IBM Mainframe to Oracle Cloud Reference Architecture

Astadia Mainframe-to-Cloud Modernization Series

Abstract

In businesses today, across all market segments, cloud computing has become the focus of current and future technology needs for the enterprise. The cloud offers compelling economics, the latest technologies and platforms, and the agility to adapt your information systems quickly and efficiently. However, many large organizations are burdened by much older, previous generation platforms, typically in the form of a mainframe computing environment.

Although old and very expensive to maintain, the mainframe platform continues to run the most important information systems of an organization. The purpose of this reference architecture is to assist business and IT professionals as they prepare plans and project teams to start the process of moving mainframe-based application portfolios to Oracle Cloud. We will also share various techniques and methodologies that may be used in forming a complete and effective Legacy Modernization plan.

In this document, we will explore:

- Why modernize a mainframe
- The challenges associated with mainframe modernization
- An overview of the IBM mainframe
- The IBM Mainframe to Oracle Cloud Reference Architecture
- An overview of Oracle Cloud services
- A look at the Astadia Success Methodology

This document is part of the *Astadia Mainframe to Cloud Modernization Series* that leverages Astadia's 25+ years of mainframe platform modernization expertise.

12724 Gran Bay Parkway, Suite 300
Jacksonville, FL 32258

Contents

This page intentionally left blank.

Introduction

The Oracle Cloud computing platform is an excellent target environment for transitioning from a mainframe workload to a cloud implementation. With the security features of Oracle Cloud and the ability to scale based on demand for the services, Oracle Cloud offers a complete operational environment in support of mainframe workloads that have been migrated to the cloud. In addition, Oracle Cloud supports innovation of the application portfolio, previously held captive by the inflexible nature of a mainframe computing model, improving the productivity of application developers and support personnel.

Even more than a typical IT project, planning to modernize mainframe applications is the most important phase of the total project effort. A good place to begin is with a thorough assessment of the existing overall mainframe application portfolio. Through the assessment process, all aspects of the existing portfolio will be inventoried and examined in detail, resulting in a catalog of each application, database, technology platform and business user profile currently in use. Once completed, the results of this application rationalization will then guide the sequence of application migration, as well as the different modernization strategies and techniques that may be called upon over the course of the entire project. We've included an overview of how Astadia tackles Legacy Modernization projects with our Success Methodology to give you an idea of what's involved.

Don't let the enormity and importance of a mainframe modernization project deter you from getting started. The skilled individuals needed to continue to maintain mainframes are increasingly leaving the workforce through retirement and are not being replaced. Hardware and software maintenance costs continue to escalate and the demands of customers, employees and partners require greater innovation than mainframe platforms can support.

How to Use This Reference Architecture

Begin by reading the "Why Should I Migrate" section first. From there:

Mainframe Experts: Skip to the IBM Mainframe to Oracle Cloud Reference Architecture and the Understanding Oracle Cloud sections

Oracle Cloud Experts: Start with the Understanding Typical IBM Mainframe Architecture section, followed by the Reference Architecture.

Business Leaders: Spend time with the "Why Should I Migrate…" section and the Ensuring Project Success section at the end.

About Astadia

Astadia has been in the legacy modernization business since 1994 and has successfully completed more than 200 mainframe modernization projects. Our repeated success has allowed us to develop a comprehensive methodology, proprietary software tools and techniques, as well as the "know how" that comes with more than 25 years of experience handling mission critical applications and data. We're pleased to share some of that experience with you through our Mainframe to Cloud Modernization Series of reference architectures, webinars, whitepapers and more. Visit our website at www.astadia.com for additional information.

Why Should We Migrate Our Mainframe Apps to Oracle Cloud?

Over the past 10 years, public cloud computing has emerged as the foundation of future enterprise technology. In terms of technology generations, mainframes are at least two generations old, perhaps three. Yet, they still survive today and are responsible for running key financial, healthcare and other vital and sensitive systems around the world.

So, why should you migrate your mainframe workloads, why migrate them to Oracle Cloud and why is now the right time?

Benefits of Mainframe Modernization

The specific benefits in moving any mainframe workload will vary between organizations and even at the application and database level. In general, here are three of the top reasons driving legacy modernization projects today:

Cost – The economics of cloud computing are compelling when compared with the status quo of maintaining a mainframe environment. A total cost of ownership (TCO) evaluation of the subscription-based, consumption driven cost model of the cloud versus the exorbitant hardware & software maintenance costs of mainframes will show a very appealing and short-term achievable ROI (potentially less than 12 months from project completion).

People – Mainframe-specific technical skills are not being replaced by today's college or technology trade school graduates. The pool of available talent with relevant knowledge and experience is shrinking exponentially each year. The cloud leverages modern technology and its use is ingrained into young software engineers worldwide.

Flexibility – The cloud offers an Open Systems environment in which high productivity and rapid innovation happen at a tremendous rate. A properly designed implementation of a cloud infrastructure scales easily and quickly, both expanding and collapsing to synchronize with business demand. Backup, redundancy and disaster recovery is seamless. Support for multiple end-user platforms and devices is inherent. Database sharing across the enterprise with high performance is achievable.

Approaches to Mainframe Modernization

You may notice throughout this document that we use the terms "Mainframe Modernization" and "Mainframe Migration". Migration is a type of modernization, whereas modernization encompasses a broader set of strategies or options. In many cases, you will employ a combination of these strategies, the right mix of which ones will be determined during the critical application portfolio rationalization step of the project's assessment phase. Here are three of the most common approaches:

Reuse – Often called "lift and shift", this is a process that reuses the existing code/program/applications, typically written in COBOL, by moving them off the mainframe, and recompiling the code to run in a mainframe emulator hosted in a cloud instance. This approach minimizes the upfront risks and the length of the project, realizing hardware and software cost savings soonest.

Running mainframe applications in an Oracle Cloud-hosted emulator also opens the possibility of innovation leveraging APIs to previously inaccessible programs and data.

Rewrite – It may be tempting to say, "Let's just write new programs from scratch," to modernize the mainframe applications. This approach is extremely risky and fails a vast majority of the time. It is complex, costly, and time consuming. The resources and investment required tends to greatly exceed the forecast.

A new, modern codebase may still be the correct end objective, but a better approach would be to first move the applications to a cloud-based emulator, migrate the database to a cloud-based database, then focus on replacing modules/code over a deliberate, multi-phased approach. When it is time to rewrite, there are several code transformation engines you can choose from to reduce the effort and minimize the risk.

Replace – Another mainframe modernization approach is to completely replace the mainframe functionality with a program or suite of programs, typically a Software-as-a-Service (SaaS) application. You typically see this with purpose-built solutions for finance, human resources, manufacturing, enterprise resource planning, etc. There are also industry specific apps that may solve the problem that a custom mainframe solution was needed for decades ago.

The upside of using SaaS is that your organization no longer worries about maintaining code. However, you will find that while you can *configure* a SaaS application with various options provided by the vendor, you will not be able to *customize* your instance, as the shared codebase runs all tenants (customers/organizations) using the "service".

There are additional variations on these three modernization approaches and you'll likely use several strategies in achieving your goal to completely migrate from the mainframe. It is commonly accepted best practice among legacy modernization practitioners to primarily use the lower-risk, lower-cost Reuse approach first to capture the gains and benefits in the shortest time possible, followed by a deliberate and phased approach to Rewrite or Replace the applications.

Challenges of Mainframe Modernization

Mainframe migration projects are complex and require close management of the process, budgets and timelines that have been set as project goals. A Reuse approach will involve rehosting (from mainframe to Oracle Cloud) and likely some re-engineering and refactoring to complete an entire mainframe migration. It will also involve data and file conversions for transitioning the database to the cloud.

As we've been emphasizing, the first challenge of any mainframe modernization project is to develop a rock-solid plan built upon a thorough application portfolio assessment and rationalization. As you put your plan together and begin to execute, here are additional factors you'll need to watch out for:

Documentation

Many mainframe environments with large and complex application portfolios do not have documentation that details what these mainframe applications do, and how they do it. Many applications are decades old, so the original system, with changes likely every year, has become a maintenance nightmare. The external interaction with these systems, the Input/Output, is how these systems get defined to the business, and the rest of the system is just a black box.

Migrating a minimally-documented system of this nature is tricky and the testing prior to the "go live" deployment is critical to mitigating this issue. (And, of course, copious documentation should be captured for the resulting system.)

Application-specific Challenges

There are a couple of general points about the application portfolio that should be noted. As mentioned above, the lack of documentation on these aging systems makes the migration effort more difficult. The project team that drives a migration project must then resort to "mining" the actual application source code to determine exactly the behavior of the application.

Another important application-specific issue for consideration is discovering the integration requirements and dependencies of the application with other systems and databases. These integrations and dependencies must be clearly identified and, if still needed, they must be re-connected (possibly rebuilt) and made operational along with the migrated system.

Running Parallel Systems

For a short while, there may need to be some parallel processing between the mainframe application, while it is still being used in production, and the newly migrated system, on the new platform. Planning and executing this parallel processing will be a challenge, and will require extra time and attention to make it successful.

Another example of when you may choose to run parallel systems is if you want to achieve quick reductions in mainframe processing consumed by moving the development and test environments to an Oracle Cloud-based emulator while keeping the production system on the mainframe for the interim.

Data Integrity

Moving the contents of large databases is very challenging on a number of levels. Typically, a database "cleanup" will be necessary to ensure that the contents of the new target database is as accurate, and as complete, as possible.

A mainframe modernization project is a good time to transform, correct and validate the organization's data.

Speed to Completion

In almost every project, speed will be a top priority. The costs and complexities of extended project cycles can have an enormous negative impact in tangible and intangible terms. As project cycles get extended, staff attrition can become a big issue and staff fatigue may also become a factor.

Paying for a continuation of the primary production system and funding the development efforts of the new system at the same time will have a temporary financial impact for as long as that duality continues. Getting to a "go live" status quickly and efficiently with the new system, and retiring the old system, will keep unexpected costs to a minimum.

Project Funding

It is very important for any modernization project to be properly funded and supported by the business management team and the executives. This support is essential to maintain project continuity and funding throughout the project cycle. Since we stated earlier that speed will be a factor in the project execution, funding must be in place to sustain that speed.

Expertise

Mainframe migration projects come in many forms. In every case, a variety of specialist skills will be needed on the project team. These specialists may include business analysts working to mine and understand the business rules embedded in the legacy applications.

It will also include experts in specific programming languages, databases, networks, terminal devices and many other components of the total application portfolio that will need to be addressed over the course of the migration to the target platform. Staff must also be available to address any specific functionality or use case of the mainframe application environment.

All this technology must be transferred to the equivalent functionality on the target cloud platform and work as it did in the original mainframe environment. Thorough testing by the project team, followed by testing amongst the business users of the original mainframe application system, is an absolute requirement. Once testing is completed, a final performance and tuning (P&T) exercise will ensure that the new cloud deployment is performing at optimal levels.

Why Oracle Cloud?

Organizations keep discovering new and improved benefits for moving their mainframe (as well as other) workloads to the public cloud such as flexibility, scalability, automatic backups, automatic software upgrades, cost model optimization, versioning control and adding multiple security layers, just to name a few.

Oracle Cloud is a recognized leader in the public cloud space with a diverse customer base and a broad range of use cases. Oracle has more than 10,000 customers and more than 25 million users that rely on Oracle Cloud every day. This attracts open source application developers as well as service providers to make their applications compatible or add their services to Oracle Cloud.

The benefits of migrating your mainframe to Oracle Cloud are:

Easy to Use – Oracle Cloud is designed with simplicity in mind. You can request new services and host your applications using their simple to use web-based Oracle Cloud Portal. All their services are well-documented and there is a wealth of forums, white papers, and discussion boards.

Flexible - You can select from a wide variety of virtual environments where you choose the software and services your application requires. If you find that the environment selections are not adequate, you can simply provision different types of instances or add compute and/or storage on demand.

Cost-Effective - Oracle Cloud services are billed using a consumption model; you only pay for the compute and storage resources you use with no upfront commitments and contracts. Alternatively, if you know you have a minimal level of needs, you can sign longer-term contracts for additional savings.

Reliable - With Oracle Cloud, you are taking advantage of its highly redundant, worldwide computing infrastructure that is built to guarantee high availability that rivals or exceeds what you've come to expect from mainframes.

Scalable - Oracle Cloud includes tools such as auto-scaling and load balancing that allow your applications to scale up or down, if you design/architect this into your solution. Oracle Cloud's massive compute and storage infrastructure guarantees that resources will be available when they are needed.

High Performance - Oracle Cloud offers a wide selection of compute and storage options to replicate or exceed the performance needs of your formerly mainframe-based applications. Compute and storage can be provisioned as they are needed, so if your application is CPU intensive you can have a larger CPU/IO ratio and vice versa.

Secure - Oracle Cloud provides several security capabilities and services to improve privacy and network traffic. These include network firewalls, a

securely featured Virtual Cloud Network, encryption in transit, and private or dedicated network connections.

Achieving the Positive Impact of Change

In any mainframe migration project, the results of a cloud-based application set may be daunting. The change will impact the technical staff, as they will likely need to learn new skills.

The end-user community may not notice too many changes using a new system if the interfaces are preserved. In fact, the move to the cloud could fuel new innovation resulting in new capabilities down the road, which are likely not available to mainframe users today.

The overall impact of a successful mainframe migration project is a positive one for the entire organization. A new and better application portfolio, a cloud platform to enable innovation, and a large cost savings in the operational and systems software maintenance categories will be realized. It's not unusual to repurpose IT staff after redeploying the mainframe portfolio to the cloud. The cloud platform has many other benefits, but flexibility and cost takeout are at the top of the list.

Understanding Typical IBM Mainframe Architecture

Since their development in the late 1940s, general-purpose mainframes were the computing workhorses for more than 50 years. Over that time, each mainframe manufacturer continuously enhanced their unique architectures to outperform competitors and meet evolving business demands. IBM and Unisys eventually dominated the market and became the gold standards of mainframe computing. This **IBM Mainframe to Oracle Cloud Reference Architecture** is part of the *Astadia Mainframe-to-Cloud Modernization Series* of architectures, whitepapers and webinars.

IBM Mainframe Heritage

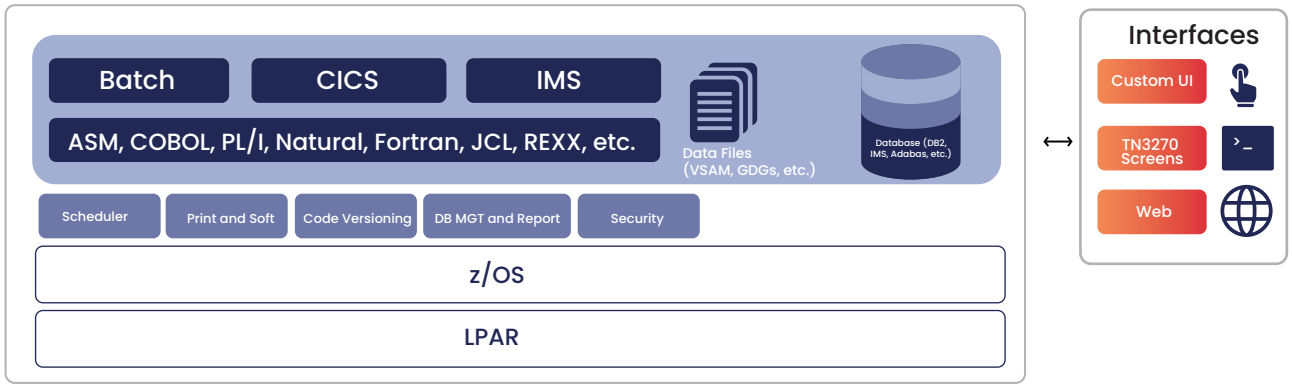
IBM began producing mainframes in 1952. These early models, known as the IBM 700 Series, were based on vacuum tube technology. The next generation, IBM 7000 Series, saw the introduction of transistor technology and became the mainstay of their mainframe business for many years, with some models remaining in service up to the 1980s.

In 1964, IBM announced availability of the System/360, with the "360" representing the idea of 360 degrees – as in, an all-around computing system. Previous IBM mainframes were delivered with no software since it was expected that the customer would write all programs. These programs were loaded and execute manually, one at a time.

With the release of the System/360, IBM delivered software such as compilers for programming languages and early operating systems. Instead of these very expensive machines sitting idle while operators loaded jobs manually, programs could be executed using a queuing mechanism to improve efficiency and ROI. IBM-provided software quickly grew in its complexity and became an important piece of its mainframe computing solutions.

The System/360 also consolidated support for processing features, like decimal arithmetic, floating-point arithmetic, and byte addressing. These features were previously available only in models built for specific purposes like business or scientific calculations.

As technologies and software advanced, newer models were released as System/370 and System/390, culminating in the 64-bit eServer zSeries, z Systems, and IBM's current line of zEnterprise mainframes. The "z" refers to "zero downtime" since the models are built with components that provide hot failover capabilities.



IBM Mainframe Components

User Interfaces

Users access the mainframe application through a variety of means. They could use green screen terminal emulators that provide character mode interface (TN3270).

Alternatively, a variety of custom user interfaces could be built on top of the character mode interface that allows a more user-friendly interface to mainframe applications. One of such user interfaces could be a web-based or mobile application serving as a front end to the mainframe.

Batch

Mainframes provide batch environments that handle bulk data processing workloads. Jobs are submitted to the system using JCL and processed with minimal operator interaction. Output from the batch jobs is spooled, printed and distributed to users.

Transaction Processing

Transaction processing is at the core of most mission-critical applications *with thousands or millions of transactions being processed daily*. IBM mainframes provide online (real-time, on-demand) processing environments (most commonly, CICS and IMS) that make this possible. Security, transaction integrity, and predictable response times are of particular importance for this type of workload.

Programming Languages

Mainframes provide an assortment of programming languages to suit customer needs. Most applications are written in COBOL but other languages are also used: Assembler, PL/I, Natural, Fortran, REXX, etc. 4GL development products like Mantis, Informix 4GL, and APS (AppMaster) are also used to develop mainframe applications.

Data Files

Mainframes store data in files with different record organizations and media types. Data files can be sequential, direct access, fixed and variable lengths, blocked or unblocked, etc. Data files can be stored on disks, magnetic tapes, CDROMs, etc. Some examples include VSAM, GSAM, and ISAM. For the most part, data in these files are stored in EBCDIC (Extended Binary Coded Decimal Interchange Code), an eight-bit character encoding system used primarily on mainframes.

Databases

Mainframes provide high performance database management systems to support online mission critical applications. In general, these databases can be hierarchical (IMS DB) or relational (DB2), and they provide high levels of availability, integrity, consistency, reliability, security, and auditing.

Database software makes intensive use of the computing and input/output capabilities of the mainframe to provide optimal response times. IBM offers specialized processors for database workloads to reduce the burden on general processors.

Environmental software

Mainframes require software to support the management, operation, application development, and security of the system.

Software tools like Time Sharing Option (TSO) and Interactive System Productivity Facility (ISPF) are used by administrators and programmers to create, store, print and delete datasets as well as submit batch jobs.

Job scheduling software is used to automate and manage batch job execution and workflow streams. Output management systems handle the collection, storage and distribution of reports to users. Source management systems are used to maintain application source code by tracking version as well as release lifecycles.

Terminals and terminal emulation software allow users to interact with mainframe software and applications. The Telnet 3250 (TN3270) communication protocol is used to communicate between the mainframe and a terminal session.

Security is tightly controlled at all levels of the mainframe software. Software provided by IBM, such as Resource Access Control Facility (RACF) and Access Control Facility 2 (ACF2) by Computer Associates, cooperate with system components to provide a robust yet secure environment for applications and data. Security software is designed to minimize the risk of data exposure and provide regulatory compliance.

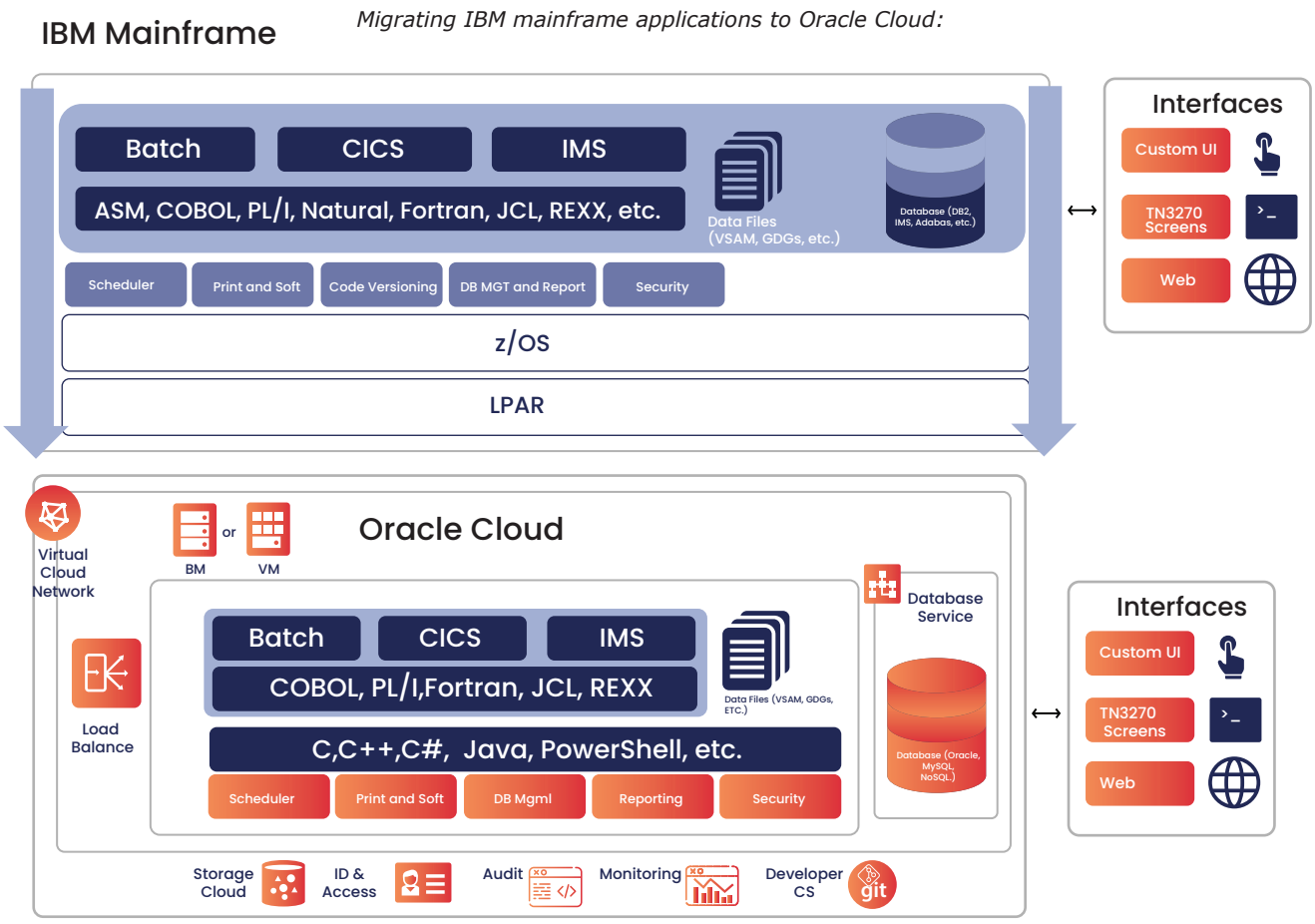
IBM Mainframe to Oracle Cloud Reference Architecture

As a Reference Architecture, the following diagrams and discussion addresses a typical use case. However, each implementation is sure to have its own customizations and variations, which is why a thorough application portfolio inventory, assessment and rationalization is critical to a successful outcome.

Below, you will see a design that includes details such as Oracle Cloud components, batch requirements, programming language conversions and replacements, integration with external systems, 3rd-party software requirements, and planning for future needs.

In an actual project, you would also consider any unique features that would necessitate custom-made solutions. We would recommend proof-of-concept conversions on application subsets to test the model selected, discover any weaknesses, and prove the viability of the design.

Migrating IBM mainframe applications to Oracle Cloud:



Code Modification

As part of any mainframe modernization project, there will be a need for partial or, in some cases, extensive code modification. Leveraging our past experience in migrating IBM mainframes to on-premises open-systems platforms, Astadia has developed an extensive set of code transformation technologies and processes to successfully re-platform mainframe workloads. We use these in concert with trusted products, such as Oracle Tuxedo and Oracle Tuxedo ART, to modify source code and deploy to Oracle Cloud. What follows is a description of our approach.

Astadia employs an iterative, hybrid process of automated code conversion and human intervention. The technology behind the automation is Astadia's Rules-Based Transformation Engine.

This tool preserves the business logic and rules of legacy applications while removing proprietary code that can only execute in the source environment and not in Oracle Cloud. Its code migration filters ensure the preservation of mission-critical applications and back-end components such as trancodes, security policies, and message routing.

Though the Rules-Based Transformation Engine (RBTE) is a proven technology, Astadia augments our technology with years of hands-on migration experience and collaboration with partners. The combination of automation and human intervention ensures that legacy applications will work in Oracle Cloud without sacrificing their original functionality.

Although every mainframe migration is unique, there are general source-to-target mappings for application components that apply to most projects, as shown in the following table.

Code Modification Mapping Table

Source	Target
z/OS, MVS, VSE	Oracle IaaS-BareMetal or Compute VM (Linux/Windows/Unix)
CICS	Oracle Tuxedo, Micro Focus, GT Software (Fujitsu)
IMS	Oracle Tuxedo, Micro Fucos
Assembler	COBOL, C#, Java, or mapped to OS functions
JCL	JCL, PowerShell, other scripting
COBOL	COBOL, C#, Java
Natural	Natural, COBOL, C#, Java
FORTRAN, PL/I	FORTRAN, PL/I, COBOL, C#, Java
REXX, PL/I	REXX, PowerShell, other scripting

These mappings are only a guideline for the most common mainframe technologies. Other technologies are addressed on an as-needed basis.

Database Migration

In parallel with code modification, data specialists will need to perform a thorough analysis of the legacy databases and files, and develop a detailed data migration strategy.

We recommend an iterative extract, transform and load (ETL) process to identify potential data-typing issues, develop fixes, and collaborate with the application subject matter experts to validate their efficacy. This iterative process continues until every issue is eliminated.

In most cases, hierarchical and flat file data structures will be replaced with RDBMS solutions, but other solutions may be implemented to address unique technical requirements or preferences.

After the target database and file structures have been created and validated, static data can be migrated to the Oracle Cloud production environment. For dynamic or other data that is created and/or modified frequently, a data migration strategy must be implemented as part of production cutover process.

Like the application component mapping above, there are general source-to-target data mappings employed by most mainframe-to-Oracle Cloud migrations

Database Migration Mapping Table

DMS	Oracle Database Cloud Service, Oracle database Express service, MySQL Cloud service etc.
DMSII	Oracle Database Cloud Service, Oracle database Express service, MySQL Cloud service etc.
RDMS	Oracle Database Cloud Service, Oracle database Express service, MySQL Cloud service etc.
Flat files	Flat File or Oracle Database Cloud Service, Oracle database Express service, MySQL Cloud service etc.

These mappings are only a guideline for the most common mainframe database and file technologies. Other technologies are addressed on an as-needed basis.

Oracle Cloud/IBM Mainframe Integration and Parallel Operations

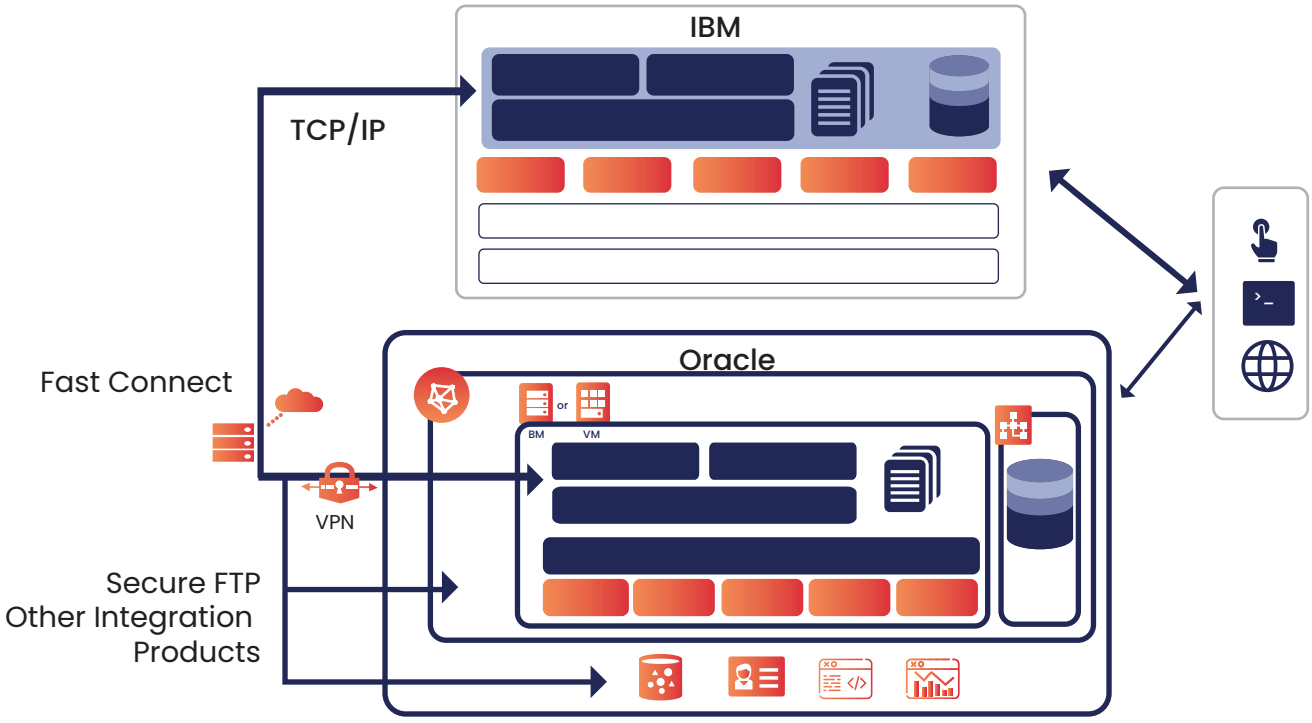
For some organizations, a one-time deployment and cutover of all mainframe applications to Oracle Cloud simply isn't feasible.

There may also be organizations who prefer to move applications one at a time or in smaller groups as a way of gradually embracing Oracle Cloud as a solution for their big-iron applications.

Still others may intend to keep their mainframes indefinitely for a subset of strategic, mission critical applications while migrating less critical applications to Oracle Cloud as a means of reducing their costs or delaying upgrades to existing mainframe hardware.

There's good news here - it is possible to do a phased rollout of migrated applications and still have ongoing communication and integration with applications residing on the IBM mainframe. This kind of mixed environment can be achieved with the proper planning, and will generally resemble the image below.

IBM mainframe integration with applications & data already migrated to Oracle Cloud



Understanding Oracle Cloud

Oracle Cloud has provided the technology and services that make running mainframe applications in the cloud a safe, securely featured, reliable way to achieve high performance results and fuel future innovation for the organization.

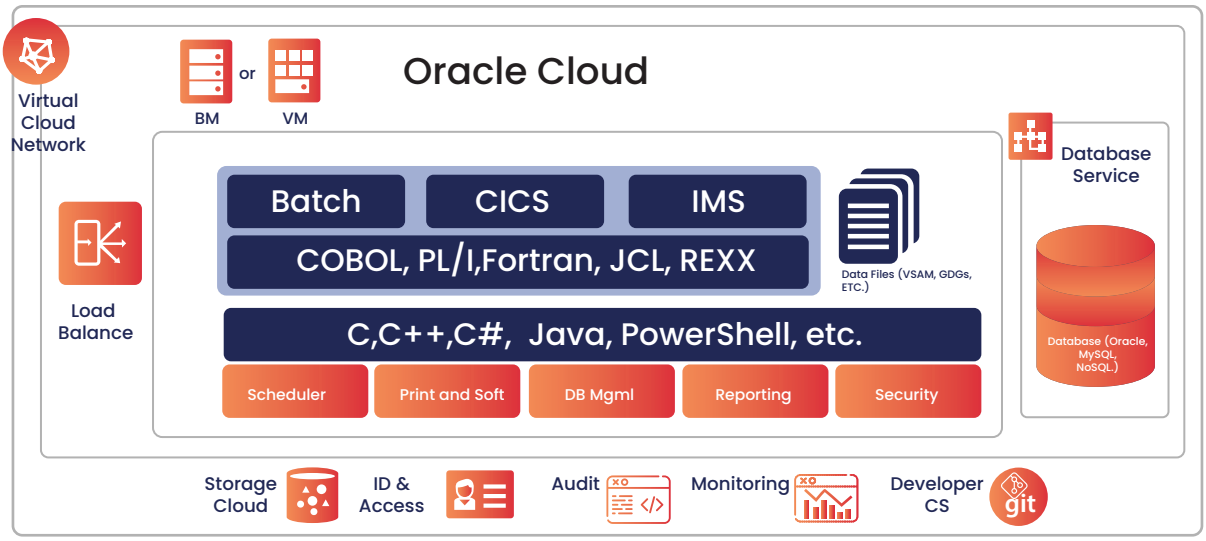
There are specific elements of Oracle Cloud that are relevant to a mainframe modernization project. Below, we address some of these – this is not the extent of all Oracle Cloud services nor is it meant to exclude the use of other Oracle Cloud service offerings.

Let's begin with Oracle Cloud's value proposition:

"Oracle Cloud is the industry's broadest and most integrated public cloud. It offers best-in-class services across software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS), and even lets you put Oracle Cloud in your own data center. Oracle Cloud helps organizations drive innovation and business transformation by increasing business agility, lowering costs, and reducing IT complexity."

In the following section, we'll take a deeper look at the Oracle Cloud portion of the Reference Architecture and the components identified.

Oracle Cloud Architecture Supporting the Migration of IBM mainframe Applications



Your Cloud Environment

Oracle Cloud's Virtual Cloud (VCN) Network lets you provision a logically isolated section of Oracle Cloud where you launch and manage Oracle Cloud resources in a VCN that you define. It's your private area within Oracle Cloud. You can think of this as the fence around systems you have in Oracle Cloud.

You have control over your virtual networking environment, including selection of your own IP address range, creation of subnets, and configuration of route tables and network gateways. A single "tenant" can create multiple VCNs, which allows related resources to be grouped and isolated, if desired. You can use both IPv4 and IPv6 in your VCN for secure and easy access to resources and applications.

Computing Resources

Oracle Iaas Cloud offers two types of compute services: standard Compute Services and Bare Metal Compute Services. Both services offer an option for dedicated hardware, including engineered systems, in Oracle Cloud's data centers, as well as typical hardware-sharing cloud architectures.

These services provide securely featured, scalable compute capacity and serves as the foundation for your migrated Unisys mainframe applications. They are the containers that hold the operating systems, mainframe emulators, application executables, and other supporting software that make up your applications.

The specific service you choose will depend on your specific circumstances. You may separate some applications or their components into their own compute instances, or you may run everything into one instance. For instance, maybe you'll have a compute instance dedicated to batch COBOL and another dedicated to Online, or you may even segregate instances by application.

Storage

Oracle Storage Cloud Services can be thought of as virtual hard drives for storing data. Lots and lots of data. These services can store any type of data, both structured and unstructured. They serve as storage "devices" for everything from on-premise data backups and archiving to virtual machine hard drives and globally-shared data repositories.

For IO Intensive database applications, Oracle offers block storage as well as Flash based storage solutions (NVMe).

All levels of Oracle Cloud storage provide enterprise-strength security features, durability and elasticity to meet the needs of the most demanding applications, and are combined to satisfy the storage requirements of your mainframe applications.

Databases

Oracle's Database Cloud Services are used to store all your legacy relational data. This includes any

flat file or hierarchical data that's been converted to relational. For example, all your IMS DB data would be converted to relational and migrated to an Oracle Cloud database service. DB2 data would also be migrated here.

As you would expect, Oracle Cloud offers Oracle 11g and 12c database services that are optimized for high-performance in Oracle Cloud's environment. It's cost-efficient, has resizable capacity, and is designed to reduce time-consuming database admin tasks. In addition to Oracle database, Oracle Cloud's database services also support MySQL and NoSQL database services.

All Oracle Cloud database services are engineered to provide high-availability, scalability, durability, and, of course, security features. An analysis of your existing legacy databases and applications will determine which database services best fit your needs, and plan your data migration strategy.

Load Balancing

Applications with a high volume of transactions require something to balance the workload. Oracle Cloud's Load Balancing Service does just that. It automatically distributes incoming application traffic across multiple compute instances to achieve scalability, high-performance, and fault tolerance in your migrated applications. It provides the load balancing capability needed to route traffic evenly among your applications and keep them performing efficiently.

Security

In the Oracle Cloud environment, you'll be using Oracle Identity Cloud Service for accessing and maintaining distributed directory information services. While there are other possibilities, this is most likely where you'll map your legacy application user IDs, passwords, permissions, etc.

Hosting identity management services on a smaller separate compute instance often makes it easier to maintain independently of applications. However, a full analysis of your legacy security environment is required to determine how to best architect and configure security in the migrated system.

Oracle Cloud Identity and Access Management (IAM), part of their Governance Services offerings, enables you to create and manage users and groups, and use permissions to allow and deny their access to resources. This is mostly for Oracle Cloud infrastructure security rather than application-level security. Oracle also offers a Governance Service for auditing that logs events for analysis to ensure security and compliance. This includes traceability to record actions, their actors, and outcomes, as well as integrity checks of data to deter and detect tampering.

Monitoring and Management

Every IT system needs to be monitored. Oracle's Infrastructure Monitoring services use purpose-built dashboards to provide a global view of the resources running the legacy applications you've deployed to Oracle Cloud.

You use these services to collect and track metrics, monitor log files, set alarms, and automatically react to changes in your Oracle Cloud resources. This data is used to resolve problems quickly and keep your migrated applications running smoothly – much like you do on the mainframe today. Other cloud-ready monitoring tools are available from 3rd parties as well.

Source Control

Just as you have products and processes to control your application sources and manage application releases on your mainframe today, you need to have a similar set of tools in Oracle Cloud.

Oracle Cloud offers a collection of Developer services that includes GIT repositories for storing your migrated application source code and binaries, new sources, and anything else you want to archive. This eliminates the need to operate your own source control system or worry about scaling its infrastructure,

These tools also provide features for team management, issue tracking, peer reviews, build and delivery functions, as well as automated deployment.

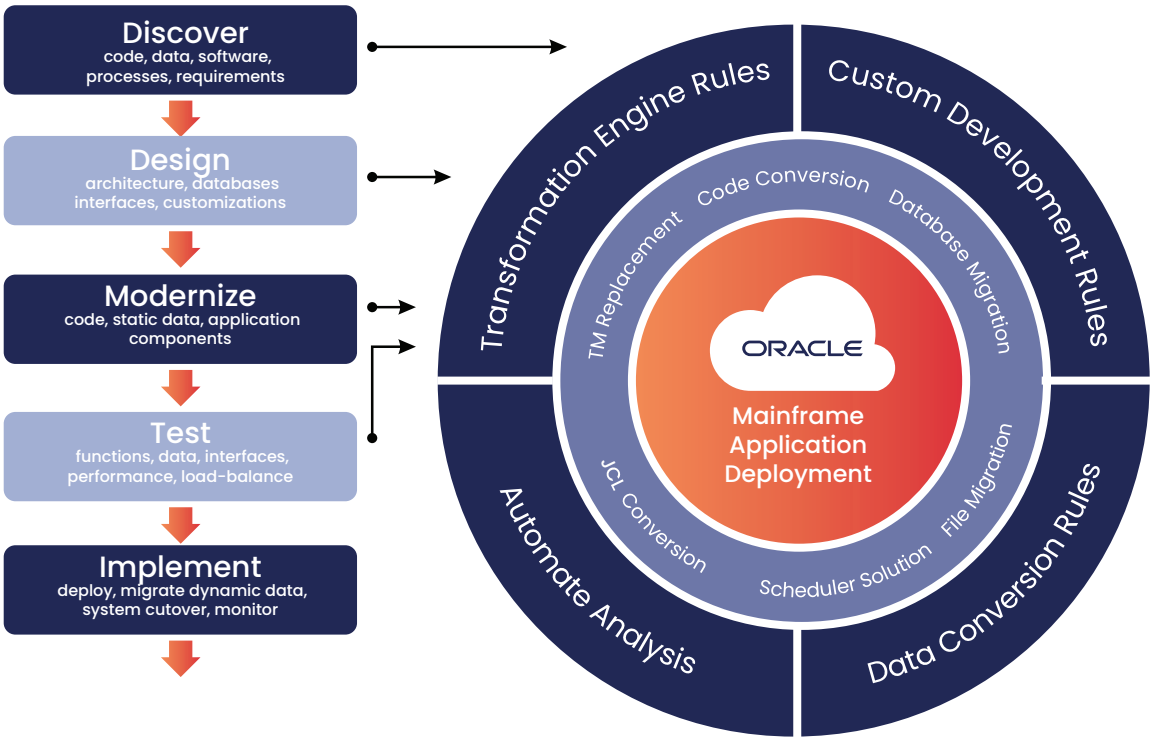
Ensuring Project Success

Astadia's Legacy Modernization practice has more than 25 years of experience migrating legacy applications to modern platforms. Since mainframe applications are the mission-critical systems of the enterprise, Astadia goes to great lengths to ensure a thorough and complete project plan is developed for each legacy modernization project we undertake.

Astadia's methodology recognizes the organizational impact that any project of this nature will have on day-to-day operations, as well as the financial and business implications for organizations in both the short and long term. Return on Investment (ROI), and Total Cost of Ownership (TCO), are carefully calculated during this process, and are closely managed throughout the project lifecycle.

Astadia's Mainframe-to-Oracle Cloud Success Methodology has been refined over the course of 200+ successful legacy migration projects, and has become an industry leading approach for our medium and large scale mainframe clients.

Astadia Mainframe-to-Oracle Cloud Success Methodology



Discover

Catalog and analyze all applications, databases, networks, platforms, and processes in the client's portfolio. Document the interrelationships between applications, and all external integration points in the client's configuration. This is a key input to Application Portfolio Management and Application Rationalization.

Design

Astadia's project team analyzes source code, data structures, end-state requirements, and Oracle Cloud components to design and architect the solution. The design includes details such as types and instances of Oracle Cloud components, transaction loads, batch requirements, programming language conversions and replacements, integration with external systems,

3rd-party software requirements, and planning for future requirements.

Modernize

Astadia employs an iterative, hybrid process of automated code conversion and human intervention to perform the necessary application changes. The technology behind the automation is Astadia's Rules-Based Transformation Engine. This tool preserves the business logic and rules of the client's legacy applications while removing proprietary code that can only execute in the source environment and not in Oracle Cloud. While a least-change, least-risk approach is employed, some source code or supporting components may be converted to new languages for technical reasons or to comply with client preferences.

Test

Since most mainframe-to-Oracle Cloud projects are typically an as-is migration of applications, testing can focus primarily on two areas: the components that have been changed or replaced, and application performance. For the most part, "parallel" testing is sufficient; that is, the results of operations in the source environment must produce the same values in the target environment, except where differences are expected due to platform changes. For performance testing, the focus is on ensuring the user experience is as good or better than the legacy environment and batch processes complete within acceptable timeframes.

Implement

When migrated applications have been tested, verified, and optimized, the process of deploying those applications may begin. In reality, many deployment activities are initiated in parallel with earlier phases – things like creating and configuring Oracle Cloud component instances, installing and configuring mainframe emulation software, migrating static data, and other infrastructure or framework activities. In some cases, environments may be replicated to achieve this, or existing environments may be re-purposed. The specifics of this may depend upon application and data characteristics and client preferences. After dynamic data is migrated and validated, cutover to Production mode can be completed.

Conclusion

Oracle Cloud and Astadia combine to create a perfect next generation platform for your mainframe applications portfolio.

Once the mainframe application set has been fully deployed on Oracle Cloud, you will have the freedom to re-engineer traditional applications in to a more contemporary computing style, modernize legacy interfaces and integrate with other applications. In addition, many new services, like mobile and wireless, can be easily connected to the cloud platform, thus enhancing the overall power of your new cloud computing environment. Your investment will serve to support all the needs of your enterprise and the future requirements of your business.

You don't have to tackle this alone. Astadia has the experience, skilled experts and the technology to successfully help you complete Legacy Migration projects of all scopes and sizes.

Astadia would be happy to hear from you about your specific Legacy Migration needs and how we may be of service to you as you prepare to leverage Oracle Cloud.

To connect with an Astadia expert, please contact us at:
Email: info@astadia.com
Web: www.astadia.com
Phone: (877) 727-8234