WHITE PAPER

Mainframe Alternative Reference Implementation Redmond MTC

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March 21, 2011

Thousands of IT organizations are looking for alternatives to their IBM mainframe systems. This mainframe alternative reference outlines a validated mainframe rehosting implementation for consideration by architects and Chief Technology Officers (CTOs) who are contemplating the rehosting or migration of their IBM mainframe–based business applications to the Microsoft Application Platform.

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Revisions

Version	Date	By	Details	Marked (Y/N)
1.0	3/4/2011	Dee Hester	Initial release	Y

Legal information

Microsoft and Micro Focus collaborate at an engineering level to ensure that our customers benefit from software, hardware and service solutions that are jointly tested, certified and tuned to deliver optimal server performance. We have developed a variety of recommended configurations and services for Microsoft applications, which are appropriate for particular business and technical situations.

The configurations enclosed in this guide are recommended configurations and services, meant as a guideline to assist you in rehosting your mainframe applications to an open-system environment; however, these configurations are provided as a reference only, because specific configurations will vary due to customer needs. Memory, processor amount and speed, in addition to I/O, storage and service recommendations, should be seen as a minimum recommended amount. We strongly recommend that you work with Microsoft to determine the best solution for your company.

The mainframe alternative reference implementation discussed in this white paper is optimized for rack-mounted servers and storage. The recommended configuration brings out the unique features provided by the selection of HP ProLiant servers and the options they contain. This mainframe alternative reference implementation provides versatile configurations to meet a wide range of customer needs - individual optimization points and trade-offs are explained below.

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Executive summary

At one time, IBM mainframes offered unparalleled reliability, availability, serviceability and security (RAS+S); therefore, it made sense to invest in this platform for mission-critical workloads, regardless of the expense. However, for quite some time, these benefits are no longer unique to the mainframe and are common among less expensive, more flexible and more open alternatives.

Many IT organizations are looking to meet four important goals: reduce costs, respond quickly to change, replace retiring developers and break free from OEM vendor lock-in to create better business value. To help with these goals, Microsoft and its partners provide a cost-effective, low-risk mainframe alternative solution that can be tailored to your needs in a highly innovative manner.

Migrating mainframe applications to the Microsoft Application Platform allows customers to reinvest in business transformation and IT innovation. At the heart of this solution is Micro Focus' enterprise application environment and modernization technology, which emulates the mainframe system software layer on Microsoft® Windows Server® 2008 R2 and Microsoft SQL Server® 2008 R2. Consequently, Microsoft, together with Micro Focus, can provide an enterprise-capable mainframe alternative for your mission-critical applications.

This white paper illustrates how the latest generation of the Microsoft Application Platform, together with Micro Focus and other technology innovators, can provide mainframe customers with significant operational and economic advantages.

This white paper documents a reference implementation for a mainframe alternative environment on the Microsoft Application Platform that exists in the Microsoft Technology Center in Redmond, Washington, and Micro Focus' headquarters in Newbury, UK. Both systems are available for customer demonstrations. This mainframe alternative reference is designed to give customers a guide to the components required to move mission-critical IBM mainframe applications to the Microsoft Application Platform with Micro Focus' enterprise application environment and modernization technology and the modernization technology of various partners.

The mainframe alternative outlined in this paper should only serve as a reference when planning an application migration. The actual implementation in a production environment may vary, depending on customer and application requirements.

Mainframe alternative environments

Before considering this implementation of the mainframe alternative reference, it is important to create a common foundation of understanding. This section discusses several industry terms at length and describes several requirements you should take into consideration when moving from the mainframe to an open-system environment.

Note: See the *Glossary* at the end of this white paper for a list of industry terms.

Rehosting

Rehosting consists of moving an application and its data from one platform to another platform. Most often, the new platform is more cost effective, flexible and modern. Hence, mainframe rehosting (also known as mainframe migration) is one option for moving away from the mainframe and pursuing platform modernization. It is often the most cost-effective, lowest-risk and first phase of an application modernization effort for a mainframe or Common Business-Oriented Language (COBOL) system.

Re-architecting

Re-architecting is the process of extracting business rules from an existing application and using them to create specifications or code for a new system. This method is an excellent way of taking advantage of existing business logic within a legacy system while introducing modern technologies and IT system concepts, such as a service-oriented architecture (SOA). You can either re-architect an entire system as a single unit, or re-architect applications one at a time. As a legacy modernization method, re-architecting is more extensive than rehosting and provides access to more advantages, such as implementing a true SOA platform. By re-architecting a legacy system with SOA concepts, companies can implement IT systems that can quickly adapt to changing markets, shifting customer requirements and new business opportunities. Although re-architecting offers many advantages, it is also more time consuming, adds additional project risk and is often completed as a second project after a rehosting project to reduce risk and cost.

Source platform

IBM mainframes are large computer systems produced by IBM from 1952 to the present. During the 1960s and 1970s, the term *mainframe computer* was almost synonymous with IBM products due to their market share. Current mainframes in IBM's line-of-business computers are developments of the basic design of the IBM System/360, which preceded the System/390. In 2000, IBM rebranded the existing System/390 to IBM eServer, zSeries, with the *e* depicted in IBM's red trademarked symbol. Because no specific machine names were changed for System/390, the zSeries in common use refers only to one generation of mainframes starting with z900.

Although most mainframes can be considered a legacy platform due to their roots and history, the older S/390 IBM mainframe servers are considered a burning platform, because support for the last S/390-compatible version of z/OS (1.5) was dropped on March 31, 2007. The following are the current zSeries mainframes and their release dates:

- z900 (2064 series), for larger customers (2000)
- z800 (2066 series), entry-level, less powerful variant of the z900 (2002)
- z990 (2084 series), successor to larger z900 models (2003)
- z890 (2086 series), successor to the z800 and smaller z900 models (2004)
- z9 Enterprise Class (2094 series), introduced in 2005
- z9 Business Class (2096 series), successor to the z890 and z990 models (2006)
- z10 Enterprise Class (2097 series), introduced on February 26, 2008
- z10 Business Class (2098 series), introduced on October 21, 2008
- zEnterprise 196 (2817 series), introduced on July 22, 2010

Mainframe languages

Mainframes have accumulated a large legacy of second-generation (2GL), third-generation (3GL) and fourth-generation (4GL) programming languages. Some of these are clearly proprietary, whereas others are general-purpose, standards-based languages.

Many of the 4GL languages are closely related to proprietary databases such as CA-IDMS (ADSO), CA Datacom (CA Ideal), Cincom Supra (Mantis) and Software AG ADABAS (Natural). Conversion of the language normally involves a database conversion. Conversion of programs or routines written in most 4GL languages is required for rehosting. This white paper does not provide the details of conversion tools, but they are generally available.

2GL languages (assembly languages) are tied to the hardware and operating system and tend to be highly proprietary. IBM 370 High-Level Assembler has been widely used to implement mainframe applications. Many applications written in 3GL and 4GL languages use some Assembler code for platform-specific functions. Conversion of programs or routines written in 2GL languages is required for rehosting. There is a partner ecosystem that provides services for this.

Job control languages such as IBM JCL (MVS and VSE variants), ICL SCL and others form another category of platform-specific code that contains business rules embedded in batch processes.

Because of and in spite of standardization, many of the languages already mentioned come in a variety of dialects. Tools to analyze, compile and convert legacy applications support specific subsets of these dialects. For example, COBOL, which has four standards (COBOL 68, 74, 85 and 2002) and one addendum (COBOL 89), has hundreds of platform-specific dialects, vendor releases and extensions.

This mainframe alternative reference supports applications written in COBOL and PL/I. The mainframe alternative reference supports applications that use the Customer Information Control System (CICS), the VSAM indexed file system or DB2 for their database. The mainframe alternative reference also supports Job Control Language (JCL) as a scripting language used to instruct the system how to run a batch job or start a subsystem.

Target platform

An application platform (Figure 1 and Figure 2) provides a set of capabilities that optimize the value of your application portfolio. Application platforms typically include the following layers:

Application layer	The application layer discussed in this paper does not refer to the Transmission Control Protocol/Internet Protocol (TCP/IP) or OSI model application layer, but to the applications that provide a bridge between your business processes and the IT department.
Middle-tier layer	The middle-tier layer provides business logic and connects multiple systems and applications with each other. In this layer, application servers handle transactions between applications and systems. Enterprise integration services make disparate systems work together, and workflow services define business processes.
Database layer	The database layer uses infrastructure services to store, retrieve and analyze application data. Database systems process application transactions, collect information from multiple systems and provide tools for reporting and analysis.

Infrastructure layer

The infrastructure layer forms the foundation of an application platform. The infrastructure layer provides core security, virtualization, identity, access and networking services.

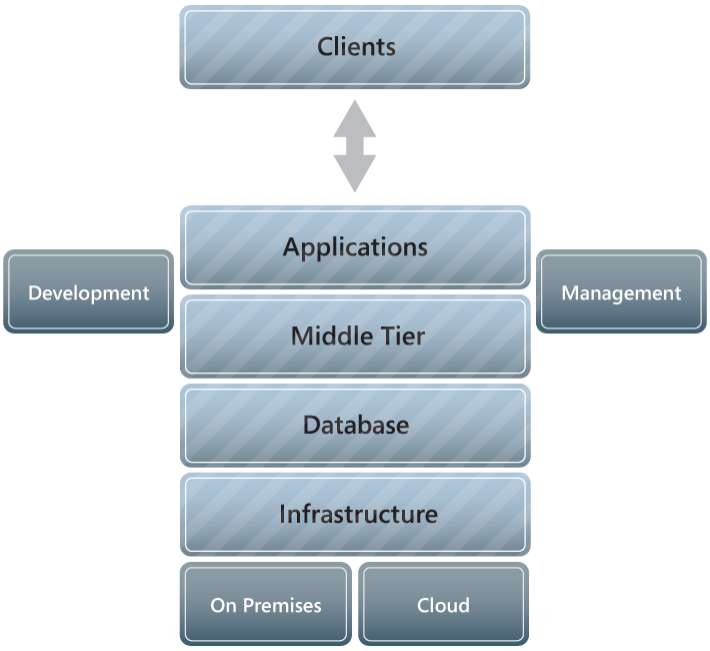

Figure 1: Typical platform layers

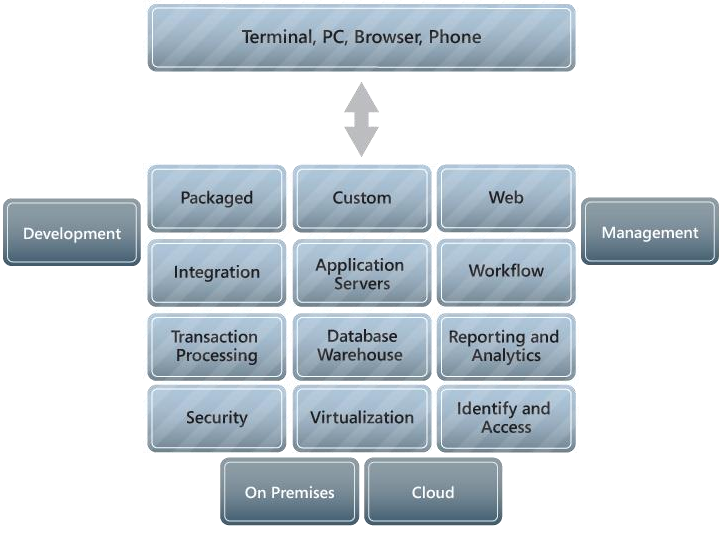

Figure 2: Typical platform components and functions

Areas of consideration

Before a target platform is chosen, it is helpful to consider the feature areas (environments) of the platform stack. Moreover, feature areas provide a framework for deeper discussion of an application platform and the technologies (and their categorization) that make up an effective implementation of the platform. Effectively integrating and balancing all the areas of a platform creates the best experience for users, managers, administrators and developers.

Packaged application	For industry-specific applications, you can realize several advantages by purchasing a packaged solution instead of custom developing one. Many software vendors are available to provide you with the solution that best meets your needs.
Custom applications	Custom applications are written to provide competitive advantage or differentiation in the market, or to address needs that are specific to the business. Custom applications can be developed faster and with higher quality if they are built on a platform with tools to manage the design, development and deployment.
Web applications	The Web can extend the capabilities of your business, combining a rich user experience with pervasive access, ease of deployment and cross-platform use. Your platform should provide a full solution of servers, databases and a communication and development environment to create Web applications with features such as search and social media.
Integration	An enterprise needs to integrate different systems and business processes. A platform that supports a service-oriented architecture (SOA) allows your business to integrate a range of heterogeneous system on premises or in the cloud.
Application servers	Application servers provide a software framework dedicated to the efficient execution of procedures (programs, routines and scripts) that support the construction of applications.
Workflow	Workflow modeling is a way to define business processes so that they can be easily transformed into software that is simple to use and maintain. A workflow platform can standardize the process and integrate it with existing systems for data processing and analysis.

Transaction processing	Transaction processing is designed to maintain a computer system in a known, consistent state by ensuring that any operations carried out on the system are interdependent, and that all operations are either completed successfully or canceled successfully. Each transaction must succeed or fail as a complete unit; it cannot remain in an intermediate state. Atomicity, consistency, isolation, durability (ACID) is a set of properties that guarantees that database transactions are processed reliably.
Data warehousing	Database warehousing enables companies to gather data from multiple systems and provide a single source of information that can be used to drive business intelligence.
Reporting and analytics	Business intelligence solutions should provide self-service reporting and analysis capabilities, so that business users can create, analyze and share their own reporting with a minimum of help from IT.
Security	When a system is architected, security must be considered at many different levels, including the perimeter, application and infrastructure.
Identity and access	For applications and systems to be secure, users need to be identified, and their access needs to be managed carefully. Identifying access needs must also be flexible enough to make systems usable and secure.
Virtualization	Virtualization helps you make the most of your hardware and software investment and provides IT flexibility. The goal of virtualization is to maximize resource utilization and centralize administrative tasks while improving scalability of workloads. Virtualization can also be viewed as part of an overall trend in enterprise IT that includes autonomic computing or self-management.
Management	Ideally, an application platform should have unified and consistent management tools to manage clients, services and databases.
Development tools	An application platform should also have a uniform development experience with a holistic lifecycle approach to improve time to market.

Cloud computing

Cloud computing describes computation, software, data access and storage services that do not require end-user knowledge of the physical location and configuration of the system that delivers the services. However, for an application platform, each area should run seamlessly, either on premises or in the cloud. This allows for just-in-time provisioning and scaling of shared resources, so that the total cost of IT is reduced via improved resource utilization and system agility.

Microsoft Application Platform solutions with Micro Focus

This mainframe alternative reference implementation is a collection of technologies that work together to provide a consistent experience for a range of tasks, from configuring the infrastructure to building, hosting and managing your applications. Figure 3 shows a high-level visualization of this mainframe alternative.

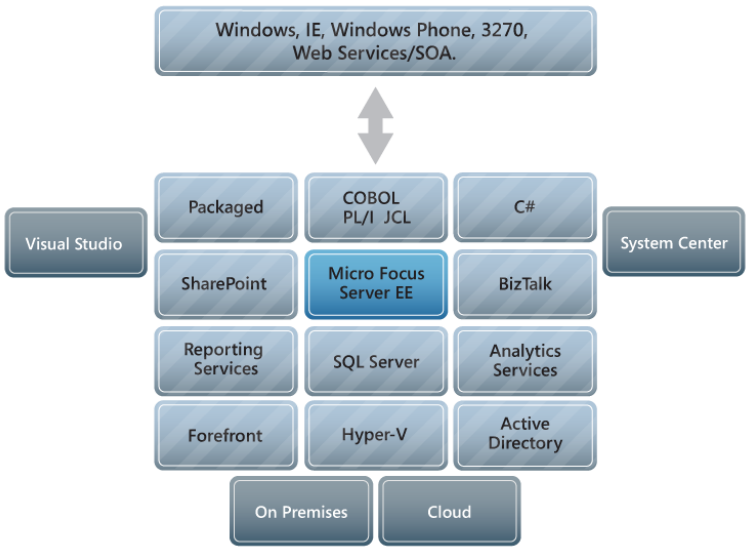

Figure 3: Mainframe alternative reference implementation

Micro Focus' enterprise application environment and modernization technology

Over a period of 35 years, Micro Focus has built up an integrated development environment (IDE), application server, testing and several analysis tools to help customers build better business applications and rehost and modernize existing mainframe applications to a lower-cost, agile platform. Rehosting enables organizations to reduce or eliminate mainframe operating costs and significantly improve developer productivity.

Mainframe rehosting in which the Micro Focus application environment while providing both EBCDIC and ASCII support, resides on the Microsoft Application Platform is the best alternative to consolidating, modernizing and adopting new infrastructures to align IT with the goals of the business. It is also the lowest-risk, highest-return alternative to rewrite or replacement strategies. To accomplish these tasks, the Micro Focus infrastructure focuses on following areas:

Execution environment	The execution environment can run mainframe applications as they run on z/OS, with no change to the business logic of the programs. In addition to the execution, this focus area delivers the management and monitoring of applications and provides an environment for CICS and IMS transactional programs written in COBOL and PL/I. Batch job JCL is also supported.
Communications interfaces	Communications interfaces enable the rehosted platform to continue its interaction with various systems and applications that allow for human and machine-based interaction. Typically, the communications interfaces are used for tight integration between applications that either have been rehosted or still reside on the mainframe.
Batch infrastructure	Micro Focus Server contains a robust batch infrastructure that drives job schedulers, high-speed sorting, output management, backup and various resident and third-party library utilities.
Data	Applications are only one part of the equation. Without the underlying data store, rehosting projects would be impossible. Micro Focus Server contains features to enable both rehosting of data still residing on the mainframe and high-speed access to that data.

Rehosting as a modernization method

Rehosting to a cost-efficient, modern and agile platform often lowers your costs enough to invest in the modernization of your system. It allows COBOL to interact easily with newer programming languages and frameworks such as C# and .NET—and this, in turn, allows for significant modernization opportunities with reduced risk. Rehosting allows an organization to retain business functionality that has been proven to deliver distinct competitive advantages over competitors. By rehosting applications and migrating off the mainframe, using this alternative reference implementation as a guide, you can realize substantial savings. These savings are possible because many of the requisite software packages on the mainframe are readily available in the Windows Server environment.

Scope

A recent International Data Corporation (IDC) study revealed that 85 percent of all mainframes worldwide are running at or below 1000 MIPS[1]. Moreover, the vast majority of mainframe applications are written in COBOL. Hence, the environment outlined in this mainframe alternative reference is designed for the specific purpose of giving organizations a viable production alternative to a 1000-MIPS environment. If additional processing capability is needed, it is a simple effort either to scale up to a larger server infrastructure or to scale out with duplicate instances of this environment. Additionally, this mainframe alternative reference targets the migration of batch and CICS applications written in COBOL or PL/I, using both VSAM and DB2 databases to the Microsoft Application Platform that uses SQL Server as the database and Micro Focus as the application environment.

Servers and features

A mainframe alternative reference platform (Figure 4) must provide the services and features that are provided on the mainframe (Figure 5). This white paper does not provide an exhaustive list of every service and feature. Instead, it maps the elements that are critical to the operation of a mission-critical environment, including:

- Transaction processing
- Operation management
- Security
- Virtualization
- Batch processing
- Job scheduling
- Output management

[1]Cohen, Lloyd and Hoang Nguyen (December, 2003). Server Census-Annual Shipments and Installed Base. IDC publication 30518.

- Data services and storage
- Development services
- Communications interfaces

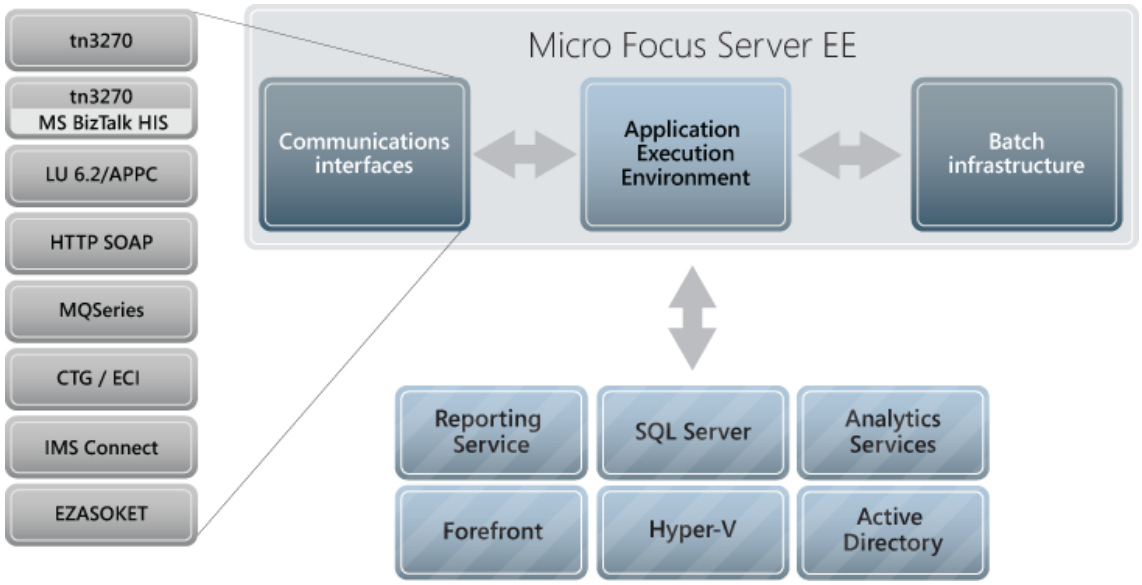

Figure 4: Mainframe alternative reference platform

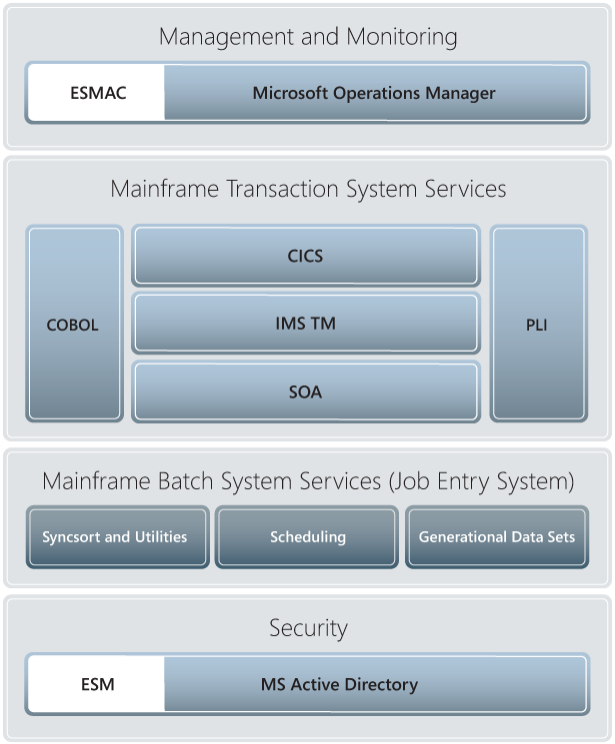

Figure 5: Mainframe application execution environment

Functions, interfaces and interactions

In the early days of the mainframe, all systems were batch systems. When communication terminal–based access was introduced, connectivity was limited to a few protocols that only required direct connectivity to the mainframe. Direct communications interfaces were the norm in the mainframe world, and organizations had little need for any other protocols at the time.

As the need for advanced application access and interoperability with other systems increased, the mainframe added support for various network and protocol interfaces. Interfaces ranging from TN3270 to CICS Transaction Gateway (CTG) were developed to offer customers a wide range of application and connectivity options. Many mainframe applications were built either to exploit or to make up for the limitations of certain protocols offered through Virtual Telecommunications Access Method (VTAM).

Because many of these added interfaces were not originally designed for the mainframe, they sometimes add a layer of complexity and cost that is not associated with interfaces in a Windows Server environment. This mainframe alternative reference supports a variety of communications interfaces and functions to allow for remote human and programmatic interactions between various mainframe and rehosted mainframe applications.

TN3270

Telnet 3270 (TN3270) defines the process of sending and receiving 3270 data streams using the Telnet protocol. A more generic term for this interface is green screen. Although green screen environments are considered legacy, a majority of mainframe users and administrators continue to rely on green screen interfaces. Most mainframe applications are driven through a green screen TN3270 interface. In this mainframe alternative reference, a TN3270 interface is available as a communications interface. Users accustomed to using TN3270 on the mainframe can continue to use TN3270 as an interface to connect to Micro Focus Server Enterprise Edition. A terminal emulator such as Micro Focus Rumba is used to connect to and drive rehosted applications in the mainframe alternative reference. Standard Telnet clients cannot be used as a substitute for TN3270 clients, because they use fundamentally different techniques for exchanging data.

CICS ISC

CICS Intersystem Communication (ISC) supports communication between various physical and virtual CICS regions. From the standpoint of this mainframe alternative reference, ISC supports communication between multiple CICS regions on Micro Focus Server Enterprise Edition and CICS regions still on the mainframe. The ISC interface in the mainframe alternative reference leverages the same LU6.2/APPC communications protocol used in the mainframe environment. Microsoft BizTalk® Host Integration Server connects the reference environment to existing IBM mainframe and Micro Focus Server Enterprise Edition host systems and uses Systems Network Architecture (SNA).

HTTP/SOAP

One of the more compelling reasons for rehosting the mainframe to a distributed environment is the availability of modern features such as HTTP interfaces for integration and usage. In this mainframe alternative reference, Microsoft Internet Information Services (IIS) drives the management and control of the HTTP interface. This interface is configured to communicate with Micro Focus Server Enterprise Edition to allow for the consumption and delivery of Web services and HTTP-driven transactions. Additionally, full support for Simple Object Access Protocol (SOAP) over HTTP is included.

CTG

CICS Transaction Gateway (CTG) provides secure access to CICS from external applications such as JAVA, using Internet protocols such as TCP/IP. In this mainframe alternative reference, full support for CTG is available using the External Communications Interface (ECI). ECI is an interface defined by CICS that allows external programs to invoke a CICS transaction as though it were a remote subroutine or procedure.

IMS Connect

Information Management System (IMS) Connect, an integrated function of IMS, improves IMS TCP/IP access and enables easier access to IMS applications and data from the Internet. IMS Connect provides high-performance communications for IMS, connecting one or more TCP/IP clients or local z/OS clients with one or more IMS systems. In this mainframe alternative reference, Micro Focus Server Enterprise Edition includes IMS Connect as one of the available communications interfaces. Through this interface, client applications in various languages, such as JAVA and C/C++, can interact with rehosted applications running within the context of the reference environment.

EZASOKET

EZASOKET is one of the major programming interfaces to TCP/IP on Multiple Virtual Storage (MVS) and is essentially a high-level language API (HLLAPI) used for programmatic integration and remote calls from various external sources. In this mainframe alternative reference, Micro Focus Server Enterprise Edition provides support for the EZASOKET interface. The Micro Focus implementation of EZASOKET is designed to emulate, as closely as possible, the IBM implementation documented in *SC31-8518-01, OS/390 SecureWay Communications Server: IP CICS Sockets Guide, Version 2, Release 8 (1999)*. It also supports some of the features introduced in the z/OS implementation documented in *SC31-8807-02, z/OS Communications Server: IP CICS Sockets Guide, Version 1, Release 5 (2004)*. Nevertheless, some differences exist, and Micro Focus EZASOKET makes use of the local platform's native TCP/IP support.

Physical architecture and infrastructure

The Micro Focus z/OS mainframe rehosting application server for the Microsoft Application Platform at the Microsoft Technology Center in Redmond, Washington, runs on an HP server and storage infrastructure. A second mainframe alternative system, based on a Dell Poweredge R910 server, exists at Micro Focus' headquarters in Newbury, UK*. Micro Focus and Microsoft created these environments to support customer demonstration and envisioning workshops. Both infrastructures are fully capable of replacing mainframe environments of 1000+ MIPS. This white paper focuses on the Redmond environment.

HP offers many hardware solutions that provide mainframe-level capabilities. The configuration described in Table 1 has proven its capability to replace a mainframe environment of 1000+ MIPS at Owens and Minor.

Table 1 Hardware infrastructure summary

Function	Implemented hardware
Server computer	HP DL580R07 four-processor server
Processors (4)	(4) Intel® Xeon® E7540 (2.0G-Hz/6-core/18-MB/105-W)
CPUs	24 CPU cores in the four previously described processors
Main memory (RAM)	128 GB of RAM in sixteen (16) HP 8-GB 2Rx4 PC3-10600R-9 DIMMs
Internal DASD storage	2.4 TB of Server Direct Attached Storage in eight (8) HP 300-GB drives (10K RPM SAS 2.5-in. HDDs)
Controller	HP P812/1-GB FBWC Controller
Attached DASD storage A	9.6 TB of Network Attached Storage in twenty-four (24) HP 300-GB drives (10K RPM SAS 2.5-in. HDD)
Attached DASD storage B	9.6 TB of Network Attached Storage in twenty-four (24) HP 300-GB drives (10K RPM SAS 2.5-in. HDD)

Table 1 Hardware infrastructure summary	
Function	**Implemented hardware**

* This will be moved to the MTC in Reading (UK) at the end of June 2011.

HP ProLiant DL580 G7

The HP ProLiant DL580 G7 (Figure 6) is an optimal choice for moderate-sized mission-critical data center deployment of a virtualized, mainframe alternative environment. For larger environments, the DL980 provides twice the capacity in the number of CPUs, amount of main memory and I/O connections and bandwidth. The DL580 G7 has DDR-3 memory expandable to 1 TB, advanced I/O slot configuration and Intel Xeon 7500 series processors capable of providing mainframe-level performance and scalability.

The DL580 G7 provides reliability and availability features such as a flash-backed write cache, redundant power supplies and fans and memory quarantine. These features, along with iLO3 and a common slot power supply, simplify and optimize management tasks for greater levels of efficiency and lower TCO.

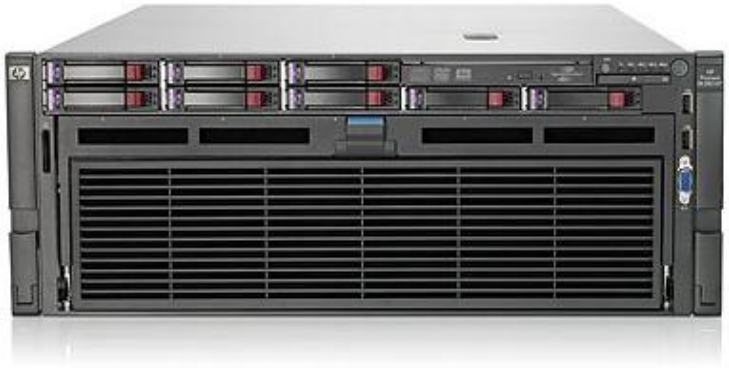

Figure 6: HP DL580 G7

The DL580 and 980 support very high rates of I/O operations. A single storage controller (the AJ763A card) can support 40K IOPS (20K IOPS per each of two I/O channels). Many of these I/O cards can be installed in a single server.

The DL980 has 2 sockets dedicated to each of its I/O bays, and each QPI link from each socket to each I/O bay runs at 25.6 GB/sec, for a total I/O bandwidth of 3*2*25.6 GB/sec = 153.6 GB/sec. And because each processor is running independently of all the other processors, it will scale linearly.

HP Insight Foundation software, integral to the DL580 and DL980, provides simplified server installation, configuration and maintenance throughout, allowing higher levels of operational efficiency and highly reliable systems. For more information, visit http://www.hp.com/go/foundation.

HP Integrated Lights-Out (iLO) simplifies server setup, health monitoring, power and thermal control and lights-out remote server administration. HP iLO functions can be accessed from any location via a Web browser and work hand-in-hand with HP Systems Insight Manager, Insight Control and Insight Dynamics to deliver the highest possible quality of IT service. For more information, visit http://www.hp.com/go/iLO.

HP P4500 G2

The HP P4500 G2 (Figure 7) is a storage area network (SAN) solution that provides high availability, scalable performance and enterprise features at a very economical cost for moderate size and I/O requirements.

Figure 7: HP Storage Works P4500 G2

The P4500 G2 storage system includes the following hardware:

- Dual redundant, active-active storage controllers
- Redundant hot-swap power supplies
- 24 450-GB 15K SAS disk drives
- 4 GB of RAM
- 1,024-MB battery-backed cache
- Support for RAID 5, 6, and 10
- 4 1-gigabit NICs
- Integrated DVD/CD-ROM

As storage needs increase, the HP P4500 G2 can scale performance and capacity online. Storage clustering simplifies scalability. All available capacity and performance are aggregated and available to every logical storage volume in the cluster. In addition, the Centralized Management Console (CMC) provides simple, easy-to-use tools that enable the management of multiple data centers and sites for storage.

The network redundant array of inexpensive disks (RAID) stripes and mirrors multiple copies of data across a cluster of storage nodes, eliminating any single data storage point of failure. Applications have continuous data availability in the event of a power, network, disk, controller or entire storage node failure.

Thin provisioning allocates space only as data is actually written, without requiring pre-allocation of storage. This feature raises the overall utilization and efficiency of the HP P4000 G2 SAN and ultimately increases your return on investment (ROI).

Finally, administrators can add capacity, increase performance, grow and migrate volumes between HP P4000 G2 SAN clusters on the fly, with no application downtime. Each time a storage node is added to the HP P4000 G2 SAN, the capacity, performance and redundancy of the entire storage solution increase. Integrated replication simplifies management with failover and failback.

Hardware considerations

When choosing hardware for the rehosting environment, it is important to match the architecture with the desired outcome of the business. Considerations should be made around the processor subsystem, storage and storage arrays, memory subsystem, network IO rates and power management.

With multicore processors, choosing the number of physical processors depends on many factors, including the workload, application complexity, number of sockets, CPU utilization goals, and so on. The configuration of the storage array needs to deliver I/O speed (generally, for mainframe applications, IOPS is more than the transfer rate), the flexibility to expand and the ability to be fault tolerant. In addition, the number of batch processing jobs required to run in parallel with the concurrent number of users will require careful planning.

Many applications running on z/OS, which are mostly older applications, issue a large number of SQL calls compared to what is found in more modern applications written for distributed systems. For these applications, the elapsed time for SQL calls between the application and the DBMS can be the limiting factor to overall throughput. Therefore, a hardware/software configuration that minimizes this time should be chosen.

Although memory has been a factor of parallel application usage in the past, when you are rehosting a mainframe workload to a Windows distributed environment, virtualization needs must be factored into the memory decision. Virtualization workloads are memory intensive. Workloads are especially intensive in the reference environment, because so many services are running in parallel. The memory needs will also depend on how many virtual servers are required by the Microsoft Hyper-V™ server. Administrators must have a full understanding of the needs and desires for scalability of the virtualization strategy.

Also important are the network IO rates and power management features of the server. Network IO rates will need to be handled in such a way that local clients and interoperability connectivity clients are satisfied. Virtualization comes into play here too, because multiple virtual hosts will be gathering data from a few physical ports. The network subsystem needs to deliver QoS on IO requests, enable key hypervisor features and connect the data center. In addition, if iSCSI storage arrays are utilized, the added traffic will drive up IO requirements.

Mainframe alternative reference configuration

Logical architecture

The Micro Focus reference environment was created to provide an end-to-end solution that can be demonstrated to customers who are interested in migrating their IBM mainframes to Microsoft Windows®. The base machine (named MFRAMEHOST) was set up with Windows Server 2008 R2 Enterprise Edition. Both Terminal Services and Hyper-V were enabled as roles, to allow multiple people to be logged on at any one time. Using Hyper-V, a virtual machine was created for each logical role envisioned for the environment. These virtual machines were connected into a virtual private network with its own domain and the following names and roles:

- Security: user security, and acts as domain controller and DNS
- Management: Source Code Management (SCM) and workspace sharing
- Development: developer environment and workload simulation
- Production: application execution environment
- Storage: disk cluster management
- DBMS1: database cluster instance 1
- DBMS2: database cluster instance 2

Each virtual machine was configured with four virtual CPUs with 4 GB of memory, 100 GB of disk space (C: drive) and two network adapters—except the production and management instances, which were set to 8 GB of memory to allow for higher volumes/workloads during the execution of the sample application. Network adapter 1 was used to connect each machine to the virtual private network, using 192.168.1.xxx IP addresses for each machine. Network adapter 2 was configured to allow for access to the Internet via the corporate domain, but it was disabled when not in use. It was only enabled to provide access for tasks such downloading product updates and license key verification. Otherwise, the external network adapter was kept disabled, because the demonstration application did not require external network communication as part of its architecture in its current state.

There is a Network Adapter 3, which is a virtual private network using 10.10.10.xxx communications only. Storage also has four 100-GB SCSI drives used to demonstrate SQL Server failover for DBMS1 and DBMS2.

Development environment

The Development Virtual Machine (VM) (192.168.1.16) was configured with Windows 7 Ultimate to represent a developer's desktop environment, and was configured with the tools that may be used during and after the completion of a mainframe migration. This environment includes the following Microsoft solutions:

- Microsoft Visual Studio® 2008 Team Edition: integrated development environment (IDE)
- Microsoft Team Explorer 2008: interface into Microsoft Visual Studio Team Foundation Server for SCM
- Microsoft SQL Server 2008 R2 Enterprise Edition: local database instance for stand-alone database testing
- Microsoft Office 2010 Professional: creation of documents, spreadsheets and more
- Microsoft Forefront® Endpoint Security 2010: antivirus and malware protection
- Microsoft Visio® 2010: creation of drawings, models and more
- Micro Focus Studio Enterprise Edition 6.0: COBOL and mainframe subsystem support within Visual Studio
- Micro Focus Rumba 8.1: TN3270 communications with mainframe subsystem
- Micro Focus Silk Performer 2010 R2: online user testing and workload simulation
- Micro Focus OnWeb: modernization of user interface to the application

Microsoft Visual Studio 2008 Team Edition

Developers used Microsoft Visual Studio 2008 Team Edition (Figure 8) as the development environment for the modification, compilation and debugging of the application source being migrated.

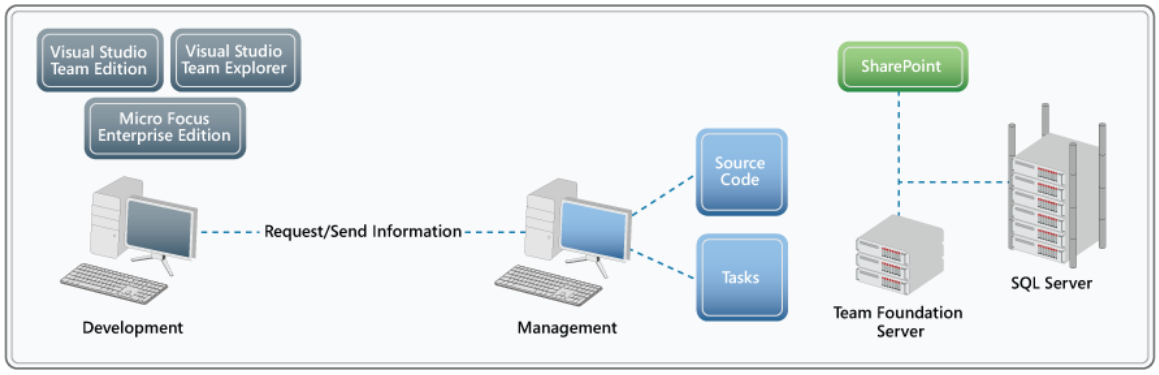

Figure 8: Microsoft Visual Studio environment

Microsoft Visual Studio 2008, not Microsoft Visual Studio 2010, was used in the reference implementation due to validated support for 2010 from Micro Focus at the time of release. In the next release of this reference implementation, Microsoft Visual Studio 2010 will be used and supported from Micro Focus.

Microsoft Team Explorer 2008

Microsoft Team Explorer 2008 (Figure 9) provides the interface between the development environment and the management server where Microsoft Visual Studio Team Foundation Server is installed. After installation, a connection to Team Foundation Server (management) is configured.

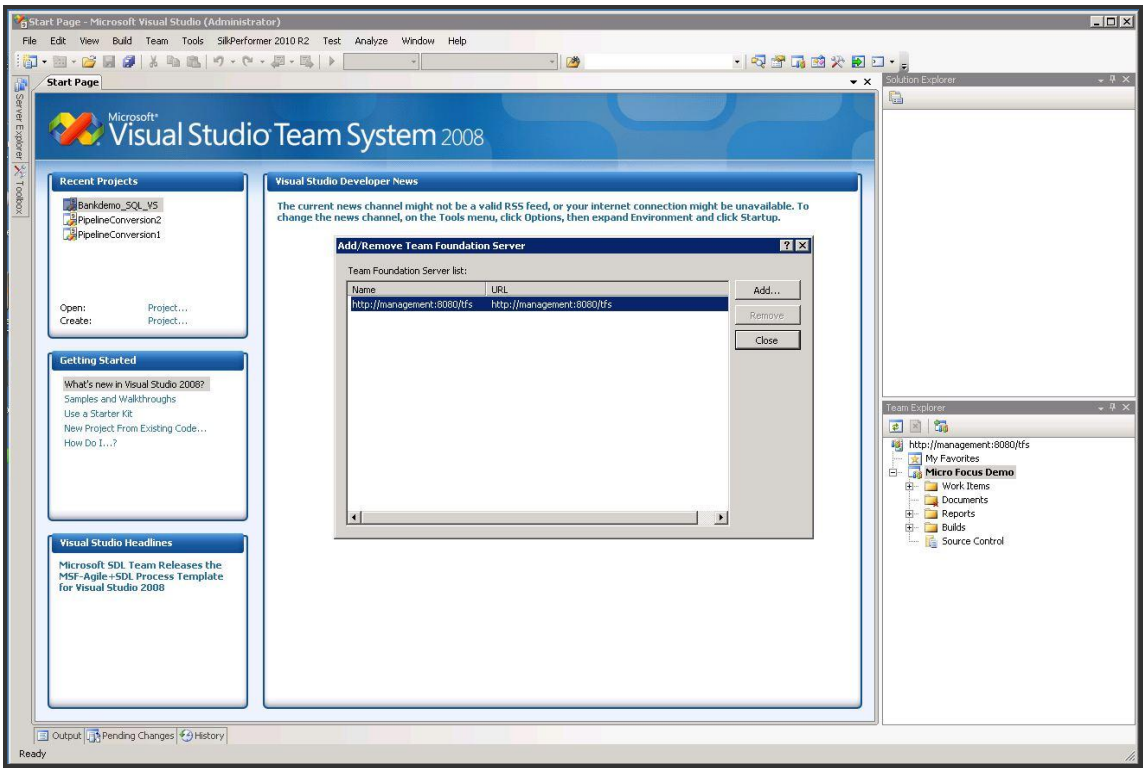

Figure 9: Team Explorer in Visual Studio Team System 2008

Once connected, the developer can use Team Explorer view to access the project/source from Team Foundation Server (Figure 10), retrieving any work items that may have been assigned to the developer by the project leader. Access to the Team Foundation Server repository is controlled by the user's access rights as they are defined within Microsoft Active Directory®, and only those features/capabilities that are enabled for that user can be accessed.

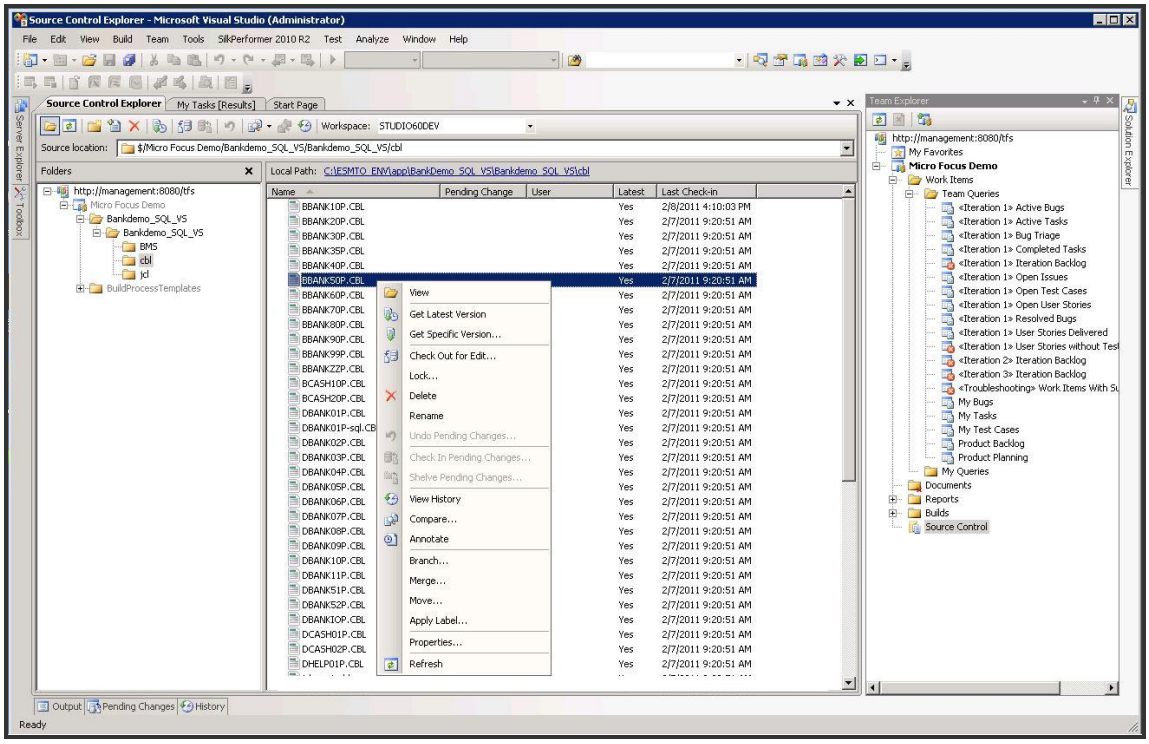

Figure 10: Team Foundation Server repository in Microsoft Visual Studio 2008

Microsoft SQL Server 2008 R2 Enterprise Edition

As part of the sample application installed in this environment, a local copy of the BankDemo database was installed. This was done to allow this server to work as a stand-alone machine for demonstration purposes only. In a full deployment configuration, each developer would be pointed to a shared instance of SQL Server.

Micro Focus Studio Enterprise Edition 6.0

Micro Focus Studio Enterprise Edition 6.0 supports Microsoft Visual Studio by enabling the modification, compilation and debugging of the COBOL application source. Micro Focus Studio Enterprise Edition also provides the mainframe subsystem with support for technologies such as CICS, IMS, VSAM and JCL.

Micro Focus Silk Performer 2010 R2

Using Micro Focus Silk Performer (Figure 11), developers can simulate workloads through the execution of test scripts. These test scripts are recorded and captured using Silk Performer (Figure 12), and are used to test the various features and functions of the application environment. The same scripts would also be used by the quality assurance and testing group.

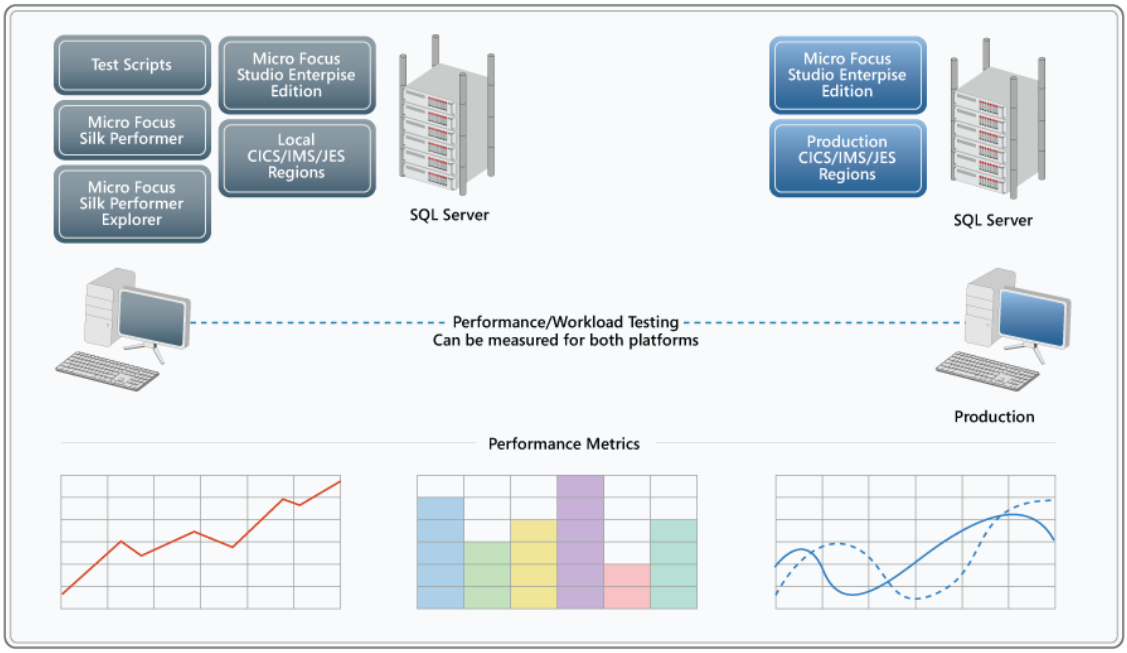

Figure 11: Micro Focus Silk Performer simulating a workload

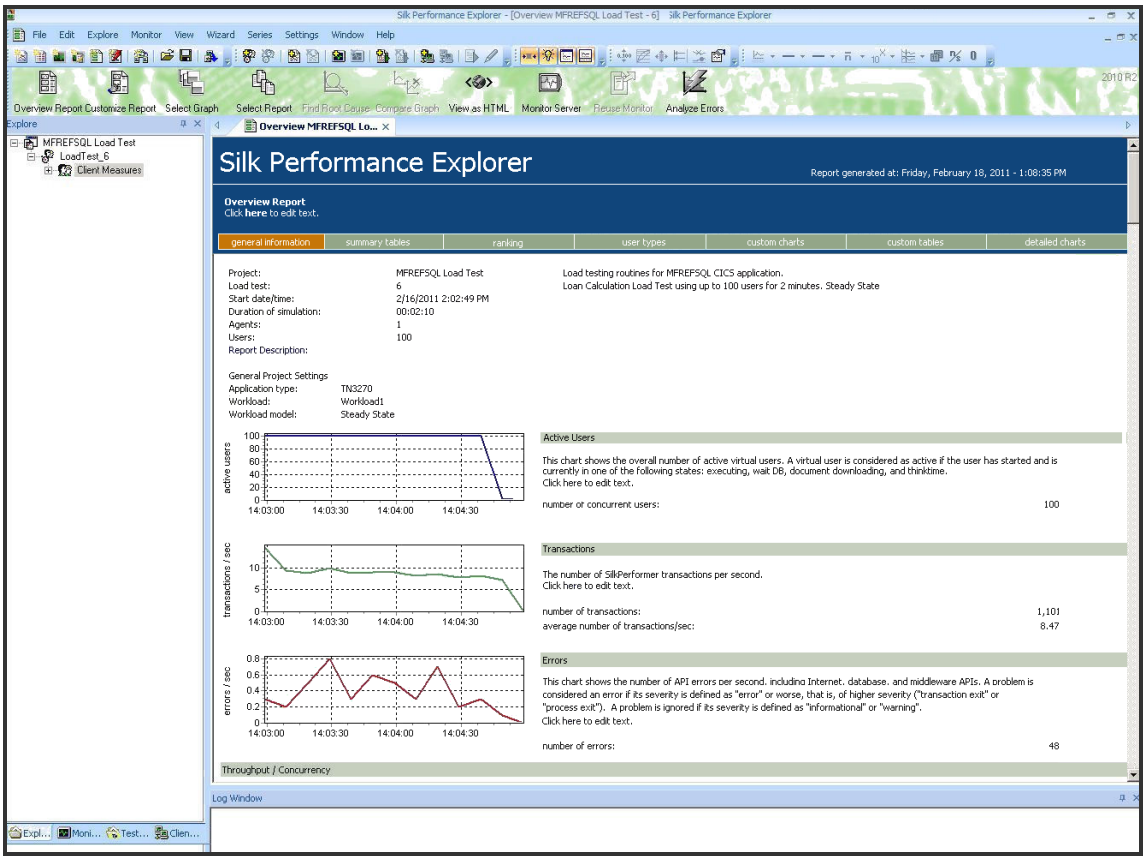

Figure 12: Test script in Micro Focus Silk Performer

Management environment

The Management VM (192.168.1.13) was configured with Windows Server 2008 R2 Enterprise Edition, and the following software was installed:

- Microsoft Team Foundation Server 2010
- Microsoft SharePoint® Server 2010
- Microsoft SQL Server 2008 R2 Enterprise Edition
- Microsoft Forefront Endpoint Security 2010
- Micro Focus Silk Test Manager 2010[2]: test case management
- Micro Focus Caliber RM[3]: requirements management
- CA Workload Automation Client[4]

The purpose of this server is to provide the tools necessary to manage the migration project and the migrated source code.

[2]Not configured for use in this version of the reference environment. To be done.

[3]Not configured for use in this version of the reference environment. To be done.

[4]Not configured for use in this version of the reference environment. To be done.

Microsoft Team Foundation Server 2010

Microsoft Team Foundation Server 2010 provides the source code management and the overall task management for the developers. It has also been extended to use SharePoint, which allows the project teams to add a shared project site as a common place to keep documentation and notes.

However, Team Foundation Server provides more than just source control. It provides data collection, reporting and project tracking, and is intended for collaborative software development projects. It is available either as stand-alone software or as the server-side back-end platform for Visual Studio Team System with Visual COBOL from Micro Focus.

Microsoft SharePoint Server 2010

Microsoft SharePoint Server 2010 provides a shared workspace for those involved in the migration and support of the application. It can also be used as a repository for printed reports generated from the application.

Microsoft SQL Server 2008 R2 Enterprise Edition

Microsoft SQL Server 2008 R2 Enterprise Edition was installed locally to enable this server to be used as a stand-alone server. The databases maintained in this instance are specific to SharePoint and Team Foundation Server. These databases could have been stored on the clustered instance of SQL Server in a normal configuration.

Micro Focus Silk Test Manager 2010

Micro Focus Silk Test Manager 2010 was installed and configured to simulate users accessing the CICS and IMS online portions of the application. Additionally, support was installed to allow scripts to be created that drive the Web-enabled versions of these user interfaces, which were created using Micro Focus OnWeb.

Microsoft Forefront

Microsoft Forefront was used via a separate server. Microsoft Forefront helps deliver end-to-end security and access to information through an integrated line of protection, access and identity management products. Forefront protects many business assets, including networks, network servers and individual devices.

Production environment

The Production VM (192.168.1.15) was configured with Windows Server 2008 R2 Enterprise Edition, and the following software was installed:

- Microsoft SQL Server 2008 R2 Enterprise Edition
- Microsoft Forefront Endpoint Security 2010
- Micro Focus Server Enterprise Edition 6.0
- Microsoft System Center Operations Manager 2007 R2
- LRS VPSX
- Micro Focus Rumba 8.1
- Syncsort DMExpress
- CA Workload Automation

Microsoft SQL Server 2008 R2 Enterprise Edition

Microsoft SQL Server 2008 R2 Enterprise Edition was installed locally to allow this server to "stand alone" and support the applications deployed on this server. The same BankDemo database has been installed and configured on this server as was installed on the Development instance.

Micro Focus Server Enterprise Edition 6.0

Micro Focus Server, Enterprise Edition (Figure 13) was installed to provide the support for the application.

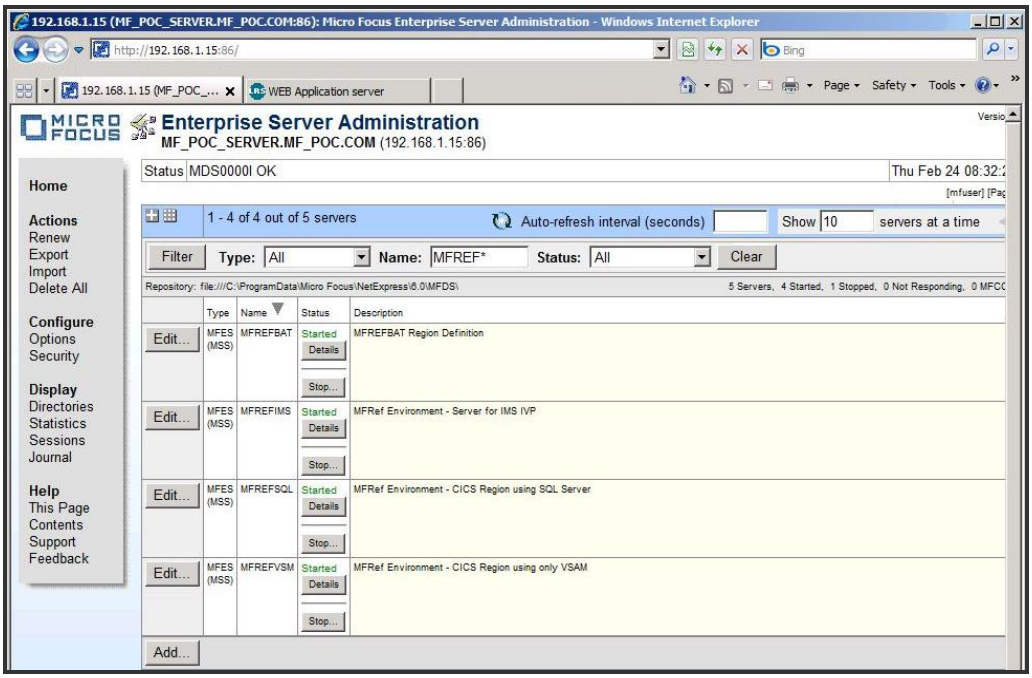

Figure 13: Micro Focus Server Enterprise Edition 6.0

Multiple regions, each with its own unique features, were configured to support the sample applications. The MFREFSQL region was configured to support the execution of the sample application BANKDEMO for its online (CICS) and batch Job Execution System (JES) elements. The data source for this application is provided by SQL Server 2008 R2 Enterprise Edition. The online portion of the application can be executed via a TN3270 connection to the region. Within this region, a TN3270 listener was configured to respond to connections on port 9223. HTTP connections are managed through an HTTP listener configured to monitor port 9221. To execute the application, users connect to the CICS region via Micro Focus Rumba or one of the other types of interfaces provided, and then execute the BANK transaction.

The MFREFBAT region was configured to support the execution of a sample batch job via the Job Entry Subsystem (JES) application consisting of multiple Job Control Language (JCL) jobs and PROCs. The primary data source for this environment was built around Micro Focus data files, such as sequential files, VSAM files and generation data groups (GDGs), to highlight the proficiency of the environment in handling mainframe-type file processing. This is the region the CA Workload Automation product was configured in for the submission of various batch jobs.

The MFREFIMS region was configured to support the execution of a sample IMS online application consisting of multiple screens used in the maintenance of an IMS database. To execute the application, users connect to the IMS region via Micro Focus Rumba or one of the other types of interfaces provided, and then type the command **MFDEMO** after completing the logon.

The MFREFVSM region was configured to support the execution of the sample application BANKDEMO for both its online (CICS) and batch JES elements. The data source for this application is provided by Micro Focus data files. The online portion of the application can be executed via a TN3270 connection to the region. Within this region, a TN3270 listener was configured to respond to connections on port 9223. HTTP connections are managed through an HTTP listener configured to monitor port 9221. To execute the application, users connect to the CICS region via Micro Focus Rumba or one of the other types of interfaces provided, and then execute the BANK transaction. Batch job submission in this region was designed to be managed through the operations console provided as part of the Micro Focus Server Enterprise Edition environment.

Micro Focus Rumba 8.1

Micro Focus Rumba 8.1 (Figure 14) was installed to allow for TN3270 connections in the Micro Focus Server environment.

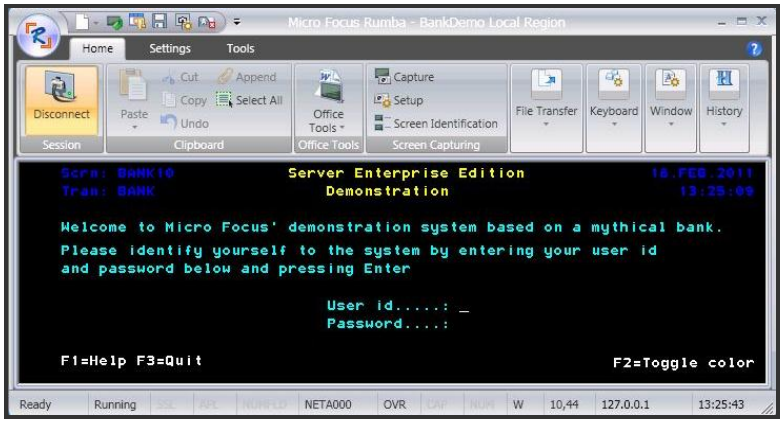

Figure 14: TN3270 screen

CA Workload Automation

CA Workload Automation (Figure 15) was installed and configured to provide the support required for batch scheduling on the distributed platform. A sample batch schedule was defined within this environment and configured to run within the MFREFBAT region. The main point of this schedule is to manage the creation, verification and printing of a fictional customer master file.

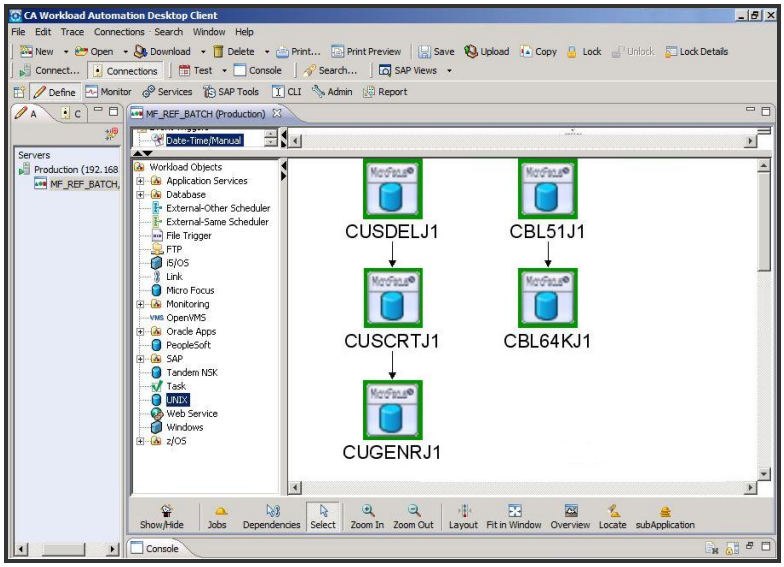

Figure 15: CA Workload Automation

Syncsort DMExpress

This file can be populated with any number of required records and was sorted with Syncsort DMExpress as part of the demonstration. The initial setup of this job was defined to create 500,000 unique customer records.

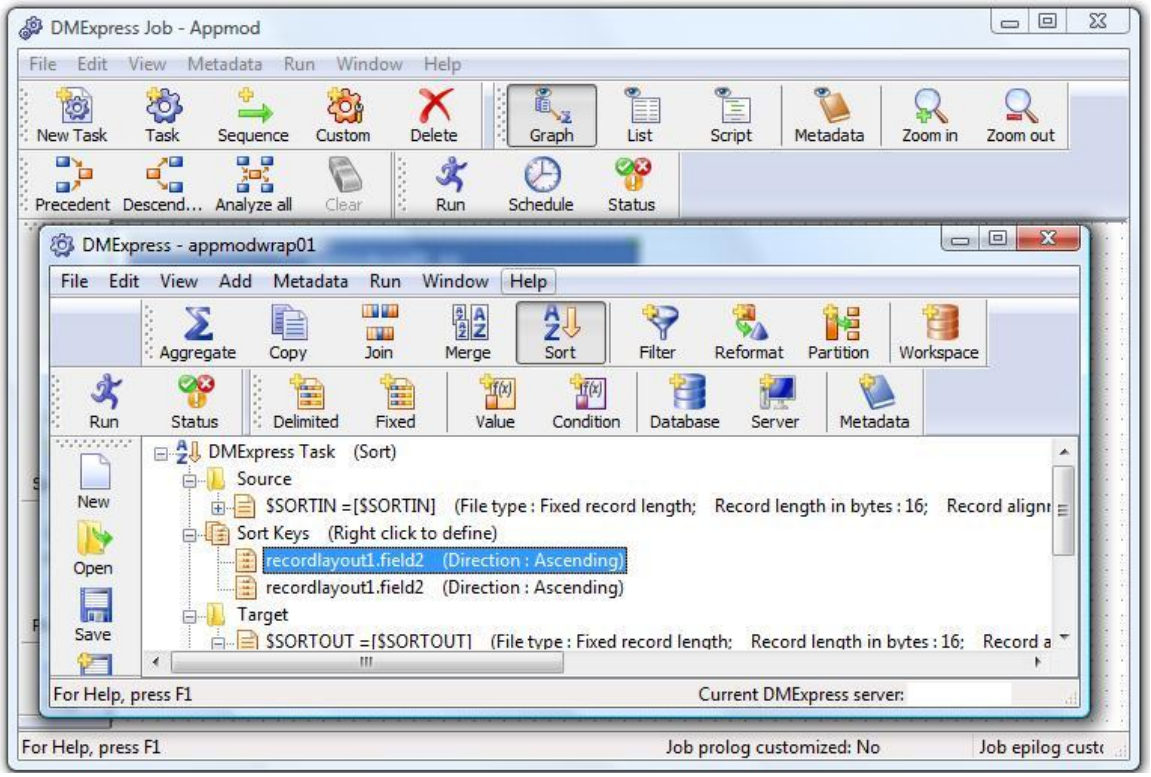

Figure 16: Syncsort DMExpress

VPSX software from LRS

The four-part mailing label generated by this job was sent to a printer managed by the VPSX output management solution from LRS. This product was installed and configured to manage multiple fictitious printer definitions. The purpose of this demonstration was to highlight how mainframe print output can be managed and delivered within the distributed environment. Each region within Micro Focus Server Enterprise Edition that produces output in this demonstration environment was configured with the settings necessary to control the output flow to the VPSX solution. Figure 17 shows the printers defined in the VPSX environment. All print output from the batch processing was routed to the LOCAL printer definition.

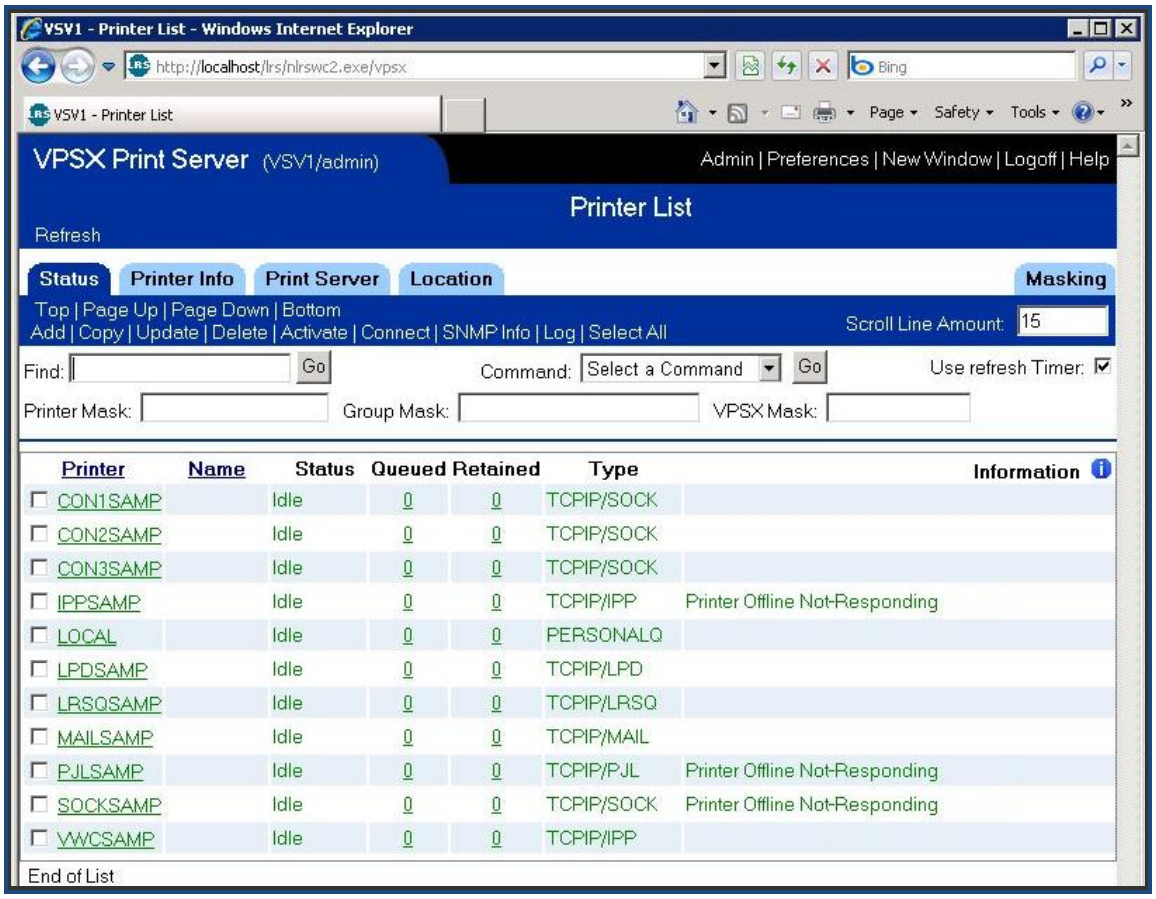

Figure 16: VPSX printers

Operations management

Microsoft System Center Operations Manager 2007 R2 (Figure 17) was installed to provide the operational support and management of the environment. Management packs for Micro Focus Server Enterprise Edition were installed and configured within this instance of System Center Operations Manager. All machines running Micro Focus Server Enterprise Edition in this private network are visible to this machine (and the other servers). In addition, information about the various states of these environments is made available to the operators through this tool.

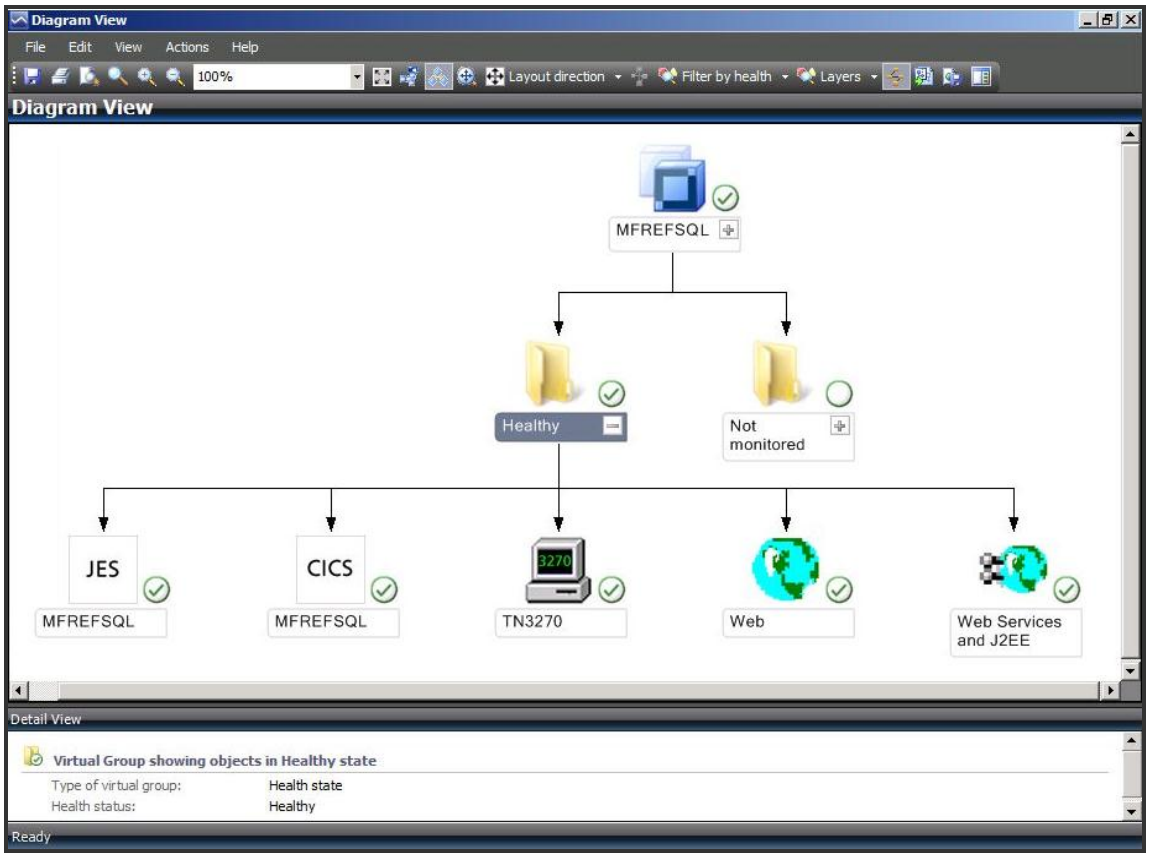

Figure 178: Microsoft System Center Operations Manager 2007 R2

Security

The Security VM (192.168.1.10) was configured with Windows Server 2008 R2 Enterprise Edition as the active domain controller (domain name: MF_POC) and the Microsoft Active Directory roles were installed. Additionally, Microsoft Forefront Endpoint Security 2010 was installed.

Storage

The Storage VM (192.168.1.12, 10.10.10.63) was configured with Windows Server 2008 R2 Enterprise Edition with SQL Server 2008 R2 Enterprise Edition. The purpose of this machine is to provide shared storage for DBMS1 and DBMS2, which are configured in a cluster. Within this instance, there are four virtual drive volumes configured, each with 100 GB of disk space. Additionally, the machine was configured to provide iSCSI support, which is required as part of the configuration of the SQL Server cluster.

DBMS1 and DBMS2

The DBMS1/DBMS2 machines were configured with Windows Server 2008 R2 Enterprise Edition to act as an SQL Server cluster. These two machines act as mirror images, and each instance is configured to handle the database workload in the event that the other instance fails.

Transaction management

The most widely used transaction management service on the mainframe is the Customer Information Control System (CICS). CICS is at the heart of many COBOL mainframe applications.

In this mainframe alternative reference, Micro Focus Server Enterprise Edition supports CICS emulation running on Windows Server 2008. CICS COBOL applications running on the mainframe will run with the same functionality in the mainframe alternative environment.

This architecture also provides full support for IMS Transaction Manager (TM) applications to be supported in the mainframe alternative reference. Production-level transaction environments are rehosted and running on the Microsoft Application Platform with no change.

Full commit/rollback and database recovery facilities are provided for each transaction. Using XA-compliant architecture, all transaction queue activity and database activity is logged, and those updates are synchronized with database commits. Consequently, both Roll Back and Roll Forward recovery functions are provided. BMP Checkpoint/Restart is also supported.

For less common environments such as IDMS/DC, Natural/Adabas and Datacom/DB, a rich partner ecosystem offers migration solutions to Micro Focus and Windows.

Batch processing

Batch applications (Figure 19) form a key element of mainframe systems, and the Job Control Language (JCL) within these applications often provides more than just program execution. JCL helps define the relationship between the components of a system, and important application logic can be contained within the JCL.

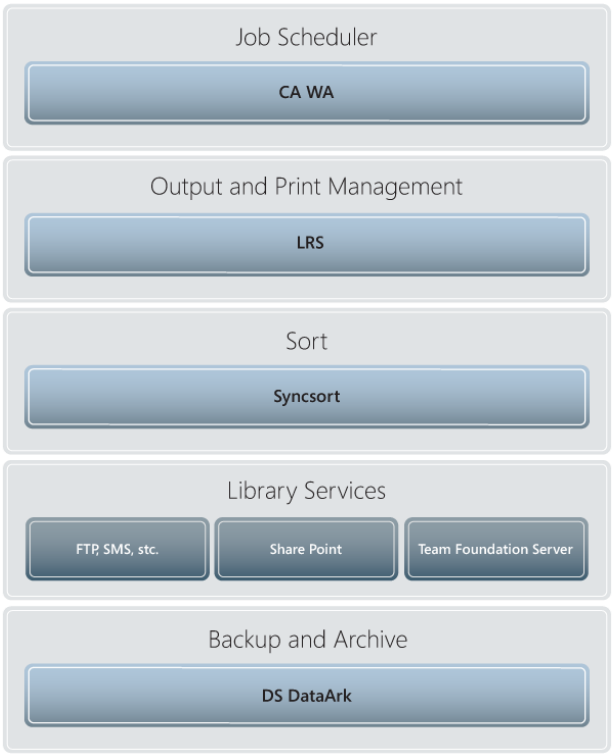

Figure 19: Mainframe batch system services

Micro Focus Server Enterprise Edition provides a robust Job Execution System (JES) engine for the submission, prioritization and execution of batch initiators that supports both MVS (z/OS) and Virtual Storage Extended (VSE) JCL. Existing JCL that defines the batch processes can be kept intact, avoiding the risks associated with converting the JCL to scripting languages.

Batch processes perform significantly faster through the parallelization of batch applications on Windows, which significantly increases throughput.

Job control statements such as JOB CARD, DISP, DSN, OUTPUT, and COND CODE logic and sort control sequences contribute to the overall functionality of an application. In this mainframe alternative reference, JCL support is fully integrated into Visual Studio (Figure 20), providing the capabilities expected for productive development, including:

- Integrated editing, including color tokenizing for z/OS and VSE JCL syntax
- File type recognition
- Hosted Web pages for administration, spool and catalog features
- Job submission from the IDE

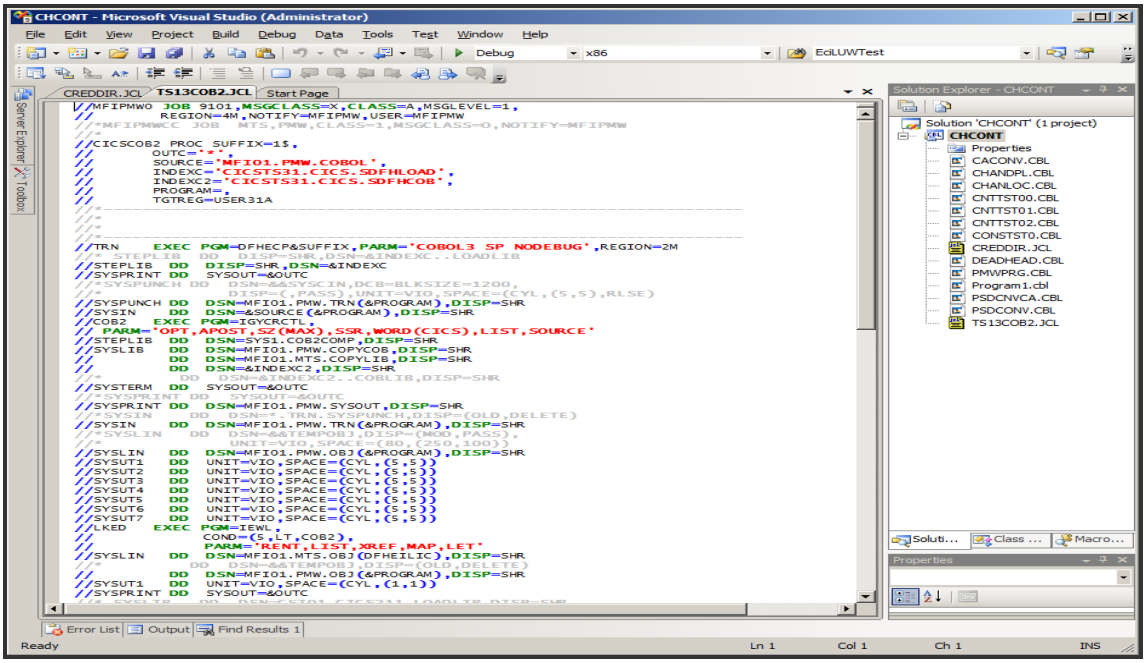

Figure 20: Rapid JCL development using the Visual Studio IDE

Job scheduling

The complex task of managing multijob and multievent scheduling is handled by CA Workload Automation. CA Workload Automation is an enterprise-class workload management solution that provides scheduled and event-triggered management of mission-critical processes and workloads. In this mainframe alternative reference, the solution is integrated with Micro Focus Server Enterprise Edition. CA provides a single solution that can manage all workloads, regardless of where they reside, including distributed and mainframe platforms and cloud or virtual environments.

The solution includes dynamic resource management for workloads, which enables dynamic workload placement and load balancing. It supports a broad array of workloads, including traditional batch, Web services, J2EE, database, SAP, Oracle eBusiness Suite, PeopleSoft and many other business solutions. In addition, this solution is built on an event-based automation paradigm that enables advanced control of your workloads, including workload execution by schedule, business event or system event. To learn more about CA Workload Automation, visit http://ca.com/workloadautomation.

Sorting

A critical component of mainframe re-hosting initiatives is to quickly perform the data integration tasks of sorting, merging, copying, and joining vast amounts of data. Over 80% of batch data processing on the mainframe is dependent on SORT. Therefore, an efficient data integration engine with high performance sort capabilities allows mission-critical applications to run more efficiently in a distributed environment. Mainframe customers have trusted Syncsort for years to accomplish performance sensitive functions with high levels of scalability and reliability, without requiring significant or complex development efforts.

Syncsort is well known and respected for helping organizations accelerate their z/OS applications with Syncsort MFX (previously known as SyncSort). Today, organizations can leverage the same technology using Syncsort DMExpress, to achieve even higher performance in distributed environments with minimum migration risk. Through the use of advanced sorting algorithms, I/O optimization, and dynamic environmental monitoring, DMExpress delivers data processing performance at near native hardware I/O speed with low CPU and memory utilization. DMExpress' optimized sort work compression also saves disk space used for sorting activity. Current Service Level Agreements (SLA) are maintained or improved.

COBOL SORT/MERGE functions that were handled by Syncsort MFX on the mainframe will be performed by DMExpress on open systems with no code changes and zero tuning required. DMExpress' Micro Focus COBOL SORT/MERGE Accelerator can be plugged in seamlessly and leverages Syncsort's exclusive pipelining and parallelism technology to significantly reduce elapsed times and system resources. The benefits are most significant with very large data sets.

In addition, DMExpress provides complete and seamless integration with Micro Focus through its JCL SORT card compatibility regardless of whether the sort engine on the mainframe is from Syncsort, or another supplier.

For more information visit Syncsort's Application Modernization page at http://www.syncsort.com/Solutions/ApplicationModernization

Output management

Output management is an essential part of mainframe computing, covering everything from billing statements and payroll check runs to user-initiated print transactions. Batch and online printing continue to be necessary in rehosted environments. In many cases, document requirements actually expand as organizations seek to leverage a single, scalable output system for both their rehosted and open-system applications.

This mainframe alternative reference incorporates the VPSX solution and other output management components from software provider Levi, Ray & Shoup, Inc. (LRS). Fully integrated with the Micro Focus JES engine, LRS software captures legacy batch COBOL, CICS and other output and securely routes documents to printers, e-mail addresses, or online destinations. No application or legacy JCL changes are required for effective document management in the mainframe alternative reference.

Differences in mainframe versus open-system print formats can complicate rehosting projects. For example, mainframes often rely on channel connections or printer-specific capabilities to process mainframe carriage control sequences, embedded DJDE codes or AFP data streams. The LRS software solution resolves legacy data formatting and converts application output for printing and viewing on standard open-system hardware.

Although many mainframe applications generate batch or online output, few have the native ability to package and disseminate output in formats tailored to end users. For this reason, nearly all mainframe organizations employ electronic document storage, bundling, decollation and viewing software. Equivalent solutions are needed in the rehosted environment. LRS software offers fully integrated document archiving, viewing and output management capabilities to ensure project success. Experienced LRS output consultants are also available to help customers migrate data and metadata definitions to ensure a smooth transition to the open-system environment. To learn more about LRS software, visit http://www.vpsx.com.

Virtualization

Mainframe users are accustomed to using virtualization and logical partitions to separate multiple processing regions or scale up workload as needed. Because the cost of mainframe resources is so high, this efficient use of resources is a well developed and, in some sense, necessary characteristic of the mainframe.

The mainframe alternative reference described in this document features advanced virtualization models that allow active workloads to be moved between physical machines without any processing interruption; have processor and memory resources increased or decreased on demand; and share physical server resources with different Windows and Linux editions concurrently. Running Windows Server 2008 R2, the virtualization of this mainframe alternative reference is managed through Hyper-V and the Microsoft System Center management suite. This environment gives the rehosted applications the ability to scale 32-bit and 64-bit virtual hosts as needed and offers significant economic and performance benefits to rehosted mainframe applications. Customers can rehost and deploy services and applications and rest assured, knowing that additional resources are simply a click away. For more information on virtualization, visit http://www.microsoft.com/virtualization.

Data

Over the years, data storage options for mainframe users have evolved greatly and led to a variety of databases and data structures. More often than not, organizations use a combination of data stores in their environment, ranging from sequential, partitioned, VSAM and IMS DB to DB2 and third-party solutions such as ADABAS and Integrated Database Management System (IDMS). The mainframe alternative reference takes a practical approach to data rehosting that gives organizations the option of either completely or partially rehosting the mainframe data structures or accessing the data on the mainframe from the distributed environment.

Microsoft SQL Server provides the relational database management system (RDBMS) layer of the mainframe alternative reference and provides high-speed bidirectional access to data from the Micro Focus Server Enterprise Edition run-time environment. The Host Compatibility Option for SQL Server (HCOSS) provides middleware to minimize SQL updates when migrating DB2-based applications to SQL Server. In addition, HCOSS mitigates performance concerns associated with moving a mainframe SQL application to a distributed environment. It provides this capability both at compile and runtime, with directives that manage SQL access. For more information, visit the Micro Focus Knowledgebase at http://kb.microfocus.com.

The Microsoft SQL Server Parallel Data Warehouse allows customers to implement data warehousing and business intelligence (BI) on this data too, at a much lower cost than doing so on the mainframe.

In the event that customers need to keep data in legacy formats, the mainframe alternative reference provides full support for VSAM, SEQ and IMS DB sources from within the Micro Focus Server. Additionally, Micro Focus Server Enterprise Edition features a Database Connectors option, which provides middleware to avoid COBOL I/O updates when migrating VSAM data to SQL Server.

For customers wanting to keep data on the mainframe, Microsoft BizTalk Server with Host Integration Server technologies can provide bidirectional access to a host of legacy data sources. The Microsoft integration technologies allow for program-to-program interaction or program-to-data access between Windows and z/OS applications. For more in-depth information on this technology, visit http://www.microsoft.com/biztalk.

Development and testing

The mainframe alternative reference takes into account the need for organizations to have an end-to-end development and testing environment. From understanding requirements to direct SOA enablement, the development and testing component of the mainframe alternative reference delivers a complete stack for customers to both maintain and modernize migrated legacy applications. The development and test stack is broken into seven components that include:

- Assessment
- IDE
- Source Management
- Test
- User Interface Modernization
- SOA Enablement

Assessment

Micro Focus i.Sight provides business and technical insight into core business applications. Assessment functionality is important before and after migration, so that customers better understand the complexities and possible interdependencies that exist on the mainframe architecture. The better the assessment before migration, the better prepared and scoped the post-migration distributed architecture will be. The gained assessment intelligence allows executives and development teams to identify, plan and execute the distributed environment architecture so that it is properly aligned with business needs.

Source management

Source code control is a common requirement in both mainframe and modern software development projects. In its base form, it provides mechanisms for checking source code in and out of a central repository. This allows different developers to work on the same project with reduced fears of lost code or overwritten changes. This base form of source control can be useful for even single-developer project teams. However, these features become critical with larger enterprise applications with multiple release versions and teams of developers. Microsoft Visual Studio Team System works in conjunction with Micro Focus Server Enterprise Edition and Micro Focus Studio to provide mechanisms for managing and tracking source code in enterprise class projects.

IDE

Microsoft Visual Studio is the integrated development environment (IDE) that Micro Focus Studio Enterprise Edition leverages to provide customers with a comprehensive set of development tools and services. Visual Studio with Studio Enterprise Edition provides support for COBOL and full support for the Microsoft .NET Framework.

One of the benefits of having COBOL working within Visual Studio is that skills are preserved. Rehosting projects are typically done in phases, and it is imperative that existing mainframe programmer skills be preserved. Letting COBOL programmers utilize their unique skill sets within Visual Studio, ensures their continued productivity, and this, in turn, will ensure that mission-critical applications are further advanced. On the other end of the spectrum, a younger generation of developers who are used to Visual Studio will find that the transition to supporting COBOL applications in a .NET environment is seamless.

Security

The mainframe has long been associated with high levels of security. Mainframe administrators are accustomed to controlling user and system access with a high level of granularity. While abundantly secure, mainframe security models were not originally designed for external access and collaboration. To secure the mainframe for a new economy of direct sharing and integration with partners and customers, layers of complexity were added to enforce new policies, and in some cases, sharing and access to information was limited.

In a distributed environment, security models and approaches have been designed from the ground up for external and internal security. Security within the mainframe alternative reference is handled from both a system level and a user access level.

From the system level, Microsoft protects the environment from outside threats through a deeply engineered multitier set of technologies within Windows Server and additional products. The result is a flexible multilayered secure ecosystem that delivers increased collaboration, sharing and access to information. From the user access level, the Windows Server environment relies on Active Directory services to provide administrators with the same level of fine-grained control they are used to in the mainframe environment when it comes to setting who can access resources on the system.

The security components of the mainframe alternative reference were designed to provide an easy transition for organizations looking to rehost the mainframe. Rather than rip apart existing applications and inconvenience end users, customers will find their existing mainframe applications will snap directly into the new security architecture.

Importance of enterprise strategy and services

Working in conjunction with Micro Focus services and support, the Microsoft Enterprise Strategy program and service offerings are available to customers to ensure success with the Microsoft platform. Enterprise architects are available to work with organizations and properly assess and create Enterprise Architecture solutions for customers. This ensures that customers maximize business value when moving to such an environment.

Summary of key products and mapping

Table 2: Key products and mapping

Product	Description
Windows Server 2008 R2 Enterprise Edition and Active Directory	Operating system foundation and application platform, and directory services, access authentication and policy management
SQL Server 2008	Relational database, BI, analytics and reporting server
SharePoint Server	Collaborative portal server for content/document management, social networking, database applications, BI and workflow
Micro Focus Server Enterprise Edition	Deployment environment for COBOL and PL/I applications
Micro Focus Studio Enterprise Edition	Graphical IDE for rehosting mainframe applications to lower-cost environments
Visual Studio	Integrated development environment and framework
Visual COBOL	COBOL application language support for Visual Studio
Team Foundation Server	Source code management
System Center	Operation management
LRS VPSX	Output management
CA Workload Automation	Job scheduling
Syncsort DMExpress	High-speed file sort operations
Rumba	Terminal emulator (IBM 3270)
SilkPerformer	Automated testing and performance measurement

Summary

This mainframe alternative reference has outlined a validated mainframe rehosting infrastructure. Customers will find that there is now a viable alternative to the mainframe for mission-critical, production-ready environments. Those who decide to choose this migration route will find this mainframe alternative reference implementation to be the lowest-risk option that yields the fastest return on investment (ROI). As you consider rationalizing your IT platform strategy, remember that migrating off your mainframe will give you several economic and innovative advantages and help you achieve the following efficiencies:

- Reduce application costs by up to 80 percent
- Modernize applications sooner by enabling IT to deliver new functionality 40 percent faster
- Complete batch processes in half the time and double the number of online transactions in the same time

For more information, contact mframe@microsoft.com or visit http://www.platformmodernization.org or http://www.mainframemigration.com.

Glossary

ASCII	American Standard Code for Information Interchange, any one of several standards that allow different code pages for language encoding but follow the same basic format. ASCII makes it very easy to write code, manipulate uppercase/lowercase and check for valid data ranges.
Batch infrastructure	The overarching mechanism resident within Micro Focus Server Enterprise Edition to enable batch processing.
Batch processing	A type of data processing in which a number of similar input items are grouped for processing serially, with a minimum of operator intervention and no end user intervention.
CICS	Customer Information Control System, an IBM-licensed program that enables transactions entered at remote terminals to be processed concurrently by several different applications. CICS provides a common terminology and a set of programming commands that allow programmers to develop consistent user interfaces, regardless of the type of terminal being used.
Communications interfaces	The collection of interfaces and protocols that enable integration, service execution and management of the rehosted applications. The communications interfaces layer includes HTTP, CTG, TN3270, EZASOKET and IMS CONNECT.
EBCDIC	Extended Binary Coded Decimal Interchange Code, an eight-bit character code used primarily in IBM 3270 and 5250 environments; compare to ASCII.
Emulation	The imitation of one device by another. The emulating device performs the same functions and appears to other network devices as if it were the emulated device.
Execution environment	The combination of technologies resident within Micro Focus Server Enterprise Edition to enable the runtime and management of various languages, transaction environments and security components. It is within the execution environment that COBOL, PL/I, CICS, IMS and JCL are executed.
GDG	Generation data group, a method used on the mainframe to allow the creation of a group of related files that can be referenced individually or as a group.
Migration	The act of moving applications and or data from the mainframe system to a distributed network on the Microsoft Application Platform (also known as rehosting).

Output management	An essential part of mainframe computing, covering everything from billing statements and payroll check runs to user-initiated print transactions.
Online processing	A type of data processing in which data is processed as it is entered into the system. Online processing provides immediate feedback to the user. It is the opposite of batch processing.
Rehosting	The act of moving applications and or data from the mainframe system to a distributed network on the Microsoft Application Platform (also known as migration).
SNA	Systems Network Architecture, the total description of the logical structure, formats, protocols and operating sequences for transmitting information between IBM software and hardware devices in the mainframe and midrange environments (S/390, AS/400 and their predecessors).
TCP/IP	Transmission Control Protocol Internet Protocol, the collection of transport and applications protocols used to communicate on the Internet and other networks, regulating how data is transferred between computers.
Telnet	A terminal emulation protocol commonly used on the Internet and TCP/IP-based networks. Telnet allows a user at a terminal or computer to log onto a remote device and run a program.
Terminal server	A computer or controller used to connect multiple terminals to a network or host computer.
Thin client	A thin processing client in a client/server environment that performs very little data processing. The client processes only keyboard input and screen output, and all application processing is done in the server. Examples are X Window terminals and Windows terminals.
TN3270	A special version of the Telnet protocol that supports the IBM 3270 terminals.
VSAM	Virtual Storage Access Method, a file management system used on IBM mainframe computers.
Web services	A standardized way of integrating Web-based applications that allows organizations to share data without needing to know the details of other organizations' computer systems.
z/OS	An operating system from IBM that is highly secure and provides high performance for mainframe computers.