



Modernize IT Infrastructure: Oracle Mainframe Rehosting

Oracle provides the most complete solution for rehosting mainframe applications and data intact to open systems without losing business value or sacrificing Quality of Service. The result – customers significantly reduce or eliminate mainframe costs, contain MIPS, and accelerate legacy modernization.

“Grupo BBVA has undertaken a major mainframe migration initiative to reduce MIPS consumption in Europe and the Americas and lower our IT costs. We have selected Oracle Tuxedo as the target platform for our CICS and IMS applications because of its robust infrastructure, mainframe compatibility, high availability, and excellent performance.”

– Antonio Gelart, Director,
Central Systems Transformation -
Technology and Operations,
BBVA

“This [Oracle] target architecture is CNAM’s first concrete step in component-based development. Functions are now reusable. Development and Maintenance workload is reduced. Improved responsiveness and IT performance resulted in faster implementation of new features.”

– Maryvonne Cronier, CIO,
CNAM-TS

Rapid changes in today’s global business environment drive organizations to reduce the costs of their IT infrastructure and operations, improve their ability to react to changing business demands, and minimize reliance on legacy systems and retiring mainframe skills—all while improving competitiveness and business alignment.

Companies and government organizations face increasing pressure to deliver more business value and better services from their IT spending and free up funding for new initiatives. In this environment reducing mainframe costs and modernizing legacy applications have become top-of-mind concerns for CIOs and CFOs alike. Business-critical mainframe applications are invaluable assets: their embedded business logic representing years of development and evolution. Among large enterprises, these assets represent 60% - 70% of all business-critical applications consuming two-thirds of IT’s operations budget. Migrating these applications from mainframes to open systems can dramatically reduce the infrastructure and operations costs and unlock the business logic for faster integration and evolution.

Three key success factors emerge from Oracle’s numerous mainframe rehosting customers:

- Leveraging automation and proven migration practices to reduce project duration, cost, and risk, accelerating savings and demonstrating business value within a year or two

- Leveraging compatibility with mainframe languages and programming models to preserve the application’s business logic and valuable data, which reduces testing effort, avoids user re-training and business process impact
- Architecting an open system target environment to meet mainframe-grade QoS requirements— to ensure that migrated applications continue to meet performance and availability SLAs

Meeting these challenges requires a uniquely powerful solution that supports mainframe applications and their programming models through compatible online and batch runtimes, while running on an application platform that delivers proven, mainframe-grade QoS on open systems. It must also:

- Enable automated rehosting of application code and data for faster and low-risk migration
- Run on a distributed infrastructure for horizontal scalability and fault-tolerance, and support enterprise cloud deployment
- Enable rapid integration and extension of rehosted applications via standards-based and legacy protocols; COBOL, C/C++, or Java modules, and JEE or .Net components

Oracle Delivers for Mainframe Customers

While some organizations delay because of risk concerns, Oracle customers have embarked on this modernization journey with confidence.

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Facts:

- 5 trillion dollars a day in global inter-bank settlement transactions
- €110B in annual healthcare reimbursement payments in France
- 2.6M S.W.I.F.T. payment messages an hour in the UK
- 50B annual credit card transactions in China
- 150M daily logistics transactions in US
- 1M US government benefit transactions an hour
- 56K mobile billing transactions per second in Japan

One system. Oracle Tuxedo.

Uniquely in the mainframe migration space, Oracle's rehosting solution is built on a mainstream foundation of leading software platforms, Oracle Tuxedo and Oracle Database, running business-critical applications for tens of thousands of large customer organizations. These custom and packaged systems are used daily by millions of people for core banking and payment services, funds transfer, travel reservations, telco billing, logistics, ERP (e.g., Peoplesoft.) The robust foundation provided by Oracle Database and Oracle Tuxedo deployed in Oracle's Maximum Availability Architecture (MAA) ensures mainframe-class or better availability and performance.

The evidence is in—proven five 9's of availability in many customer production environments delivering business-critical financial services, mobile billing, managing reservations, and handling government benefit transactions. A number of these applications run at tens of thousands of transactions a second (tps), and in some customer benchmarks Oracle Tuxedo and Oracle Database/RAC exceeded 100,000 tps leveraging optimizations for engineered systems – Oracle Exalogic and Exadata.

For mainframe customers considering migration, this provides the confidence of using proven foundation systems with Oracle's global support, services, and R&D investment. Customers who have already migrated to open systems have experienced mainframe-class reliability and performance and have gained additional scalability and flexibility at a fraction of the mainframe cost.

In addition to the mainframe-class availability and performance, Oracle's solution is uniquely open and flexible – it runs on a number of hardware/OS platforms, supports multiple COBOL compilers, enables use of multiple languages for new extensions (e.g. COBOL,

C/C++, Java), integrates with JEE and .Net, supports Web Services and SOA, etc. to help customers align with their enterprise standards, simplify the evolution and modernization of the rehosted application, and to promote choice and budget efficiency long after the initial migration.

Customers Cut Costs, Gain Flexibility

At one utility company migration of customer care and billing suite from IBM CICS/DB2 environment to Oracle Tuxedo and RAC has resulted in shutting down 14 mainframe processors, while enabling a 300x increase in volume of data traffic and processing required to support new modes of client interaction. This level of scalability wasn't affordable with mainframe OLTP and database processing. As the result of the migration, the customer experienced about 25% performance gain in online and batch processing and was able to take advantage of a cost-effective scalability architecture provided by Oracle's Database (RAC) and Tuxedo-powered application grid. Leveraging a portion of \$5M/year in savings from decommissioning the mainframe has also enabled them to deploy active/active disaster recovery capabilities for business continuity.

Another customer has replaced 12,000 MIPS of mainframe capacity with Oracle Database and Tuxedo infrastructure on UNIX servers, in the process reducing their annual cost from \$65M to \$10M. This customer is handling health insurance services in France for over 50M members and supports over 80,000 portal users, generating over €110B/year in reimbursement payments. Migrating data and applications from disparate mainframe environments to an Oracle open systems stack enabled them to extend the functionality with component-based approach. The extensibility of Oracle Tuxedo with Oracle Fusion Middleware solutions enabled more agile response to frequent regulatory changes, and



enabled them to add claim processing services for other government agencies.

A large European banking group is rehosting portions of the core banking system to begin a 25,000 MIPS reduction in their mainframe footprint. Starting with a 5000 MIPS customer records system, the Bank is using Tuxedo and Application Runtime (ART) for CICS and Batch in a 3-tier architecture of their new generation core banking system composed of:

- JEE front end with Tuxedo JCA adapter
- Rehosted CICS applications in Tuxedo ART retaining CICS APIs and services
- Remaining mainframe components integrated via Tuxedo Mainframe Adapter

The Bank benefits from the flexibility to shift applications between mainframe and Tuxedo application grid, which enables them to continue rapid expansion while containing and reducing MIPS, and helps to reduce their TCO/Revenue ratio below industry average.

A global car manufacturer in Japan has migrated their batch cost accounting system to Tuxedo ART using the batch runtime for JCL production support, but also modernizing some programs by recoding in Java. They are also modernizing the rehosted batch jobs by adapting provided templates for auto-generation for ease of adding future jobs, using the database-backed file catalog for managing GDG files, and parallelizing batch streams over distributed nodes to shorten the batch elapsed time.

Simplifying and Accelerating Migration

Combining the support for CICS, IMS, and batch programming models and functions, with Tuxedo Application Rehosting Workbench, which provides tooling and

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methodology for automating the migration life-cycle, simplifies and accelerates the rehosting process. Oracle's solution supports CICS and IMS APIs and services, batch JCL functions and utilities, and helps to migrate VSAM/flat file/DB2 data, as well as provide remote access to DB2 and IMS DB on z/OS. This enables customers to keep application logic and data intact, while moving them to Oracle Tuxedo, the #1 C/C++ and COBOL application server for traditional and enterprise cloud deployments with mainframe-grade RASP.

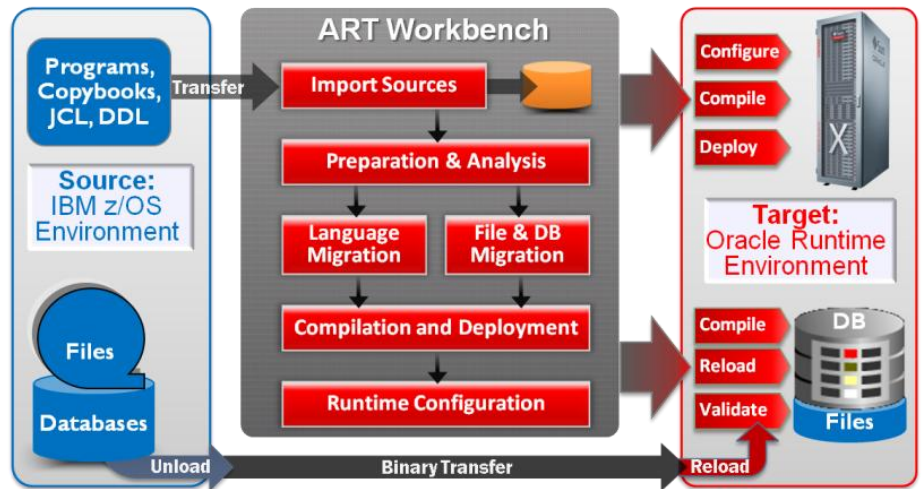
The application runtimes leverage distributed Tuxedo foundation for:

- Fault-tolerant cloud application foundation on open systems delivering five 9's availability through health and service level monitoring, autonomous recovery and fail-over
- Multi-language SOA with COBOL, C/C++, Java, Python, Ruby, PHP containers with rich integration options and gateways
- XA-compliant distributed transactions (i.e., 2-PC or SYNC Level 2)
- Robust workload management with dynamic load balancing, priority management, and distributed resource management
- Exalagic performance optimizations delivering up to 8X performance gains
- Cloud deployment features - simplified provisioning, virtualization and application isolation, integrated end-to-end and app-to-disk monitoring and management

On top of this foundation, the Oracle solution provides Application Runtimes for CICS, IMS, and batch. However, a complete migration project goes beyond the APIs and related functions. Oracle's solution caters to the full migration lifecycle and provides automated tools to support it.

Tuxedo Application Rehosting Workbench

The Workbench provides complete lifecycle support from initially loading the mainframe source code to analyzing the entire code base, automatically migrating code as required, and automatically creating deployment configuration



files and scripts for running rehosted applications in the Tuxedo domain.

The workbench provides an Eclipse UI which integrates the relevant tools in a guided, industrialized migration process. After importing the application's source assets, the workbench automatically organizes and catalogs COBOL, JCL, and DB2 DDL components, validates all cross-dependencies generating reports for any anomalies (e.g., missing components or unresolved references), and creates an internal abstract representation.

Based on this analysis and configuration settings, the migration tools adapt COBOL components between compiler dialects, transform embedded DB2 SQL to Oracle SQL, convert JCL to batch job scripts, convert DB2 DDL and VSAM Copybooks to Oracle Database schemas (or keep VSAM files as is), and generate tools (JCL/programs/scripts) that automate bulk data migration. The unique capabilities of the workbench simplify data migration, including supporting migration of VSAM files to Oracle Database transparently to the application – allowing the applications to retain the same data access logic as well as their CICS and IMS APIs.

While many customers choose to migrate the data along with applications, in partial or phased migration projects shared data access between migrated and mainframe applications may be required. The Oracle solution can remotely access data on the mainframe (e.g., DB2 Connect for mainframe DB2), or synchronize migrated data between Oracle Database and mainframe DB2 using Oracle GoldenGate.

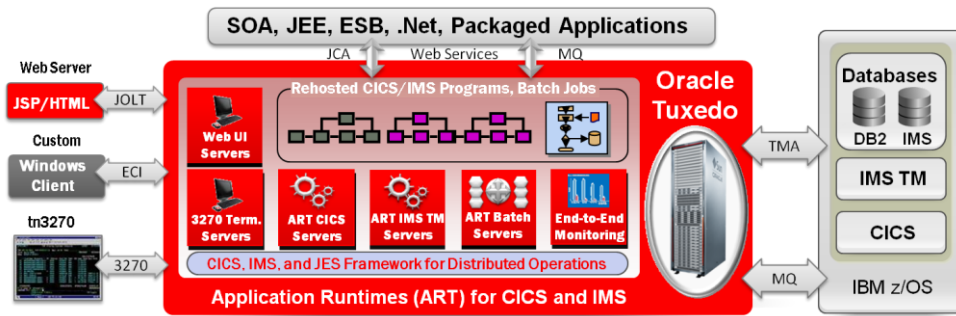
Following the migration of the programs and data, the Workbench facilitates the compilation, configuration, and deployment process to the target environment supported by Tuxedo Application Runtimes for CICS, IMS, and batch. Leveraging a configuration and deployment wizard, the Workbench automates conversion of the IBM CICS system definition (CSD) file with CICS resources configuration, generation of makefiles for running CICS and SQL pre-processors and specified compiler, creation of Tuxedo configuration with CICS and batch runtimes, and generation of deployment scripts.

As a result of its high precision, uniform rule-based transformations, and effective automation, Workbench-driven migration projects have experienced extremely low error rates, which reduces testing and debugging time, lowers overall project risk and cost, and results in much faster project delivery. The Workbench enables an industrialized, repeatable migration approach, which has provided high efficiency and productivity in migrating very large mainframe applications with tens of millions of lines of code.

Tuxedo Application Runtime for CICS

As the target environment for rehosting CICS applications from IBM z/OS to open systems, this runtime supports the EXEC CICS programming model and provides services required by the API. It includes support for synchronous and asynchronous transactions, DPL programs, conversational and pseudo-conversational programs, TS and TD queues, 3270 BMS services, VSAM file access, MQ,

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and database (DB2 and Oracle) access and transaction coordination/recovery.

Users connecting to CICS applications via traditional tn3270 emulators or Windows clients using CICS ECI protocol can simply point to a different server after migration – these connections are built-in as part of the CICS runtime to avoid any impact on the users. In addition, customers can eliminate the cost of tn3270 emulator licenses and replace them with just a Web browser leveraging Web UI integration and identical JSP/HTML screens converted from 3270 BMS using one time conversion service offered by Oracle partners.

Many CICS applications are also message-driven and Oracle solution provides standard integration options, including JCA adapter to replace IBM CTG in JEE app servers, support for MQ-initiated transactions, and mainframe CICS connectivity using APPC/DTP or DPL over Tuxedo Mainframe Adapters (TMA). In addition, CICS transactions and DPL programs can leverage configuration-based integration with other Tuxedo services (in Java, COBOL, and C/C++), Web Services, Oracle Service Bus (OSB), and other standards-based services and gateways with no coding changes.

The runtime leverages underlying Tuxedo infrastructure for CICS MRO configurations providing the benefits of fully distributed deployment model using horizontally scalable traditional servers, engineered systems like Oracle Exalogic, which integrate compute nodes, storage, and network fabric in a single system, or an enterprise cloud using physical or virtualized resource pools. Centralized monitoring and resource management for such CICSplex-like environments is provided out-of-the-box by Tuxedo System and Application Monitor (TSAM) and Oracle

Enterprise Manager (OEM). Dynamic resource provisioning and management through Tuxedo's Distributed Resource Broker enables elastic scale-out of CICS regions on-demand or based on pre-defined policies.

Tuxedo Application Runtime for IMS

As the target environment for rehosting IMS applications from IBM z/OS to open systems, this runtime supports the IMS programming model and the CBLTDLI API. It includes support for MPP regions with multiple transaction types (response/non-response mode, conversational/non-conversational mode), tn3270 interface (with basic edit mode and MFS mode), and IMS batch support (BMP regions, DFSRRC00 utility). IMS programs can access migrated IMS DB and DB2 data, or use remote access to the mainframe databases.

Similar to the CICS runtime, the user interface is provided through tn3270, or a Web browser using Web UI integration and partner services to convert 3270 MFS screens into JSP pages.

The JCA adaptor for JEE connectivity and TMA for mainframe connectivity support message-driven integration requirements. When used with mainframe IMS TM regions, TMA provides APPC and OTMA for synchronous and asynchronous connections with full SYNC Level 2/2-Phase Commit support. Rehosted IMS transactions can also integrate with other Tuxedo services, Web Services, OSB, IBM MQ, and other Tuxedo-supported protocols.

Similar to the CICS runtime, the IMS runtime fully leverages Tuxedo features for MSC configuration and distributed deployments across traditional servers, engineered systems, or in an enterprise cloud, with TSAM/OEM providing centralized monitoring and management.

Tuxedo Application Runtime for Batch

Batch jobs are critical in mainframe environments, and the Oracle solution provides robust support for rehosting JCL jobs and their programs, files, and databases without changing job flow or business logic. This runtime integrates JES-like production management capabilities with built-in JCL functions, standard utilities, and access to migrated and mainframe data in an open, extensible framework. This robust production environment supports job scripts converted from JCL by the Oracle Tuxedo Application Rehosting Workbench.

The Batch runtime provides JES-like management using job queues defined in Tuxedo QSPACE and job control using standard job parameters (e.g., job name, class, priority, etc.) and job stages. Standard JES functions to submit, hold/release, cancel, purge, and query jobs cluster-wide are available through a command-line interface (CLI), open services API, and Web UI. The CLI and services API enable integration with any batch scheduler, including Oracle Enterprise and Database schedulers as well as 3rd party enterprise schedulers, and mainframe schedulers. The services API can be used via Web Services, JCA adapter, and other gateways to enable real-time job control from other enterprise applications. In addition to scheduled jobs, the Web UI provided by TSAM/OEM enables centralized end user job control, job status views, and job log access.

The jobs are processed through regular JES stages and queued by job class and priority until picked up by a Tuxedo initiator service that monitors queues for its assigned job classes. The runtime distributes the workload in a batch cloud by defining initiators on multiple nodes and provides mainframe-compatible file management and locking in a local filesystem and over NFS for shared file access from multiple batch nodes.

Once the job is launched, it leverages all the typical production functions provided by the batch execution environment, including automatic DB connection/disconnection, commit/rollback, file access with concurrency control based on DISP, support for GDG

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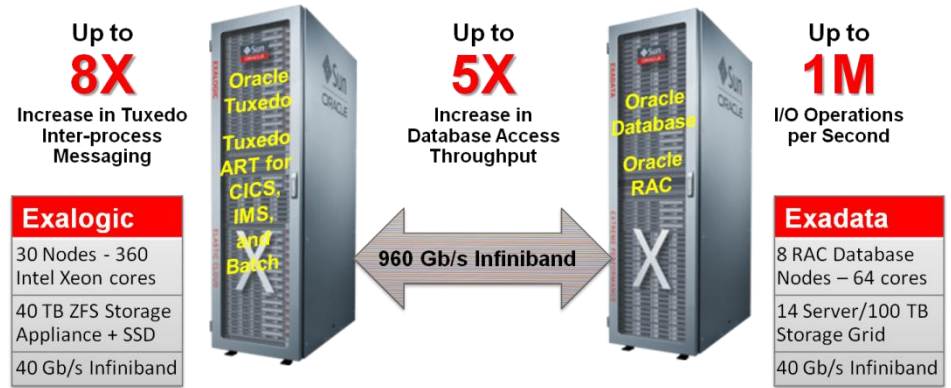
functions and file catalog for their metadata, a library of built-in utility functions, and conditional execution based on return codes.

This open batch environment can easily incorporate new steps or jobs using any 3GL or Java programs, COTS modules, native OS scripts or tools, integrating with any scheduler and with open system versions of the traditional mainframe 3rd party components (e.g., Syncsort DMX, LRS VPSX for printing). Rehosted batch jobs can retain CICS and IMS integrations using Tuxedo Application Runtimes for CICS and IMS, including full use of IMS BMP. They can also leverage a rich set of integration options – from DB2 Connect and IMS ODBA for remote access to mainframe databases to Oracle Data Integration (ODI) services and Business Intelligence (BI) solutions for modernizing data extracts, transformations, and reporting.

Powered by the Tuxedo infrastructure, the batch runtime supports centralized job submission and control with distributed execution across multiple nodes, which enables batch workloads to use more resources and helps to parallelize batch execution whenever possible. Elastic scale-out of batch environments provided by the new Tuxedo Dynamic Resource Broker (DRB) as well as Tuxedo plug-in for Oracle Virtual Assembly Builder (OVAB) can be used to dynamically manage resources in response to fluctuating workloads and longer than expected job wait times by providing additional capacity when needed or shifting capacity between batch and online workloads based on various conditions.

Leveraging Mainstream Platform

Customers leveraging a mainstream platform, like Oracle Tuxedo, benefit from its broad customer base and robust R&D investments in Tuxedo product family, the rest of the Oracle Fusion Middleware, Oracle Database, and new engineered systems – Oracle Exalogic Elastic Cloud and Oracle Exadata Database Machine. Tuxedo optimizations for engineered systems deliver dramatic performance gains for online and batch applications – up to 8X faster messaging, up to 5X throughput gain for database access. Oracle's investment in cloud-enabling features, including Tuxedo plug-ins, delivers direct benefit for rehosted applications:



- Simplified provisioning and virtualization supported by Oracle Virtual Assembly Builder (OVAB) and Oracle VM
- End-to-end monitoring/tracing enabled by TSAM and business transaction monitoring (BTM) across Oracle middleware and database stack
- Integrated app-to-disk management enabled by Enterprise Manager's Ops Center, Cloud Control, and TSAM plug-in

Managing Migration Project Risks

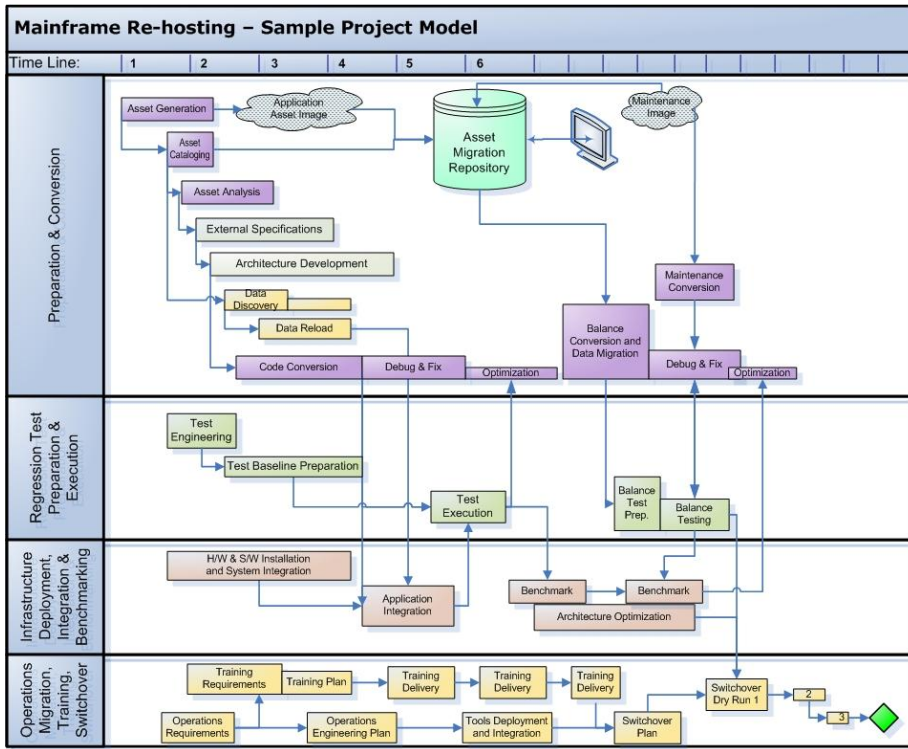
In addition to a strong target platform and architecture, an industrialized methodology focused on risk mitigation is an essential ingredient in successful migration projects. Oracle and our partners have developed and honed a proven methodology for low risk migrations.

Oracle offers a comprehensive discovery process where mainframe modernization experts delve into the details of the mainframe environment and applications, including the overall architecture, functional and technical dependencies, integration requirements, and performance and availability SLAs. The discovery also covers target architecture requirements, production deployment architecture, development and test requirements, and enterprise standards for High Availability and Disaster Recovery configurations. This comprehensive discovery process results in a report that documents the findings, maps source environment to target architecture and software components (not only Oracle products, but a comprehensive mapping of any 3rd party software), and provides specific migration recommendations and roadmap to guide the project.

Following the initial analysis, additional focus areas must be studied and documented, resulting in a series of deliverables, including:

- Migration plan with clear scope definition, project roles and responsibilities, timeline, dependencies, and budget
- An external specification that identifies integration requirements and replacement software packages and specifies how the integration interfaces and replacement software will be provided on target
- Deployment architecture blueprint that defines production configurations, dev/test environments, and DR systems, as well as integrations into the IT operations, monitoring, and management ecosystem
- Testing plan that defines types of testing to be performed (e.g., regression, integration, performance, stability/resilience, etc.), tools required, and test scenarios and artifacts required to execute and evaluate them
- Training plan based on mapping existing skill sets to those required in the new environment and recommended training for developers, system administrators, production operations, etc.
- Switch-over plan that defines approach to moving users from mainframe to rehosted application, including production data synchronization, and fail-back procedures in case of unforeseen issues

To support these, an assessment at the code and data level may be performed to determine the level of complexity, 3rd party/package software dependencies, data access patterns, and identify any areas that need additional analysis and specification.



The assessment is also used to identify a subset of the application for potential pilot migration. The role of a migration pilot is three-fold:

- Migrate a part of the application and data to validate the automated approach and evaluate any specific technical concerns
- Deploy and benchmark the migrated portion on the target architecture to validate the performance and other SLAs, and apply the results to capacity planning
- Validate the testing approach and verify that customer’s test libraries provide sufficient coverage or need to be supplemented through automated capture of test cases from the production environment

A pilot project provides a wealth of information that can be used to adjust the project plans and other deliverables mentioned above based on the actual application environment, and thus increase the confidence in the overall plan and speed up the rest of the migration project.

Once the decision is made to go forward beyond the pilot, multiple project tracks can be used to parallelize the effort and speed up the project timeline. Typically at least four tracks running in parallel are recommended to optimize the project duration:

- Core migration of code and data
- Testing preparation and execution
- Infrastructure deployment and integration
- Training and operations migration

While the project moves forward, the normal application maintenance and evolution continues, and this must be taken into account in project planning. An important benefit of Oracle’s automated approach is that all conversion work is 100% automated – any changes in the migration rules or custom extensions are captured and incorporated in the Workbench. This makes it possible to re-run entire conversion process at any time.

Based on incremental processing capabilities of the Workbench tools and automated re-processing that produces consistent results, the maintenance changes can be brought into the project towards the end and easily processed using the complete rule set. This enables “frozen” window to be minimized since the freeze is only necessary at the very end when the maintenance changes are incorporated and final stages of regression testing are executed.

Supporting Hybrid Environments

For many large scale mainframe customers, the co-existence of rehosted and mainframe environments is a long term requirement. In some cases, they rehost an application at a time, or just some specific transactions and/or batch jobs that are responsible for peak MIPS consumption. By lowering the peak, the overall cost of the mainframe environment can be significantly reduced.

Oracle customers often run in such hybrid environments even before migration using a broad range of strong mainframe integration capabilities at an application and database level. In order to support such hybrid environments during multi-phase migration, or forever, customers can leverage:

- Interoperability with CICS and IMS using Tuxedo Mainframe Adapters for TCP and SNA, supporting global transactions (XA)
- IBM MQ gateway in Oracle Tuxedo
- Oracle/DB2 bi-directional data replication using Oracle GoldenGate
- IMS DB remote access ODBA gateway in Application Runtime for IMS
- DB2 access via Oracle Database using Oracle Transparent Gateway (OTG)

The Bottom Line

Your partnership with Oracle presents a unique opportunity for you to get more value from your legacy applications, while greatly reducing their infrastructure cost. With Oracle’s mainframe rehosting solution you get a unified, flexible technology platform that combines the mainframe-class RASP with advanced rehosting capabilities, supported by Oracle training, support, and consulting services and a broad ecosystem of delivery partners. Freed from the mainframe lock-in, your application assets can help you to get the most from your business.

CONTACT US

To learn more, call +1.800.ORACLE1 to speak to an Oracle representative or visit oracle.com/tuxedo