



Highlights

- Comprehensive protection of all data with pervasive encryption
 - Improved performance and larger capacity with up to 170 cores, 32 TB memory, and 50 percent larger on-chip cache
 - Designed for data serving with new IBM zHyperLink and FICON Express 16S+
 - Real-time insights and applied machine learning to more accurately anticipate customer and business needs
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Trusted digital experiences with SAP on IBM z14

IBM Z delivers leading security, performance and availability for critical applications

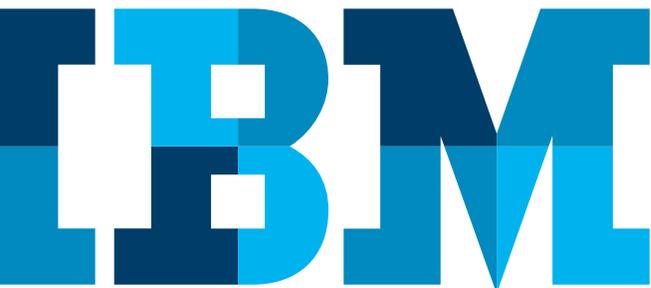
IBM z14 delivers increased benefits for SAP workloads

Today's businesses face a variety of challenges when it comes to SAP workloads: the amount of business data in the world is growing exponentially, businesses are more interconnected than ever before, cloud environments are replacing traditional on-premises IT environments, and security threats are growing more prevalent and sophisticated all the time.

Enterprises need a new, more modern solution to help them master these changes and stay current in a new business world. This is certainly the case when it comes to SAP workloads.

In an era when gaining visibility and insight into business operations is becoming an imperative, SAP business applications provide that visibility and insight for organizations across the globe. However, SAP solutions require a solid hardware platform in order to function effectively. As enterprise technology has changed, so too must the hardware requirements for SAP solutions.

This is where IBM® z14™ dominates. It is a new generation of the IBM Z® product line that has continued to evolve the best-in-class server platform with a new design, and new capabilities, while maintaining the legacy of IBM Z® value propositions. IBM z14 redefines what organizations can accomplish with their SAP workloads in order to keep up with the changes going on in the business world.



IBM is well positioned to assist organizations in transforming their current IBM Z enterprise infrastructures to obtain improved and more extensive results with SAP applications. IBM z14 includes new features designed specifically for SAP workloads, improved system performance and throughput when compared with previous generations of z processors, ultimate protection for an organization's data, machine learning to gain deeper insights, and the ability to handle modern SAP workloads better in an open and connected world.

“SAP recognizes the continued investment that IBM makes in extending the capabilities of IBM Z to meet the complex needs of our joint customer base. The expansion of memory size (up to 32TB), enhanced FICON adapters and zHyperLink with reduced latency and improved I/O rates will help to further enhance the performance of transactional and analytic workloads running in SAP software, which we anticipate will lead to measurable enhancements in the responsiveness of SAP banking solutions. In addition, the introduction of the pervasive encryption and zEDC data compression will help further the overall characteristics for modern SAP industry applications. This, combined with the traditional strengths in continuous availability and workload management, will lead to an excellent platform upon which clients can build cutting-edge, high-performance and highly secure mission-critical SAP applications.”

—Dr. Bernd Kohler, Development Manager,
SAP on IBM Z & Db2 for z/OS, SAP SE

New features for SAP workloads

SAP workloads are unique, and they therefore benefit from specific features. The z14 offers an outstanding foundation for SAP business applications, combining pervasive encryption, unprecedented speed, scale and efficiency. Compared to its predecessor platforms, the z14 provides more of what SAP customers need to satisfy today's growing IT demands:

- Pervasive encryption to help secure transactions and data
- Compute power for increased throughput
- Large-scale memory to process data faster
- Industry-unique cache design to optimize performance
- Accelerated I/O bandwidth to process massive amounts of data
- Data compression to economically store and process information

Achieving pervasive encryption

IBM z14 allows businesses to defend and protect critical assets with unrivaled encryption and intelligent data monitoring—without compromising transactional throughput or response times. Most importantly, there are no application changes. IBM calls this pervasive encryption.

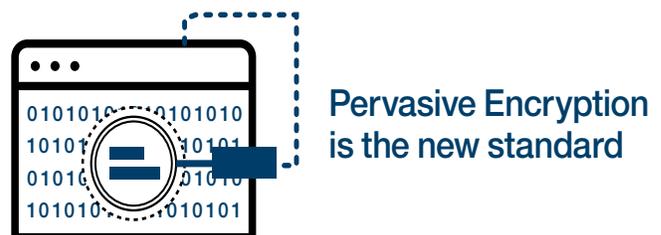


Figure 1: IBM z14 pervasive encryption provides the ultimate protection for core corporate data and simplifies compliance to expanding regulations.

Data protection and compliance are business imperatives

The z14 pervasive encryption enables businesses to provide the ultimate protection for core corporate data and simplify compliance for expanding regulations. No longer do organizations have to be selective in what they encrypt; 100 percent is the new standard. By encrypting as much data and transactional pipeline as possible, businesses can reduce potential data breach risks and financial losses, comply with complex regulatory mandates, simplify the audit process, and pass compliance audits.

IBM z14 pervasive encryption capabilities give clients a transparent and consumable approach to encrypt virtually all in-flight and at-rest data. Using simple policy controls z14 pervasive computing streamlines data protection for mission-critical datasets. The IBM z14 pervasive encryption is complemented by PR/SM™ technology, LPAR design, and RACF®. PR/SM technology on the z14 received Common Criteria EAL5+ security certification. PR/SM is always active on the system and is enhanced to provide better performance and platform management benefits.

The LPAR definition includes a number of logical processor units (LPUs), memory, and I/O devices. IBM z/Architecture® is designed to meet requirements with low overhead and also has achieved Common Criteria EAL5+ (the highest security certification in the industry) with a Specific Target of Evaluation (Logical Partitions). This design has been proven in client installations over several decades.

RACF rounds out the security suite by providing access control to the z/OS® system. Only authorized users and programs can access the data under RACF control.

More compact and faster compression

The z14 can efficiently manage storage tiers and help to move data closer to the processor in anticipation of an application's needs. There is improved compression ratio on the z14 processor core using Huffman coding which can lead to additional disk and memory cost savings—even where compression is already in use today. With better compression, and order preserving compression enhancements in Db2®, clients can save disk space and cut transfer time to Db2.

Data compression with zEDC further reduces cost to pervasively encrypt data with less data to encrypt. It can efficiently compress data like SMF data sets or Db2 LOBs using a dedicated compression accelerator (zEDC Express feature) and uses industry standard compression for cross platform data distribution.

Additional features for improved system performance and throughput

IBM Z running SAP software

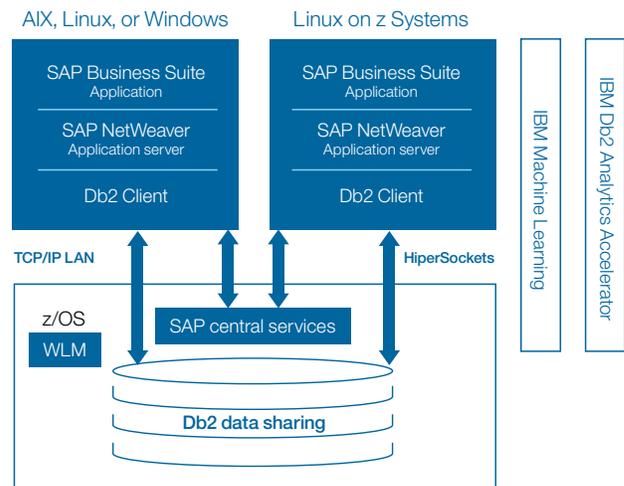


Figure 2: IBM Z brings together different platforms under a single management umbrella.

IBM has continued to build on the business value it provides to SAP customers with this latest release of IBM Z. In addition to the new security enhancements, z14 offers additional features that deliver availability, efficiency, scalability and integration.

z14 was designed and built specifically to handle cloud, cognitive, and mobile workloads, making it the logical choice at a point when those particular workloads are becoming increasingly important.

The benefits offered by z14 for SAP workloads include performance and capacity. z14 is powered by up to 170 of the industry's fastest microprocessors running at 5.2 GHz. This represents up to 35 percent more total general system processing capacity than the previous generation of Z processors.

On a per-processor core level, z14 also promises better performance than previous generations of IBM z processors, particularly for SAP workloads. When compared to z13, z14 has 10 percent higher performance per processor core for general workloads, and 12 to 13 percent higher performance per processor core for the database server of SAP workloads. This level of performance improvement is a direct result of the cache design enhancements described later in this paper. SAP database serving has been one of the target workloads influencing cache design for IBM Z.

zHyperLink

IBM zHyperLink™ was created to provide fast access to data via extremely low latency connections between the IBM Z platform and storage. The zHyperLink Express feature allows clients to make synchronous requests for data that is in the storage cache of the IBM DS8880. This process is done by directly connecting the zHyperLink Express port in the z14 to an I/O bay port of the DS8880. This short distance (up to 150 m) direct connection is currently intended to speed up Db2 for z/OS blocking read requests. Working in conjunction with the FICON® SAN Infrastructure, zHyperLink can improve application response time, cutting I/O-sensitive workload response time by up to 50 percent without requiring application changes.

Large memory and increased scalability

The rapid proliferation of mobile devices has coincided with a growing desire for companies to offer users direct access to information and services stored on back-end systems. For instance, while bank customers used to go through a proxy to access their financial information (the bank teller), today's customers can use mobile banking to access this information directly.

As more users begin to access back-end systems, the need for greater scalability in those systems increases as well. If these systems are open to customers, then customers must be able to access them continuously, with consistent response times.

Larger memory capacity

The z14 processor retains the strengths from z13, and additionally features a larger memory capacity—up to 32TB of real memory per server—which can play an important role in providing the high performance and availability needed by many modern SAP workloads. This amount of memory is three times the maximum memory capacity offered by z13.

With a higher memory capacity, z14 allows users to allocate more memory to Db2 buffer pools and the SAP application servers running on Linux, which in turn opens up significant performance improvements for SAP workloads, especially in data-sharing environments.

The large memory capacity is also beneficial when planning future growth. Very large Linux on IBM z Systems application server environments can enjoy significantly more headroom on z14, delivering high levels of capacity as today's workloads continue to grow.

The ability to have 32TB of memory provides the foundation for in-memory databases and applications. This will best be exploited by analytics and machine learning.

Multi-processor scaling

z14 features a number of design improvements that enable improved multi-processor scaling. One example of this can be found in the redesigned cache architecture of z14. IBM Z has redesigned the cache architecture with 1.5x more on-chip cache per core compared to the IBM z13. Bigger and faster caches help to avoid untimely swaps and memory waits while maximizing the throughput of concurrent workloads

The L4 caches in the z14 processor are significantly larger than the caches on other mainstream servers. The L4 cache can grow up to 3,840 MB on a single z14 system. This allows z14 to manage dozens or even hundreds of SAP databases by keeping working sets closer to the z14 engines.

The z14 processor also features a new, more efficient LPAR memory allocation scheme. By allocating memory to the same drawer as the processor, z14 is able to access data using significantly fewer cycles than if the data were stored in remote memory. This greater memory affinity helps z14 offer improved multi-processor scalability.

World-class performance for banking

IBM Z has achieved a new industry-leading result in running SAP Banking Services with Db2 12 for z/OS. The result was obtained using a SAP Core Banking day processing workload with the database and application servers all residing in a single z14 footprint. The result demonstrates superior client value in delivering world-class performance and scalability, reaffirming that IBM Z is the most scalable mainframe ever and the ideal platform for banks with large core banking workloads.

A throughput of 1.6 billion account postings per day was achieved using a 60 million account database on a single IBM z14 with 18 general CPs and 140 IFLs (IBM Integrated Facility for Linux).

FICON Express16S to support I/O-intensive SAP workloads

High-speed connectivity to data is critical to achieve exceptional transaction throughput. The FICON Express16S+ feature is designed to boost I/O rates and reduce single stream latency. This feature helps absorb large application and transaction spikes driven by unpredictable analytic and mobile workloads.

Larger coupling facility to support data-sharing workloads

The coupling facility included with the z14 processor is also designed with larger workloads and data sharing in mind, which is another reason that z14 is a good choice for SAP workloads. The z14 processor supports up to 512 coupling channel path identifiers (CHPIDs)—twice that of z13. In addition to supporting greater connectivity and allowing for the consolidation of multiple Parallel Sysplex® environments onto the same set of physical servers, this fact also means that z14 can scale to enable large cache structures, making it a natural choice for large data sharing workloads. Larger coupling facility structures help increase throughput in IBM Db2 subsystems, and therefore reduce processing overhead.

Simultaneous multithreading technology (SMT)

The z14 processor further improves benefits introduced in z13 with two-way simultaneous multithreading technology (SMT-2). SMT-2 is implemented automatically and intelligently, allowing each operating system or hypervisor to use SMT in the way that best meets its own unique requirements. Design enhancements such as pipeline optimization have led to improved SMT-2 performance of the z14 when compared to the z13.

As a result, z14 helps support the best SMT-2 results possible for both IBM Z Integrated Information Processor (zIIP) and IBM Integrated Facility for Linux (IFL). Large systems performance reference testing has demonstrated a 25 percent average throughput improvement for zIIP and IFL processors on a core-to-core basis.

Achieving continuous availability

Every second of downtime—be it planned or unplanned—can mean lost revenue. It is crucial to keep critical systems running 24x7, and to rapidly recover from an outage and resume critical business operations. Our leading customers define continuous availability as less than one hour of planned plus unplanned downtime per year, which can be restated as 99.99 percent or four 9s availability. These customers further define availability as end users and application programs being able to access and update data in the production databases. To achieve this level of availability requires reliability (resilience to unplanned outages) plus continuous operations, which is the ability to avoid planned outages. In the typical SAP shop, planned outages are 98 to 99 percent of all outage time. IBM Z hardware is designed to provide a foundation of five 9s reliability with a mean time to failure of more than 40 years. The engineered reliability is complemented by elimination of single points of failure within the z14. This is further supported by a robust operation system, z/OS, which has more than one million lines of recovery code. The z14

has many innovations that improve RAS as shown in the figure below.

The synergy between the z14, z/OS, Db2 for z/OS, and Parallel Sysplex enables the system to avoid planned outages. The z14 provides dynamic provisioning of processors, concurrent maintenance, the ability to upgrade in place, and virtual flash memory (VFM) for faster dumps and greater reliability than I/O adapters.

Db2 enhances the availability of the z14 with Online Reorg, System Backup/Restore, and continues to remove planned downtime for database administration with Db2 12 features such as dynamic insert partition, table scalability up to four PB, and buffer pools up to 16 TB. Db2 is unique in its ability to be upgraded to a major new release without taking the database down. This is being further enhanced with continuous delivery of new Db2 functions.

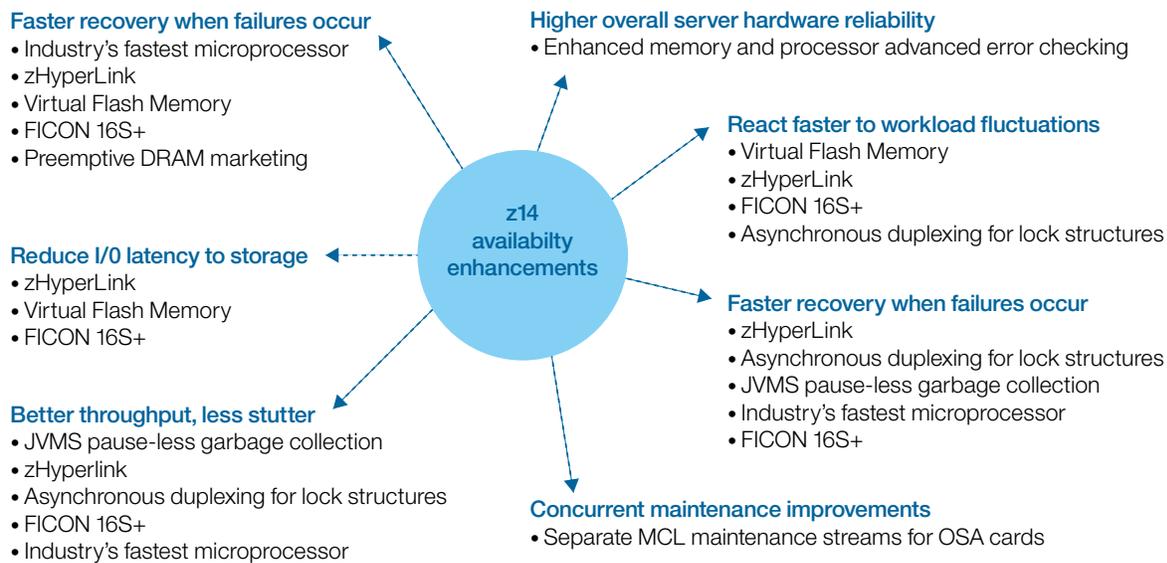


Figure 3: z14 innovations to improve reliability, availability and serviceability (RAS)

Parallel Sysplex data sharing for Db2 is a shared-everything architecture implementation that removes the SAP database as a single point of failure, and enables continuous availability of the databases for processing. It puts the z14 in the unique position of being able to support upgrades and maintenance of the hardware, the z/OS operating system, and Db2 without a planned outage. This has been recently further enhanced through the combination of z14 internal coupling facilities, z14 high-speed links, z/OS, and Db2 12 enabling of asynchronous DB2 lock duplexing. This is an efficient and economical way to eliminate the lock structures as a single point of failure. It also provides enhanced availability for

customers who run split work loads at extended distances either in a campus mode or where the IBM Geographically Dispersed Parallel Sysplex™ (IBM GDPS®) family of solutions is being used to provide business continuity in the case of unplanned failures, power outages, fire, or human error. The GDPS family of solutions provides additional tools to ensure IBM Z availability, and mask or significantly reduce the effects of critical component outages or failures. Using IBM HyperSwap® technology, the disk subsystem is eliminated as a single point of failure in an SAP on Db2 environment.

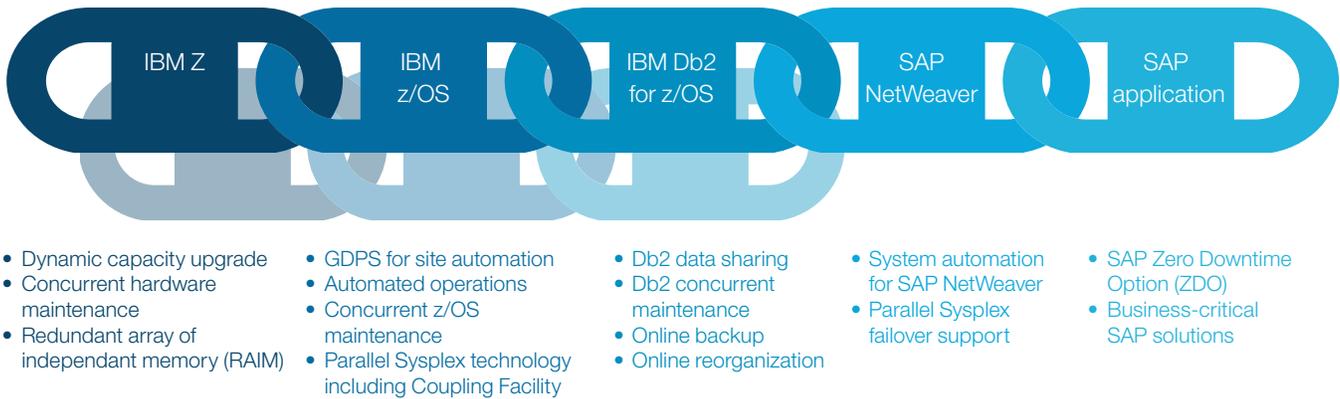


Figure 4: Together, these components form a highly available business continuity solution for SAP on IBM Z.

Analytics and Machine Learning for continuous intelligence across the enterprise

Only 20 percent of data is searchable through the internet; 80 percent lives in the enterprise, behind firewalls, in private infrastructure. As this data continues to grow exponentially, those organizations that have the systems and technology in place to draw insights from that data will be at a competitive advantage. That's why z14 offers features that can drive better results for analytics workloads.

IBM Machine Learning for z/OS helps organizations quickly ingest and transform data to create, deploy and manage high quality self-learning behavioral models using IBM Z data, securely in place and in real time, to more accurately anticipate customer and business needs. SAP customers running on z14 can apply machine learning directly to their most valuable data to:

- Exploit imbedded cognitive capabilities to build better models
- Cut data preparation time in half and enable repeated model creation
- Simplify creation, deployment and management of models
- Continuously re-evaluate on new data to monitor model accuracy

IBM Db2 Analytics Accelerator delivers high-speed processing for complex Db2 queries to support business-critical reporting and analytic workloads. It drives out cost and complexity and enables analytics on transactional data as it is generated. z14 allows businesses to run Db2 for z/OS and the IBM Db2 Analytics Accelerator on the same box. This brings transactional and analytical workload into co-location.

Leverage Blockchain to transform business

SAP systems have been and continue to be a central registry to record assets and transactions, built on ledgers. Blockchain technology provides a tamper-proof distributed ledger, allowing multiple individuals and organizations to access and modify without the need for a central registry. Hyperledger offers a shared, permissioned, and encrypted ledger, an immutable record of all transactions within a business network.

IBM Blockchain technology is based on Hyperledger Fabric, an open source blockchain framework implementation and one of the Hyperledger projects hosted by The Linux Foundation®. Its modular architecture with pluggable, interchangeable services provides integration points for SAP applications and processes collaborating in cross-company business networks.

About SAP business solutions, and how IBM enables them

The collaboration of IBM and SAP drives the development of both IBM and SAP products and services. Many IBM products have SAP-specific features and functionality built into them. Industry-specific solutions are based on best practices and business experience gained in thousands of customer engagements worldwide. IBM and SAP are committed to continuously work together to meet global customer business needs.

SAP Business Suite and digital innovation with SAP Leonardo

The SAP Business Suite is a collection of applications that support key processes across the enterprise, all built on a common core application set. All of these applications help organizations get the most out of their people, data, and resources. The SAP Business Suite applications include:

- SAP Enterprise Resource Planning
- SAP Customer Relationship Management
- SAP Supplier Relationship Management
- SAP Supply Chain Management
- SAP Product Lifecycle Management

Augmenting capabilities such as Machine Learning, Artificial Intelligence, Internet of Things, Big Data and Blockchain brings digital transformation to systems of record based on SAP Business Suite. SAP Leonardo is a methodology for digital innovation through rapid implementation of emerging technologies in the cloud. It can augment every existing SAP system of record based on SAP Business Suite running on IBM Z. SAP Leonardo is open and extendable so that customers can integrate it with capabilities from IBM Watson and Cloud.

About the IBM Z platform

Trust is the currency of the digital economy. The world is in the midst of a transformation. It's having a profound effect on us as individuals, in business and in society at large. As businesses adapt to capitalize on digital, trust will be the currency that drives this new economy. The IBM Z platform is the core of trusted digital experiences.

The IBM Z platform provides a premier infrastructure with tightly integrated solutions including a comprehensive database, advanced virtualization, security and a systems management portfolio. It is designed for zero downtime, which makes it an ideal platform for SAP applications. This added value makes IBM Z a perfect fit for globally acting clients, as business processes have to be continuously available in order to avoid lost revenue.

Several key advantages of the IBM Z platform are unmatched by other platforms. The reliability of the IBM Z family of servers is renowned, and the ability to upgrade or exchange hardware and software components with all systems up and running provides an impressive demonstration of maximum availability.

IBM Z servers have the highest level of security for sensitive business-critical data commercially available today. The platform's backup and disaster recovery capabilities and near-linear scalability are both supreme, allowing it to handle big volumes of data efficiently. Contrary to popular belief, the mainframe is one of the most flexible architectures available; for instance, organizations can use the mainframe to implement new SAP applications quickly, without interrupting their existing SAP operations.

About IBM Db2 for SAP

With IBM Db2, the partnership and collaboration between IBM and SAP extends to the database level. Db2 releases are strongly influenced by the needs of SAP customers, and are often synchronized with SAP product releases. Customer requirements play a key role in the IBM solution design process, and many current IBM technologies, such as Db2 for z/OS, were directly influenced by customer requirements.

Db2 can run on a cluster of IBM mainframes acting together as a single system image, a configuration known as a Parallel Sysplex. A Parallel Sysplex offers a number of benefits that capitalize on the capabilities of IBM Z processors and help optimize SAP applications. These benefits include the ability to scale from the database tier, and the ability to run multiple SAP applications in parallel.

Db2 data sharing groups at larger distances

Db2 for z/OS Data Sharing, a patented IBM technology, provides key capabilities to keep databases running continuously. Database locking is a crucial component to availability. Prior to Db2 12, to achieve the highest level of availability, the Db2 lock structures must reside in a failure-isolated Coupling Facility or they are duplicated in multiple Coupling Facilities, a process known as synchronous system-managed duplexing. System-managed duplexing resulted in overhead and the failure-isolated CF was recommended. Additionally, stretched Db2 data sharing groups had a practical limit of approximately 10 km.

Db2 12 introduces asynchronous duplexing of the lock structure. The change to asynchronous processing significantly reduces the overhead of system-managed duplexing allowing for near-linear scaling of up to 32 z/OS LPARs, each with up to 80 user accessible CPUs. It also greatly increases distances for stretched Db2 data sharing groups to approximately 100 km at a low cost and enables new disaster recovery topologies.

Support of SAP Core Data Services

SAP has introduced Core Data Services (CDS) to provide a common data abstraction layer that unifies the different data models present in SAP applications. CDS helps enable new and performance-optimized applications that merge analytical and transactional functionality. Db2 for z/OS fully supports SAP Core Data Services. Db2 12 for z/OS introduced major query performance improvements, particularly for CDS queries, which delivered up to 100x faster performance.

SAP NetWeaver 7.40 and 7.50 delivered many new capabilities for SAP CDS and ABAP Open SQL. As an example, SAP ERP 6 EhP8 exploits this and ships more than 2,300 CDS views. SAP ERP Commodity Management as well as other SAP applications like Rapid Replenishment Planning take advantage of CDS. For the banking industry-solution, SAP has delivered Fiori applications that leverage CDS.

Agile innovation and continuous delivery

Db2 has taken an agile approach with continuous delivery, a software engineering approach in which development teams create software in short cycles. It aims at building, testing, and delivering software faster and more frequently while ensuring quality. Db2 12 for z/OS is the starting point for continuous delivery, which means that new functionality is delivered in a continuous manner in the Db2 service stream. To control the introduction of new Db2 features, customers can use Db2 function levels so that new Db2 innovations can be delivered to customers much faster than before. SAP fully embraces Db2 continuous delivery.

Reference Architectures SAP on IBM Z

Examples of how IBM Z can enable SAP success in large, demanding environments can be found in many industries. SAP has published reference architectures for the Business Suite as well as for Banking and Insurance, showing how to run SAP solutions on IBM Z. These reference architectures are based on real-world experience gained from high-end SAP implementations at large enterprises as well as top banks and insurance companies across the globe.

For many of these companies, SAP solutions are used at the core of their business processes. This means that these solutions pose extremely high requirements on the underlying infrastructure, based on the interplay of servers, operating system, database, and storage. The reference architectures detail how a tightly integrated IBM infrastructure, based on IBM Z hardware, z/OS operating system, and Db2 for z/OS provide the level of performance needed for these demanding workloads, while also enabling the sophisticated features of SAP NetWeaver and the SAP business applications themselves.

Read the appropriate SAP on IBM Z reference architecture to learn more:

- [SAP Business Suite on IBM Z](#)
- [SAP for Banking on IBM Z](#)
- [SAP for Insurance on IBM Z](#)

For more information

To learn more about IBM z14, visit ibm.com/us-en/marketplace/z14

To learn more about running SAP applications on IBM Z, talk to your IBM salesperson, or visit the following website: ibm.com/services/us/en/sap/solutions/systemz.html

Share with other users and experts in the SAP on IBM Z Community at ibm.biz/BdHmpM



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