Microsoft Azure Government cloud for mainframe applications

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Why consider mainframe migration?

Many public sector entities would love to move their mainframe applications to a more modern, flexible platform, but they don't know where to begin. Mainframes have a place in running specialized, high-throughput transactions, but many applications—and the people who design and maintain them—benefit from a more agile, cost-effective, cloud-based environment.

In our work with government customers, we often hear about mainframe costs, resource limitations, and how hard it is to find qualified people with mainframe skills. These issues aren't new. What has changed is the maturity of today's cloud-based platforms and their capacity to handle mainframe workloads. Microsoft Azure Government is a physically separated instance of cloud services based on the global Microsoft Azure platform but packaged for federal, state, and local government systems. The result is hyper-scale compute and storage in a highly availability environment capable of supporting traditional mainframe workloads. Azure Government adds the value and agility of a modern, cloud-based platform without the costs associated with a mainframe environment.

Azure Government provides world-class security, protection, and compliance services specifically for United States government agencies and their partners. Azure Government services handle data that is subject to certain government regulations and requirements, such as the Federal Risk and Authorization Management Program (FedRAMP), National Institute of Standards and Technology (NIST) 800.171 (DIB), International Traffic in Arms Regulations (ITAR), Internal Revenue Service (IRS) 1075, Department of Defense (DoD) L4, and Criminal Justice Information Services (CJIS).

In addition, Azure Government earned a Provisional Authority to Operate (P-ATO) for FedRAMP High Impact for systems that need this type of environment. Microsoft continues to add features to Azure Government when they meet the requirements for FedRAMP High Impact. For more information, see the Microsoft Trust Center: FedRAMP website.

The easiest way to get started is to lift your mainframe applications and shift them to the cloud, using mainframe emulation software on Azure Government. This is the lift-and-shift approach. Going forward, you can enhance your applications using Azure platform-as-a-service (PaaS) offerings and analytics services. PaaS options make it easy for developers to get up and running quickly, and PaaS is often a quicker path to compliance.

This document provides a quick overview of the most common ways to use Azure Government for traditional mainframe workloads and is written for decision-makers in government IT with a cloud background.

Types of mainframes

Mainframe systems are used in many different industries, including the financial sector, healthcare, manufacturing, and government.

Mainframe generally refers to:

- IBM and IBM plug-compatible mainframe computers from Amdahl, Hitachi, and Fujitsu. Most mainframes fall into this category.

- Unisys servers from Sperry (OS2200) and Burroughs (MCP).

- Others from Fujitsu and International Computers Limited Virtual Machine Environment (ICL VME).

A main driver of migration projects is the total cost of ownership of these systems. Azure Government has been shown to offer significant savings over IBM Mainframe, Unisys Mainframe, and IBM Db2. It also provides public, private, and hybrid options for deployment.

Types of mainframe applications

Regardless of how mainframe applications are used, certain server components are common in their architecture:

- **Online transaction process (OLTP) systems.** Many mainframes have OLTP systems that process millions of updates for thousands of users. These applications often use transaction processing, screen handling, and form-entry software, such as Customer Information Control System (CICS), Information Management System (IMS), and Transaction Interface Package (TIP).

- **Data-ingestion systems.** Mainframes ingest large batches of data for processing of retail systems, financial services, and manufacturing solutions.

- **High availability.** Mainframe systems often offer 99.999-percent uptime when mainframe coupling is used together with Parallel Sysplex or a similar clustering technology.

Some mainframe systems include solutions that combine all of these components.

The following sections describe how applications using these types of components can be migrated to Azure Government.

Online applications on Azure Government

In mainframe environments, a transaction monitoring system is typically used for online applications. CICS, IMS, and TIP systems are often referred to as transaction processing (TP) monitors. They allow business logic to be combined with entry forms and with data transactions.

When moving these applications to Azure Government, you can use an emulator for mainframe TP monitors as Figure 1 shows. These are available from various vendors and run in virtual machines (VMs), an infrastructure-as-a-service (IaaS) option on Azure. The screen handling and form entry functionality is commonly implemented using web servers, which can be combined

with database APIs for data access and transactions, such as ActiveX Data Objects (ADO), Open Database Connectivity (ODBC), and Java Database Connectivity (JDBC).

Examples of mainframe TP monitors include the following:

- Micro Focus Enterprise Server

- TmaxSoft Open Frame

- NTTData UniKix

- Raincode CICS

- GT Software NeoKicks

- LzLabs Software Defined Mainframe

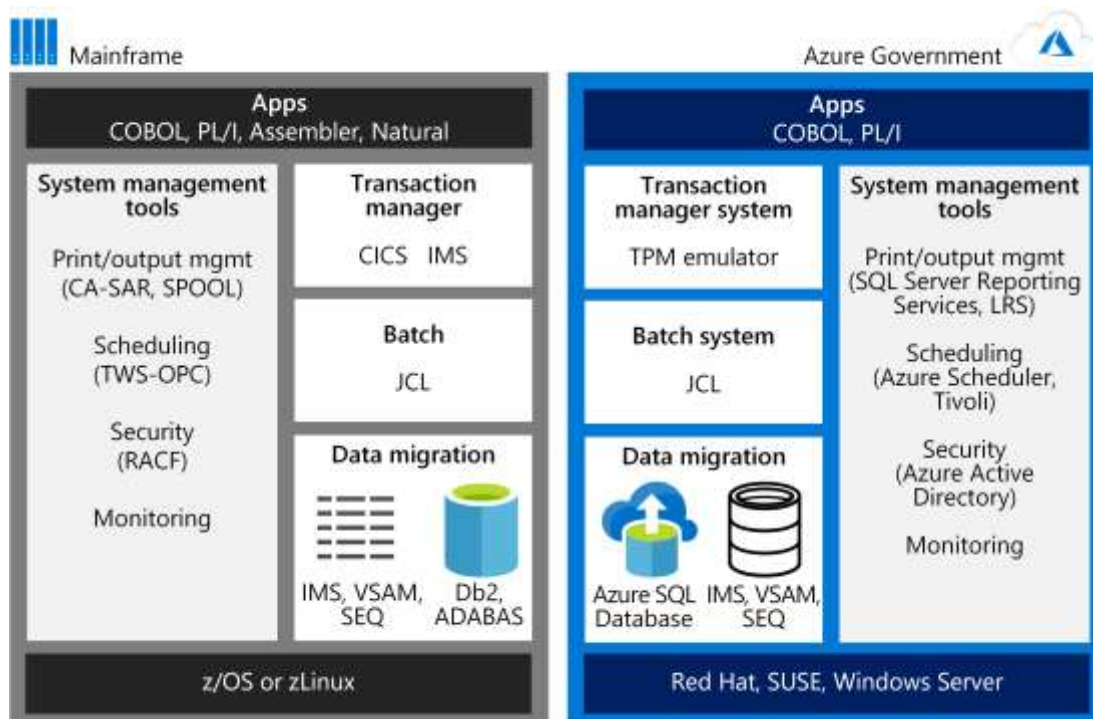For more mainframe migration solutions, see the Platform Modernization Alliance website.

Figure 1. In this customer example, a factory tracking system was moved from IBM z/OS to Azure Government. Mainframe emulators were used on Azure for the Transaction Manager, Batch, and the data shown in white. Azure services or other software hosted in Azure VMs can be used for the system management tools.

Using IaaS on Azure, you can deploy a combination of web servers and data access software for screen handling and business logic. The exact line-up of components depends on the operating system you prefer to run on the Azure VMs:

- If Windows Server, you can use Internet Information Server (IIS) along with ASP.NET for the screen handling and business logic. You can use ADO.NET for data access and transactions.

- If Linux, Java-based application servers are available. For example, you can use Tomcat for screen handling and Java-based business functionality, and JDBC for data access and transactions.

This approach works the same on Azure Government as on global Azure—with one major exception. The emulators or application servers may use ports that are locked down by default in Azure Government. If this is the case, open the ports for specific VMs in the environment or use alternative ports. An example is a license verification server needed by a third-party product.

Keep in mind the Azure Government P-ATO for FedRAMP requires an ATO for each use and takes into account any ports that are not locked down by default. An alternative is to configure the emulation or server software to use a port that is open by default in Azure Government.

When you get your online application running in Azure Government, you can size it according to the throughput needed at any given time. Applications can use features such as Azure Virtual Machine Scale Sets, an autoscaling mechanism, and Azure Load Balancer, which distributes inbound and outbound flows. In addition, you can easily resize a VM. For details, see the What are virtual machine scale sets? and What is Azure Load Balancer? articles.

Batch applications on Azure Government

Batch operations in Azure Government differ from the typical batch environment on mainframes. Mainframe batch jobs are typically serial in nature and depend on the IOPS provided by the mainframe backbone for performance. Cloud-based batch environments use parallel computing and high-speed networks for performance.

To optimize batch performance in Azure Government, consider the compute, storage, networking, and monitoring options in the following table.

Table 1. Considerations for optimizing batch performance

Considerations	Recommendation
Compute	- Use VMs with the highest clock speeds. Mainframe applications are often single-threaded, and mainframe CPUs have very high clock speeds. - Use VMs with a large memory capacity to allow caching of data and application work areas. - Use VMs with higher density vCPUs to utilize multithreaded processing if the application supports multiple threads. - Consider using parallel processing. Azure easily scales out to deliver more compute for a batch run.

Storage	- Use Azure Premium SSD or Azure Ultra SSD (in preview as of October 2018) for maximum available IOPS. - Use striping with multiple disks for more IOPS per storage size. - Consider using partitioning for storage to spread IO over multiple Azure storage devices.
Networking	Use Azure Accelerated Networking to minimize latency.
Monitoring	Use monitoring tools. Azure Monitor, Azure Application Insights, and Azure logs enable administrators to monitor any over-performance of batch runs and help eliminate bottlenecks.

Scale and throughput for Azure Government

Mainframes scale up, the cloud scales out. This is an oversimplification, of course—mainframes can scale out with the use of the Coupling Facility (CF). However, a CF offers tightly coupled compute, whereas the scale-out features of Azure Government are loosely coupled.

To optimize scale and throughput of mainframe-style applications running on Azure Government, it's important to look at how a mainframe separates and isolates applications. A z/OS mainframe uses a feature called logical partitions (LPARs) to isolate and manage the resources for a specific application on a single instance. For example, a mainframe might use one LPAR for a CICS region with associated COBOL programs, and a separate LPAR for Db2. Additional LPARs are probably used for the development, testing, and staging environments.

On Azure Government, it's more common to use separate VMs to serve this purpose. Azure architectures typically deploy VMs for the application tier, a separate set of VMs for the data tier, another set for development, and so on. Each tier of processing is optimized using the most suitable VMs and features for that environment. Each tier can also provide appropriate disaster recovery services. For example, production and database VMs can support hot or warm recovery, while the development and testing VMs require a cold recovery.

Figure 2 shows how functionality that is separated using LPARs on the mainframe (the production, testing, and development environments) can be migrated to VMs on Azure Government.
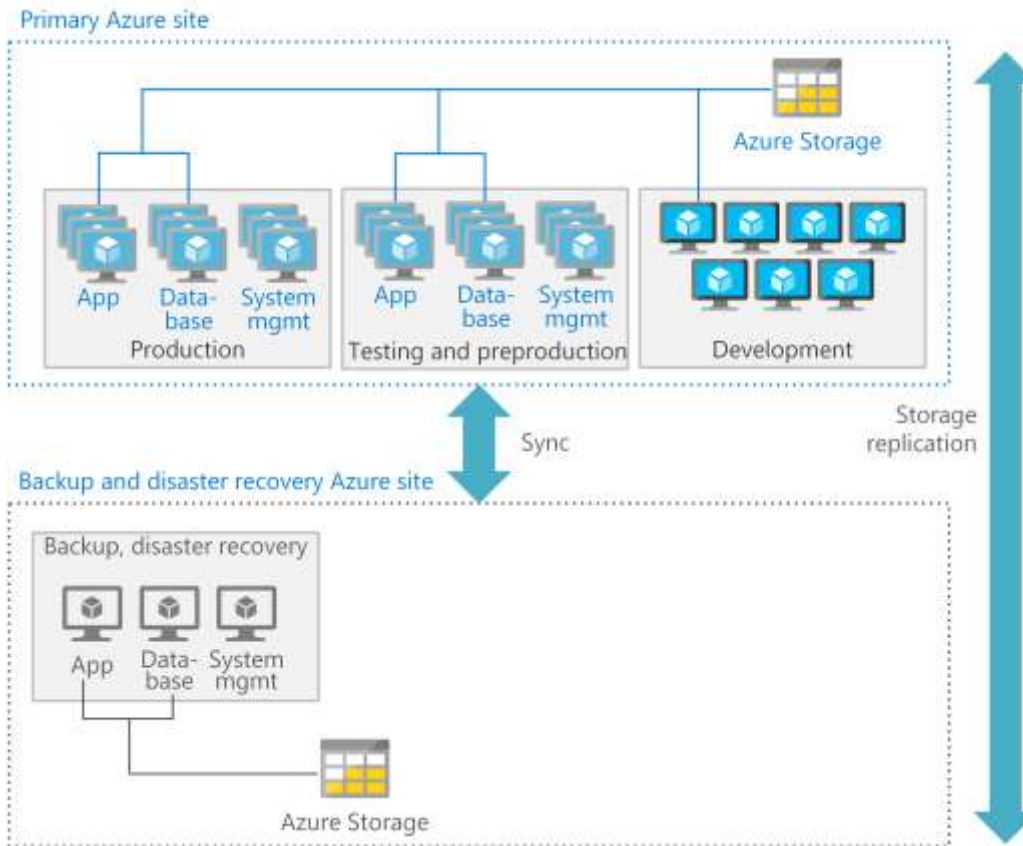
Figure 2. Possible deployment using primary and disaster recovery sites. VMs outlined by dotted lines are deployed with high availability.

For more information about making applications more scalable, resilient, and manageable on Azure, see Ten design principles for Azure applications.

Summary

Planning an application migration is the ideal time to add value and agility to even well-established mainframe workloads. Azure Government delivers the advantages of a mainframe in a more cost-efficient and agile environment suitable for running even mission-critical mainframe applications. Moreover, Azure Government offers integration with load balancing, Big Data, artificial intelligence, and other capabilities that are not as easily done with mainframes.

Although Azure Government is a completely isolated version of the Azure cloud, most Azure features are supported on Azure Government—and will continue to be. New Azure features are designed to meet the security requirements of United State government applications. As of this writing, the global Azure cloud is undergoing approval for FedRAMP High P-ATO (with the exception of data isolation to the United States).

Typically, it takes some time before global Azure features are added to Azure Government because of the required certification process. Microsoft works closely with government agencies to minimize this lag time. For the latest list of features, see the Azure Government website.

Learn more

For more information about Azure Government, see these resources:

- [Microsoft Trust Center: FedRAMP](#)
- [Platform Modernization Alliance: IBM Db2 on Azure](#)
- [Azure Virtual Data Center: Lift and Shift Guide](#)

For technical details about Azure migration, see these resources:

- [GlusterFS iSCSI](#)
- [IBM Data Studio](#)
- [Creating required users for a Db2 pureScale Feature installation](#)
- [Db2icrt - Create instance command](#)
- [Db2 pureScale Clustered Database Solution](#)