

CELENT

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THE FUTURE OF THE MAINFRAME IN FINANCIAL SERVICES

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EXECUTIVE SUMMARY

The mainframe (i.e. consolidated data, storage, and compute) is the traditional workhorse of the financial services industry, providing the processing power to handle workloads for 44 of the top 50 banks. The industry, however, continues to evolve as financial institutions face new pressures from market entrants, regulations, and industry dynamics. Cloud technology is maturing, and more institutions are seeing it as a valuable path to digital transformation and renovation.

Still, the role of the mainframe is critical, and institutions are far from replacing this existing component of their infrastructure. These machines have a history of providing unparalleled security, stability and processing power, forming the backbone of some of the most mission-critical and high velocity processes in the industry.

For good reason, considerable on-premise infrastructure isn't going anywhere any time soon. The challenge for institutions seeking broader digital transformation will be to balance the on-premise and cloud infrastructure. As such, Celent finds most institutions are pursuing a hybrid cloud model, where data and applications interact across different deployment models. This allows a mixed infrastructure approach and best of breed deployment.

The role of the mainframe is changing in an era of digital transformation and hybrid multi-cloud infrastructure. The release of the IBM z15 is IBM's answer to the age of cloud computing, evolving to meet the needs of hybrid cloud deployments, leveraging investment in data and applications, and adding features and functionality to complement this strategy.

This report, commissioned at IBM's request, describes how many financial institutions are combining the new generation of mainframes with hybrid cloud resources to achieve both business and IT goals.

Specifically, it discusses the new generation mainframes' capabilities such as:

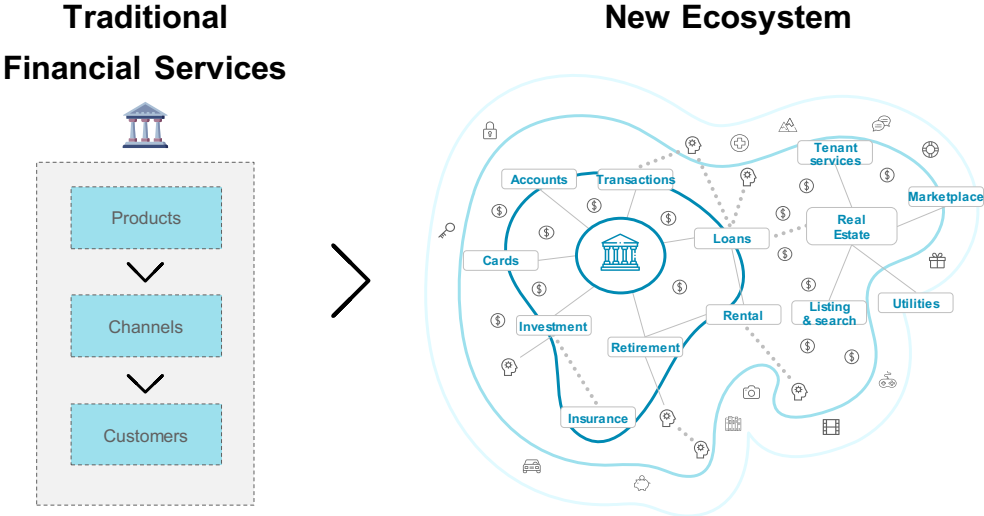
- Security/ Encryption
- Reliability and Resiliency
- Processing power
- Cloud native development capabilities
- Blending core processing and digital transformation

The findings in the report are based on a series of discussions between Celent, banks, insurers, capital market firms, and IBM.

INTRODUCTION: THE MAINFRAME, THE CLOUD, AND DIGITAL TRANSFORMATION IN FINANCIAL SERVICES

The financial services industry is evolving with a new competitive landscape driving changes in firms' IT and technology needs. Figure 1 shows how traditional financial services are evolving towards new ecosystems of capabilities and partners. Customers are looking for interoperability, connectedness, and agility.

Figure 1: Evolution of business models and ecosystems



Source: IBM/ Celent

At the same time, financial institutions (FIs) are confronted with the realities of intense competitive pressures from non-traditional FIs, business model evolution, and regulatory risks. As digital transformation is broadened across the organization, there's a need for security and scalability.

Many financial institutions are responding with technology investments such as cloud deployment to support digitization strategies. Most of the initial migration to the cloud was for areas like advanced analytics, sandboxes for testing solutions and tools, and other non-critical applications. Many banks are even well underway with migrations of front-end applications to the cloud. However, institutions are reticent to shift mission critical applications. Many core computing functions remain with the mainframe.

CONTINUED RELEVANCE OF THE MAINFRAME

“The reports of my death are greatly exaggerated” – Mark Twain

Mainframes have been the workhorses of the back-office for decades and that continues to be the case today. 67 of the top 100 Fortune 500 enterprises continue to rely on them, according to IBM. When it comes to high-speed transaction processing mainframes really have no equal. They bring speed, cost-effectiveness and security unmatched by cloud or x86 servers. However, traditionally this has come with some trade-offs, notably the speed and agility to make system changes.

While there have been debates within IT organizations around how to stand up new infrastructure elements, the bread and butter of financial organization remains the critical transaction and large batch processing of the back office. Midrange cloud platforms have a hard time matching the cost, speed and security of processing with on-premise options.

The industry has accepted that the mainframe remains an undeniably crucial asset. However, the need to transform digitally is leading many to the public cloud and emerging technologies. The challenge is the integration between these multiple environments, specifically the hybrid cloud.

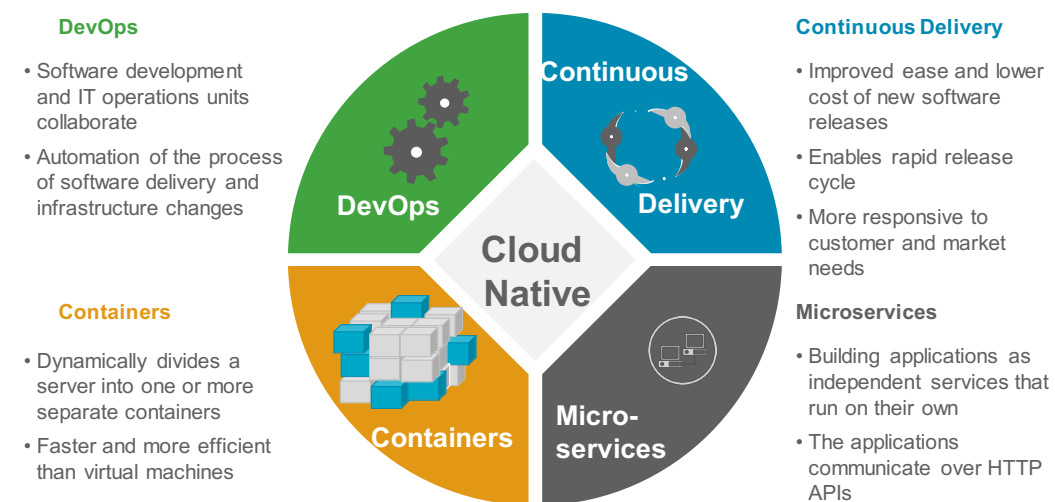
THE HYBRID CLOUD

According to Celent’s research and conversations, most institutions (>50%) are using Hybrid cloud, and many we’ve spoken to view it as a critical piece of the infrastructure. But what is “hybrid” cloud?

Celent defines the hybrid cloud as computing and data infrastructure that combines an on-premises private cloud with one or more public clouds.

The hybrid cloud facilitates faster software development, system updates, and rapid code correction allowing firms to embrace agile practices. This is particularly valuable as client demands for data insights have moved to real-time. A cloud-based infrastructure supports the migration to real-time by providing the on-demand computational power and making it easier to co-locate common utility data on which the real-time processes can operate.

Figure 2: Main Tenets of Native Cloud Computing



Source: Celent

For most financial institutions, the case for cloud use is based on very large amounts of data and the need for significant, quickly available computing power. Applications migrating to the cloud include complex risk analysis, stress testing, analytics, regulatory solutions, compliance, and operations. Many of these use cases require the integration of many different types of infrastructure, data access, and application development silos that have developed over the years on-premise. With the demand for digital transformation high, there is a need for FIs to incorporate cloud architectural mandates into their legacy infrastructure and create paths to operating effectively across cloud, hybrid cloud, on-premise, private data center, mainframe, and other compute resources.

In more than any other area, the cloud has remapped the process of creating internal and customer facing applications. The ability to dynamically clone and recreate environments has readjusted the expectations for development and operations (DevOps) and has been instrumental in creating an efficient and agile approach to software creation, release and production. Cloud enabled DevOps has changed the frustratingly slow system development life cycle (SDLC) process of looping in IT infrastructure, ticket opening, patching, updating, and provisioning of hardware by shifting that process directly to software engineers and support teams.

The cloud has accelerated delivery by ensuring that the specifications, coding, testing, and release are undertaken in a holistic manner. By automating these processes on the cloud, and mapping the metadata associated with development, firms will benefit from systematic tracking, provisioning, and versioning. This continuous integration/continuous delivery (CI/CD) is rapidly becoming the standard for forward-looking FIs.

The ability to unify application development and data across a variety of environments is a key to effective technology development, and optimization of different types of resources.

As institutions are increasingly deploying selected workloads into a cloud environment, including traditional on-premise, private cloud, and public cloud, they need to think about the overall extent of their different infrastructures.

MIXED INFRASTRUCTURE IN FINANCIAL SERVICES TODAY

While the move to a hybrid infrastructure is becoming the norm, different verticals are experiencing it in different ways. Across financial services there are multiple examples of processes that incorporate combinations of technology stacks of on premises servers and mainframes and various public cloud environments. Table 1 below shows areas that require careful planning across mixed environments that include mainframe.

Table 1: Multiple Infrastructures Provide A Variety of Benefits

VIEW	COMMENTS
MULTI-CLOUD DEPLOYMENT	<ul style="list-style-type: none"> • Many institutions still want on-premise data storage • Mixed infrastructure with different clouds allows data to flow to applications based on costing, latency, and other demands
APPLICATION DEVELOPMENT	<ul style="list-style-type: none"> • Optimizing application development across different infrastructures • Institutions are standing up Java instances in the mainframe to take advantage of its capabilities
AI MACHINE LEARNING	<ul style="list-style-type: none"> • Mainframes can tap into tools like Apache SparkML, TensorFlow, and others to leverage the processing power for AI • Performing big data analytics with Hadoop and Splunk
OPEN SOURCE TOOLING	<ul style="list-style-type: none"> • Open source tools are a given for many public cloud environments • Mainframes in hybrid environments can also take advantages of Red Hat Linux and many more technologies

Source: Celent

Table 2 lists some of the use cases Celent is seeing in the market.

Table 2: Examples of Use Cases Using Mixed Infrastructure

VIEW	COMMENTS
REAL-TIME TRANSACTION RECONCILIATION	<ul style="list-style-type: none"> • Real-time views with client or internal dashboards • Ability to reconcile between different functions and environments
REAL-TIME FINANCIAL REPORTING	<ul style="list-style-type: none"> • Real-time transaction data for business decision making • Anytime reporting and ad hoc analysis
360 DEGREE VIEW OF THE CUSTOMER	<ul style="list-style-type: none"> • Linking client data through additional tools in a mixed environment • Better retention and customer acquisition opportunities
SMB CREDIT ASSESSMENT	<ul style="list-style-type: none"> • More accurate risk assessments mean faster decisioning • Able to improve profitability and reduce risk

Source: Celent

INSURANCE

The mainframe continues to play a critical role in the infrastructures of major US-based insurers. The mainframe runs a variety of workloads, including core operating systems, commission and distribution management systems, financial systems, regulatory reporting, and actuarial analyses. Insurers speak highly of their mainframe's reliability, stability, security, speed, and ability to distribute workloads. While insurers see the mainframe retaining its workhorse role, they also express concern over the continued availability of necessary skill sets (e.g. COBOL) and the mainframe's relatively high operating costs.

At the same time, many insurers see a multi-cloud hybrid environment as especially suitable to rapid development (e.g. DevOps), use of advanced analytic tools (e.g. machine learning) with large data sets, and creating digital agility (e.g. fail fast, reset, start over).

CAPITAL MARKETS

Capital markets technology is marked by the high variability of infrastructures, compute, and data storage across the front, middle, and back offices. Business and regulatory challenges continue to reshape the capital market ecosystem, altering the traditional roles played by different participants in the buy and sell sides as well as market infrastructure providers. As these firms undertake critical evaluation on where to compete, which clients to serve, and what business lines to grow and divest, optimizing cost of operations and infrastructure is becoming a key challenge, as well as an opportunity.

Moreover, the capital markets are not going to rearchitect their entire infrastructure just as a cost-cutting exercise, or for a simpler route to static data lookup. Innovation, flexibility, insights around data in the cloud, and its analytical prowess will be the drivers. The end game is creating automated, data-driven insights to provide value for internal and external clients. This digital journey has to weave in the many architectures, compute infrastructures, and data storage models across on-premise, collocated, and cloud deployments.

In every area of capital market firms have a broad range of infrastructures, compute capabilities, and data storage options. A key part of the digital journey is creating efficiencies to create better processes to operate in various infrastructures, development environments, and data types. Creating similar coding, testing, and implementation across mainframe, cloud, and other infrastructures is a key to creating agility and long-term value. This creation of value is driving change across key capital market participants. This is particularly true in the highly mixed infrastructure environment areas across the spectrum of capital market services. The goal for firms is to optimize their technology estate across the many types of environments that exist.

For instance, participants on the sell-side, such as investment banks and broker-dealers, have traditionally looked to retain a high degree of control over their systems and processes primarily because they are highly regulated. Areas such as security processing have highly mixed environments of mainframe, fintech, SaaS solutions that need to coexist to minimize risk and costs while maximizing usability.

The buy side, such as investment managers and pension funds, are dealing with a wave of new regulations, constant competitive pressure, and the need to remap their business for simplicity. They are faced with a wall of new costs and are trying to lower costs as waves of changes sweeps industry. They are open to outsourcing everything except their core expertise and are facing regulatory and operational costs that could quadruple over the next decade according to BIS. Large buy side firms have considerably varied

technology stacks with mainframes leveraged in the account management process, on premise core systems, and using the cloud for new applications.

BANKING

Though many banks are still in the early days of public cloud adoption, they are increasingly enabling sophisticated ways of migrating specific workloads into a cloud environment. Public cloud is not a new concept by any measure, but it has largely remained the realm of non-critical pieces of the application landscape like email, CRM, or application development/testing.

Banks today have a highly mixed tech stack. Using the hybrid cloud, the mainframe supports the use of mixed development between on-premise, private cloud, or public cloud applications.

While the capabilities of the public cloud have matured significantly, banks are still running most workloads (and almost all of those deemed mission critical) on-premise. The prevailing view among banks is that mainframes are still remarkably good at doing what they were built for: speed, reliability, security. As a result, most institutions prefer to keep the mainframe in place. There's a significant organizational risk in trying to migrate away and rely on distributed compute.

Banks Celent spoke to are putting most of the new applications on the public cloud, but the expansion of existing workloads is remaining on premise. Public cloud is extremely important for the benefits it brings, but banks are not close (and many say they never will be) to migrating away from on-premise workhorses. There tends to be a cultural divide between distributed servers and mainframe, where some staff assume that the more modern route is to launch on servers. Celent found there to be a lack of awareness of the capabilities of the mainframe and the potential tools to build with it. Some institutions voice consternation with what they see as organizational lethargy to take advantage of certain existing assets. As long as they run, they're fine.

As hybrid emerges, IT teams are beginning to explore how to integrate assets within an infrastructure, yet there isn't always a clear understanding of what the mainframe can do. The lack of awareness tends to challenge deeper modernization initiatives.

HOW IBM IS POSITIONING Z15 FOR DIGITAL TRANSFORMATION AND HYBRID CLOUD STRATEGIES

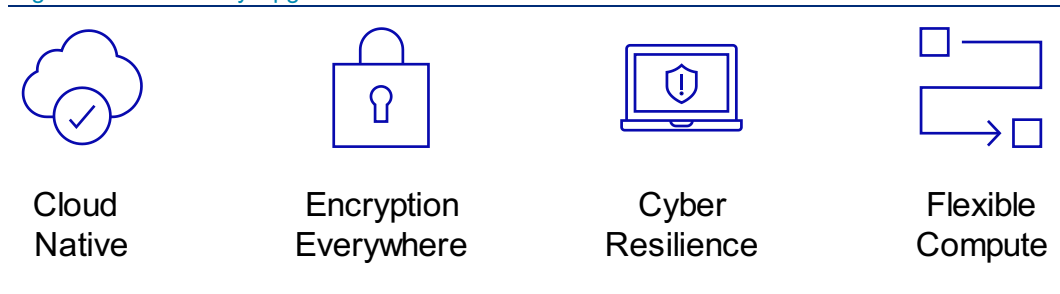
Since September 2019, IBM has provided Celent with numerous briefings and interviews around the state of the mainframe in digital transformation. IBM is changing the relationship of the mainframe to other environments and described this to Celent. Concurrently, Celent conducted interviews with FI to get a sense of where some major players in the industry were at with regard to the mainframe and their digital transformation.

The release of the IBM z15 is positioned as the company's answer to the age of cloud computing, evolving to meet the needs of hybrid cloud deployments, leveraging investment in data and applications, and adding features and functionality to complement this strategy. This section is a combination of fact-based feature overviews and anecdotes from current IBM Z users.

IBM has made changes that reflect the changing role of the mainframe in an era of mixed cloud and on-premise infrastructure. In addition to the z15's traditional role for processing key workloads, and its vertical scaling ability for some of the largest institutions in the world, IBM is positioning z15 to be a critical component in a broader digital transformation agenda, imbuing it with new functionality to work within a hybrid cloud deployment model.

IBM has designed the z15 with tools and capabilities for digital transformation, in a hybrid cloud environment.

Figure 3: IBM z15 Key Upgrades



Source: IBM

Hybrid Cloud Support

In the interviews it was clear that many institutions are beginning to explore IBM z15 in a hybrid cloud and multi-cloud environment. Within a hybrid cloud, the mainframe supports the use and mixed development between on-premise, private cloud, or public cloud applications. Multi-cloud is often being used to leverage the advantages each cloud brings. Certain workloads will make sense to keep within the data center, while others may be better suited for the cloud.

Hybrid cloud becomes much more important in a digital transformation strategy, where optimization of operations and development across infrastructure is critically important. However, workloads deployed in a hybrid cloud infrastructure will require that institutions have a well-developed cloud strategy and technology which can interoperate.

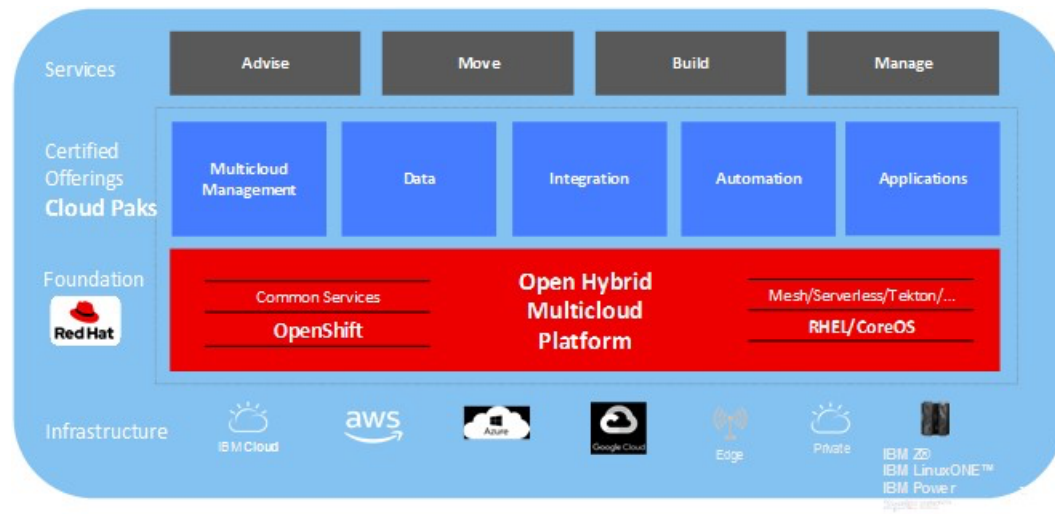
The key to mixed infrastructure is the ability to effectively manage all aspects of creating and managing applications. IBM z15 is designed to integrate into a cloud environment and enable deployment of mission-critical applications and data safely and with

confidence across all of these different deployment environments. Financial institutions are taking a closer look at what that means and in what context.

OpenShift Container Platform Support

IBM is bringing OpenShift Container Platform to IBM Z and LinuxONE. Built by Red Hat (and acquired by IBM in 2019), OpenShift is a container-orchestration platform built on Kubernetes. It enables enterprises to harness open-source technologies to boost current application deployment and support next generation applications.

Figure 4: IBM Use of OpenShift



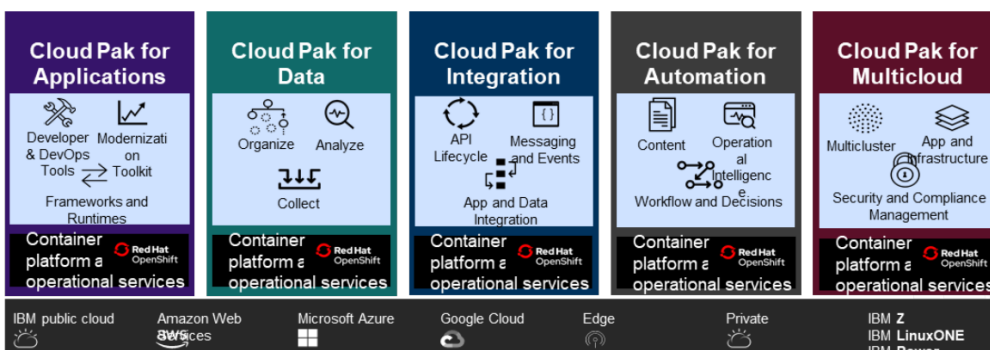
Source: IBM

There are more than 2 million developers using OpenShift, bringing cloud-native application development, modernization, and deployment to IBM Z. The availability of OpenShift for Z and LinuxONE is a milestone for both hybrid multi-cloud and for enterprise computing. OpenShift supports cloud-native applications being built once and deployed anywhere – and now extends this to on-premises enterprise servers such as IBM Z and LinuxONE.

IBM Cloud Paks

IBM Cloud Paks are designed to help integrate a container platform, the middleware services, open source components, and software services in a cloud environment. There are IBM Cloud Paks for Applications, Automation, Data, Integration, and Multi-cloud Management.

Figure 5: IBM Cloud Paks



Source: IBM

By combining the capabilities of Red Hat OpenShift and IBM Cloud Paks with the security features, scalability and reliability of IBM Z and LinuxONE, FIs can build new cloud-native applications while modernizing current applications. Deploying Red Hat OpenShift and IBM Cloud Paks on IBM Z allows for the following:

- Vertical scalability enables existing applications to be containerized, and horizontal scalability enabling support for containers in a single IBM Z system.
- Integration and co-location of cloud-native applications on the same system as the data enables faster response and lower latencies.

Encryption Capabilities

In a hybrid cloud environment, data moves beyond the four walls of the data center, and FIs demand very high levels of security. To protect data even when it's outside of the organization, IBM z15 includes what IBM describes as “pervasive encryption,” a feature which protects data privacy while it's in transit or at rest, inside or outside of the data center. This is underpinned by the ability to manage and revoke access to eligible* data anywhere in an institution's enterprise.

Data protection through “pervasive encryption” goes along with IBM's Data Privacy Passports which protect eligible* data as it moves throughout the enterprise. In a hybrid cloud environment this works to encrypt the data as it travels into the cloud and back to on-premise. Data Privacy Passports can be customized for specific roles and restrictions. Encryption requires no application changes and produces no meaningful impact to performance SLAs. It offers complete data encryption at rest.

Resiliency

Resiliency is a critical function of a complex IT system and even more important when discussing hybrid cloud environments where workloads and data are often traveling between clouds and on-premise applications. With IBM z15, IBM has built “instant recovery” capabilities for either planned or unplanned downtime, lessening the impact of downtime from planned or unplanned outages by returning partitions and systems back to normal service faster.

The protocols written into z15 aim to diminish the impact of any one event. Instant recovery minimizes downtime from routine maintenance by returning partitions and systems back in less time.

*Eligible data is data that can be accessed via a JDBC or REST connection.

THE EXPERIENCE OF A TIER 1 NORTH AMERICAN BANK

FS technology is evolving rapidly, with profound implications for the business. But what are institutions thinking when considering the role of the mainframe in broader digital strategies?

Celent spoke to a large tier 1 bank in North America about what they were doing with IBM z15 and how it factored into their existing digital transformation goals. Celent asked about:

- The value which the mainframe currently provides
- The role it will play in their digital transformation going forward
- How the institution plans to leverage capabilities of a hybrid cloud

The information below was received through an in-depth interview with key stakeholders within the bank's IT department overseeing infrastructure maintenance and transformation.

Opportunity

Many institutions are undergoing long-term digital transformation strategies, and this bank is no exception. The bank started a tech transformation five years ago, focusing on tech stack modernization, rationalization, among other areas. The next five years will continue to focus on maximizing the use of the public/hybrid cloud. The organization breaks digital down into two components: customer digital and internal digital. Internal digital is where the mainframe plays a key role. Using DevOps, teams within the bank establish new development delivery pipelines for the internal delivery of applications. As a bank, they've focused the internal digital transformation goals around three questions:

1. Where can they automate?
2. How can they enable continuous delivery?
3. How can they speed up time to market for new development?

At the enterprise level, the bank has a multi-cloud strategy. They use a private cloud leveraging OpenShift and Cloud Foundry PaaS, and a public cloud of AWS and Azure depending on the needs of the applications.

Of the internal tech stack, mainframe handles most workloads. Around 50% of the bank's mainframe activity is on the retail banking side. As an organization, mainframe is critical to the stability, security, and scalability of some of its most critical back-office processing.

Solution

The institution uses the mainframe in a digital transformation strategy. The bank has also decided to transition from its z14 to the newer z15, based on its evaluation of z15's enhancements.

The bank points out how the toolsets around mainframe have evolved considerably over the last few years. For a long time, distributed infrastructure staff have used different toolsets – to enhance ease of development, speed to market, and an ability to automate certain processes. As mainframe developers became aware of new capabilities to leverage IBM DBB (Dependency Base Build), Compuware, Robin, and other solutions, these tools began to increase the speed and effectiveness of the entire IT organization.

Another area of opportunity was using a source code management system like GitHub with the mainframe. This reduced the time and resources necessary to maintain source code, and shortened development timeline for new enhancements. GitHub now has specific toolsets for the mainframe. In addition, the bank is finding some developers who can work in both Java and COBOL environments.

The bank also leveraged the new IBM DevOps pipeline on IBM z/OS systems. This allowed the bank to utilize some of the practices of agile software development to build, test, and deploy applications on the mainframe. This also allows the bank to leverage standard dev tools to achieve greater efficiency.

When weighing the costs and benefits of the mainframe against distributed computing, it was clear that mission critical workloads weren't moving any time soon. The bank has been able to get the most out of the infrastructure by exploring the breadth of its capabilities.

Key Lessons

The mainframe has come a long way since the bank adopted it decades ago. And the way the bank utilizes the mainframe has also evolved.

- **Specific languages have a big impact on cost.** A mainframe running 100% COBOL is going to be more expensive. They found that taking the 20% of applications running the most workloads and moving them to Java on z/OS significantly reduced costs.
- **Some applications make sense for the mainframe, others do not.** The bank cautioned against staying with mainframes because it has been there forever, or conversely migrating to distributed processing because it is newer. Applications and workloads made sense in certain deployment models, and the bank took the time to figure out which was which.
- **Benchmarking can show which type of infrastructure is superior:** For example, resiliency requirements of active-active-active for distributed made core processes expensive to back up. Likewise, the lifecycle of servers or the physical space required was often a weakness. Putting effort into benchmarking paid off in considering the complete lifetime value of hardware.

Large-scale transformations of a top-tier financial institution is a monumental task. The bank's experience demonstrates the benefits of working with existing assets. By reexamining all aspects of an IT organization, institutions can maximize existing assets and begin to unlock the potential for enterprise-wide digital transformation, especially in a hybrid cloud environment.

MAINFRAMES CONTINUE TO PROVIDE VALUE

Financial institutions need to start thinking about the road ahead, mixing the use of existing assets with newer delivery models. The workhorses of the back office might have been around for a long time, but they are tried and tested. Institutions are retaining legacy assets while also transforming or shifting workloads to the public cloud.

Based on Celent's conversations, we see a few critical considerations when considering the move to a mixed infrastructure which includes hybrid cloud:

- **Understand the value of data and mainframe resources:** Interoperability is key, and while most FIs prefer to leave the mainframe alone, digital strategies will require different pieces to work together.
- **Innovate on the mainframe where possible:** New toolsets allow for innovation on top of existing assets. Institutions should look to explore and take advantage of what's out there. Many find similarities enough to breed confidence in a hybrid approach and modern development on top of existing infrastructure.
- **Accept that some workloads will come at a premium:** But benefits to security, reliability and availability may justify those costs. Still, the TCO between different deployment models is not always apples-to-apples—many different factors need to be considered.
- **Find quick wins for mainframe evolution:** Most institutions aren't prioritizing the mainframe, so quick wins might be the best way to drive value. Looking into easy-to-deploy tools could expedite the discovery of value drivers.
- **The culture is going to be a driver:** There are divergent views on how to deployment applications and infrastructure, mostly between on-premise and cloud. There's a place for both, especially where cultures allow for a best-fit approach.

Financial institutions need to make the most of existing assets, even during large-scale digital transformations. The capabilities built by IBM for z15 show an effort to align with where the market is heading and provide a value for a hybrid cloud and digital transformation strategy. Still, institutions need to weight the pros and cons of deployment models. For many applications, modern on-premise might make the most sense. Other systems may benefit from the speed and agility of a cloud implementation. Many will be mixed. Institutions have many valuable exiting assets and taking full advantage of their capabilities will require an honest look.

LEVERAGING CELENT'S EXPERTISE

If you found this report valuable, you might consider engaging with Celent for custom analysis and research. Our collective experience and the knowledge we gained while working on this report can help you streamline the creation, refinement, or execution of your strategies.

SUPPORT FOR FINANCIAL INSTITUTIONS

Typical projects we support related to infrastructure include:

Vendor short listing and selection. We perform discovery specific to you and your business to better understand your unique needs. We then create and administer a custom RFI to selected vendors to assist you in making rapid and accurate vendor choices.

Business practice evaluations. We spend time evaluating your business processes, particularly in infrastructure. Based on our knowledge of the market, we identify potential process or technology constraints and provide clear insights that will help you implement industry best practices.

IT and business strategy creation. We collect perspectives from your executive team, your front-line business and IT staff, and your customers. We then analyse your current position, institutional capabilities, and technology against your goals. If necessary, we help you reformulate your technology and business plans to address short-term and long-term needs.

VendorMatch digital service. Our digital service offers a vendor discovery and shortlisting tool that enables you to scope the market for financial technology that meets your requirements, quickly determine a solution's core functionality and features, compare solutions, and manage your evaluation.

SUPPORT FOR VENDORS

We provide services that help you refine your product and service offerings. Examples include:

Product and service strategy evaluation. We help you assess your market position in terms of functionality, technology, and services. Our strategy workshops will help you target the right customers and map your offerings to their needs.

Market messaging and collateral review. Based on our extensive experience with your potential clients, we assess your marketing and sales materials — including your website and any collateral.

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