IMS Version 12 Performance Evaluation Summary

Maintaining superior performance with greater efficiency

IMS Performance Evaluation Team (IBM Silicon Valley Laboratory)
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Abstract

The latest release of one of the most widely used database and transaction managers, IMS™ Version 12 exemplifies efficiency. IMS 12 adds a significant amount of critical functionality without any additional overhead: Fast Path Secondary Indexing, DFSMS Extended-Formatted Sequential Logging, Full Function Dynamic Buffer Pools, IMS Connect-to-IMS Connect Communication, and Fast Path 64-bit Buffer Expansion/Compression. With its optimized modules, IMS 12 proves to demonstrate equal or better CPU efficiency by comparison. This paper illustrates the performance characteristics of the newly enhanced IMS product and the additional functionality now provided therein.

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

Introduction

With any new release, new functionality can increase the execution path length, resulting in some normally acceptable increased processing cost. One way of quantifying this processing cost in IMS over a previous release is to measure and compare the Internal Throughput Rate (ITR) of each release. ITR is a measure of CPU efficiency calculated by dividing the total transaction rate measured by the CPU consumed. The IBM IMS Performance Evaluation team works with IMS product development teams to conduct performance evaluations, release-to-release ITR comparisons, and code path analysis, ensuring optimal performance and providing meaningful capacity planning and migration aid documentation. With the IMS 12 release, a primary part of the design was to provide additional key functionality and to enhance existing functionality without any additional processing costs and, in some areas, to improve the existing CPU efficiency. This white paper documents the observations and findings of the IMS Performance Evaluation team's IMS 12 evaluations. The evaluations summarized in this report include:

- IMS General Performance (ITR Comparisons)
    - Fast Path Environments
    - Full Function with HALDB Environments
    - Full Function Shared Message Queues Environments
    - BMP Environments
- IMS Enhanced Logger with 64-bit Buffering
- WADS Enhancement
- Fast Path 64-bit Buffer Manager
- Dynamic Resource Definition (DRD) Repository
- Full Function Dynamic Buffer Pool
- OTMA Synchronous Shared Queues Enhancement
- APPC Synchronous Shared Queues Enhancement
- IMS Connect-Connect
- MSC TCP/IP Benchmark

Comparison is the preferred method of evaluation, and it is the primary method used for this set of evaluations.   ITR values for each of the Base Evaluation Workloads are compared with the prior release ITR values. Certain pre-defined performance goals were also defined and evaluated for any new function within the IMS 12 release. It should be noted that while the same workloads and processor configurations were used for any given IMS Version 11 to IMS Version 12 comparison, there might be variations of the configuration or workload between different types of measurement evaluations; therefore, direct comparisons of one measurement evaluation to another should be avoided. Please refer to the disclaimers section for additional considerations.

1. Executive Overview

The IMS Version 12 performance evaluation observations and their results highlight the functionality and efficiency of the IMS release. The performance characteristics demonstrate that the latest release of IMS provides a significant amount of additional functionality while maintaining its excellent efficiency, scalability, and performance. The key evaluation points and characteristics of these observations are:

- Customers migrating from IMS 11 to IMS 12 should expect equivalent performance and CPU efficiency in some cases, and significant improvements in others, depending on the environment.

- IMS 12 approaches 4 billion transactions a day, achieving over 46,000 transactions per second in a single image Fast Path environment.

- 40-50% ITR improvements (CPU efficiency) were observed with IMS 12 APPC/OTMA Synchronous Shared Queues environments using cross-system coupling facility (XCF), compared with the same environments using Resource Recovery Services (RRS).

- 60% ITR improvements were observed with IMS 12 Data Entry Databases (DEDBs) using Fast Path Secondary Indexes (FPSI) over the equivalent workload environments using Hierarchical Direct Access Method (HDAM) Virtual Storage Access Method (VSAM) databases with secondary indexes.

- Logging rates over 350 MB/sec were achieved using the IMS 12 Logger with 64-bit virtual buffering and Sequential Access Method (SAM) striping.

- Virtual Storage Constraint Relief (VSCR) – IMS 12 demonstrated significant extended common service area (ECSA) savings, in our sample 64MB, with the use of 64-bit log buffers.

- Customers that are logging bandwidth constrained can significantly improve transaction throughput rates and can reduce their batch time and BMP windows; we have observed gains of twice the throughput in our environment.

- Device response time reduced by up to 10% with the enhanced channel program for the IMS 12 WADS devices in comparison to IMS 11 WADS response time rates.

- IMS 12 MSC TCP/IP achieves transaction rates over 10,500 transactions per second.

- Negligible increased processing cost for all the base function measurements.

Base Evaluation	Performance characteristics
➢ Fast Path with Fast Path 64-bit Buffer Manager	ITR decrease is negligible <1%
➢ Full Function with HALDB	ITR increase is negligible <1%
➢ Full Function with Shared Message Queues	ITR increase is negligible <1%
➢ Batch Message Processing	~2% reduced CPU consumption for IMS 12

Table 1: Base evaluations summary.

Note: In environments for which the transaction workload is split across two separate LPARs (a front-end and back-end setup), the ITR values were calculated by taking the total transaction rate divided by the average of the CPU busy across both the front- and back-end LPARs. The ITR values for the split environments should not be used as a measure of maximum transaction rate, but instead should be used only as a measure of relative CPU usage.

2. General Silicon Valley Laboratory IMS Performance Evaluation Information

Hardware Environment

Processor
The measurement results in this white paper were conducted either on the IBM System z10^{TM} Enterprise Class (z10 EC) model 2097 E64, or the IBM zEnterprise^{TM} System 196 (z196) model 2817. Each measurement evaluation involved a unique system configuration with varying numbers of LPARs or cores (general purpose or specialty engines), documented in greater detail during the introduction of each measurement evaluation.

50% more capacity than z9 EC

4.4 GHZ quad core processing books

Supports up to 1.5 TB of real memory

60% more capacity than z10 EC

5.2 GHZ core processing

40% faster core over z10 EC

Storage
IBM System Storage® DS8000® models DS8300 and DS8700 were used with 8 FICON® channel paths and 8 Parallel Access Volumes (PAVs) per volume. The DASD volumes and paths for each measurement evaluation set remained consistent for comparison purposes unless otherwise noted.

Coupling Facilities
All measurements were performed with internal coupling facilities (ICFs) with CFCC levels 15 and 16.

Software Environment

Operating System
The evaluations were performed on z/OS V1R11.0, running with IMS 11 and IMS 12.

Workloads and Workload Driver
Teleprocessing Networks Simulator (TPNS) V3R5 was used as the workload driver simulating either SNA or TCP/IP clients.

A set of IMS workloads are used to exercise specific IMS code paths: Fast Path, Full Function, Shared Queues support, OTMA, and APPC. The specific IMS workloads are used for both comparison sets to maintain a consistent environment suitable for comparison. The following workloads were used to simulate typical banking, warehouse, hotel, and inventory customer-like workloads:

- Data Sharing Full Function Workload (DSFF) with high availability large database (HALDB) – Mix of OSAM and VSAM with HDAM, HIDAM, PHDAM, and PHIDAM databases using inventory, hotel, and warehouse-type transactions: read, replace, and insert transactions.

- Data Sharing Full Function Workload (DSFF) with Shared Queues – DSFF workload performs updates to a variety of OSAM and VSAM Full Function databases and uses the IRLM address space for the data sharing lock manager.

- Fast Path Banking Workload (FP) – 2 DEDB databases with up to 240 areas using simple credit card transactions (CCCK - Credit Card Check read, CLCK - Credit Limit Check read, DEBIT - Debit update, CREDIT - Credit update, and LOST – report a card lost or stolen)   The Fast Path base evaluations included scenarios with and without the Fast Path 64-bit Buffer manager (FPBP64), and the latest buffer pool expansion and compression enhancements. The Fast Path workload with the buffer manager active, FPBP64=Y, is our base Fast Path workload.

- Banking BMP – performs extensive sequential updates to Fast Path databases simulating end-of-day account reconciliation.

3. "Out the Box" General Performance (CPU efficiency ITR Comparisons)

Introduction

The results of the general performance evaluations show equal or better CPU efficiency with the IMS 12 release in comparison to the IMS 11 release, demonstrating the IMS 12 optimized modules and cost reduction enhancements. The results demonstrate that even though the IMS 12 release added a significant amount of additional functionality, ITR values remained the same or were improved in specific testing scenarios.

The ITR values for each of the specific types of IMS workloads were used to evaluate the general performance and CPU efficiency of the new IMS 12 release.   IMS 12 "base" workload ITR values were compared with the IMS 11 base workload ITR values as comparison points to assist with migration and capacity planning. The base workloads consist of workloads exercising Fast Path, Full Function with HALDB, Full Function with Shared Message Queues, and Batch Message Processing (BMP) IMS code paths

All of the base workload evaluations were executed on machine configurations from the environment detail below in Table 2. The system configuration of each measurement evaluation will be explained in greater detail for each of the evaluations.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, IBM zEnterprise System z196 25 GB storage, 2 ICFs with 2 engines / ICF and 19 GB storage per ICF
DASD:	IBM System storage DS8300, DS8700 (2107) MOD-27 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 11, IMS 12, TPNS V3R5

Table 2: IMS 12 Base Evaluation Environment.

3.1 Fast Path Base Evaluation

The Fast Path base evaluation results demonstrate the performance efficiency of the IMS 12 release. The evaluation used the Fast Path workload, simple credit card type transactions, CCCK, CLCK, CREDIT, DEBIT, and LOST, and included ITR comparisons using the workloads in IMS 11 and IMS 12 environments.

3.1.1 System Configuration (Fast Path Base)

The Fast Path base evaluations were executed on a z196 (2817) configured in a two-way sysplex environment with each LPAR having 2 general processing engines. The machine was configured in a sysplex environment; however, this workload was executed with a single IMS. The exact configuration and workload setup was used for both the IMS 11 and IMS 12 evaluations.

- Single image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
- DS8000 model 8700 DASD connected via 8 FICON channel paths

Figure 1: Fast Path Base System Configuration

3.1.2 Evaluation Results (Fast Path Base)

The results of the ITR comparison between IMS 11 and IMS 12 demonstrate that the latest IMS release maintains its current performance and CPU efficiency. Table 3 shows the results of the Fast Path evaluation with the Fast Path 64-bit Buffer Manager.

Observations:
- IMS 11 FPBP64=N vs IMS 12 FPBP64=N comparisons demonstrated a 1.9% reduction in ITR for IMS 12. (Enhancements were put in the FPBP64=Y code path.)
- With the Fast Path 64-bit Buffer Manager, no significant ITR impact was observed with or without the latest expansion and compression functionality (Table 3).

ITR Comparison IMS 11 vs IMS 12				
Values:	IMS 11 FPBP64=Y	IMS 12 FPBP64=Y Expand/Compress=N	IMS 12 FPBP64=Y Expand/Compress=Y	Delta % from IMS 11
ETR (Tran/Sec)	22,361.45	22,314.88	22,305.72	--
CPU%	89.15%	89.25%	89.78%	-0.3%
ITR (Tran/Sec)	25,082.95	25,002.67	24,842.09	-0.96%

Table 3: IMS Version 12 Fast Path base evaluation comparison.

3.2 Full Function with HALDB (Base Evaluation)

IMS 12 maintains its CPU efficiency and outstanding performance in Full Function HALDB environments as well. The IMS 12 ITR values were higher in comparison to IMS 11.

3.2.1 System configuration - Full Function with HALDB (Base Evaluation)

Two z10 EC LPARS configured with 3 general purpose engines were configured to conduct the Full Function HALDB base evaluations.

- Single image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
- TPNS simulating 4,000 clients
- DS8000 model 8700 DASD connected via 8 FICON channel paths
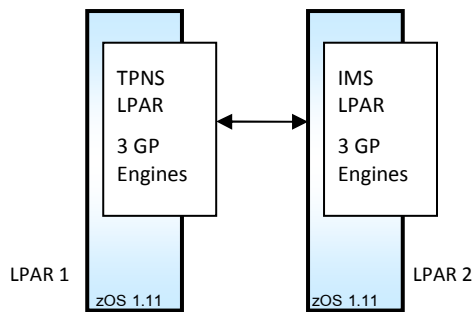
Figure 2: Full Function with HALDB Base Configuration

3.2.2 Evaluation Results - Full Function with HALDB (Base Evaluation)

The results of the ITR comparison between IMS 11 and IMS 12 demonstrate that the latest IMS release maintains its current performance and CPU efficiency. Table 4 shows a slight ITR improvement for IMS 12 over IMS 11.

Observations:
➢ Internal Throughput Rate (ITR) comparisons of the IMS Version 11 and IMS Version 12 Full Function with HALDB workload demonstrate equal or better performance for the IMS 12 environment.

Values:

ITR Comparison IMS 11 vs IMS 12				
	IMS 11	IMS 12	Delta	Delta %
ETR (Tran/Sec)	1,543.43	1,548.26	4.83	0.31%
CPU%	82.47%	82.61%	0.14	0.17%
ITR (Tran/Sec)	1,871.43	1874.10	2.68	.14% Improvement

Table 4: IMS Full Function with HALDB Base Evaluation.

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3.3   Full Function HALDB Shared Message Queues (SMQ) Base

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The IMS Full Function with HALDB Shared Message Queues (SMQ) evaluation was performed in a z10 EC sysplex environment with a single IMS. IMS is started with Common Queue Server (CQS) and is using the shared message queues. With IMS 12 and subsequent releases, IMS SMQ or Shared IMS Fast Path Message Queues environments can processes eligible work on System Z Integrated Information Processor (zIIP) specialty engines. Request Response Processing for authorized Common Queue Server (CQS) clients in IMS 12 will request z/OS to process such work on available zIIPs. We have incorporated zIIP engines into this evaluation.

3.3.1 System Configuration - Full Function HALDB SMQ (Base Evaluation)

The Full Function HALDB SMQ evaluation environment is similar to the other base evaluation environments;
- 2 LPARS with 2 general purpose engines each and 2 zIIP engines with IMS LPAR
- Single-image IMS on 1 dedicated LPAR and 4,000 client TPNS on its own LPAR
- DS8000 model 8700 DASD connected via 8 FICON channel paths
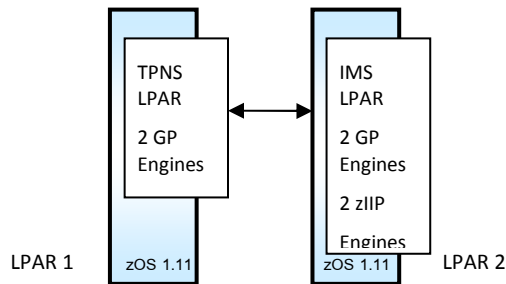
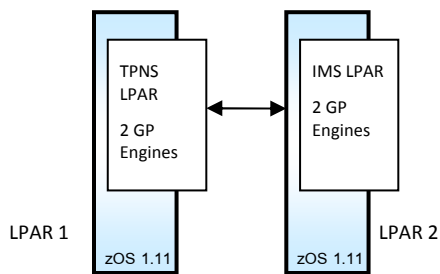**Figure 3: Full Function HALDB SMQ Configuration**

3.3.2 Evaluation Results - Full Function HALDB SMQ (Base Evaluation)

The results of the ITR comparison between IMS 11 and IMS 12 demonstrate that the latest IMS release maintains the current performance and CPU efficiency, even demonstrating minimal improvement, see Table 5.

Values:

Full Function SMQ Base Evaluation				
	IMS 11	IMS 12	Delta	Delta %
ETR (Tran/Sec)	1028.69	1031.91	3.22	0.31%
CPU%	80.64%	80.85%	0.21	0.26%
zIIP %	4.23%	5.39%	1.16	27.42%
ITR (Tran/Sec)	1275.66	1276.33	.67	0.05%

Table 5: IMS Full Function HALDB SMQ base comparison.

3.4   Banking BMP Base Evaluation

The goals for the Banking BMP base measurements were focused on the total elapsed time required to execute a set of banking-like BMPs. The following charts demonstrate the results of the base function comparisons.

3.4.1 System configuration – Banking BMP (Base Evaluation)

One z10 LPAR configured with 3 general purpose engines were configured to conduct the Banking BMP base evaluations.

- 1 LPAR with 3 general purpose engines
- Single-image IMS on 1 dedicated LPAR
- DS8000 model 8700 DASD connected via 8 FICON channel paths

IMS BMP
LPAR

3 GP
Engines

LPAR 1

zOS 1.11
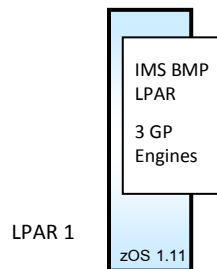
Figure 4: Banking BMP System Configuration

3.4.2 Evaluation Results – Banking BMP (Base Evaluation)

The results of the Banking BMP comparison between IMS 11 and IMS 12 demonstrate that the latest IMS release maintains its current performance and CPU efficiency. Table 6 shows a slight processing time improvement for IMS 12 over IMS 11.

Observations:
➢ IMS 12 demonstrated a 2.4% reduction in total CPU % Busy over IMS 11.

Values:

	Elapsed Time (Sec)	CPU Busy %	EXCP #	CSA Below 16 MB Key 7	Task CPU Time	ECSA Above 16 MB Key 7
IMS 11	76	7.88	41	204K	7.39	49.5M
IMS 12	78	7.69	42	208K	7.39	49.5M

Table 6: IMS Version 12 Banking BMP evaluation results.

4. IMS 12 Enhanced Logger with 64-bit Buffering

A key enhancement with the IMS 12 release is the support of extended format online log data sets (OLDS), which allows the IMS log buffers storage to move above the 2-gigabyte boundary and also allows the IMS log data sets to be striped. This striping can be used to increase logging bandwidth and overall throughput in logging constrained environments. With the log buffers now above the 2-gigabyte boundary, internal IMS components can log data directly from above the boundary, without first copying the data below the boundary, improving logging rates. We observed some exciting benchmark logging rates when evaluating this enhancement within a range of striping configurations: no stripe, 2-stripe, 4-stripe, 6-stripe, and 8-stripe configurations. Additionally, this enhancement frees up ECSA by moving the log buffers above the bar. We have also documented the ECSA savings observed by using the IMS 12 logger enhancement.

4.1 Environment (Enhanced Logger with 64-bit Buffering)

There were several scenarios involved with evaluating the enhanced logger in the IMS 12 release. Each scenario was conducted on the z10 machine with DS8700 DASD. To demonstrate the enhancement effectively, large amounts of log data per transaction was logged using a Fast Path workload with a 24K CI size and a modification used to force full CI logging, allowing us to create a logging constraint in the workload. The amount of log data per transactions was varied to evaluate the effect; log data sizes of 25KB, 50KB, and 75KB was used with each of the striping configurations. The workload hardware and software used is shown in Table 7.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage, 10 total GP engines, 5/LPAR
DASD:	IBM System storage DS8300 and DS8700 (2107) 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 7: IMS Version 12 Enhanced Logger with 64-bit buffering environment

4.2 System Configuration (Enhanced Logger with 64-bit Buffering)

Two LPARS configured with 5 general purpose engines on the IMS LPAR with a dedicated isolated TPNS LPAR.

- Single-image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
- DS8000 model 8700 and 8300 DASD connected via 8 FICON channel paths
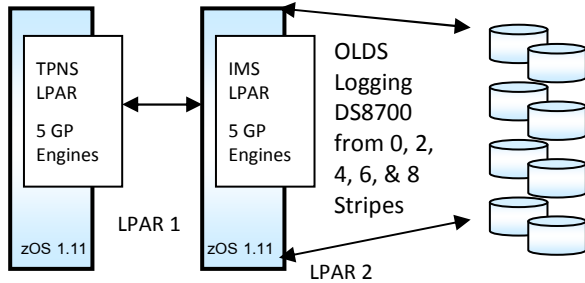
Figure 5: IMS V12 Enhanced Logger System Configuration

4.3   Evaluation Results – (Enhanced Logger with 64-bit Buffering)

Logging rates of over 350 MB per second were achieved with the enhanced IMS 12 logger and SAM striping. A significant improvement in IMS throughput can be observed for IMS logging constrained environments.

Observations:

➢ 354 MB/sec IMS 12 OLDS logging rate was achieved using SAM striping (8 stripes with 74KB log data size).

➢ 64MB ECSA Virtual Storage Constraint Relief (VSCR) with 2,516 64-bit log buffers.

➢ 35% logging rate improvement was observed using DS8700 vs DS8300 volumes (DS8300 4-stripe, 74KB log data size setup achieved a logging rate of 205MB/sec).

Values:

IMS 12 Enhanced Logging DS8700 25 KB Log Data Size		
Scenario	**Transaction Rate (Tran/sec)**	**PA OLDS (Writes/sec)**
No Stripes	6,321	156 MB/sec
2 Stripes	9,790	244 MB/sec
4 Stripes	11,225	280 MB/sec
6 Stripes	12,506	309 MB/sec
50 KB Log Data Size		
No Stripes	3,203	155 MB/sec
2 Stripes	4,887	238 MB/sec
4 Stripes	5,981	289 MB/sec
6 Stripes	6,642	323 MB/sec
74 KB Log Data Size		
No Stripes	2133	154 MB/sec
2 Stripes	3162	228 MB/sec
4 Stripes	3825	277 MB/sec
6 Stripes	4536	329 MB/sec
8 Stripes	4908	354 MB/sec

Table 8: IMS 12 Enhanced Logger with SAM striping.

5. IMS 12 Logging WADS Enhancement

The enhanced IMS 12 WADS Channel Program now conforms to E-C-K-D architecture, providing greater efficiency and reducing channel program operations. This improvement is expected to provide a significant impact on global and metro mirroring environments. Observations in non-mirroring environments have also demonstrated significant results.

5.1 Environment – (WADS Enhancement)

The evaluation of the IMS 12 WADS enhancement used a Full Function with HALDB workload in the following environment, shown in Table 9.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage, 6 total GP engines, 3 engines / LPAR
DASD:	IBM System storage DS8700 (2107) 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 11, IMS 12, TPNS V3R5

Table 9: IMS Version 12 WADS enhancement evaluation environment

5.2 System configuration – (WADS Enhancement)

Two LPARS configured with 3 general purpose engines were configured to conduct the Full Function HALDB base evaluations.

- 2 LPARs with 3 general purpose engines each
- Single-image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
- TPNS simulating 4,000 clients
- DS8000 model 8700 DASD connected via 8 FICON channel paths
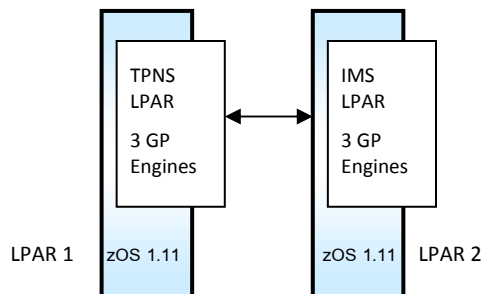
Figure 6: IMS V12 Enhanced WADS System Configuration

5.3 Evaluation Results – (WADS Enhancement)

IMS 12 with the enhanced WADS demonstrated a significant improvement in WADS device response time.

Observations:

➢ IMS 12 demonstrated improvements up to 10% in WADS device response time in comparison to IMS 11 with the same Full Function HALDB workload

Values:

IMS 11 (top) and IMS 12 (Bottom)

```
                                              DEVICE   AVG  AVG   AVG  AVG   AVG  AVG  AVG    %     %     %    AVG    %     %
STORAGE  DEV  DEVICE   NUMBER  VOLUME PAV  LCU  ACTIVITY RESP IOSQ  CMR  DB    PEND DISC CONN  DEV   DEV   DEV  NUMBER ANY   MT
GROUP    NUM  TYPE     OF CYL  SERIAL                RATE   TIME TIME  DLY  DLY   TIME TIME TIME  CONN  UTIL  RESV ALLOC ALLOC PEND
         240D 33909    31164   S24$0D 1.0H 0023 1143.49 .384 .000  .025 .000  .179 .001 .204  23.32 23.42  0.0  1.0   100.0  0.0
         240D 33909    31164   S24$0D 1.0H 0023 1163.02 .344 .000  .028 .000  .184 .001 .159  18.47 18.60  0.0  1.0   100.0  0.0
```

	IMS Version 11	IMS Version 12
WADS AVG RespTime	.384	.344
% Improvement	--	10.41%

Table 10: IMS Version 12 WADS Device Response Time.

Note: DASD mirroring environments have not yet been evaluated by this team.

6. IMS 12 FP 64-bit Buffer Manager Enhancement

The IMS 12 enhancement to the Fast Path 64-bit buffer manager introduces subpool expansion and compression, reduced ECSA usage, code length reduction and removal, and an enhanced QUERY POOL command, improving both performance and manageability. Now the IMS Fast Path subpools are pre-expanded prior to wait-for-buffer conditions, and subpools are compressed when the storage is no longer needed. This greatly improves the manageability of the world's greatest database and transaction manager, IMS.

6.1 Environment – (FP 64-bit Buffer Manager Enhancement)

Following is the evaluation of the IMS 12 FP 64-bit Buffer enhancement executed with our Fast Path Banking workload in a single image environment. The environment specifics are shown in Table 11.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 12 total GP engines, 2 ICFs, 2 engines / ICF and 19 GB storage per ICF
DASD:	IBM System storage DS8700 8 FICON channels, 8 LSS, 16 Ranks, Volume = 3390-9 , 7 PAVs per real volume
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 11: IMS Version 12 FP 64-bit Buffer Manager Enhancement evaluation environment

6.2 System configuration – (FP 64-bit Buffer Manager Enhancement)

Two LPARS configured with 6 general purpose engines each were configured to conduct the IMS 12 FP 64-bit Buffer enhancement evaluations.

- Single-image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
- DS8000 model 8700 DASD connected via 8 FICON channel paths
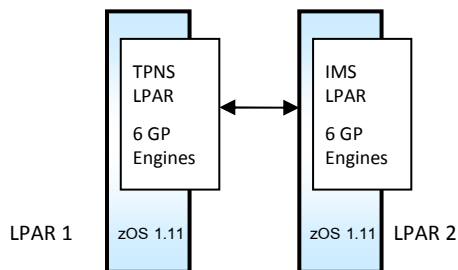
Figure 7: IMS 12 FP 64-bit Buffer Configuration

6.3   Evaluation Results – (FP 64-bit Buffer Manager Enhancement)

The enhanced buffer manager efficiently managed the IMS subpools by compression when the storage was no longer needed and expansion when more space was required, providing a more easily managed Fast Path environment.

Observations:
- As workload requirement for FP Buffers increased, the total number of FP Buffers in the pool expanded.
- As workload requirement for FP Buffers decreased, the total number of FP Buffers in the pool compressed.
- Total ECSA requirements adjusted as workload requirements adjusted.

Values:

Time	Event	Tran. Rate/Sec.	Total # of Buffers	Total ECSA Usage
08:24:30	3K Clients Executing	9,025	536	747K
08:24:33	Open 1K More Clients			
08:27:35	4K Clients now Executing	12,380	1,406	1279K
08:27:35	Close All Clients			
08:37:42	Clients are Quiescing	3,018	1,290	1279K
09:00:17	All Clients are stopped	0	1,000	1092K

Table 12: IMS 12 FP 64-bit Buffer Manager Enhancement evaluation.

7. IMS 12 Repository and Usage for DRD Resources

The IMS 12 Repository enhancement provides a centralized store for managing Dynamic Resource Definition (DRD) resource definitions across an IMS sysplex and is the preferred option over managing multiple Resource Definition Data Sets (RDDS). This enhancement provides IMS customers simplified management, allowing all IMS systems in any IMS sysplex accessibility to a single centralized store for the DRD resource definitions instead of one RDDS per IMS.

7.1   Environment – (Repository and Usage for DRD Resources)

The focus of the evaluation was to determine the usability, manageability, and efficiency of using the IMS Repository compared to managing RDDSs in both sysplex and non-sysplex environments. Two environments were used for this evaluation, a single image IMS environment and a 3-way IMS sysplex with the following:

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 9 total GP engines, 3 engines LPAR
DASD:	IBM System storage DS8700 (2107) 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12

Table 13: IMS 12 Repository and Usage for DRD Resources environment

7.2   System configuration – (Repository and Usage for DRD Resources)

We focused on evaluating the total elapsed time for importing and exporting 135,000 DRD resources from the IMS Repository in comparison to using RDDS in both single image and sysplex IMS environments.

- Up to 3 LPARs with 3 general purpose engines each, up to 3-way IMS sysplex
- 135K DRD definitions (30K DB, 30K PGM, 60K Tran, 15K Routing Code)
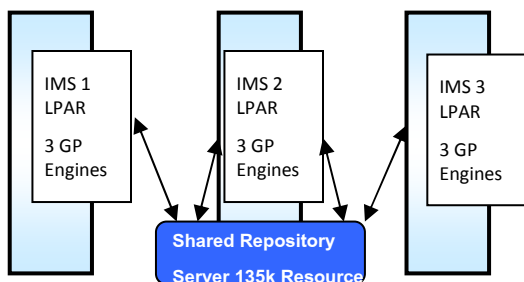
Figure 8: IMS V12 Repository Configuration

7.3 Evaluation Results – (Repository and Usage for DRD Resources)

Table 14 demonstrates the total elapsed times to EXPORT, IMPORT, and AUTOIMPORT our 135,000 resources and definitions in our single-image IMS environment, and Table 15 shows the elapsed times in our 3-way environment. EXPORT comparisons evaluated the performance characteristics of exporting all of the resource definitions exported to the repository. However, unlike export to the system RDDS, IMS repository supports export of resource definitions that were changed, or specific resource definitions based on name or time when resource was created or updated. The new EXPORT options were not tested as there is no equivalent function for RDDS.

Observations:
- The IMS 12 AUTOIMPORT into the IMS Repository took roughly 1 minute longer than the AUTOIMPORT time with IMS 11 RDDS
- The IMS 12 IMPORT into the IMS Repository took roughly 1 minute longer than the IMPORT time with IMS 11 RDDS
- IMS 12 EXPORT elapsed time in comparison to IMS 11 was roughly 16 minutes longer
- The elapsed time of AUTOIMPORT, IMPORT, and EXPORT for Repository is in general greater than for RDDS. However, customers may find that the manageability aspects of the Repository outweigh the increase in total elapsed time for these commands.

Values:

Single IMS Version 12 RDDS vs Repository (REPO) with 135K definitions			
	RDDS	REPO	Delta
EXPORT CMD	00:00.54	15:55.41	15:54.87
IMPORT CMD	25:21.82	26:40.19	01:18.37
AUTOIMPORT	01:09.96	02:19.36	01:19.40

Table 14: IMS 12 Single Image Elapsed Time Evaluation using IMS Repository

3-Way IMS Version 12 Sysplex Repository AUTOIMPORT with 135K definitions			
	Start command issued at same time for all 3 IMS regions		
	IMS 1	IMS 2	IMS 3
Start Time	11:12:17.14	11:12:17.14	11:10:08.92
End Time	11:15:49.37	11:15:49.52	11:13:28.96
Elapsed Time (individual)	3 min 32 sec	3 min 32 sec	3 min 20 sec
Total Elapsed Time	5 min 40 sec		

Table 15: IMS 12 3-Way IMS Sysplex Elapsed Time Evaluation using IMS Repository

8. IMS 12 Full Function Dynamic Buffer Pool

A new function introduced in the IMS 12 release is the ability for Full Function database customers to dynamically configure their OSAM subpools and VSAM resource pools. This new function allows you to now increase or decrease buffers and to add and delete subpools and resources pools without having to bring IMS systems offline. The IMS 12 Full Function Dynamic Buffer Pool capability uses the existing type-2 UPDATE POOL command to provide this feature without taking the IMS system offline.

8.1 Environment – (Full Function Dynamic Buffer Pool)

The focus for this evaluation was to evaluate the impact of issuing the UPDATE POOL command against an online IMS environment, to measure the performance characteristics against OSAM and VSAM databases and pool resources, and to evaluate the impact of issuing the command with BMP workloads. Our DSFF Full-Function workload was used on a z10 processor with the following:

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 8 total GP engines, 2 engines / LPAR
DASD:	IBM System storage DS8700 (2107) 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 16: IMS 12 Full Function Dynamic Buffer Pool evaluation environment

8.2 System configuration – (Full Function Dynamic Buffer Pool)

Two LPARs configured with 4 general purpose engines:
- 2 LPARs with 4 general purpose engines each, 1 IMS and 1 TPNS LPAR
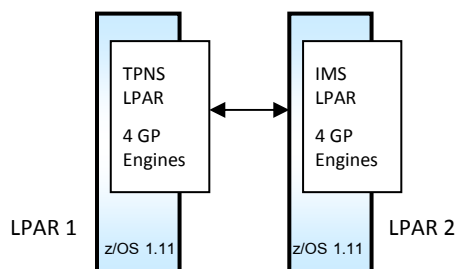
Figure 9: IMS V12 FF Dynamic Buffer Pool Configuration

8.3 Evaluation Results – (Full Function Dynamic Buffer Pool)

Our performance evaluation results demonstrate that issuing the UPDATE POOL command to increase or decrease and to add or delete subpools performed more quickly with less impact against OSAM databases. Tables 19 and 20 show the changes requested on the OSAM and VSAM pools during the UPD POOL command.

Observations:

➢ Using the UPD POOL command against OSAM databases performs more quickly and with less online activity impact than issuing the command against VSAM databases.

➢ A ~26% transaction rate impact to the online system was observed during the command execution against our VSAM database resource pool vs a ~1% transaction rate impact when the command was issued against our OSAM buffer pools.

➢ Issuing the command with BMPs active slightly increased the online transaction rate impact from 26% in the VSAM case to 29% but remained ~1% for the OSAM buffer pool case.

➢ Transaction rate drop during UPD POOL processing
  - Slight drop for OSAM
  - Moderate drop for VSAM

Values:

Single Image IMS Full Function workload with 128 MPP regions at approximately 850 tx/sec			
	OSAM	VSAM	OSAM & VSAM
Tran Rate before UPD POOL	851.3 tx/sec	852.2 tx/sec	852.6 tx/sec
Tran Rate during UPD POOL	846.3 tx/sec	628.1 tx/sec	632.9 tx/sec
Total time to process UPD POOL (sec)	.7 sec	16 sec	.7 sec / 17 sec
CPU busy % before/during/after UPD	36.2% / 36.2% / 36.2%	36.7% / 29.2% / 37.1%	35.7% / 28.6% / 36.4%
Transit execution time	44 msec	43 msec	41 msec
DBBP latch conflict (OSAM only)	44.8/sec	--	43.5/sec

Table 17: IMS 12 Full Function Dynamic Buffer Pool impact against online activity.

Single Image IMS DSFF workload with 128 MPP regions and 4 BMPs at approximately 850 tx/sec			
	OSAM	VSAM	OSAM & VSAM
Tran Rate before UPD POOL	852.2 tx/sec	852.7 tx/sec	852.6 tx/sec
Tran Rate during UPD POOL	850.1 tx/sec	603.7 tx/sec	605.5 tx/sec
Total time to process UPD POOL (sec)	.7 sec	36 sec	.7 sec / 36 sec
CPU busy % before/during/after UPD	40.9% / 42.5% / 36.4%	33.5% / 29.4% / 37.4%	41.1% / 22.1% / 37.2%
Transit execution time	42 msec	43 msec	43 msec
DBBP latch conflict (OSAM only)	43.9/sec	--	42.5/sec

Table 18: IMS 12 Full Function Dynamic Buffer Pool impact against online activity with BMPs.

Change Requested (command issued)	Pool ID	Buffer Size
Decrease the number of buffers from 2,000 to 1,500	ALL	4,096
Increase the number of buffers from 400 to 1,000	ALL	8,192
Delete buffer pool of 400 buffers	CUV2	8,192
Increase the number of buffers from 400 to 600	CUV4	8,192

Table 19: VSAM UPD POOL commands issued, IMS 12 Full Function Dynamic Buffer Pool.

Figures 10 and 11 display the VSAM buffer pools before and after the UPD COMMAND
has been issued as shown from a QUERY POOL command.

```
Response for: QUERY POOL    TYPE(DBAS) SUBTYPE(VSAM) SHOW(ALL)
Subpool  MbrName   CC BufSize PoolId  NBuf ProcMbr   Section FixOpt LctReq/RRba NewBlk/RKey AltReq/BfAlt PurgRq/NRec
-------  --------  ---- ------- ------ ----- --------  ------- ------ ----------- ----------- ------------ -----------
VSAM-D   IMF8       0    2048 ALL     1000 DFSVSMD3          N/Y/Y          0           0            0           0
VSAM-D   IMF8       0    4096 ALL     2000 DFSVSMD3          N/Y/Y    2929306     1726862       318402           0
VSAM-D   IMF8       0    8192 ALL      400 DFSVSMD3          N/Y/Y    1109148       52952            0           0
VSAM-D   IMF8       0   12288 ALL       10 DFSVSMD3          N/Y/Y          0           0            0           0
VSAM-D   IMF8       0    4096 ITMV     400 DFSVSMD3          N/Y/Y     458085           0            0           0
VSAM-D   IMF8       0    4096 VNDV     400 DFSVSMD3          N/Y/Y          0           0            0           0
VSAM-D   IMF8       0    8192 CUV2     400 DFSVSMD3          N/Y/Y    5416075           0       580862           0
VSAM-D   IMF8       0    8192 CUV4     400 DFSVSMD3          N/Y/Y    5473428           0       586907           0
```

Figure 10: VSAM Buffer Pools prior to issuing the UPD POOL command.

```
Response for: QUERY POOL    TYPE(DBAS) SUBTYPE(VSAM) SHOW(ALL)
Subpool  MbrName   CC BufSize PoolId  NBuf ProcMbr   Section FixOpt LctReq/RRba NewBlk/RKey AltReq/BfAlt PurgRq/NRec
-------  --------  ---- ------- ------ ----- --------  ------- ------ ----------- ----------- ------------ -----------
VSAM-D   IMF8       0    2048 ALL     1000 DFSVSMD3          N/N/N          0           0            0           0
VSAM-D   IMF8       0    4096 ALL     1500 DFSDFF11  VSAM010 N/N/N        721         393          110           0
VSAM-D   IMF8       0    8192 ALL     1000 DFSDFF11  VSAM010 N/N/N       1122          12           96           0
VSAM-D   IMF8       0   12288 ALL       10 DFSVSMD3          N/N/N          0           0            0           0
VSAM-D   IMF8       0    4096 ITMV     400 DFSVSMD3          N/Y/Y     458237           0            0           0
VSAM-D   IMF8       0    4096 VNDV     400 DFSVSMD3          N/Y/Y          0           0            0           0
VSAM-D   IMF8       0    8192 CUV4     600 DFSDFF11  VSAM010 N/N/N        211           0           21           0
```

Figure 11: VSAM Buffer Pools after the UPD POOL command has been issued.

Change Requested (command issued)	Pool ID	Buffer Size
Decrease the number of buffers from 1,000 to 400	--	4,096
Increase the number of buffers from 400 to 1,000	--	8,192
Delete buffer pool of 400 buffers	CU3O	8,192
Decrease the number of buffers from 400 to 200	CU1O	8,192

Table 20: OSAM UPD POOL commands issued, IMS 12 Full Function Dynamic Buffer Pool.

Figures 12 and 13 display the OSAM buffer pools before and after the UPD COMMAND
has been issued as shown from a QUERY POOL command.

```
Response for: QUERY POOL    TYPE(DBAS) SUBTYPE(OSAM) SHOW(ALL)
Subpool  MbrName   CC BufSize PoolId  NBuf ProcMbr   Section FixOpt LctReq/RRba NewBlk/RKey AltReq/BfAlt PurgRq/NRec
-------  --------  ---- ------- ------ ----- --------  ------- ------ ----------- ----------- ------------ -----------
OSAM     IMF8       0    4096          1000 DFSVSMD3           Y/Y    2933073           0       319029       42594
OSAM     IMF8       0    4096 ITMO     400 DFSVSMD3           Y/Y     460556           0            0           0
OSAM     IMF8       0    4096 VNDO     400 DFSVSMD3           Y/Y          0           0            0           0
OSAM     IMF8       0    8192          400 DFSVSMD3           Y/Y    1052963           0            0           0
OSAM     IMF8       0    8192 CU1O     400 DFSVSMD3           Y/Y    5390076           0       578555       23009
OSAM     IMF8       0    8192 CU3O     400 DFSVSMD3           Y/Y    5488670           0       589142       23315
```

Figure 12: OSAM Buffer Pools prior to issuing the UPD POOL command.

```
Response for: QUERY POOL    TYPE(DBAS) SUBTYPE(OSAM) SHOW(ALL)
Subpool  MbrName   CC BufSize PoolId  NBuf ProcMbr   Section FixOpt LctReq/RRba NewBlk/RKey AltReq/BfAlt PurgRq/NRec
-------  --------  ---- ------- ------ ----- --------  ------- ------ ----------- ----------- ------------ -----------
OSAM     IMF8       0    4096          400 DFSDFF11  OSAM010  Y/Y    2937854           0       319588       42660
OSAM     IMF8       0    4096 ITMO     400 DFSVSMD3           Y/Y     461278           0            0           0
OSAM     IMF8       0    4096 VNDO     400 DFSVSMD3           Y/Y          0           0            0           0
OSAM     IMF8       0    8192         1000 DFSDFF11  OSAM010  Y/Y    1054369           0            0           1
OSAM     IMF8       0    8192 CU1O     200 DFSDFF11  OSAM010  Y/Y    5395508           0       579144       23032
```

Figure 13: OSAM Buffer Pools after the UPD POOL command has been issued.

9. IMS 12 OTMA Synchronous Shared Queues Enhancement

The IMS 12 OTMA Synchronous Shared Queues Enhancement provides support using XCF for Commit Mode 1 (send-then-commit) transactions with a sync-level of NONE or CONFIRM in the shared queues environment. This capability removes the Resource Recovery Services (RRS) dependency and provides a simplified solution by using IMS as the sync-point manager for shared queues transactions enhancing performance.

9.1   Environment – (OTMA Synchronous Shared Queues)

The objective of this evaluation is to determine the performance improvement of IMS 12 using the new XCF enhancement compared to using RRS in a shared queues environment for transactions with a sync-level of NONE or CONFIRM. All measurements were conducted within a stable and isolated environment using a Full-Function workload.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 19 total GP engines (2 ICFs with 2 engines each)
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 21: IMS Version 12 OTMA Synchronous Shared Queues environment

9.2   System configuration – (OTMA Synchronous Shared Queues)

Three total LPARS configured with 6 general purpose engines for Front-End (FE) and Back-End (BE) IMS LPAR, and 3 general purpose engines for an isolated dedicated TPNS LPAR.
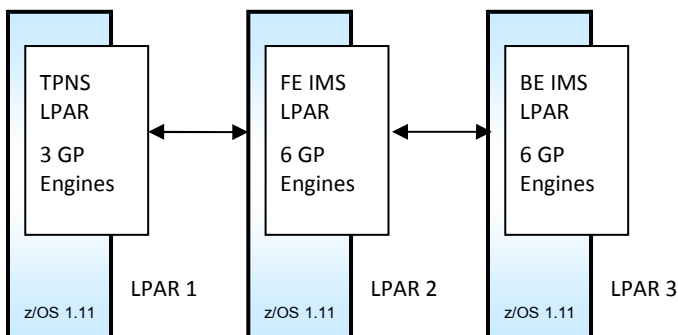

Figure 14: IMS V12 OTMA Enhancement System Configuration

9.3 Evaluation Results – (OTMA Synchronous Shared Queues)

The IMS 12 OTMA Synchronous Shared Queues Enhancement with XCF for Commit Mode 1 (send-then-commit) provides significant CPU efficiency improvements leading to increased throughput compared to RRS for Commit Mode 1 transactions with a sync-level of NONE or CONFIRM. Based on our performance evaluation, we have seen a transaction rate (ETR) improvement of 6-18% and path-length (ITR) improvement of 27-81%. Note that the ITR values used with this evaluation were calculated using an average CPU busy % of the FE and BE LPARs.

Observations:
➢ 63% ITR Path-length improvement for SYNCLVL=NONE using XCFIMS, (Table 22)
➢ 81% ITR Path-length improvement For SYNCLVL=CONFIRM using XCFIMS, **(**Table 23)
➢ For SYNCLVL=NONE in splitting the workload between a FE and BE situation, path-length (ITR) improved by 27% (see Table 24)

Values:

IMS 12 OTMA Sync. SQ Enhancement (SYNCLVL=NONE)				
	CM1/SL0		Delta	%
	AOS=Y	AOS=X		
ETR	2533.09	2688.27	155.18	6.13%
ITR	3,910.50	6,375.60	2,465.10	63.04%
FE CPU	37.64%	14.24%	-23.40	-62.18%
BE CPU	91.91%	70.10%	-21.81	-23.74%

Table 22: IMS 12 OTMA Sync. SQ RRS (AOS=Y) vs XCF (AOS=X) ITR Comparison

IMS 12 OTMA Sync. SQ Enhancement (SYNCLVL=CONFIRM)				
	CM1/SL1		Delta	%
	AOS=Y	AOS=X		
ETR	2688.49	3163.94	475.45	17.68%
ITR	4,072.24	7,363.85	3,291.62	80.83%
FE CPU	45.04%	20.62%	-24.42	-54.21%
BE CPU	87.00%	65.31%	-21.69	-24.93%

Table 23: IMS 12 OTMA Sync. SQ Enhancement RRS (AOS=Y) vs (AOS=X) ITR Comparison

V12 OTMA Sync. SQ Enhancement (SYNCLVL=NONE) Split				
	CM1/SL0		Delta	%
	AOS=Y	AOS=X		
Total ETR	2813.79	2821.04	7.25	0.26%
Total ITR	5,440.74	6,906,66	1,465.92	26.94%
FE CPU	79.64%	68.09%	-11.55	-14.51%
BE CPU	16.68%	10.43%	-6.25	-37.46%

Table 24: IMS V12 OTMA RRS (AOS=Y) vs (AOS=X) ITR Comparison Split (MPP FE & BE IMS)

10. IMS V12 APPC Synchronous Shared Queues Enhancement

Also implemented in IMS 12 is XCF communication within IMS APPC synchronous conversations, with sync levels of NONE or CONFIRM, in IMS Shared Queues (SQ) environments. With this enhancement, customers might be able to eliminate Resource Recovery Services (RRS) as a requirement in their SQ environments, because XCF can be used for the communications between IMS systems in a SQ group. As with the OTMA enhancement, also in IMS 12, our performance evaluation results have demonstrated that by using XCF communications compared to RRS, significant CPU efficiency improvements leading to increased throughput can be achieved.

10.1 Environment – (APPC Synchronous Shared Queues)

Three total z10 EC LPARs were used to conduct the evaluation for this enhancement, an LPAR for the Front-End IMS, an LPAR for the Back-End IMS, and an isolated third LPAR for the TPNS driver.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 11 total GP engines, (2 ICFs with 2 engines / ICF)
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 11, IMS 12, TPNS V3R5

Table 25: IMS 12 APPC Synchronous Shared Queues enhancement evaluation environment

10.2 System configuration – (APPC Synchronous Shared Queues)

Three total LPARS configured with 2 general purpose engines for Front-End and 1 general purpose engine for the Back-End IMS LPAR, with 4 general purpose engines for an isolated dedicated TPNS LPAR simulating 5,000 clients.
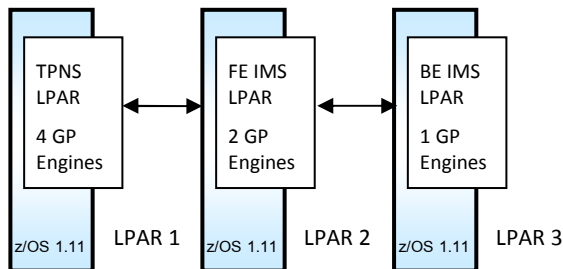

Figure 15: APPC Sync. SQ Enhancement System Configuration

10.3 Evaluation Results – (APPC Synchronous Shared Queues)

The results of the IMS 12 APPC Synchronous Shared Queues Enhancement evaluation confirm significant performance gains are achieved by using XCF in comparison to RRS: An average of 78% reduction in CPU utilization for Back End and Front End IMS, and 35% reduction in IFP region occupancy with ETR gains of 22%.

Observations:

➢ Significant performance gains in the APPC Synchronous SMQ enhancements.

➢ An average of 78% reduction in CPU utilization for Back end and Front end IMS

➢ 35% reduction IFP region occupancy demonstrating quicker transaction transit times (8 IFPs used with 57.13 percent region occupancy for AOS=Y and 42.12% for AOS=B)

Values:

IMS 12 APPC Synchronous Shared Queues Enhancement				
	AOS=Y	AOS=B	Delta	%
ETR	1,521	1,938	417	21.51%
ITR	3135.44	7100.20	3964.76	126.45%
FE CPU	59.59%	33.66%	-25.93	-77.03%
BE CPU	37.43%	20.93%	-16.5	-78.83%

Table 26: IMS 12 APPC Enhancement - RRS (AOS=Y) vs APPC (AOS=B) ITR Comparison

Note that the ITR values used with this evaluation were calculated using an average CPU busy % of the Front End and Back End LPARs.

11. IMS 12 IMS CONNECT-to-IMS CONNECT Enhancement

The IMS 12 IMS Connect-to-IMS Connect enhancement refines OTMA, enabling IMS Connect-to-IMS Connect communication across TCP/IP connections. With IMS 12, OTMA can now send transaction messages from application programs running in a dependent region across a one-way TCP/IP connection to another IMS system for processing. This reduces the maintenance cost for OTMA customers by eliminating the need to maintain their own IMS Connect gateway application solution. It also increases performance by eliminating the need for an additional external gateway program.

11.1 Environment – (IMS Connect to IMS Connect)

The environment used to evaluate this enhancement was similar to a typical setup customers might use between Site-to-Site communications over a TCP/IP network using IMS Connect to IMS Connect:

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 24 total GP engines, 2 ICFs with 2 engines / ICF and 19 GB storage
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 27: IMS Version 12 IMS Connect to IMS Connect enhancement evaluation environment

11.2 System configuration – (IMS Connect to IMS Connect)

Three total LPARS configured with 8 general purpose engines for Front-End (FE) and 8 general purpose engines for the Back-End (BE) IMS LPAR with 4 general purpose engines for an isolated dedicated TPNS LPAR.

The focus of this evaluation was to evaluate the performance characteristics involved with executing IMS Connect-to-IMS Connect communication from one local IMS1/IMS CONNECT1 to a second remote IMS2/IMS CONNECT2 over a TCPIP network. Local IMS1/IMS CONNECT1 used 120 OTMA descriptors communication over a TCPIP network to our remote IMS2/IMS CONNECT2.

- IMS1 and IMS CONNECT1 using XCF1 on local site to send messages
- IMS2 and IMS CONNECT2 using XCF2 on remote site to receive messages
- IMS CONNECT1 to IMS CONNECT2 using TCP/IP
- CHNG and ISRT ALTPCB calls from local application running in 132 MPP regions
- OTMA one-way asynchronous messages distribution among 120 OTMA descriptors to remote site
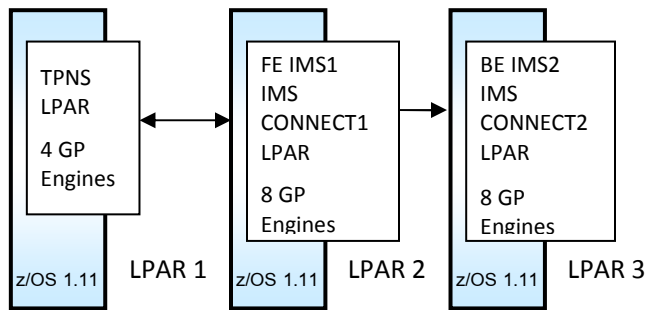
Figure 16: IMS Connect to IMS Connect Enhancement System Configuration

11.3 Evaluation Results – (IMS Connect to IMS Connect)

In our testing environment we achieved a message sending rate of over 9,500 messages a second between our local IMS Connect and our remote IMS Connect over a TCP/IP network. All measurements were conducted within a stable and isolated environment using the enhanced SMQL workload.

Observations:

➢ IMS1 achieved a message send rate of 9,570 messages per second

➢ Based on the CPU usage, an ITR of 11,815 messages per second was achieved in our Local IMS 1 sending side.

Values:

	IMS Connect-IMS Connect OTMA (Send Only)
ETR (sending)	9,570 tx/sec
CPU	81%
ITR (sending)	11,815 tx/sec

Table 28: IMS Version 12 IMS Connect to IMS Connect enhancement Benchmark results

12. IMS 12 MSC TCPIP

The IMS 12 MSC TCP/IP enhancement provides support for TCP/IP-type MSC links in addition to the existing VTAM-type MSC. This enhancement provides excellent throughput capability through the use of the new TCP/IP-type MSC links providing a greater bandwidth over the existing VTAM MSC links; it also provides an MSC platform capable of maintaining transactions rates over 10,000 transaction per second!

12.1 Environment – (MSC TCPIP)

All measurements were conducted within a stable and isolated environment using configurations of the following:

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 19 total GP engines, (2 ICFs, 2 engines / ICF)
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 29: IMS Version 12 MSC evaluations environment

12.2 System configuration – (MSC TCPIP)

Two scenarios were used to evaluate the benchmark characteristics of the TCP/IP type MSC link and VTAM type MSC link connections and the bandwidth characteristics of all the available IMS MSC Links, TCP/IP, VTAM, MTM, and CTC.

Overall configuration
- 4 CPs for Front-End (FE) IMS with 32 MSC Links (ESCON CTC)
- 8 CPs for Back-End (BE) IMS with 64 MPP regions, 32 transactions
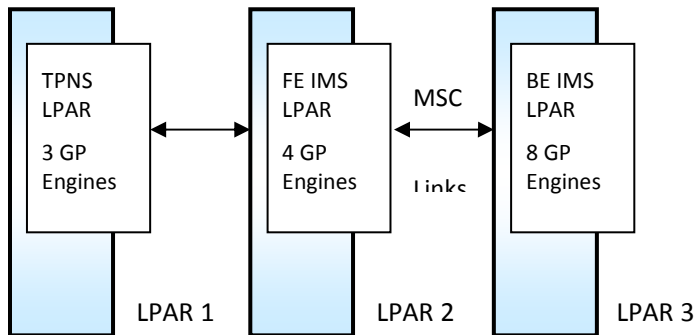- 3 CPs for TPNS simulating 8,000 clients

Figure 17: IMS V12 MSC Evaluation System Configuration

Scenario 1 (Benchmark Evaluation)
Each TPNS client would randomly select one of 32 remote transactions to send to the FE IMS, which then sent the transaction across the MSC link to the BE IMS to process. The BE IMS processed the transaction and sent a response message to the FE IMS, which in turn sent the transaction to the TPNS session. This random transaction selection method resulted in an even distribution of the workload across the 32 MSC links. 32 VTAM links were tested, and then 32 TCP/IP links were tested.

Scenario 2 (Link bandwidth evaluation of CTC, MTM, TCP/IP, and VTAM links)
This measurement technique was designed to measure the bandwidth capacity of a single MSC link of each link type, and how the bandwidth improves as the link buffer size is increased. 9,999 transaction messages are queued on the FE IMS, and the MSC link is then started. All 9,999 messages are sent one way from the FE IMS to the BE IMS. The QUERY MSLINK SHOW STATISTICS command is then issued to gather timing information of this process, such as the message processing time and send I/O time. TCP/IP links send I/O time statistics, which can be broken down further into the I/O components such as SCI, IMS CONNECT, and TCP/IP.

12.3 Evaluation Results – (MSC TCPIP)

The objective of this evaluation is to determine the performance capability of the new TCP/IP MSC enhancement and existing links by conducting a high stress and bandwidth evaluations.

Observations:
- IMS 12 TCP/IP MSC type link achieves 10,587 transactions per second
- TCP/IP MSC links have a higher bandwidth than VTAM MSC links
- MTM continues to be the fastest link
- CTC is slower than VTAM, despite all the layering and longer path in VTAM. Also CTC does not share the channel connections like VTAM LNCTL=MPC does.
- FICON CTCs should improve performance

Note that the ITR values used with this evaluation were calculated using an average CPU busy % of the FE and BE LPARs.

Values:

IMS V12 MSC TCPIP 16K Buffers (1K message size)	
	TCPIP
ETR	10,587.57
ITR	15,594.03
FE CPU	80.52%
BE CPU	55.27%

IMS V12 MSC VTAM 16K Buffers (1K message size)	
	VTAM
ETR	9,303.86
ITR	13,383.96
FE CPU	81.14%
BE CPU	57.89%

Table 30: IMS Version 12 MSC TCPIP Results   Table 31: IMS Version 12 MSC VTAM Results
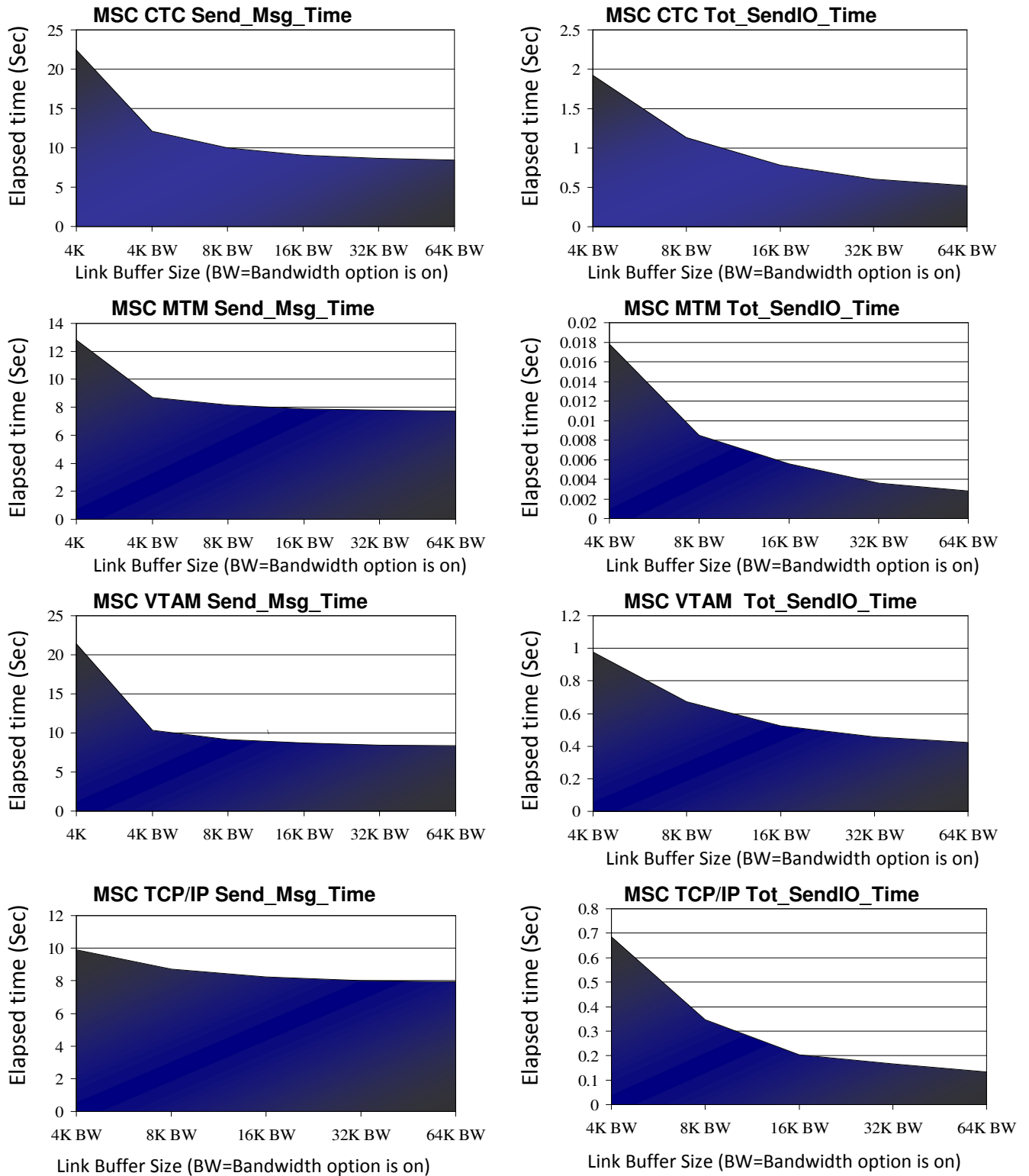
Figure 18: IMS 12 MSC Bandwidth Link Evaluation Results

Figure 18 demonstrates the bandwidth evaluation results for the IMS 12 MSC TCP/IP, VTAM, MTM, and CTC link evaluations. The graphs depicted in Figure 18 show the Send_Msg_Time and Tot_SendIO_Time for the MSC links. The following main message rate statistics were captured from the QUERY MSLINK SHOW STATISTICS command:

➢ The Send_Msg_Time, which is the total time the message took to be sent across the MSC link from the FE IMS to the BE IMS and return (Time across the MSC link + any CSL regions and IMS CONNECT for TCP/IP links + IMS processing, including BE processing time)

➢ The Tot_SendIO_Time, which is the time the FE IMS sends the message until the BE IMS receives the message (time across the MSC link + CSL regions and IMS CONNECT for TCP/IP links). See Figure 19.
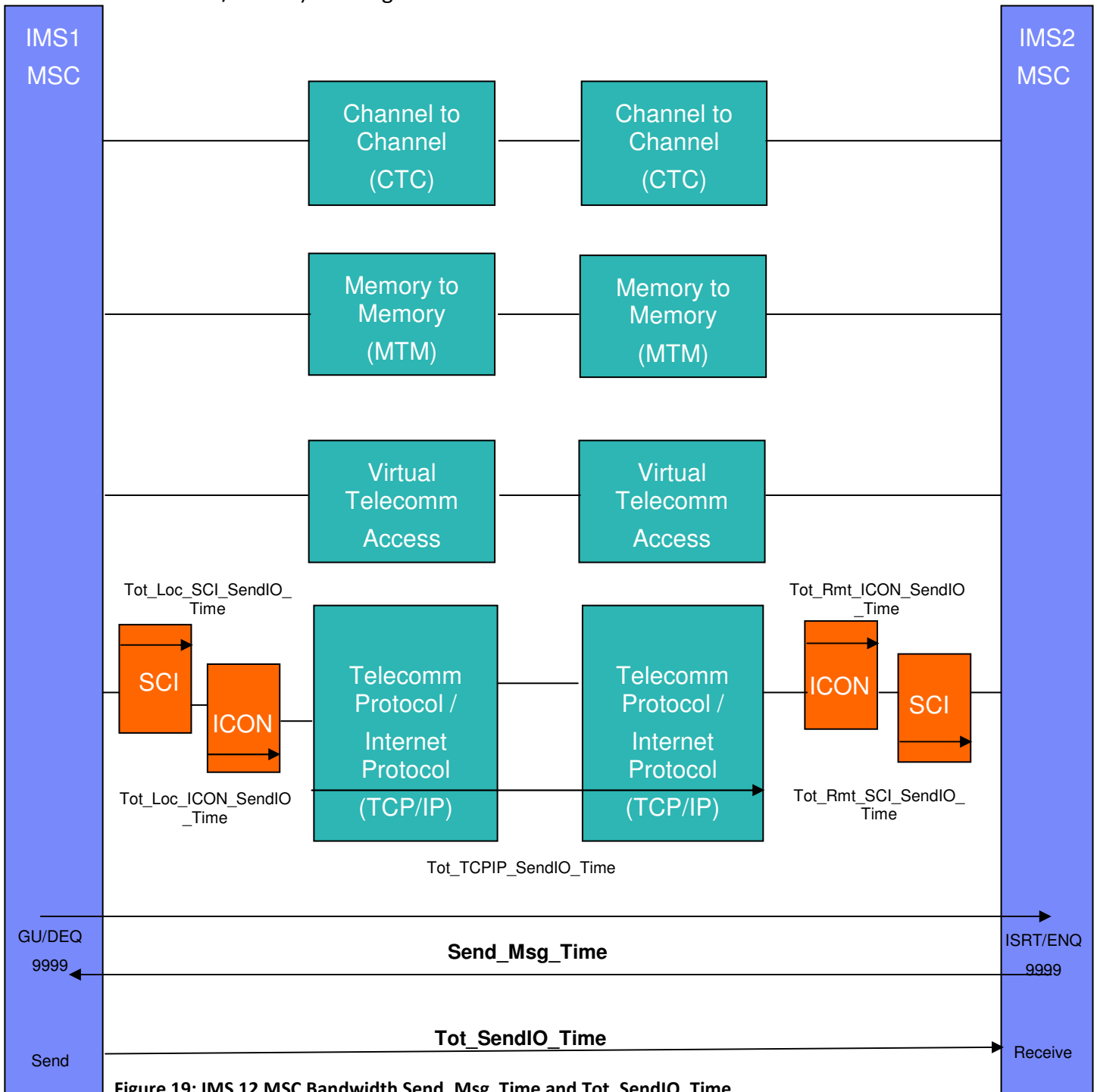

Figure 19: IMS 12 MSC Bandwidth Send_Msg_Time and Tot_SendIO_Time

13. IMS 12 Fast Path Secondary Index (FPSI)

Customers running IMS Full Function environments strictly for the support of secondary indexing are now encouraged to evaluate the IMS 12 Fast Path Secondary Index feature. IMS Version 12 provides support for Fast Path DEDB secondary indexes, providing alternate paths of access to primary DEDB databases with automatic index maintenance performed by IMS. Our evaluations demonstrate a 60% improvement in ITR and 44% saving in CPU usage by using FPSI DEDBs over the equivalent secondary indexed HDAM VSAM DB. Tools or utilities to build a secondary index database for DEDB databases exploiting this function could be separately offered by IBM or other vendors. This report does not cover the evaluation of any jobs or programs that were used in creating the secondary indexes used in this study.

13.1 Environment – (FPSI)

The Full Function workload was driven by TPNS and by BMP to evaluate the IMS 12 FPSI feature. The objectives were:

- ➢ To determine performance expectations of executing with an FPSI DEDB compared to an equivalent workload with an HDAM VSAM DB and secondary indexes, and
- ➢ To determine the performance characteristics of defining the FPSI DEDB if the index is used or not.

All measurements were conducted within a stable and isolated environment using a Full-Function workload.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 5 total GP engines
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS IMS 12, TPNS V3R5

Table 32: IMS 12 Fast Path Secondary Index (FPSI) enhancement evaluation environment

13.2 System configuration – (FPSI)

Single Image IMS on 1 dedicated LPAR with 2 general purpose engines and TPNS on its own dedicated LPAR with 3 general purpose engines.
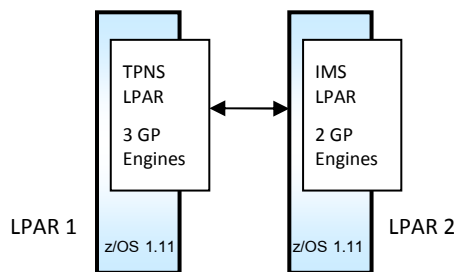

Figure 20: IMS 12 FPSI Evaluation System Configuration

Three Evaluation Scenarios were used:

Scenario 1: One area DEDB with 2 secondary indexes in ROOT segment, application updates DEDB roots randomly with: 100% GHU/GHN/REPL calls; 10% issuing ISRT/DLET calls, which caused secondary index maintenance
  ➢ Determine the performance improvement of running with DEDB with 2 secondary indexes.

Scenario 2: Using BMP to access DEDB with secondary index sequence (PROCDEQD), issuing GU to identify one particular primary key, and GHN/REPL next 10 records sequentially.
  ➢ Determine the performance improvement of running with DEDB with secondary index case.

Scenario 3: DEDB with 2 and 4 secondary indexes definition, applications update DEDB roots randomly with GHU/GHN/REPL DL/I calls, which don't cause secondary index maintenance.
  ➢ Determine the performance of running with DEDB with 2 and 4 secondary indexes, but not using the secondary indexes.

13.3 Evaluation Results – (FPSI)

Observations:
  ➢ Scenario 3: With FPSI defined but not used, there is no significant performance impact
  ➢ Scenario 1: DEDB with 2 secondary indexes executed this workload with a 60% ITR improvement compared to the same workload with HDAM VSAM databases with 2 secondary indexes
  ➢ I/O Activity per second is reduced by 43% by the use of FPSI and DEDBs

Values:

	HDAM VSAM with 2 secondary indexes	DEDB with 2 secondary indexes	Delta
ETR	526	471	-55 (10%)
CPU	34%	19%	-15% (-44%)
ITR	1547	2479	+932 (+60%)
DLI Stats. (per second)			
GHU	1,168 (4.47%)	1,006 (4.67%)	
GHN	11,625 (44.53%)	10,398 (44.43%)	
ISRT	29 (0.11%)	25 (0.11%)	
DLET	30 (0.11%)	27 (0.12%)	
REPL	12,206 (46.75%)	10,917 (46.83%)	

Table 33: IMS 12 FPSI Scenario 1: HDAM/VSAM with 2 secondary indexes vs. one area DEDB with 2 secondary indexes

Fast Path Secondary Index Enablement		
	FP DEDB w/o secidx	FP DEDB with secidx (Using PROCSEQD)
Elapsed Time	0:00:41	0:00:01
CPU	5.44%	2.22%
I/O Activity (per second)		
DEDB	2,106.53	1.978
Secondary Index	0	2.182
DLI Stats. (per second)		
DB GU	0	1
DB GHU	1	0
DB GHN	534,990	10
DB REPL	10	10
Total DLI DB Calls	535,001	21

Table 34: IMS 12 FPSI Scenario 2: Access DEDB with secondary index sequence vs. no secondary index sequence

	DEDB with 0 sec. indexes	DEDB with 2 sec. indexes	DEDB with 4 sec. indexes
ETR	265	265	265
CPU	14.2%	15.3%	15.6%
ITR	1866	1732	1699
DLI Stats. (per second)			
GHU	529 (2.33%)	529 (2.33%)	529 (2.33%)
GHN	10,584 (46.51%)	10,584 (46.51%)	10,585 (46.51%)
REPL	11,113 (48.84%)	11,113 (48.84%)	11,114 (48.84%)

Table 35: IMS 12 FPSI Scenario 3: Access DEDB with 0, 2, and 4 secondary indexes

14. IMS 12 OTMA ACEE Reduction

The IMS 12 OTMA ACEE Reduction enhancement reduces the RACF Access Control Environment Element (ACEE) requirement to only one ACEE per TCP/IP client instead of one per TCP/IP client per each OTMA client. This reduces the unnecessary duplication, which in turn reduces storage requirements, improves security, eases capacity constraints, and helps maintain high availability. Previously, RACF ACEE for the same user could be created and cached multiple times (one for each OTMA client) in an IMS Control region. Based on our performance evaluation, a 70% ACEE storage reduction was observed by comparison to IMS 11.

14.1 Environment – (OTMA ACEE Reduction)

The evaluation of the IMS 12 OTMA ACEE Reduction enhancement used a Fast Path workload in the following environment, shown in Table 36.

Hardware and Software Environment	
Processor:	IBM System z10 Enterprise Class Model E64, 25 GB storage 12 total GP engines
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 11, IMS 12, TPNS V3R5

Table 36: IMS 12 OTMA ACEE Reduction enhancement evaluation environment

14.2 System configuration – (OTMA ACEE Reduction)

Two LPARS configured with 4 general purpose engines, one LPAR for IMS and 3 IMS Connect address spaces, and 8 general purpose engines on the second LPAR for TPNS.

- Single Image IMS on 1 dedicated LPAR with TPNS on its own dedicated LPAR
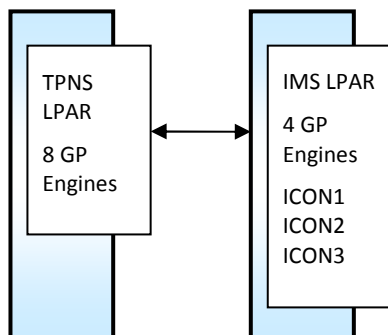

Figure 21: OTMA ACEE Reduction System Configuration

14.3 Evaluation Results – (OTMA ACEE Reduction)

Executing with IMS 11 OTMA, 3000 different TCP/IP clients, and 3 IMS Connect clients, we observe that 9000 ACEEs are created, one per TCP/IP client per TMEMBER. With IMS 12, the number is reduced to just 3000 ACEEs, demonstrating a reduction of 72% Subpool 249 space (see Table 37). As the number of TMEMBERs and clients increase, the amount of storage savings increases.

Observations:
- We are expecting significantly reduced EPVT usage for the IMS control region when many TMEMBERs have the same user IDs. We observed 70% EPVT subpool 249 reduction for IMS 12 over IMS 11.
- Greater savings are expected as the number of OTMA clients increases (Table 37 and Table 38 demonstrate the results with 3 OTMA clients)

Values:

3K TCP/IP Clients	IMS 11	IMS 12	Delta
CPU	73%	73%	--
ITR	17,532	17,539	--
SUBPOOL 249 (MB)	6.8	1.9	-4.9 (72%)
# of ACEEs	9,000	3,000	-6,000

Table 37: IMS 12 OTMA ACEE Reduction enhancement evaluation environment

10K TCP/IP Clients	IMS 11	IMS 12	Delta
CPU	73%	73%	
ITR	17,542	17,539	
SUBPOOL 249 (MB)	22.5	6.7	-15.8 (70%)
# of ACEEs	30,000	10,000	-20,000

Table 38: IMS 12 OTMA ACEE Reduction enhancement evaluation environment

15. IMS 12 Fast Path High Volume Benchmark

The IMS 12 benchmark approaches 4 billion transactions a day! Using a single IMS Version 12 control region executing on a single IBM zEnterprise System z196 LPAR, we observed transaction rates over 46,000 transactions per second. The high volume benchmark result demonstrates the high performance capabilities of a single IMS in a Fast Path environment.

15.1 Environment – (Fast Path High volume Benchmark)

The IMS 12 Fast Path high volume benchmark measurements consisted of a Fast Path workload in the environment shown in Table 39.

Hardware and Software Environment	
Processor:	IBM zEnterprise System z196 (2817), 25 GB storage 11 total GP engines
DASD:	IBM System storage DS8700 (2107), 8 FICON channels
Operating Systems/Software:	z/OS V1R11.0, IMS 12, TPNS V3R5

Table 39: IMS 12 Fast Path high volume benchmark environment

15.2 System configuration – (Fast Path High Volume Benchmark)

A single IMS Version 12 Fast Path control region was used to process transactions from four separate TPNS networks. Figure 22 illustrates the configuration used to achieve the high transaction rate. Testing involved the following:

- Single IMS LPAR with 7 general purpose processors driven from a separate TPNS LPAR with 4 general processors
- 48 active IMS Fast Path (IFP) Regions
- 30,000 terminals - (Terminal Network is simulated by executing TPNS using SNA protocol on separate processors)
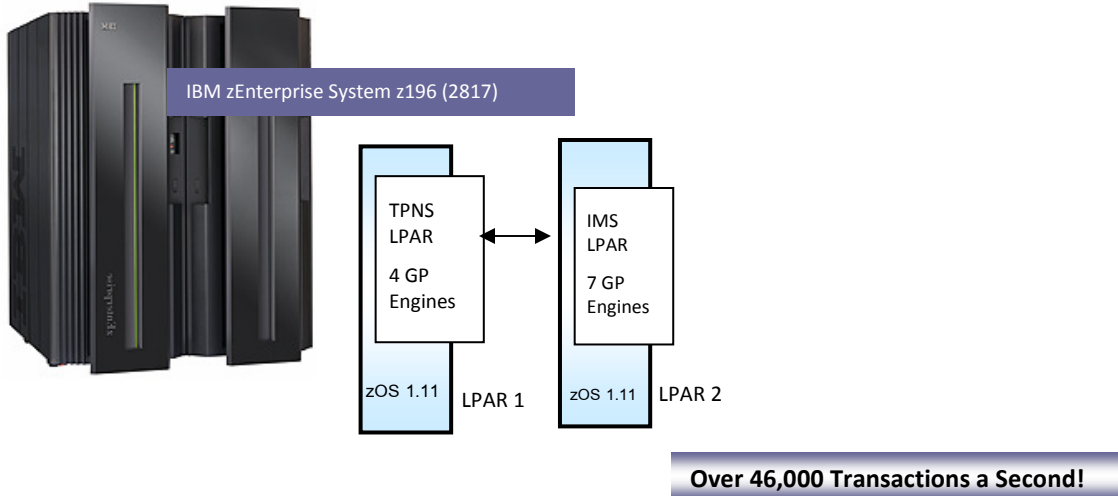- VTAM internal trace disabled

Figure 22: IMS V12 Fast Path high volume system configuration

15.3 Evaluation Results – (Fast Path High Volume Benchmark)

With this configuration IMS Version 12 achieved transaction rates over 46,000 transactions per second. During this measurement the total CPU utilization for the IMS system was measured at 74.88% for seven dedicated general purpose processors.

- ➢ Transaction Rate - 46,004 transactions per second
- ➢ CPU Utilization Percentage - 74.88%
- ➢ ITR value of 61,437

Single Image IMS Fast Path High Stress	
	IMS 12
ETR	46,004
CPU Busy %	74.88%
ITR	61,437

Table 40: IMS 12 Fast Path high volume benchmark results

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 = 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 12 performance study is similar to the methodology described in the *IBM Large Systems Performance Reference*, document number SC28-1187-15, 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:
https://www-304.ibm.com/servers/resourcelink/lib03060.nsf/pages/lsprintr?OpenDocument&pathID

The LSPR document can be found at:
https://www-304.ibm.com/servers/resourcelink/lib03060.nsf/pages/lsprindexpdf/$file/SC28118715.pdf

Measurement data is to be considered equivalent for comparison purposes in this document when it is between +/-1%.

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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.

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