IMS TM is a proven transaction processing and communications system for delivering reliable, high volume transaction throughput. Similarly IMS DB is a proven Data Base Management System (DBMS) for delivering extremely high performance data processing against large volumes of data. However, there are valid reasons why organizations consider moving away from these proven technologies.

This paper discusses these drivers and explores Micro Focus’ products and approach for re-hosting IMS-based applications to alternative platforms. It also explores the comprehensive support for both IMS TM and IMS DB that is critical in enabling such applications to be moved with as few changes as possible. This paper will be of interest to those responsible for migration projects as well as IMS-based application experts.
Overview

Micro Focus provides support within its Studio and Server product lines to enable IMS Database (DB) and IMS Transaction Manager (TM) applications to be migrated to open systems and modernized.

- Micro Focus Studio Enterprise Edition includes the analysis, development, debug and testing tools required to effectively migrate IMS based applications and to subsequently modernize them.
- Micro Focus Server Enterprise Edition provides the IMS TM and IMS DB compatible production level environment to enable migrated COBOL/IMS applications to be deployed on Linux, UNIX or Windows platforms with virtually no changes.

Why Migrate from IMS or Re-host IMS Applications?

IMS TM is a proven transaction processing and communications system for delivering reliable, high volume transaction throughput. Similarly IMS DB is a proven Data Base Management System (DBMS) for delivering extremely high performance data processing against large volumes of data.

So why would any organization consider moving away from either of these proven technologies or moving any IMS DB/TM based applications from the mainframe to an alternative platform?

The main drivers for moving away from IMS DB include:
- the need to make data more accessible or manageable by migrating to a Relational Data Base Management System (RDBMS)
- the desire to reduce software costs and operating costs by utilizing a single RDBMS
- initiatives to simplify IT infrastructure by consolidating to a single architecture and relational data model across the enterprise.

The main drivers for moving away from IMS TM include:
- the desire to move to an On-Line Transaction Processing (OLTP) system that is perceived as more strategic
- the need to reduce software and operating costs by consolidating to a single OLTP system
- requirements to extend and modernize online application functionality.

However, the vast majority of organizations with IMS based applications are still utilizing IMS because switching to alternative technologies is not a simple task.

Changing the data model of an application from a hierarchical model to a relational model is a significant undertaking.

Similarly, updating applications to use an alternative OLTP system and implement an alternative style of user interface involves much planning and effort.

When organizations attempt to replace both the IMS database and the IMS transaction manager within the same project, the effort, cost and risk rises dramatically.

The net result is that switching from IMS to alternative technologies is:
- an expensive and time consuming exercise
- very risky, especially without proven expertise and tooling
- often never completed or completed late and over budget.

With the IMS support within Micro Focus Studio and Server, Micro Focus offers a new low risk approach to modernizing IMS applications while reducing application operating costs. Essentially the IMS applications are moved virtually untouched to server environments where the applications can be run more cost effectively and modernized more efficiently. This approach is very low risk as the Micro Focus technology enables the existing applications to be re-hosted without changing application logic, user interface screens or database models.

The cost reductions can be realised in a number of ways depending on the scale of the project:
- migrating a sub-set of IMS applications means mainframe MIPS utilization is reduced and this may be sufficient to postpone or avoid an otherwise expensive hardware upgrade
- if all applications using IMS can be re-hosted, all annual costs related to mainframe IMS can be permanently removed in addition to reducing MIPS requirements
- if the IMS applications are the only applications remaining on the mainframe then there is the opportunity to drastically reduce costs by shutting down the entire mainframe.

So, if cost reduction, while mitigating risk is paramount to your organization, this approach will be a good fit.

After the IMS applications are re-hosted, the savings in operational costs can then be used to fund a more incremental, pragmatic and lower risk approach to modernizing the migrated IMS-based applications. For example, some of the savings in annual operating costs can fund value add projects such as:
- migrating from IMS DB to a RDBMS like IBM UDB, Microsoft SQL Server or Oracle
modernizing the online application user interface

opening up the IMS transactions to a Service Oriented Architecture under .NET or J2EE.

**IMS Re-hosting Support Summary**

Micro Focus provides three key capabilities to support the re-hosting of IMS applications to Linux, UNIX or Windows servers.

1. A Windows based IMS TM and DB development environment within Micro Focus Studio

   This is the integrated Development Environment (IDE) used by developers maintaining and enhancing any re-hosted IMS applications, regardless of the target deployment platform. It provides:
   - improved tooling for COBOL/IMS developers to increase productivity
   - advanced analysis and testing tools to improve quality
   - a contemporary environment offering faster time to market for new deliveries.

2. An IMS TM compatible transaction processing system within Micro Focus Server

   This is the production transaction processing engine used to deploy the IMS TM based applications on the chosen target environment whether it is Linux, UNIX or Windows. It provides:
   - the support for IMS transactions and communications
   - MFS screen management
   - system administration, monitoring and diagnostics.

3. An IMS DB compatible database within Micro Focus Server

   This is the production DBMS used to deploy the IMS DB based applications on the chosen target environment whether it is Linux, UNIX or Windows. It provides:
   - The support for the IMS data access elements of the application
   - Support for the IMS hierarchical data model
   - The actual database to hold the migrated IMS data.

Together these three key elements combine to offer a complete low risk solution for re-hosting IMS applications to reduce operational costs and increase agility. This solution is appropriate for:

- Applications using IMS TM and/or IMS DB
- Applications running under VSE, OS390 or z/OS
- Both batch and online IMS applications.

**The Development Environment within Micro Focus Studio**

After an IMS based application is migrated from the mainframe to an alternative platform, it would be inappropriate for the developers who maintain and enhance the application to continue using the mainframe development tools they traditionally used.

As part of the migration project, a new development and test infrastructure is established, and developers are trained to use the Micro Focus Studio product.

Micro Focus Studio is a contemporary, Windows based, IDE that enables application analysis, development and unit testing to be carried out on Windows, regardless of the target deployment platform. It also includes all the tooling required to publish applications to Linux, UNIX or Windows for compilation and linking with the appropriate native run-time libraries to test applications on the specific target platform.

The IDE features many capabilities to increase the quality of application updates and to improve developer productivity related to IMS application development. These include:

- System definition and product configuration features from within the IDE
  - Ability for developers to configure IMS transaction codes and properties
  - Compilation of MFS Maps (MFSGEN)
  - Database schema (DBDGEN, PSBGEN) compilation.

- IMS DB management tools
  - Utilities to unload, reload and reorganize databases
  - Database editor
  - Database recovery tools.

- Integrated IMS development
  - Sophisticated analysis tools providing support for IMS/MFS applications
  - Problem determination facilities: tracing, debugging, etc.
  - Support for COBOL applications using the “CBLTDLI” API interface
A pre-processor to support COBOL applications using EXEC DLI.

IMS application modernization facilities to

- Expose 3270 MFS screen interactions as a programmable interface
- Expose IMS TM transactions as Web services
- Combine multiple exposed services into a single business transaction
- Quickly add new GUI or web interfaces
- Integrate IMS transactions into SOA, .NET or J2EE.

Deployment aids to

- Configure the deployment environment
- Check and debug the deployment environment configuration
- Publish applications to the target Linux, UNIX or Windows environment.

The Deployment Environment within Micro Focus Server

IMS based applications re-hosted from the mainframe are deployed on the target Linux, UNIX or Windows server using Micro Focus Server Enterprise Edition.

Micro Focus Server Enterprise Edition, not only provides the IMS Transaction Manager and IMS DB support to deploy IMS application elements, it also provides the QLTP system to deploy CICS applications and a production JES engine for executing re-hosted JCL.

It therefore provides a complete integrated environment on which to re-host and deploy migrated batch COBOL/IMS DB applications or online COBOL/IMS or COBOL/CICS applications accessing DB2, IMS DB or VSAM data stores.

As all these capabilities are supported within a single product, the specific functionality required for each application is enabled with the appropriate mainframe sub-system “Compatibility License” from Micro Focus.

For example, to deploy applications using

- IMS TM - an IMS TM Compatibility License is required
- IMS TM and JCL - an IMS TM and JCL Compatibility License is required
- IMS-DB - an IMS DB Compatibility License is required
- CICS and IMS DB - a CICS and IMS DB Compatibility License is required.

Regardless of the type of mainframe application being re-hosted, Micro Focus Server Enterprise Edition offers a mission critical deployment environment with a high degree of mainframe compatibility to:

- Help minimize change and reduce risk during the initial migration
- Enable the migrated application to deliver comparable mainframe level Quality of Service
- Support the integration of migrated applications within contemporary .NET, J2EE and SOA architectures.

Performance and scalability

Micro Focus Server provides a scalable, high performance transactional deployment environment for COBOL services and processes.

This allows multiple concurrent database connections (execution threads) providing UOW (Unit of Work) integrity, supporting multiple applications accessing and updating the same IMS databases. This provides user level database record locking, lock contention retry, deadlock detection and resolution.

Micro Focus Server also provides a DBCTL environment for CICS applications and integrates with the JES engine within Micro Focus Server for execution of batch (DBB, DLI and BMP) programs.

Transactional integrity, recovery and other RAS capabilities

Full commit/rollback and database recovery facilities are provided. Using XA-compliant architecture, all transaction queue activity, as well as database activity, is logged and those updates are synchronized with database commits. Consequently both Rollback (in the event of deadlocks and failed processes), and Roll Forward (in disaster recovery situations) recovery is provided. BMP Checkpoint / Restart are also supported.

Database recovery is supported via a batch tool that restores a database from a backup image and applies log entries to restore the database to the current state.

Security support

IMS resources (PSBs, transactions, databases) are secured. Security exits are called when a PSB is scheduled, when a transaction is scheduled, and at database access points to allow third party security subsystems to be accessed to provide appropriate security.
Monitoring, administration and configuration tools

Micro Focus Server administration tools allow you to perform functions such as starting and stopping message processing regions and DBCTL regions, transaction scheduling and concurrency management.

While administration through Micro Focus Server’s web interface, ESMAC, is typically the primary mechanism to control the production IMS environment, support for several IMS terminal commands is also provided (commands such as /FOR, /RCL)

Detailed IMS Feature Set

The Micro Focus Server deployment environment is instrumental in providing the ability to move IMS based applications from the mainframe to Linux, UNIX or Windows in a low risk manner.

The fewer the changes to the application code, screens, transaction logic, database access code and data model, the less chance there is of errors being introduced into working systems.

Minimizing change is therefore vital to minimizing risk, which is why Micro Focus’ feature rich, mainframe compatible implementation of IMS TM and IMS DB on open systems is central to ensuring the smooth migration of IMS applications.

The IMS TM (or IMS DC) and MFS support ensures online IMS applications can be migrated without users noticing the deployment platform has actually changed.

The IMS DB support means a complex database migration project can be avoided because the internal data representation is very similar to the mainframe. On the mainframe, IMS DB is implemented on top of VSAM files, while on open systems, the IMS DB support is implemented on top of Micro Focus’ indexed file system called ISAM.

From an application perspective the database will behave the same as it does on the mainframe as the objective is to provide a low risk approach to migrating from the mainframe by keeping database access logic and the hierarchical data model intact while the application is migrated.

As Linux, UNIX and Windows support the ASCII character set, this is currently the only character set supported but EBCDIC support is under consideration based on customer demand.

IMS TM – Supported Features

DLI interface functions supported

- DL/I functions:
  - GU, GN, ISRT, CHNG, PURG
- System service functions:
  - CHKP, XRST, ROLL, ROLB, SYNC
  - INIT
  - INQY (DBQUERY, ENVIRON, and PROGRAM).

Transaction types supported

- Conversational
- Non-conversational
- Response mode
- Non-response mode.

Also provided are mechanisms for

- Transaction scheduling supporting:
  - Class codes
  - Prioritization
  - Serialized or parallel transaction processing control
- Message region management
  - Start/Stop regions as needed
  - Control by transaction class.

3270 devices supported

- Support for models 2, 3, 4 and 5
- A TN3270 interface
- Communication with terminals either in Bypass MFS mode or through the use of MFS (Message Formatting Services).

MFS facilities supported

- 3270 devices
- Logical and physical paging
- Multi-segmented messages
- Dynamic and default attributes, extended attributes, cursor positioning
- MFS language control.

IMS DB – Supported Features

DLI functions and interfaces support

- GU, GHU, GN, GHN, GNP, GHNP, ISRT, REPL, DLET
Fast Path: FLD, POS
GSAM: OPEN, CLSE
AIBTDLI: INQY
AERTDLI: CIMS, APSB, DPSB
SRRCMIT, ATRCMIT, SRRBACK and ATRBACK call interfaces
CICS DL/I calls: PCB, TERM.

Database access types supported (all types supported)
IMS DB provides several database access types, typically chosen for best performance as determined by the application.
- DEDB
- GSAM
- HDAM, HIDAM, HISAM, HSAM
- INDEX
- LOGICAL
- MSDB
- PHIDAM, PHDAM, PSINDEX
- SHISAM, SHSAM.

Database segment types supported
- Uniquely keyed segments
- Non-uniquely keyed segments - first, here and last rules
- Non-keyed segments - first, here and last rules
- Fixed and variable length segments
- Segments containing source data for secondary index segments
- Logical children and logical parents
- DEDB sequential dependents (SDEP) segments.

Maximum database size supported
The maximum IMS database size supported within Micro Focus Server is approximately 2Tb.

However, the key and data compression performed within the Micro Focus Server file system will typically compensate for this overhead.

Segment Search Argument (SSA) support
Programs retrieve data by qualifying the retrieval with a Segment Search Argument (SSA).

Micro Focus Server provides compatible SSA support including support for:
- Up to 15 SSAs per call
- each SSA limited to 4,000 bytes
- All SSA relational operators
- supporting up to 125 boolean operations on each SSA
- All SSA command codes except
- DEDB subset pointers
- The Set Lock “Q” Command code
- The L command code when it appears in either or both of the last two SSAs.

User exits supported
The IMS user exits within Micro Focus Server provide a mechanism to implement custom extensions to maximize compatibility with the original mainframe implementation. However, within Micro Focus Server exit routines must be written in COBOL rather than in Assembler as mainframe Assembler is not supported in production on open systems.

This means that during any migration, existing mainframe exit routines written in Assembler will need to be converted to or re-written in COBOL as part of the migration.

The following IMS-specific user exits are supported:
- Sparse index exits
- Data Capture exits
  - The EXIT operand is supported for both the DBD and SEGM statements along with all of the EXIT options (DATA, PATH and CASCADE options) except the LOG option. The sub options for CASCADE (KEY, DATA and PATH) are also supported. A maximum of nine different exit routines can be specified for any one segment.
  - All fields in the XPCB and XSDB parameter blocks are supported.
Miscellaneous IMS DB features supported

- The optional "parm count" field is supported for all calls
- There is no limit to the length of the I/O area in a path call
- CBLHSSR (High Speed Sequential Retrieval) interface
  - HSSR restrictions are not enforced as, internally, HSSR is implemented as standard DLI. HSSR applications will function properly but no speed advantage is gained.

IMS Limits Comparison Chart

<table>
<thead>
<tr>
<th>Segment Types Full-function database</th>
<th>Mainframe IMS</th>
<th>Open Systems IMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment Types DEDB database</td>
<td>255 per database</td>
<td>255 per database</td>
</tr>
<tr>
<td>Segment size DEDB</td>
<td>127</td>
<td>255</td>
</tr>
<tr>
<td>Maximum Segment Length – MSDB</td>
<td>32000 (must be multiple of 4)</td>
<td>32760</td>
</tr>
<tr>
<td>Maximum segment length – VSAM</td>
<td>30713</td>
<td>32760</td>
</tr>
<tr>
<td>Maximum segment length – tape</td>
<td>32760</td>
<td>N/A</td>
</tr>
<tr>
<td>HISAM/SHISAM maximum logical record length (must be even except for SHISAM)</td>
<td>30720</td>
<td>32760</td>
</tr>
<tr>
<td>Maximum key length – MSDB</td>
<td>240</td>
<td>255</td>
</tr>
<tr>
<td>DBD Version string max length</td>
<td>255</td>
<td>128 after substitution</td>
</tr>
<tr>
<td>PCBs per PSB</td>
<td>2500</td>
<td>500</td>
</tr>
<tr>
<td>SENSEGs per PSB</td>
<td>30,000</td>
<td>127,500</td>
</tr>
<tr>
<td>SENFLDs per SENSEG</td>
<td>255</td>
<td>255</td>
</tr>
<tr>
<td>SENFLDs per PSB</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Fields per database</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Segments per DBD</td>
<td>255</td>
<td>255</td>
</tr>
<tr>
<td>Maximum hierarchic levels (defined with SEGM statements)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Secondary Indices per database</td>
<td>1000</td>
<td>32</td>
</tr>
<tr>
<td>Secondary Index size (CONST+SRCH+SUBSEQ fields)</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Secondary Index size (CONST+SRCH+SUBSEQ+DDATA+user data)</td>
<td>Unknown</td>
<td>1536 (1532 if non-unique key)</td>
</tr>
<tr>
<td>Maximum message length via TP PCB</td>
<td>32,767 bytes</td>
<td>32,768 bytes</td>
</tr>
<tr>
<td>Maximum message length via IO PCB</td>
<td>32,767 bytes</td>
<td>32,768 bytes</td>
</tr>
<tr>
<td>Data capture exits per segment</td>
<td>unknown</td>
<td>9</td>
</tr>
<tr>
<td>Data capture exits active</td>
<td>unknown</td>
<td>256</td>
</tr>
</tbody>
</table>

Table 1: Opens Systems IMS and mainframe IMS limits comparison.
About Micro Focus

Micro Focus, a member of the FTSE 250, provides innovative software that allows companies to dramatically improve the business value of their enterprise applications. Micro Focus Enterprise Application Modernization and Management software enables customers’ business applications to respond rapidly to market changes and embrace modern architectures with reduced cost and risk.