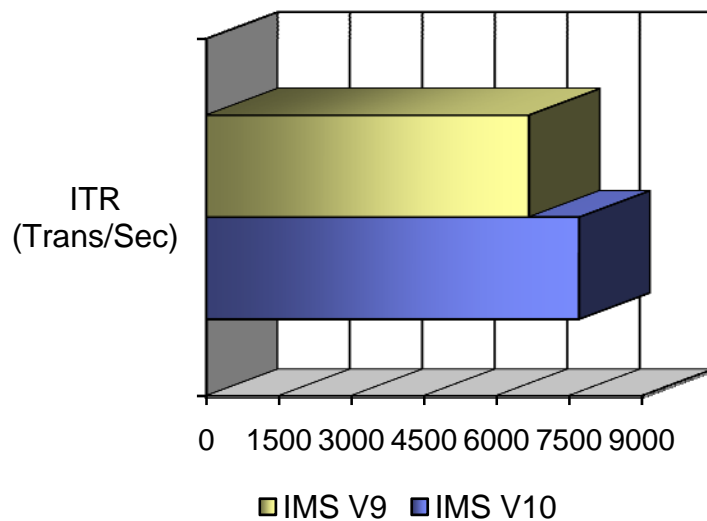


Chart 8: ITR comparison of IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 20 IFP regions.

Values:

Table 9 represents the measurement values that were observed comparing IMS Version 9 Shared EMH with the IMS Version 10 enhanced Shared EMH function with 20 active IFP regions.

	Ave. EMH Input QTIME (MSEC)	Ave. SEMH Input QTIME (MSEC)	Ave. Transit Time (MSEC)	ITR Trans./Sec
IMS V9				
IMS A	616	544	634	3,281
IMS B	617	538	635	3,387
IMS V10				
IMS A	65	76	143	3,871
IMS B	65	76	137	3,834
Improvement				15.6%

Table 9: Measurement values for IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 20 IFP regions.

5.3.2 Fast Path Shared EMH 40 IFP Regions Results

The following table and chart demonstrate the performance characteristics observed by comparing the IMS Version 10 Shared EMH enhancements to the IMS Version 9 Shared EMH function. Chart 9 below illustrates the ITR performance improvement gained by the use of IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 with 40 active IFPs present.

Observations:

- An improvement in ITR of approximately 5.8% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 40 IFP regions are active.
- ITR values represent the total ITR across all IMS systems in the sysplex.

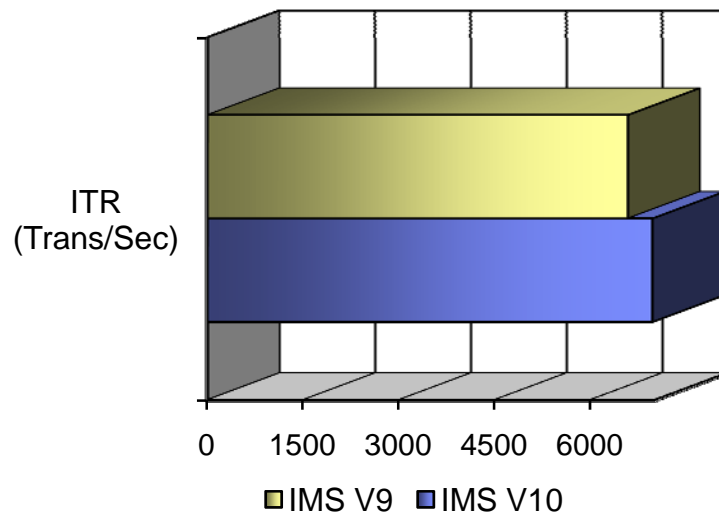


Chart 9: ITR comparison of IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 40 IFP regions.

Values:

Table 10 represents the measurement values that were observed comparing IMS Version 9 Shared EMH with the IMS Version 10 enhanced Shared EMH function with 40 active IFP regions.

	Ave. EMH Input QTIME (MSEC)	Ave. SEMH Input QTIME (MSEC)	Ave. Transit Time (MSEC)	ITR Trans./Sec
IMS V9				
IMS A	874	973	896	3,306
IMS B	868	931	888	3,272
IMS V10				
IMS A	124	142	244	3,497
IMS B	117	132	241	3,465
Improvement				5.8%

Table 10: Measurement values for IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 40 IFP regions.

5.3.3 Fast Path Shared EMH 60 IFP Regions Results

The following table and chart demonstrate the performance characteristics observed by comparing the IMS Version 10 Shared EMH enhancements to the IMS Version 9 Shared EMH function. Chart 10 below illustrates the ITR performance improvement gained by the use of IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 with 60 active IFPs present.

Observations:

- An improvement in ITR of approximately 2.2% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 60 IFP regions are active.
- ITR values represent the total ITR across all IMS systems in the sysplex.

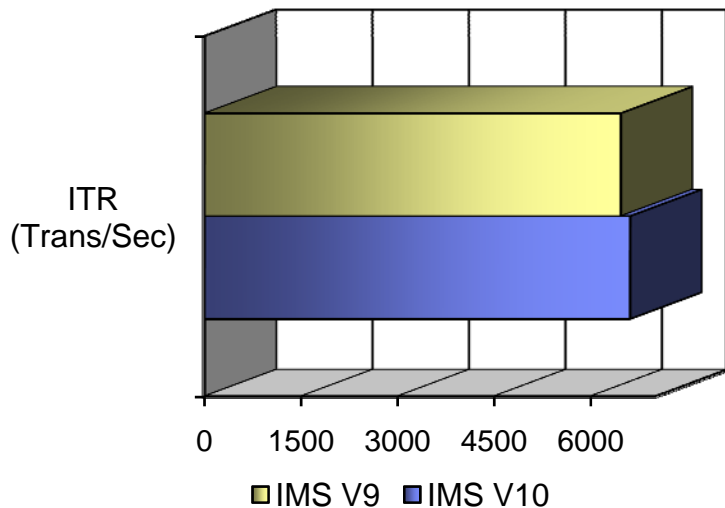


Chart 10: ITR comparison of IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 60 IFP regions.

Values:

Table 11 represents the measurement values that were observed comparing IMS Version 9 Shared EMH with the IMS Version 10 enhanced Shared EMH function with 60 active IFP regions.

	Ave. EMH Input QTIME (MSEC)	Ave. SEMH Input QTIME (MSEC)	Ave. Transit Time (MSEC)	ITR Trans./Sec
IMS V9				
IMS A	1,098	1,563	1,128	3,274
IMS B	1,119	1,579	1,149	3,195
IMS V10				
IMS A	231	249	351	3,361
IMS B	231	253	349	3,254
Improvement				2.2%

Table 11: Measurement values for IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 60 IFP regions.

5.3.4 Fast Path Shared EMH 80 IFP Regions Results

The following table and chart demonstrate the performance characteristics observed by comparing the IMS Version 10 Shared EMH enhancements to the IMS Version 9 Shared EMH function. Chart 11 below illustrates the ITR performance improvement gained by the use of IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 with 80 active IFPs present.

Observations:

- An improvement in ITR of approximately .4% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 80 IFP regions are active.
- ITR values represent the total ITR across all IMS systems in the sysplex.

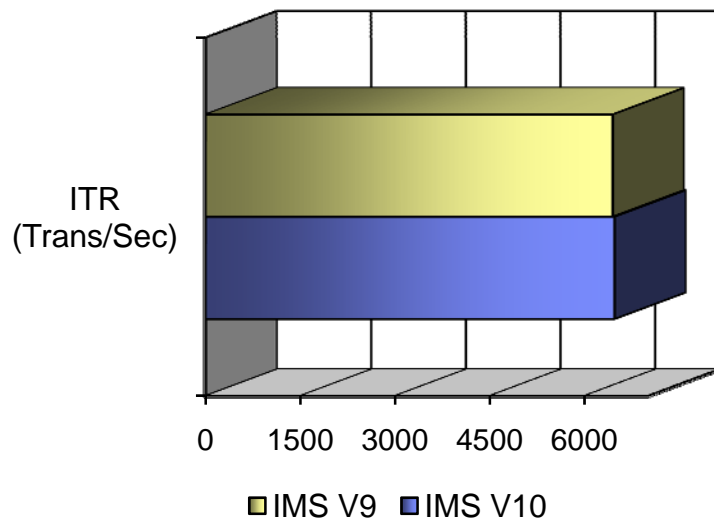


Chart 11: ITR comparison of IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 80 IFP regions.

Values:

Table 12 represents the measurement values that were observed comparing IMS Version 9 Shared EMH with the IMS Version 10 enhanced Shared EMH function with 80 active IFP regions.

	Ave. EMH Input QTIME (MSEC)	Ave. SEMH Input QTIME (MSEC)	Ave. Transit Time (MSEC)	ITR Trans./Sec
IMS V9				
IMS A	898	1,019	937	3,173
IMS B	857	1,875	899	3,276
IMS V10				
IMS A	322	319	474	3,242
IMS B	330	329	485	3,237
Improvement				.4%

Table 12: Measurement values for IMS V9 FP Shared EMH & IMS V10 FP Shared EMH with 80 IFP regions.

5.4 Fast Path Shared EMH Enhancements Summary

The IMS Version 10 Fast Path Shared EMH enhancements provide significant ITR performance improvements from changing the Shared EMHQ balancing group scheduling algorithm. The overall average performance ITR improvement was observed at 6% for the accumulated ITR results.

- An improvement in ITR of approximately 15.5% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 20 IFP regions are active.
- An improvement in ITR of approximately 5.8% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 40 IFP regions are active.
- An improvement in ITR of approximately 2.2% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 60 IFP regions are active.
- An improvement in ITR of approximately .4% was observed with IMS Version 10 with the FP Shared EMH enhancement over IMS Version 9 when 80 IFP regions are active.

6 Fast Path Serviceability / Usability

6.1 Introduction

The ability to start a database and all of its areas with the “/STA (ACCESS) AREA(*)” command is provided as part of the IMS Version 10 Serviceability / Usability enhancement. The following evaluation was performed to determine if any performance degradation can occur as a result of executing the new command during regular IMS online workload periods.

6.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 13: IMS V10 Serviceability / Usability enhancement test hardware & software environment.

Testing Scenarios:

Using a Fast Path workload, the performance characteristics of IMS Version 10 serviceability enhancements and the characteristics of IMS Version 9 Fast Path functions were measured and compared at CPU utilization of 70 percent or higher. Terminal network activity was simulated using TPNS executing on separate processors. The testing involved the following:

- Execution and measurement of a IMS Fast Path non-sysplex workload environment with:
 - 64 Message Processing Regions - 4000 terminals
 - (Terminal Network is simulated by executing TPNS using SNA protocol on separate processors)
- Execution of the “/STA (ACCESS) AREA(*)” command while taking the above measurement. This command will issue the command for a total of 4800 areas.

6.3 Fast Path Serviceability / Usability Results

For this measurement an IMS Fast Path workload sustaining roughly 6,400 transactions a second was measured during the execution time of the new “/STA (ACCESS) AREA(*)” command. Chart 12 illustrates an ITR value comparison of the IMS Fast Path workload during and without the execution of the command.

Observations:

- Roughly a .3% degradation in ITR was observed during the execution time frame of the new command.
- During command execution ITR value was 8,288 for Version 10 with the enhancements compared against an ITR value of 8,315 for Version 10 without the enhancements.
- CPU Busy percentage for both values was approximately 78%.

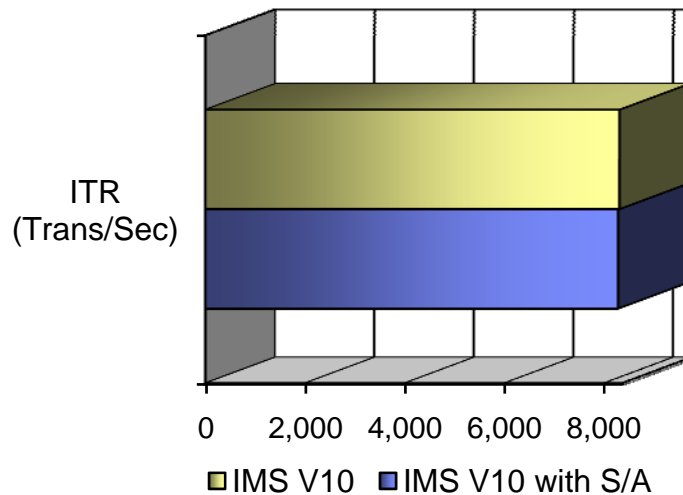


Chart 12: ITR values during and without execution of /STA (ACCESS) AREA(*) command.

6.4 Summary

No significant ITR performance impact was observed during the execution of the IMS Version 10 Serviceability / Usability command enhancement.

7 HALDB Index/ILDS Rebuild Utility Free Space

7.1 Introduction

The IMS Version 10 HALDB Index/ILDS Rebuild Utility Free Space enhancement increases performance by reducing the ILDS build elapsed time. The ILDS build elapsed time is reduced by eliminating CA and CI splits and reducing the number of Execute Channel Programs (EXCPs) required to build the ILDS. The following measurements evaluated and document the performance characteristics of the ILDS build enhancement.

7.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 14: HALDB Index/ILDS Rebuild Utility test hardware & software environment.

Testing Scenarios:

To evaluate the performance characteristics of the IMS V10 ILDS rebuild utility a comparison between the ILDS rebuild utility and the enhanced ILDS rebuild utility was used. The performance characteristics monitored during this evaluation were the total elapsed time, number of EXCPs, and the amount of free space in the ILDS. The testing involved the following:

- Execution of the ILDS rebuild utility against a large HALDB DB with:
 - 17 Partitions
 - Over 4 million DB records

7.3 HALDB Index/ILDS Rebuild Results

Chart 13 below demonstrates the significant improvement in total elapsed time observed by the IMS Version 10 HALDB Index/ILDS Rebuild Utility Free Space Enhancement over the previous ILDS rebuild utility. In Chart 13, “ILE” represents the ILDS rebuild without the enhancements, “ILEF” represents the ILDS rebuild with the free space enhancements.

Observations:

- An improvement of, or a reduction in, total elapsed time of 19.6% was observed for the enhanced ILDS rebuild utility.
- During this measurement a reduction in EXCPs of approximately 14% was observed for the enhanced ILDS rebuild utility over the previous version.

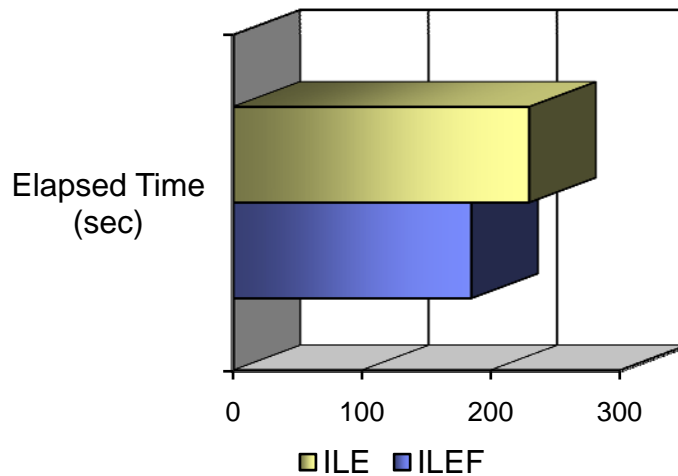


Chart 13: IMS V10 ILDS with and without enhancements comparison chart.

Values:

Table 15 represents the values for the measurement charted in Chart 13. The second row labeled “ILE” documents the values of the rebuild of the ILDS for the HALDB partition without the enhancements. The following column labeled “ILEF” documents the values of the rebuild of the ILDS for the HALDB partition with free space enhancements.

	#DB records	#ILE Inserted (after rebuild)	Free Space (bytes) (after rebuild)	EXCPs	Elapsed Time (mm:ss)
ILE	4,549,177	4,491,520	49,352,704	2,595,021	3:50
ILEF	4,549,177	4,491,520	48,742,400	2,211,395	3:05
Performance Improvement			-1.2%	14.8%	19.6%

Table 15: IMS V10 ILDS with and without enhancements comparison data.

7.4 ILDS Rebuild Summary

As demonstrated in the previous charts and tables the IMS Version 10 HALDB Index/ILDS Rebuild Utility Free Space enhancement improves the ILDS rebuild total elapsed time and overall database recovery time.

- An improvement of, or a reduction in, total elapsed time of 19.6% was observed for the enhanced ILDS rebuild utility.
- During this measurement a reduction in EXCPs of approximately 14% was observed for the enhanced ILDS rebuild utility over the previous version.
- In cases where the ILDS must be rebuilt overall database recovery times can be improved by improved ILDS rebuild performance.
- An ILDS produced using the IMS V10 HALDB Index/ILDS Rebuild Utility Free Space enhancement may improve the overall performance when updated by subsequent reorganizations or ILDS rebuilds with the ILE option because of the increased VSAM KSDS free space if the ILDS is not deleted and redefined.

Fast Path High Stress

8.1 Introduction

Previous documents have demonstrated the astonishing capabilities of IMS with Fast Path data bases and transactions under high stress. The following sections document a high stress evaluation of the IMS Version 10 Fast Path within a single IMS system.

8.2 Environment

Hardware and Software Environment	
Processor:	IBM System z9 Enterprise Model S54 Mainframe (Type 2094, Model S54) for IMS with 8 dedicated processors IBM eServer zSeries 990 Model C24 (Type 2084, Model C24) as TPNS workload driver partitioned into 4 LPARs, 3 CPs/LPAR
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 16: IMS V10 Fast Path High Stress test hardware & software environment.

Testing Scenarios:

A single IMS Version 10 Fast Path control region was used to process transactions from four separate TPNS networks. The four TPNS networks were divided among four logical partitions (LPARs) of a C24 model zSeries 990 mainframe. Testing involved the following:

- Execution of a Fast Path workload in an IMS sysplex environment with:
 - 48 active IMS Fast Path (IFP) Regions
 - 28,000 terminals - (Terminal Network is simulated by executing TPNS using SNA protocol on separate processors)
- Single IMS control region

Figure 2 illustrates the configuration used to achieve the high transaction rate.

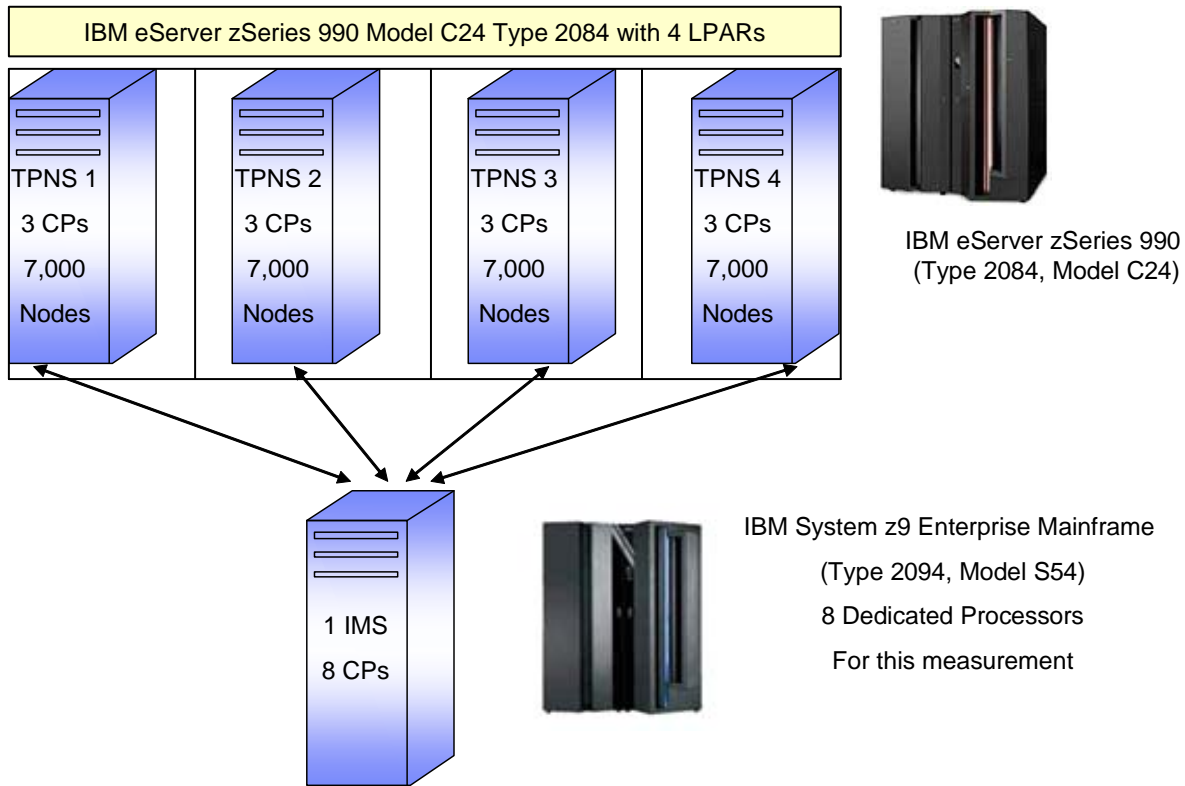


Figure 2: Hardware configuration for Fast Path high stress measurement.

8.3 Fast Path High Stress Results

With this configuration IMS Version 10 was able to achieve a high transaction rate of over 22,300 transactions per second. During this measurement the total CPU utilization for the IMS system was measured at 55.54% of eight dedicated processors.

- Transaction Rate - 22,372 transactions per second
- DASD I/O Rate - 30,193 I/Os per second
- CPU Utilization Percentage - 55.54%

8.4 Summary

IMS Version 10 continues to provide an unparalleled solution providing high transaction rate capability and performance.

- Transaction rate of 22,300 transactions per second (tps) was observed within a single IMS control region.
- This high transaction rate was achieved at 55.54% CPU utilization of eight dedicated IBM System z9 Enterprise 2094-S54 processors.

9 Image Copy 2 FlashCopy Support

9.1 Introduction

The IMS Version 10 Database Image Copy 2 utility, DFSUDMT0, which is used to create database image copies for backup and recovery has been enhanced to support the use of FlashCopy capabilities. The FlashCopy enhancement performs faster database copies and is known as the "instant copy" technology available on ESS. The following sections demonstrate the impact of using the enhanced utilities during database backup using the database Image Copy 2 utility in comparison to using the utility without enhancements.

9.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 17: IMS V10 Image Copy 2 FlashCopy support hardware & software environment.

Testing Scenarios:

To effectively demonstrate the performance characteristics of the enhanced image copy utility a comparison was made against the previous version of the utility. Large database data sets were used for the comparison with the elapsed time and resource usage documented in the results section following. A brief description of the comparison is as follows:

- Evaluate Image Copy 2 performance using a large database with a comparison technique: execute DFSUDMT0 with current utility vs DFSUDMT0 with enhanced FlashCopy capability.
- HIDAM-OSAM DB used with, 10 Million root segments

9.3 Results

Chart 14 demonstrates the performance impact on total elapsed time observed when exploiting the FlashCopy services for the IMS Version 10 Image Copy 2 utility.

Observations:

- An improvement of approximately 97.5% in total elapsed time was observed for the enhanced IMS Version 10 Image Copy 2 utility.
- IC2 represents Image Copy 2 utility.

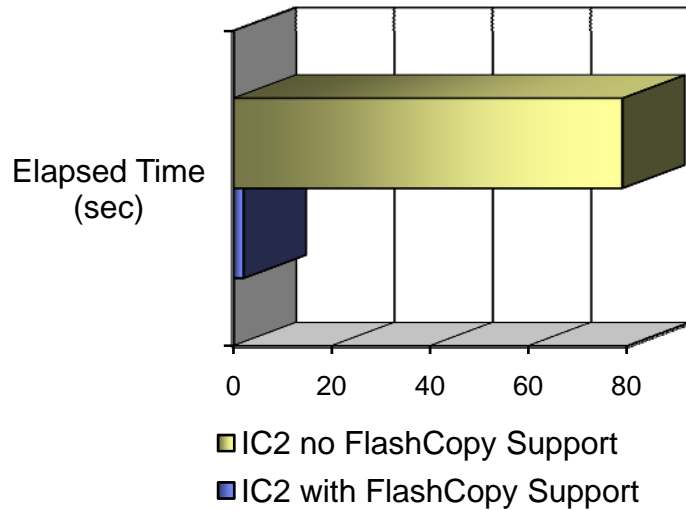


Chart 14: IMS V10 IC2 with and without FlashCopy support elapsed time comparisons.

Values:

The enhanced IMS Version 10 Image Copy2 utility with FlashCopy support completed the image copy in a time of 2 seconds with a total of 548 EXCPs. This is compared against a total completion time of 79 seconds with 566 EXCPs.

9.4 Summary

The enhanced IMS Version 10 Image Copy 2 utility with FlashCopy effectively reduces the total elapsed time required to complete image copies.

- A 97.5% improvement in total elapsed time was observed for the enhanced IMS Version 10 Image Copy 2 utility.
- IMS Version 10 greatly improves the data base recovery process by reducing the time frame required to complete image copies.

10 OTMA Performance

10.1 Introduction

The following documents the evaluation of a workload using IMS Version 10 Open Transaction Manager Access (OTMA) and demonstrates the performance characteristics in comparison to the same workload in IMS Version 9 OTMA.

10.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R7, IMS V9R1, IMS V10R1, TPNS V3R5

Table 18: IMS Version 10 OTMA Enhancements environment.

Testing Scenarios:

Comparison of a full function workload using IMS Version 9 OTMA with the same workload using IMS Version 10 OTMA was completed. Testing involved the following:

- Single Image IMS with Full Function data base workload, data sharing workload with SHRLVL=3 and IRLM with sample industry transactions (such as hotel and inventory transactions)
- Approximately 384 OSAM & VSAM data bases
- 4,000 terminals - (Terminal Network is simulated by executing TPNS using SNA protocol on separate processors)

10.3 OTMA Results

Chart 15 demonstrates the performance characteristics in terms of ITR values of the IMS Version 10 OTMA and IMS Version 9 OTMA comparison.

Observations:

- An improvement of 1.5% was observed for the IMS Version 10 OTMA measurement in comparison to IMS Version 9.

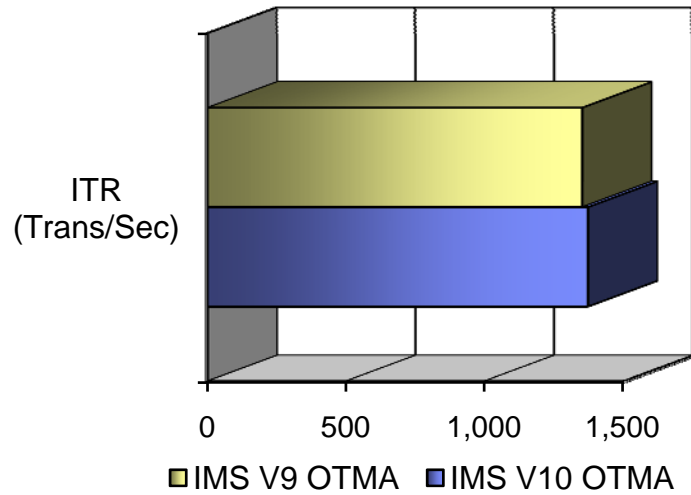


Chart 15: ITR comparison of IMS V10 OTMA without IMS V9 OTMA.

Values:

	V9 OTMA	V10 OTMA
ETR (tx per sec)	1,169	1,175
CPU Busy (%)	86.5	85.6
ITR (tx per sec)	1,351	1,372
ITR improvement (%)		+1.5%

Table 19: IMS V10 OTMA vs IMS V9 OTMA comparison.

10.4 Summary

- An improvement of 1.5% was observed for the IMS Version 10 OTMA measurement in comparison to IMS Version 9.

11 IMS Connect with Shared Queues

11.1 Introduction

The following section documents an evaluation for the IMS Connect function for IMS Version 10. During this evaluation comparisons between IMS Version 10 Connect were compared against measurements with IMS Version 9 Connect.

11.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R7, IMS V10R1, TPNS V3R5

Table 20: IMS V10 Connect with Shared Queues hardware & software environment.

Testing Scenarios:

A comparison of a full function workload using IMS Version 9 Connect against the same workload using IMS Version 10 Connect was completed. Testing involved the following:

- Single Image IMS with Full Function data base workload, data sharing workload with SHRLVL=3 and IRLM with sample industry transactions (such as hotel and inventory transactions)
- Approximately 384 OSAM & VSAM data bases
- 4,000 IMS Connect Clients - (Network is simulated by executing TPNS using TCPIP protocol on separate processors)

11.3 Results

The following charts represents an ITR comparison for the results of IMS Version 9 Connect compared against IMS Version 10 Connect. Chart 16 illustrates the ITR for both measurements.

Observations:

- There was minimal impact in ITR for the IMS Version 10 system in comparison to the IMS Version 9 system, a degradation of 1%.
- An 80% average CPU Busy utilization during the evaluations was observed.

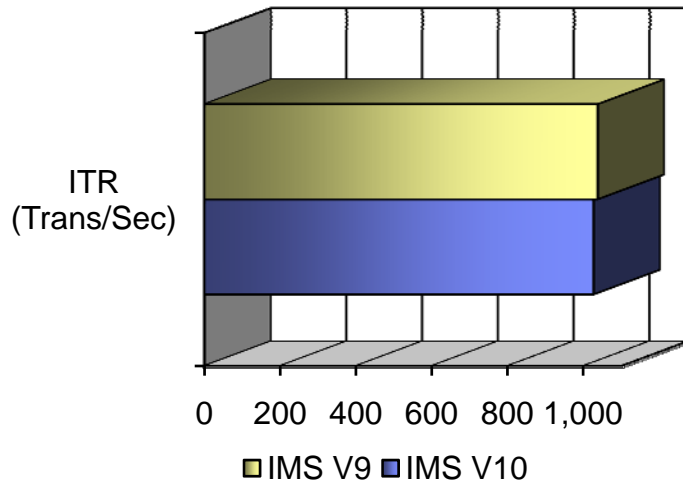


Chart 16: IMS V10 versus IMS V9 Connect with Shared Queues comparisons chart.

Values:

	V9	V10
ETR (tx per sec)	827	828
CPU Busy (%)	79.9	80.6
ITR (tx per sec)	1,038	1,027
ITR impact (%)		-1.0%
MSQ		
• Acc/sec	3,296	3,614
• Sync	100%(10.9)	100%(11.0)
• Async	0%	0%
Logger		
• Acc/sec	1,804	1,750
• Sync	94.9%(13.3)	93.7%(13)
• Async	5.1%(638.8)	6.3%(924.3)

Table 21: IMS V10 versus IMS V9 Connect with Shared Queues evaluation values.

11.4 Summary

There was no significant performance degradation or improvement observed for IMS Connect for IMS Version 10 in comparison to IMS Connect for IMS Version 9 in a shared queues environment.

- There was minimal impact in ITR for the IMS Version 10 system in comparison to the IMS Version 9 system, a degradation of 1%.

12 IMS Connect with Data Sharing

12.1 Introduction

The following section documents an evaluation for the IMS Connect function for IMS Version 10 in a data sharing environment. During this evaluation comparisons between IMS Version 10 Connect were compared against measurements with IMS Version 9 Connect in data sharing environments.

12.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 22: IMS V10 Connect with Data Sharing evaluation hardware & software environment.

Testing Scenarios:

A comparison of a full function workload using IMS Version 9 Connect against the same workload using IMS Version 10 Connect was completed. Testing involved the following:

- Full Function data base workload, data sharing workload with sample industry transactions (such as hotel and inventory transactions)
- Approximately 384 OSAM & VSAM data bases
- 4,000 IMS Connect Clients - (Network is simulated by executing TPNS using TCPIP protocol on separate processors)

12.3 Results

The following charts represents an ITR comparison for the results of IMS Version 9 Connect compared against IMS Version 10 Connect both with data sharing environments. Chart 17 illustrates the ITR for both measurements.

Observations:

- There was some performance improvement, a 2.5% increase in ITR for the IMS Version 10 system in comparison to the IMS Version 9 system.

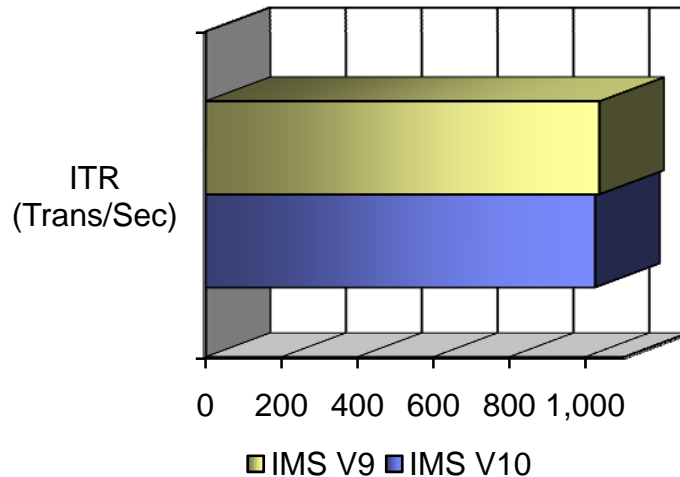


Chart 17: IMS V10 verses IMS V9 Connect with Data Sharing.

Values:

	V9	V10
ETRs (tx per sec)		
IMS1	666	666
IMS2	667	664
ETR Aggregate (tx per sec)	1,333	1,330
CPU Busy (%)	79.8	77.6
IMS Connect Response time (msec)	6.7	6.2
ITR (tx per sec)	1,670	1,713
The ITR improvement (%)		2.5%

Table 23: IMS V10 verses IMS V9 Connect with Data Sharing evaluation values.

12.4 Summary

There was a slight performance improvement, 2.5% ITR increase, observed for IMS Connect for IMS Version 10 in comparison to IMS Connect for IMS Version 9 in a data sharing environment.

13 IMS Version 10 Connect Benchmark

13.1 Introduction

The following sections document an evaluation of IMS Version 10 Connect with emphasis on total transaction rate achieved within a specific environment.

13.2 Environment

Hardware and Software Environment	
Processor:	IBM System z9 Enterprise Model S54 Mainframe (Type 2094, Model S54) for IMS with 8 dedicated processors IBM eServer zSeries 990 Model C24 (Type 2084, Model C24) as TPNS workload driver partitioned into 4 LPARs, 3 CPs/LPAR
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 24: IMS Version 10 Connect environment.

Testing Scenarios:

IMS Version 10 Connect with a Fast Path control region running on a partition of IBM System zSeries z9 Enterprise Model S54 Mainframe, were used to process transactions from 10 TPNS networks. The TPNS network was running from a partition of IBM System zSeries 990 mainframe Model C24. A brief description of the testing environment is as follows:

- Execution of an IMS Connect Fast Path workload in an IMS monoplex environment with:
 - 10,000 IMS Connect Clients - (Network is simulated by executing TPNS using TCP/IP protocol on separate processors)
- Single IMS control region using OTMA and a total of 56 active IMS Fast Path (IFP) Regions
- Single IMS Connect

13.3 Results

With this configuration, IMS Version 10 Connect was able to achieve a high transaction rate of over 11,000 transactions per second. During this measurement the total CPU utilization for the IMS system was measured at 55.2% of the eight engine LPAR .

- Transaction Rate - 11,320 transactions per second
- DASD I/O Rate - 16,793 I/Os per second
- CPU Utilization Percentage - 55.2%

13.4 IMS Connect Benchmark Summary

IMS Version 10 Connect demonstrates the ability to achieve high transaction rates.

- Transaction rates of over 11,300 transactions per second were achieved with IMS Version 10 IMS Connect.

14 Transaction Level Statistics

14.1 Introduction

With the IMS Version 10 Transaction Level Statistics enhancements IMS users have the ability to log transaction level statistics to an OLDS in a X'56' record. The following sections evaluates the performance impact of this IMS Version 10 enhancement.

14.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, Single IMS LPAR with 3 processors.
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 25: IMS V10 Transaction Level Statistics evaluation hardware & software environment.

Testing Scenarios:

During this evaluation the IMS Version 10 Transaction Level Statistics enhancement was evaluated by running the statistics in a variety of options while executing a Full Function workload. Data collected was the total cost in terms of service units to execute the collection of the transaction level statistics. Options tested included are:

- TRAN No PGM No
- TRAN Yes PGM No
- TRAN No PGM Yes
- TRAN Yes PGM Yes

14.3 Transaction Level Statistics Results

The following chart and table, Chart 18 & Table 26, represent the cost in service units per transactions that was observed by activating the transaction level statistics for the various options.

Observations:

- The total increase or cost in service units/transaction observed from no statistics collected to collecting transaction level statistics with the options “TRAN YES” and “PGM YES” was measured at approximately 1.72%.

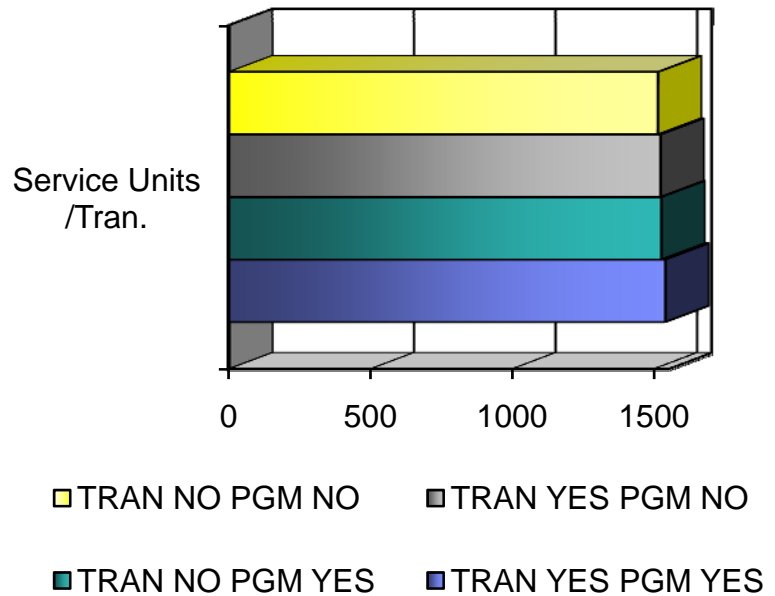


Chart 18: IMS V10 Transaction Level Statistics evaluation chart.

Values:

	TRAN RATE	Service Units CPU	Service Units SRB	Total Service Units	Service Units/Tran	Increment Percentage
TRAN No PGM No	505.96	553,873	211,942	765,815	1,513.59	
TRAN Yes PGM No	506.37	556,525	214,628	771,153	1,522.91	.62%
TRAN No PGM Yes	506.01	558,587	213,503	772,090	1,525.84	.81%
TRAN Yes PGM Yes	506.77	565,420	214,843	780,263	1,539.68	1.72%

Table 26: IMS V10 Transaction Level Statistics evaluation values.

14.4 Summary

A small increment in terms of service units per transaction was observed by activating the IMS Version 10 Transaction Level Statistics enhancements. This cost is not a significant amount.

- An increment of service units per transaction of 1.72% was observed when activating the transaction level statistics with both TRAN and PGM statistics turned on.
- Increments of less than 1% were observed for turning on the statistics with either just the TRAN or PGM statistics activated.

15 ACBLIB Member Online Change

15.1 Introduction

IMS Version 10 is now enabled to execute changes to individual members of ACBLIB or additions of ACBLIB members without the need for a full library switch online change. The following section documents the performance characteristics observed while executing the enhanced functions of ACBLIB online change.

15.2 Environment

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, 2 CPs and 8 GB storage per ICF (for shared queues tests)
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V10R1, TPNS V3R5

Table 27: IMS V10 ACBLIB online change evaluations hardware and software test environment.

Testing Scenarios:

➤ Performance Test Scenario 1:

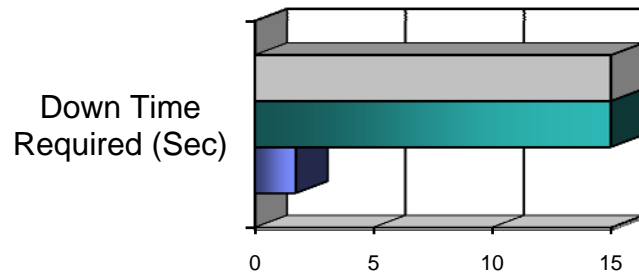
- Determine the performance characteristics of the ACBLIB Member OLC function in a full function workload, monitoring the elapsed time or down time required to execute ACBLIB online change.

15.3 Results

Chart 19 represents the total down time required to execute the specific changes to the ACBLIB using IMS Version 9, IMS Version 10 Online Change, and IMS Version 10 Member Online Change.

Observations

- There was a significant performance improvement of approximately 98% in terms of the total elapsed time reduction for the IMS Version 10 with ACBLIB Member online change enhancement.



- “Down Time Required” in Chart 19 represents the total elapsed in seconds needed to deallocate and re-allocate the data base data sets, if needed, and the time needed to execute the ACBLIB online changes.

- IMS V9
- IMS V10
- IMS V10 Member Online Change

Chart 19: IMS V10 ACBLIB Member online change.

Values:

Table 28 represents the values for the measurement charted in Chart 19. The total elapsed times in seconds for each of the measurements are represented in Chart 19. The “DB Ready Time” in Table 28 represents the elapsed time in seconds required to re-allocate the data base data sets after “MOD Commit” command was executed.

	Elapsed Time (Sec)	Improvement Percentage
IMS V9		
MOD Prepare	0.51	
MOD Commit	25.61	
DB Ready Time	59.75	
Total Time	85.87	-
IMS V10		
MOD Prepare	0.47	
MOD Commit	25.72	
DB Ready Time	57.5	
Total Time	83.69	2.53%
IMS V10 Member		
MOD Prepare	1.61	
MOD Commit	0.11	
DB Ready Time	-	
Total Time	1.72	98%

Table 28: IMS V10 ACBLIB online change evaluation values.

15.4 Summary

The ability to execute changes to individual members of ACBLIB or additions of ACBLIB members without the need for a full library switch online change provides a highly sufficient change function without disruption to the complete online system.

- Improvements of up to 98% were observed by using the IMS V10 ACBLIB Member Online Change function over the IMS V9 full library switch online change function.

Addendum 1 Parallel RECON Access (PRA)

A1.1 Introduction

As IMS sysplex environments and system workloads grow the need for recovery services also increases. The IMS Version 10 Parallel RECON Access (IMS V10 PRA) enhancements provide a solution towards eliminating performance bottles caused by IMS DBRC RECON contention. The IMS Version 10 PRA enhancements takes advantage of Record Level Sharing (RLS) provided by Transactional VSAM (DFSMSStvs) which provides a record level sharing of the RECON data sets. This means that multiple DBRC RECON requests from multiple IMS systems can be processed in parallel.

A1.2 Environments

Hardware and Software Environment	
Processor:	IBM eServer zSeries 990 Model C24 (Type 2084 Model C24) 12 GB storage with 2 x ICFs, 2 CPs and 8 GB storage per ICF (for shared queues tests)
DASD:	IBM System Storage DS8000 Turbo (2107-F21, 8100 Model) IBM TotalStorage Enterprise Storage Server (ESS) 2105 Model 800 36GB 15K RPM disk drives, 4 FICON channels, 8 LSS, 16 Ranks, Volume config = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R8, IMS V8R1, IMS V9R1, IMS V10R1, TPNS V3R5

Table 29: IMS Version 10 PRA enhancement test hardware & software environment.

Testing Scenarios:

Several testing scenarios were used to evaluate the performance characteristics of the IMS Version 10 PRA performance enhancements. Each of these scenarios are designed to create large amounts of DBRC RECON data set access contention. The scenarios are:

- PREOPEN - In this scenario either 4,000 or 6,000 FP areas are defined as PREOPEN in the RECON data set for an n-way IMS sysplex. The IMS systems are started in parallel causing RECON access contention.
- Large Batch Contention - For this scenario a large number of Image Copy jobs are submitted via change accumulation group across multiple IMS's in parallel.
- /DBD DB - In this scenario the /DBD DB command is issued against a set of databases in parallel across multiple IMS systems in a sysplex creating a large amount of RECON contention.

A1.3.1 PRA Large Batch Workload & PREOPEN Results

Chart 20 below demonstrates the performance improvements observed by the use of the IMS Version 10 PRA enhancements for the large batch workload and FP area PREOPEN scenarios. In the documented comparisons IMS Version 10 systems with RECON definitions of “ACCESS=Serial”, non PRA, verses the “ACCESS=Parallel”, with PRA “turned on”, were evaluated.

Observations:

- A reduction of 22% of total elapsed time was observed for the IMS Version 10 PRA enhanced system for the large image copy scenario.
- A reduction of 15% of total elapsed time was observed for system using the IMS Version 10 PRA enhancement for the PREOPEN scenario.

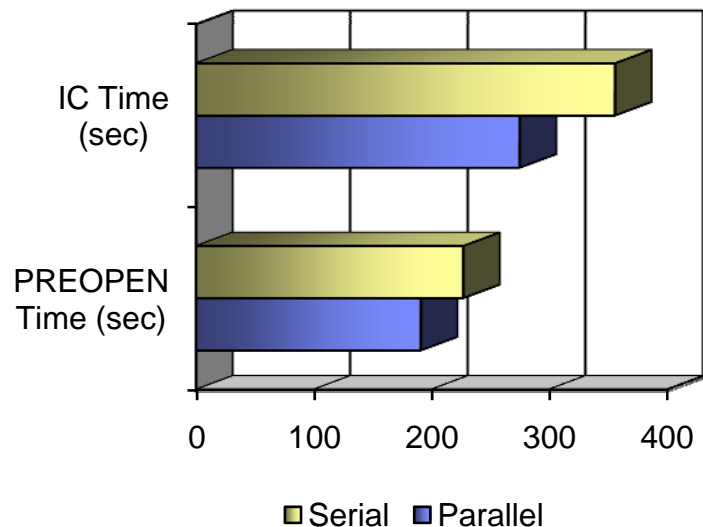


Chart 20: Large IC workload (top) and PREOPEN (bottom) total elapsed time comparisons.

Values:

For the large batch workload, 513 full function data bases were image copied in parallel across a 4-way IMS sysplex using the IMS Version 10 DFSUDMP0 Image Copy utility. The values represented in Chart 20 are the comparisons of the total elapsed time required to complete the image copies for both the ACCESS=PARALLEL and the ACCESS=SERIAL scenarios. The time required to complete the image copies without the IMS Version 10 PRA enhancements was 356 sec. This was compared against 275 sec, the total elapsed time for IMS Version 10 system with the PRA enhancements to complete the image copies. (5 min 56 sec vs. 4 min 35 sec)

During the PREOPEN evaluations 6,000 IMS Fast Path areas were opened in parallel across a 2-way IMS sysplex with the total elapsed time values of 227 sec for the non PRA enhanced version and 191 sec for the IMS Version 10 system with the PRA enhancements. (3 min 47 sec vs. 3 min 11 sec)

A1.3.2 PRA /DBD DB Results

Chart 21 below demonstrates some of the performance characteristics of the IMS Version 10 PRA enhancements during online system activity and during a large amount of /DBD DB processing. The documented comparisons are with IMS Version 10 systems with and without the PRA enhancements active.

Observations:

- The results of the ITR evaluations and the /DBD DB comparisons both demonstrate less than 1% impact to IMS system performance.

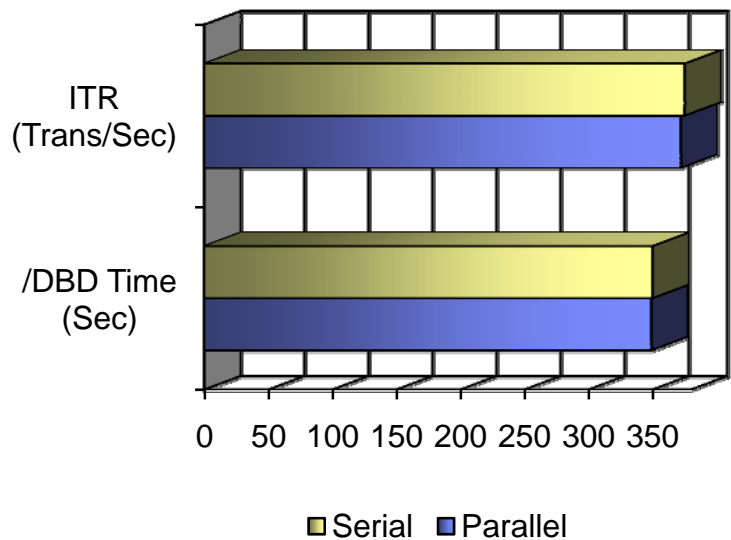


Chart 201: ITR (top) and /DBD DB (bottom) evaluations.

Values:

Internal Throughput Rate (ITR) comparisons during a full function online measurement for IMS systems with and without the IMS Version 10 PRA enhancements demonstrated no significant impact to the IMS system performance. Values were 375 transactions per second for the non PRA enhanced IMS system versus 372 transactions per second for the IMS PRA enhanced system. Values for the /DBD DB scenario also demonstrated no significant performance impact when executing the command against 513 full function data bases with values of 349 seconds for the non PRA enhanced system versus 350 seconds for the IMS PRA enhanced system in a 6-way IMS data sharing environment.

A1.3.3 IMS V8, V9, V10 & V10 PRA PREOPEN Comparison Results

Chart 22 below demonstrates the elapsed time spent completing an IMS cold start with the PREOPEN of 4,000 IMS Fast Path areas per IMS. This test was conducted with 1, 2, 4 and 8 IMS control regions executing PREOPEN of the 4,000 IMS Fast Path areas in parallel. The IMS V10 comparison was done with and without the IMS Version 10 PRA enhancement executing, (ACCESS=SERIAL vs ACCESS=PARALLEL).

Observations:

- IMS Version 10 with PRA activated achieved significant reductions in total elapsed time spent executing PREOPEN and IMS Cold start over previous releases and IMS Version 10 without PRA active.
- The chart demonstrates that as the number of IMS control regions running in parallel increase, or as the amount of RECON contention increases, the performance improvements gained by using the IMS Version 10 PRA enhancement also increases.

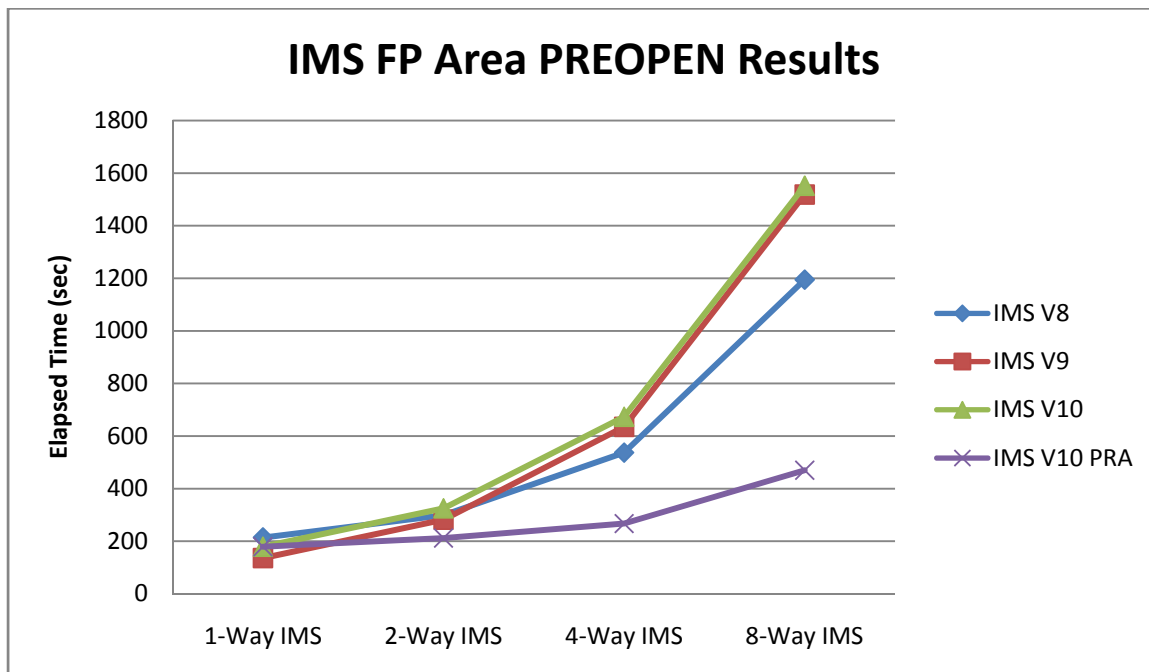


Chart 22: IMS V8, IMS V9, IMS V10, IMS 10 with PRA PREOPEN Comparison.

A1.4 PRA Summary

The results of the IMS Version 10 PRA enhancements performance evaluation demonstrate the affective reduction of IMS DBRC RECON contention without adding any significant additional costs to the IMS system within a specific environment. The IMS Version 10 PRA enhancements provide effective methods of exploiting Transactional VSAM and RLS as a means towards eliminating DBRC RECON contention and any performance bottlenecks caused by that contention. It should be stated that these results were achieved under a controlled and performance tuned environment, these results should not be used as an expectation across every environment.

- A reduction of 22% of total elapsed time was observed for the IMS V10 PRA enhanced system for the large image copy scenario over the non PRA enhanced IMS V10 measurement.
- A reduction of 15% of total elapsed time was observed for system using the IMS V10 PRA enhancements for the PREOPEN scenario over the non PRA enhanced IMS V10 measurement.
- No significant performance degradation was observed by the use of the PRA enhancements for the IMS online or /DBD DB workload scenarios.
- Significant improvements were observed for the IMS V10 PRA enhanced system for the PREOPEN scenario over previous non PRA enhances versions of IMS, IMS Version 8 and IMS Version 9.

16 Testing Methodology

An effective way of comparing two IMS workload environments that remain with a constant hardware environment is to compare the Internal Throughput Rate (ITR) of the two workloads. ITR is the number of units of work accomplished per unit of processor busy time; therefore, $ITR = \text{units of work/processor busy time}$. The ITR comparison gives us a sense of which software environment is best suited to perform on a given machine as it is currently configured.

The test methodology used in the IMS Version 10 performance study is similar to the methodology described in the IBM Large Systems Performance Reference, document number SC28-1187-09, with the exception of the choice of terminal simulators. This study used the IBM Teleprocessing Network Simulator on a stand-alone processor in place of the proprietary 'internal driver' employed in the LSPR measurements.

The Large System Performance Reference for IBM can be found at:
<http://www-1.ibm.com/servers/eserver/zseries/lspr>

The LSPR document can be obtained at:
<http://www-1.ibm.com/servers/eserver/zseries/lspr/pdf/SC2811879.pdf>

Measurement data is to be considered equivalent for comparison purposes in this document when it is between +/-3%.

16.1 Disclaimer

References in this document to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM program product in this document is not intended to state or imply that only IBM's program product may be used. Any functionally equivalent program may be used instead.

The information contained in this document has not been submitted to any formal IBM test and is distributed on an "AS IS" basis without any warranty either expressed or implied. The use of this information or the implementation of any of these techniques is a customer responsibility and depends on the customer's ability to evaluate and integrate them into their operational environment. While each item may have been reviewed by IBM for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environments do so at their own risk.

Any performance data contained in this document was obtained in a controlled environment based on the use of specific data. The results that may be obtained in other operating environments may vary significantly. Users of this document should verify the applicable data in their specific environment.

The test scenarios (hardware configuration and workloads) used in this document to generate performance data are not considered 'best performance case' scenarios. Performance may be better or worse depending on the hardware configuration, data set types and sizes, and the overall workload on the system.

16.2 Trademarks

The following terms are trademarks of International Business Machines Corporation in the United States, other countries, or both:

IBM®
z/OS

Enterprise Storage Server
zSeries

FICON

IMS