White Paper

IBM's Enterprise Storage Refresh Brings Strong New Storage Technologies to Mainframe Customers

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IDC OPINION

Although most of the revenue in the enterprise storage market overall is driven by spend on distributed systems, most large enterprises still have mainframes that run mission-critical workloads. The mainframe hardware market, which includes mainframe servers and external storage and tape subsystem products, is relatively mature and exhibiting low but consistent growth rates. Mainframe platforms tend to be deployed for mission-critical workloads that require extremely high availability. For mainframe technology refresh cycles, which occur roughly every four years, IBM generally introduces new IBM Z and LinuxONE enterprise servers. In between major mainframe refreshes, IBM provides new DS8000 external storage families and TS7700 Virtual Tape Libraries with improvements focused on enhancing the functionality of the core platforms to ensure they continue to meet evolving market needs.

With the move to much more data-centric business models that is happening as part of the digital transformation that so many enterprises are undergoing, mainframe workloads continue to grow. IBM mainframe customers depend on IBM being able to integrate new, higher-performance compute and storage technologies into its offerings as well as provide enhanced cloud integration capabilities as the needs of hybrid cloud computing evolve. IBM released a comprehensive mainframe technology refresh in 2019, but in August 2020, it released a number of enhancements for its mainframe storage and tape products that improved performance and introduced additional security capabilities, more efficient packaging, more extensive hybrid cloud integration features, and support for additional cyber-resiliency strategies. All in all, this announcement brings exciting new technologies and capabilities to help customers meet business requirements and better manage their mainframe (and distributed) workloads for high performance, availability, and efficiency.

IN THIS WHITE PAPER

In August 2020, IBM enhanced its mainframe offerings, providing improved security, seamless cloud tiering, disaster recovery, and racking options that impact IBM Z and LinuxONE servers as well as its IBM DS8900F and TS7700 external storage platforms. This white paper provides a brief overview of the mainframe market and then turns to a quick analysis of the new IBM mainframe storage capabilities.

SITUATION OVERVIEW

In banking, finance, healthcare, insurance, utilities, transportation, government, and many other public and private enterprises, mainframes continue to make up the foundation of large-scale business computing. Mainframe technology has a long-standing and well-deserved reputation for reliably servicing the industry's most demanding mission-critical workloads in these areas. These platforms and their surrounding ecosystem of software, storage, and networking products are designed to handle massive amounts of I/O by leveraging significant parallelization in both the hardware and software architectures. While open systems solutions have matured to support "five-nines plus" availability in just the past several years, mainframe computing solutions have been consistently exceeding that bar for decades.

The mainframe's continuing popularity is driven by several factors. The inherent reliability and stability of mainframes, refined over 50 years of mission-critical usage, are buttressed by a continuing compatibility that spans decades. Many applications developed on mainframes in the past still run on those environments and continue to meet business requirements. Even as enterprises introduce new next-generation applications needed for digital transformation, there is little benefit to migrating many traditional COBOL-based workloads to other environments. And for customers concerned about security, mainframes are extremely secure and provide an excellent option for customers looking to protect themselves against cyberattacks. These customers continue to trust mainframe technology to keep applications and services running reliably, safely, and securely as their businesses thrive.

While the mainframe market has been growing in the low single digits over the past several years, it exhibits somewhat cyclical revenue. Mainframe refresh cycles occur roughly every four years, and the market leader in this space (IBM) takes that opportunity to provide a coordinated refresh of not only mainframe server but also storage technology. IBM is the largest mainframe server provider in terms of market share by revenue, and it has also been the leader in mainframe-attached storage for several years. As the original developer of mainframe technology, this is not surprising. IBM did a major mainframe refresh announcement in 2019, and with the most recent announcements, the vendor has introduced important enhancements for IBM mainframe customers running mission-critical workloads in the new hybrid cloud computing era.

This announcement's features build on the performance enhancements, z/OS container extensions, hybrid cloud capabilities, better security, and broader recovery options introduced in September 2019 for the new z15 and LinuxONE III enterprise servers and mainframe storage (i.e., DS8900F and TS7700). Enhancements to the mainframe storage systems introduce higher performance, improved security, and better efficiency, as well as additional cyber-resiliency strategies. The IBM storage systems leverage the POWER9 processor platform to deliver the performance, capacity, and functionality that the mission-critical workloads driving today's business success need.

The DS8900F Enterprise Storage System

The DS8900F is an enterprise-class storage platform that supports both mainframe and distributed systems workloads. Based on a proven storage operating system (OS) that has been vetted in mission-critical environments for decades, the latest version of the platform features solid state storage technologies for significantly higher performance and capacity density, improved security and disaster recovery capabilities, and seamless hybrid cloud integration. There are two DS8900F models — the DS8910F and the DS8950F — and while the throughput, bandwidth, scalability, and cost of the two platforms differ, the low storage latencies, reliability, availability, and functionality are equivalent.

These arrays only come in all-flash configurations — there are no more hard disk drive (HDD)–based options in them. Customers upgrading to one of these new systems can consolidate additional workloads, accommodate significant data growth in place, reap improved efficiencies in energy and floorspace consumption, and will enjoy lower operating costs through improved administrative productivity.

The flagship DS8950F can deliver over 2.3 million IOPS, 63GBps of bandwidth, and up to 5.9PB of physical capacity (using 15.36TB solid state disks [SSDs]). The smaller DS8910F can deliver 860,000 IOPS, 36GBps of bandwidth, and almost 3PB of capacity. The new IBM POWER9 processors in the storage controllers, along with storage OS and network bandwidth enhancements, help drive this level of performance. The new DS8900Fs offer extremely low latencies — as low as 18 microseconds for mainframes (using FICON and zHyperLink) or 90 microseconds for distributed systems (using Fibre Channel [FC]). It is interesting to note that latencies provided for mainframe environments are better than those of NVMe-based all-flash arrays (NAFAs) using remote direct memory access (RDMA)–based NVMe over Fabrics host connections and in fact are the lowest in the industry for a SAN-attached device.

Cyberattacks are a major concern for most IT organizations looking to protect corporate data assets in this era of heightened privacy requirements. IBM's mainframe infrastructure incorporates the features needed to address this challenge. Data can be encrypted at rest as well as in flight with AES-256-compliant encryption either on the mainframe or in the storage. All the encryption is done in hardware to ensure that there are no noticeable impacts to the performance of latency-sensitive workloads. Data can be encrypted on the mainframe servers themselves using Pervasive Encryption. The IBM Fibre Channel Endpoint Security feature can enable all data flowing on FICON and Fibre Channel Protocol (FCP) links from IBM Z to IBM DS8900F systems to be encrypted in flight. Conversely, data can be encrypted on the DS8900Fs. The encryption facilities in the DS8900F recognize whether data has already been encrypted by Pervasive Encryption on the mainframe to avoid wasting processor cycles on redundant encryption.

In addition, a Safeguarded Copy feature in the DS8900F provides immutable points of data recovery that are hidden and protected from being modified or deleted due to user errors, malicious destruction, or ransomware attacks. These immutable copies are a trusted and secure source of data that can be used for forensic analyses as well as surgical or catastrophic recoveries. For increased security, Safeguarded Copy provides dual management control and can be integrated with different disaster recovery and high-availability configurations.

The DS8900Fs include a variety of features that ensure data availability. RAID, snapshots, and synchronous and asynchronous replication provide a number of options for customers to configure a "defense in depth" approach for data protection, disaster recovery, and business continuity. IBM Geographically Dispersed Parallel Sysplex (GDPS) technology enables the creation of two-, three-, and four-site replication configurations with DS8900Fs (as well as with earlier model DS8000 arrays), which enable very fast operational recovery. These configurations can meet recovery point objectives (RPOs) as low as 2-4 seconds and recovery time objectives (RTOs) as low as 60 seconds in deployments that can span more than 1,000mi. The optional IBM System Recovery Boost feature can access "dark cores" preconfigured into IBM Z and LinuxONE 19in. racks to help boost application recovery times in the wake of outages. These features all contribute to the DS8900Fs' ability to support more than "seven-nines" availability — with a statistical average of only 3 seconds of downtime per year.

The DS8900Fs support Transparent Cloud Tiering (TCT) to IBM Cloud Object Storage and IBM TS7700 Virtual Tape Libraries, as well as public cloud environments like Amazon S3 and IBM Cloud. This TCT feature opens up public cloud options as an additional storage tier for data archiving, long-term retention, data protection, and disaster recovery, providing effective support for hybrid cloud environments. Data can be moved to different object and cloud tiers based on predefined policies, and this feature does not require an additional server or gateway, enabling simplified, less expensive configurations. TCT offloads the data movement responsibility from the mainframe to the DS8900F while encrypting data in hardware at full speed and without any impact on performance. This offload provides up to 50% savings on mainframe CPU utilization when migrating large data sets as compared with other traditional archiving methods.

Artificial intelligence and machine learning (AI/ML) are being harnessed by many vendors to help reduce administrative overhead, ensure that systems run more efficiently, and improve overall system availability. IBM Storage Insights provides for comprehensive telemetry and leverages AI/ML-driven predictive analytics to streamline trouble ticket creation and management and resolve issues faster through more proactive response. IBM Storage Insights is a cloud-based application (SaaS) that also manages systems for more predictable performance with evolving workloads, enables better capacity planning, and provides for tiered storage recommendations to help systems run more efficiently at lower cost.

The IBM DS8900F includes other features besides IBM TCT that support hybrid cloud integration. IBM Cloud Paks are middleware tools that extend the functionality and capabilities of Red Hat OpenShift, and the IBM Storage Suite for Cloud Paks leverages the Container Storage Interface (CSI) to provide the software-based storage infrastructure to enable the DS8900Fs to deliver persistent, enterprise-class storage to containers running mission-critical workloads. Many new workloads are developed using a cloud-native architecture, which centers around microservices designs and container-based deployment, and the IBM Storage Suite for Cloud Paks brings the performance, availability, and enterprise-class functionality of the DS8900F to those environments.

Recent DS8900F Enhancements

With the August 2020 announcements, IBM has enhanced the DS8900F with higher performance, improved security, more efficient packaging options, and more extensive hybrid cloud integration capabilities, as well as additional cyber-resiliency strategies. First, IBM has increased the system cache (up to a maximum of 3.4TB on the DS8950F) to enable denser storage consolidation without performance risks. With the advent of new processor and storage technologies, storage consolidation is becoming an increasingly popular way to reduce infrastructure costs, lower energy and floorspace consumption, and boost administrative productivity. A fully configured DS8950F can now enable the consolidation of storage workloads that were running on up to eight of the older IBM DS8870s for a significant total cost of ownership savings.

Second, IBM is leveraging the 19in. rack packaging on the DS8900Fs, announced in September 2019, to support the integration of DS8910Fs into z15 and LinuxONE III single-frame solutions. This solution is integrated by design, delivering an end-to-end mission-critical solution for mainframe computing into a single 19in. standard rack. In addition to the existing DS8910F model 994 and the IBM DS8950F model 996 (both designed to operate as standalone systems in their own 19in. rack), IBM offers a DS8910F model 993 designed for integration into mainframe server racks. Customers can integrate the DS8910F model 993 into the IBM z15 model T02, IBM LinuxONE III model LT2, or existing 40U industry-standard 19in. racks for a cleaner single-rack mainframe infrastructure solution.

Third, IBM has announced AES-256 encryption enhancements for data in flight. This new feature allows customers to extend SP 800-131A-compliant encryption from a DS8900F to all TS7700 tape systems within a grid network connected over TCP/IP. Not only is data protected end to end in these configurations, but it does not require configuring key groups or key managers, making cybersecurity much simpler and less expensive than before. Data can be moved using TCT, reside in TS7700s, and be retrieved to the DS8900Fs when needed.

Fourth, IBM now allows customers to extend their cyber-resiliency strategy with offline backups to the hybrid cloud. TCT can be used to create point-in-time copies of data and store them either in IBM TS7700s or in one of three S3-enabled repositories (IBM Cloud Object Storage, IBM Cloud, or AWS S3). Data can be backed up from DS8900Fs to any of these targets leveraging the immutable capabilities that they provide and/or restored from any of them. And data stays encrypted end to end as it is moved around between these repositories, whether for backup, recovery, or other purposes.

The TS7770 Virtual Tape Library

The TS7700 Virtual Tape Libraries provide a high-performance, cost-effective disk-based backup target that looks like a standard physical tape library to backup applications. The TS7770 is the latest version of this platform, drawing upon the experience of decades of delivering virtual tape libraries in mainframe environments. The TS7770 features high data ingestion and mobility performance, high efficiency in how it uses mainframe resources, high availability, multipetabyte capacities, and a host of security options.

The system supports two 10-core POWER9 processors, 2.37PB of usable capacity (assuming the second expansion frame is used), up to eight 16Gb FICON connections, and up to four 10GbE grid network connections. The TS7770 is supported in Grid Network configurations of up to eight nodes for disaster recovery and/or data distribution purposes. Grid Networks support data mobility between IBM Z mainframes; DS8800/8900F arrays; TS7700 Virtual Tape Libraries used as an object store, backup, or archive target; and TS4500 physical tape libraries – all of which can be mixed and matched in any configuration. Data movement is managed by a combination of TCT and/or DFSMS (both of which also work with DS8900F-based data), depending on data mobility requirements.

Software optimizations, combined with the high-performance IBM POWER9 processor technology and increased bandwidth, make the TS7770 extremely efficient when moving large data sets. The two POWER9 processors resident in each TS7770 offload data movement tasks from the mainframe, enabling up to a 50% reduction in zMIPS usage during data mobility operations. That frees up mainframe processor cycles to focus more on revenue-generating mainframe transactions.
The TS7770 offers 2.5GBps of bandwidth per library, provides a large landing pad for rapid data ingest, delivers "five-nines plus" availability (99.9996%), and offers multilayered security options that solidly protect data from bad actors. Grid Network configurations can provide nearly instantaneous failover with no operator intervention across up to eight grid-linked TS7700s using IBM's Automated Grid Cloud Failover capabilities.

With its support for 10TB SAS HDDs, a single tape drawer can hold up to 79TB, a base frame up to 789TB, and a fully expanded system up to 2.37PB of usable (i.e., formatted but uncompressed) capacity. Using the built-in hardware-driven compression, a single system can support roughly 11.85PB of effective storage capacity (assuming a very achievable 5:1 data reduction ratio). In an eight-node Grid Network configuration, TS7770s enable customers to manage almost 95PB of backup, archive, and other long-term retention data from a single console, and that network can move data at up to 20GBps.

The TS7770 features SP800-131A-compliant strong encryption both for data in flight and at rest (both in on-premises infrastructure and on the public cloud). This capability complements IBM Z Pervasive Encryption to provide end-to-end security across all scenarios, regardless of data mobility requirements and imposes no performance penalty during data ingest (all encryption is done in hardware).

Recent TS7700 Enhancements

With the August 2020 announcements, IBM improved security, disaster recovery, and cloud tiering capabilities for its mainframe tape subsystems. Using TCT, the DS8900F can transfer compressed and/or encrypted data over TCP/IP to a TS7700 configured as an object store, supporting faster data transfer rates, reduced bandwidth requirements, and better capacity utilization in virtual tape libraries. The TS7770 also now supports dual security authentication to proactively reduce the risk of human error for accidental deletion and/or malicious damage. Specified sensitive modifications for expire hold enablement and cloud retention pools can be required to be checked by a separate user. This feature is ideal for customers looking for an additional security level over and above existing security and administrative safeguards.

A new cloud-based disaster recovery capability for tape makes tape IP addressable, providing additional options to restore saved copies of data in the cloud to locations outside their source grid. Point-in-time backups can be copied from TS7770 Cloud Connect to the cloud, cloud pools can now be managed with DFSMS (enabling copy versioning capability), and data can be restored to any empty (new) TS7770 Cloud Connect outside the grid. Supported cloud repositories using this new feature include IBM Cloud, IBM Cloud Object Storage on-prem, AWS S3, and RSTOR. All data movement using these capabilities can be protected with end-to-end AES-256 encryption.

Finally, IBM is now leveraging the 19in. rack mainframe packaging announced in April 2020 on the TS7770 tape library as well. Customers can either purchase the TS7770 as a prepackaged racked solution or insert a new TS7770 system into their own industry-standard 19in. racks. For small and medium-sized businesses, TS7770 provides the performance, capacity, and security (with its ability to support end-to-end encryption) needed for mission-critical workloads on IBM Z series mainframes (including the latest z15), supporting both physical air-gap protection (to address corruption and malware concerns) and an attractive entry point (20TB capacity uncompressed).

CHALLENGES/OPPORTUNITIES

Given IBM's dominant position in mainframe technology, the company's challenges are more around effectively meeting evolving customer requirements in a mature, slow-growing market. IBM is the dominant player in mainframe servers — it owns 50% of the mainframe-attached storage market (competing primarily in this space with two other vendors: Dell EMC and Hitachi) and roughly 80% of the mainframe tape subsystem market (which includes both physical and virtual tape libraries). While almost all large enterprises have at least some mainframe servers, they are also at the same time managing the digital transformation of their organizations. CIOs in these enterprises are tasked with simultaneously maintaining critical legacy workloads while bringing on next-generation applications and looking to improve the efficiency of IT infrastructure through both public and private cloud technologies. IBM will need to stay abreast of how mainframe infrastructure will need to be evolved to meet the requirements of digitally transforming organizations.

IBM offers a strong portfolio of storage solutions for both legacy and next-generation workloads, and how these two facets of IT infrastructure integrate to meet the growth, flexibility, availability, and security requirements of today's much more dynamic business model is becoming an increasingly important purchase criterion as IT organizations implement and evolve their hybrid cloud strategies. IBM's acquisition of Red Hat in 2019 is definitely paying dividends in helping the vendor fill out its hybrid cloud capabilities, most recently in the storage arena with the introduction of the IBM Storage Suite for Cloud Paks. The IBM LinuxONE mainframe, based as it is on Linux, will in most cases provide the best fit for customers that have to create hybrid cloud environments that span mainframe and public cloud infrastructures.

IBM's challenge will be how to continue to implement newer technologies on top of the solid mainframe foundation while providing a compelling hybrid cloud strategy for its customers. IBM offers its customers a strong hybrid cloud strategy with support for container-based environments (through the IBM Storage Suite for Cloud Paks and CSI) and efficient, secure data mobility between on-premises and off-premises environments. Given its market position, the opportunity is to retain all of its existing mainframe installed base while capturing as much of the new IT spend as possible as existing customers maintain existing mainframe-based applications, refactor some workloads, develop and deploy entirely new next-generation (i.e., cloud-native and container-based) workloads, and add new distributed systems to their on-premises infrastructure.

CONCLUSION

With these latest mainframe storage announcements, IBM continues to enhance the performance, availability, security, data mobility, and hybrid cloud integration capabilities of the entire product line. These new enhancements will make existing mainframe customers happy, providing increased performance density, boosting administrative productivity, and lowering the cost of managing and maintaining mainframe infrastructure over time. As part of a more general evolution across its entire storage systems product line to move toward more industry-standard technologies, IBM is now standardizing its mainframe offerings on the same 19in. rack form factor that is today used for most distributed enterprise infrastructure. The latest round of enhancements announced in August 2020 expands capabilities for IBM mainframe customers even as it raises the bar for IBM's mainframe competitors.

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