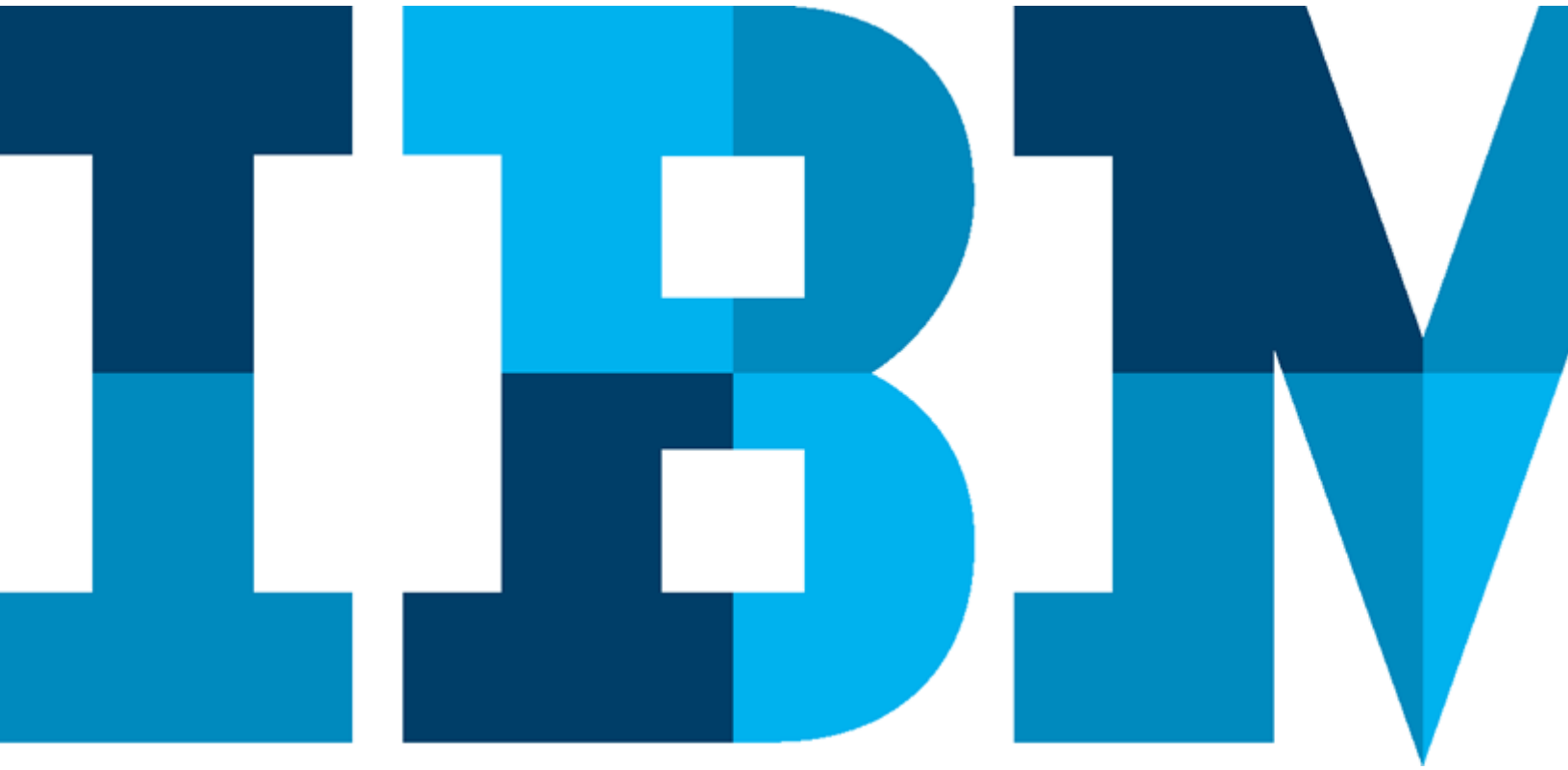
SAP HANA on IBM Power Systems

IBM Power Systems delivers the flexibility, resilience and performance needed to support demanding SAP HANA workloads



IBM

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Introduction

As SAP® clients seek to gain maximum business value from their most strategic IT systems, they are faced with both opportunities and challenges. The opportunity comes from the promise of combining transactional and analytics systems into a single solution, something SAP calls “real-time business.” This approach combines mission-critical day-to-day online transaction processing (OLTP) with online analytics processing (OLAP). Historically, these were separate activities, requiring organizations to move data between systems, which caused a delay between activity and analytics.

By removing the barrier between the two systems, businesses will be better positioned to garner deep business insights that support better decision making and deliver real competitive advantage. The release of S/4HANA® establishes a new generation of SAP HANA® based applications. Simplification of applications and data models results in more efficient and faster business transactions.

The challenges come from the high demands these real-time applications place on IT infrastructure. As an in-memory database, SAP HANA is designed to work best on hardware that delivers high levels of memory bandwidth, multithreading, processor data caching, and automated error checking and correcting. Since SAP HANA often forms the basis for the most critical applications a business uses, high levels of resilience are also required. Finally, a newly implemented SAP HANA database must also integrate well into an organization’s established system landscape. This means that the platform it runs on needs to be flexible enough to integrate new workloads into existing resources and operations.

Against this background, it is clear that deciding to implement SAP HANA is merely the first step toward capitalizing on everything it has to offer. To really make the most of SAP HANA as well as the applications leveraging its capabilities, you need to deploy it on a platform that can provide the unmatched flexibility, rock-solid resilience and industry-leading performance that SAP HANA workloads demand.

This paper will demonstrate why IBM® Power Systems™ is the optimal platform to meet the unique requirements of SAP HANA, now and into the future. By deploying SAP HANA on IBM Power Systems, organizations can simplify their IT infrastructure, decrease total cost of ownership, and maximize the benefits of SAP HANA.

About SAP HANA on IBM Power Systems

SAP HANA customers are moving their workloads to IBM Power Systems to take advantage of a hardware platform that was designed specifically to support big data and analytics workloads, while also providing enterprise-level mission-critical 24x7 reliability.

One key benefit of running SAP HANA on IBM Power Systems is its unmatched flexibility. Today, many of our competitors' SAP HANA configurations are deployed as appliances. This means the user has to accept preconfigured and pre-installed hardware and software. This limited customers' choices in how they could deploy their SAP HANA configurations.

SAP HANA on IBM Power Systems is not offered as an appliance, meaning that customers have the flexibility to deploy on a wide range of IBM POWER®-based servers, combined with various storage options. In many cases, current IBM customers will be able to integrate their SAP HANA workloads into their existing IBM Power Systems infrastructure; this is in stark contrast to traditional appliance-based SAP HANA deployments from other vendors, which require organizations to deploy single-purpose dedicated hardware appliances.

IBM Power Systems also provides market-leading capabilities for reliability, availability, and serviceability (RAS), including self-monitoring and predictive failure alerts, making it the perfect choice to support mission-critical workloads running on SAP HANA. The built-in virtualization capabilities of IBM Power Systems reduce the need to maintain dedicated redundant hardware systems for failover. Instead, organizations can use portions of virtualized hardware as failover targets. These virtualized standby nodes can also be used for test and development workloads, or in active/active mode contribute to SAP HANA production systems. This represents a very efficient way to maintain the high availability that organizations need for their SAP HANA workloads.

Finally, organizations that run SAP HANA on IBM Power Systems can take advantage of the well-established performance advantages of the IBM POWER CPU. With its support for leading technologies, like up to eight-core simultaneous multithreading (SMT8) and excellent memory bandwidth the outstanding speed and throughput of IBM Power Systems make it the platform of choice for SAP HANA workloads. In addition, the performance benefits of IBM Power Systems often translate into more efficient operations, due to the ability to better virtualize workloads by sharing and easily adapting compute resources. By reducing the number of their physical system footprints, organizations are able to cut SAP HANA infrastructure costs in a variety of key areas, including staffing, ongoing maintenance, and periphery.

Flexibility

When you are running a SAP HANA configuration, having the flexibility to support specific organizational needs is of the utmost importance. Platforms that force a one-size-fits-all approach on their users limit what those organizations can accomplish with SAP HANA.

IBM Power Systems offers a number of features to create greater flexibility, including support for virtualization out of the box, and the ability to deploy as a tailored data center integration, rather than an appliance.

With support of SAP HANA Version 2, the IBM POWER platform has introduced full data compatibility with x86 platforms. This increases flexibility on business data level. It allows easy data migration from x86 to IBM POWER (and vice versa) by using simple copy or backup/restore tasks. Even mixed SAP HANA replication clusters can be built for database resiliency.

Virtualization

Together, IBM and SAP took steps to enable flexibility in SAP HANA environments through virtualization. SAP announced support for virtualization based on IBM PowerVM® technology, consolidating up to 8 SAP HANA

virtual machines on a single system[1]. This completely redefines what organizations accomplish with their SAP HANA workloads, while also allowing them to deploy their SAP HANA environments in a manner that avoids the complexity found on bare metal infrastructures.

Organizations that deploy IBM Power Systems can take advantage of both dedicated and shared processor resources via PowerVM virtualization. Users can virtualize up to eight production SAP HANA LPARs with fine granularity not linked to a physical CPU (socket) grid on a single IBM Power Systems. In addition, customers can run non-production workloads and traditional production workloads in a shared processor pool, all on a single server.

By also supporting legacy SAP-systems or other workloads in LPARs IBM Power Systems allow organizations to maximize the flexibility and efficiency they can achieve using virtualization. This helps consolidate workloads onto fewer servers, while also keeping overall usage rates for processors high, even in the face of fluctuating demand. In turn, this leads to greater efficiency and lower total cost of ownership.
Another important virtualization feature offered by IBM Power Systems is the ability to better manage peaks and troughs in demand through dynamic capacity sizing. Processors from other vendors rely on inexact “T-shirt” sizing, where organizations that need to add more memory will have to jump up in large increments—like moving from a medium T-shirt size to a large. Each move up in size requires the organization to add more CPUs, and to take the performance hit that comes from having to reboot. With agile capacity sizing based on virtualization, IBM Power Systems allows organizations to scale the amount of capacity in their environment quickly and granularly, without the need to purchase new systems.

IBM Power Systems also offer Live Partition Mobility, a virtualization feature that supports flexibility and application availability. Live Partition Mobility allows an LPAR containing a running SAP HANA database to be moved from one server to another, without disrupting the database. This supports both non-disruptive cross server workload balancing and planned hardware maintenance with no downtime.

SAP Tailored Data Center (TDI) integration

IBM Power Systems are designed to be deployed as part of SAP’s Tailored Data Center integration (TDI) model. TDI is meant to leverage existing customer IT environments, including storage and networking. This is in contrast to other vendors, which may require SAP HANA to be deployed as an appliance, separate from other IT infrastructure. As the figure below illustrates, deploying SAP HANA as an appliance requires an organization to use preconfigured and pre-installed hardware and software, leaving the organization with no choice in the technology they use to support their SAP HANA environment.

A TDI approach is more efficient and cost-effective than deploying SAP HANA as an appliance. This is because organizations running SAP HANA as an appliance on bare metal will need to purchase new hardware specifically to support their new SAP HANA application, rather than using the strategic storage and network systems they may have already deployed.

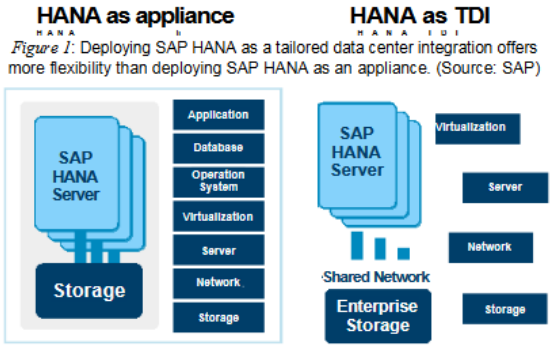

Figure 1: Deploying SAP HANA as a tailored data center integration offers more flexibility than deploying SAP HANA as an appliance. (Source: SAP)

Support for scale-up and scale-out architecture

Different types of workloads imply certain qualities of database updates and node synchronization – some requiring a single-node, i.e. scale-up deployment, others in addition allowing a scale-out topology across multiple database nodes. IBM supports both SAP HANA scale-up nodes for transactional SAP Business Suite workloads and scale-out

[1] SAP Tech Note #2230704: https://launchpad.support.sap.com/#/notes/2230704

topologies for SAP Business Warehouse type workloads (16 nodes max.) and high-end S/4HANA (4 nodes max.). IBM PowerVM provides highly efficient virtualization on any IBM Power System. Thus, any supported server with SAP HANA can be used for both deployment types. This means S-class servers can host smaller scale-up SAP HANA databases plus their surrounding SAP eco-system. On the high-end side, E-class models can exploit their physical scalability by collocating multiple SAP HANA scale-out nodes in LPARs onto one server, and in addition consolidate various associated workloads into a shared resource pool. Both choices help customers to significantly reduce IT and operational complexity and cost compared to identical SAP landscapes residing on numerous dedicated servers and appliances.

Resilience

While availability is important in any database environment, it is particularly important for in-memory databases such as SAP HANA. As a result, it's important that organizations using SAP HANA maximize availability and minimize reboots. Deploying SAP HANA on a highly resilient architecture like IBM Power Systems can help accomplish that goal. In fact, while some vendors consider mission-critical reliability to be optional, this reliability is built into IBM Power Systems by default.

IBM Power Systems offer a variety of features and technologies to support reliability, availability, and serviceability (RAS). Many of these features are considered industry leaders, while others are completely unique.

System reliability

IBM Power Systems are intended to support 24/7 mission-critical enterprise customer operations, and this fact shows in how it keeps both planned and unplanned downtime to a minimum. In a recent report from ITIC[2], IBM Power Systems delivered the highest level of reliability and uptime.

One example of how IBM Power Systems accomplishes this is by using IBM FlashSystem™ storage to minimize start-up time, helping organizations meet their recovery time objectives. IBM FlashSystem can also deliver enterprise-grade reliability, extreme performance based on IBM FlashCore™ technology, and a wide range of operational and cost efficiencies. By using an all-hardware data path, FlashSystem arrays can maximize I/O bandwidth, significantly reducing SAP HANA table load times. As a result, organizations can load even very large SAP HANA databases into memory in a matter of minutes.

Scale-up architecture and virtualization for graceful failover

The fact that IBM Power Systems can operate as a best-of-breed scale-up architecture creates several built-in resilience benefits. A traditional scale-out architecture requires a minimum of n+1 redundant hardware nodes. The spare node remains passive until it's activated to respond to the failure of an active host.

However, on an IBM Power Systems scale-up architecture, with its out-of-the-box support for virtualization, organizations can perform quicker, more effective failover techniques by creating separate virtual footprints within the same server, or on different servers running other workloads. One of these footprints could serve as the failover target, providing the same level of protection offered by passive physical hardware nodes within scale-out environments.

However, since on IBM Power Systems the failover resources are virtualized, they do not have to idle until a failure occurs. Instead, the failover target can be shared to perform active workloads such as testing and development, contributing to better overall utilization of hardware assets.

Predictive failure alerts

By the time you've received an indication that there is something wrong with the platform you're using to run your SAP HANA configuration, it may be too late for you to do anything about it. Ideally, your database administrators would find out about all possible failures before they occur, giving them the opportunity to take action in order to prevent unplanned downtime or data loss.

IBM Power Systems offers this capability through its support for predictive failure alerts. Instead of waiting until a failure has already been detected, IBM Power Systems uses heuristics, running in the background of

[2] ITIC 2017 Reliability Survey

ongoing SAP HANA workloads, to pre-emptively warn DBAs when a failure is likely to occur. This allows the DBAs to take action immediately and migrate at-risk workloads before a failure occurs. By tracking key characteristics of different elements throughout the database environment, IBM Power Systems help organizations address any issues that may endanger the continued uptime of their SAP HANA configurations.

Chipkill memory

Another example of a feature IBM Power Systems offers to support the very high level of reliability required by SAP HANA is chipkill memory. Chipkill memory is an advanced error checking and correcting (ECC) technology that allows organizations to protect data stores from single memory chip failure. By isolating and neutralizing the failing chip, IBM Power Systems removes the potential for memory loss. This helps organizations keep their throughput levels high, while still providing the level of memory protection than SAP HANA demands.

Many Intel-based systems offer a similar type of technology called lockstep memory or RAS mode. However, this technology is not included by default, and it can significantly harm performance when enabled. In addition, customers may not realize that all performance benchmarks for Intel systems are run with RAS mode disabled. This means that customers would have to choose between accepting a less reliable system, or a system that can't provide the level of performance quoted in published benchmarks. Since IBM Power Systems offer RAS capabilities that are enabled by default, reliability is factored into the benchmark results. As a result, IBM customers don't have to choose between reliability and maximum performance.

Extra chip per memory rank

IBM Power Systems offerings also come with an extra chip per memory rank, enabling built-in memory rank sparing. In the unlikely case that a chip begins to fail, the contents of the failing chip will be copied to the extra chip, ensuring ongoing availability. Since Intel systems do not provide an extra chip per memory rank, they can only replicate this level of availability using memory mirroring, which reduces the maximum available memory in a system by half.

Performance

IBM Power Systems were designed specifically for big data and analytics workloads like SAP HANA. This section of the paper will explore the performance benefits of IBM Power Systems over competing platforms in more detail. Using these performance benefits, organizations can put themselves in a better position to manage transactions and queries with consistent load times, even at very high load conditions.

Simultaneous multithreading

Perhaps the clearest indication of the performance benefits offered by IBM Power Systems can be found in its support for simultaneous multithreading with eight threads per core (SMT8). SMT refers to a system's ability to concurrently execute multiple sets of instructions during the same CPU clock cycle. Simply put, SMT helps a platform respond to a greater number of CPU requests within the same period of time, cutting down on the amount of time one must spend waiting for workloads to finish executing.

While previous IBM Power Systems processors have provided support for simultaneous multithreading with four threads per core (SMT4), IBM POWER take its SMT capabilities to the next level, doubling the amount of threads per core.

In addition, SMT on IBM POWER offers up to four times as many threads per core as any Intel-based platform, as these platforms top out at only two threads per core. SMT modes can be switched to best accommodate optimal working environment for changing workloads.

As one would clearly expect, the ability to run more threads per core contributes to significantly higher levels of per-core performance. This, in turn, allows organizations to do more with less. Higher throughput per core allows an organization to meet all of their SAP HANA performance requirements while running a smaller number of cores.

It also provides greater flexibility to run in scale-up mode, which allows SAP HANA to operate in a single memory space for customers who choose not to cluster across multiple servers.

Memory capacity

The performance of SAP HANA workloads can be directly affected by the level of memory capacity provided by the platform that the database is operating on. This is because the performance benefits of in-memory databases such as SAP HANA can all be traced back to the fact that data is stored in memory. By removing the need to store data on external disk systems, an organization can also do away with the latency that arises when the database has to access data stored on those disk systems.

The more memory capacity a platform can offer, the more data SAP HANA can actually keep in memory. In spite of its built-in data compression algorithms, SAP HANA can still benefit greatly from running on a platform that provides it with ample memory capacity.

By providing up to 32TB of memory on a single scale-up server, IBM Power Systems is the optimal platform for unlocking the full potential of in-memory databases like SAP HANA and their associated ecosystems.

IBM Power Systems are able to provide this level of memory capacity for consolidation of SAP HANA and further collocated workloads, so that organizations can benefit from high memory capacity while still using a single server.

This is in contrast to a scale-out architecture where additional capacity is added to the platform by implementing multiple servers. For those organizations that are willing to invest in premium hardware systems in order to pursue performance optimization, the scale-up capabilities offered by IBM Power Systems are unmatched.

In addition to the reliability benefits of scale-up environments described above, maintaining a single server also has performance benefits. Adding additional servers creates the need for a network connection to facilitate synchronization operations between the servers. Keeping everything on a single server allows organizations to avoid the latency created by these inter-server connections.

Memory bandwidth

When it comes to supporting SAP HANA databases, being able to store large amounts of data in memory is really only half the story: SAP HANA performance is also highly dependent on how quickly the CPU can access that data. This is a concept known as memory bandwidth. IBM Power Systems CPUs offer more memory bandwidth per socket of Intel-based systems, another clear indication that IBM Power Systems is better suited to helping organizations capitalize on all the benefits that an in-memory database like SAP HANA can offer.

Memory latency

Taking advantage of local caches for data storage represents another important opportunity to maximize the performance of SAP HANA. Data on local caches can be accessed much quicker than data stored in the main memory. This means that the more cache capacity a system offers, the lower its latency for accessing data in memory.

Single instruction multiple data vector processing

Single instruction multiple data (SIMD) vector processing refers to an in-memory database's ability to process multiple elements of data as a single instruction. It represents another important performance benefit for in-memory databases such as SAP HANA; however, both the hardware and software must support SIMD if the database is to take advantage of the benefits it can offer. This provides yet another example of how getting the most out of SAP HANA depends on choosing the right platform to run it on.

IBM Power Systems CPUs offer an integrated dual-pipeline vector scaling floating point unit that supports SIMD instructions. It can support up to eight single-precision or four double-precision floating point operations per clock cycle.

The SAP HANA code has been optimized to fully exploit IBM Power Systems vector instructions. Organizations that choose IBM Power Systems to run their SAP HANA configuration would have the vector instructions needed to support SIMD processing.

New developments for SAP HANA on IBM Power Systems

At IBM, we're always looking for new opportunities to better meet the needs of SAP

HANA users. While IBM Power Systems already provides the best mix of flexibility, resilience and performance for running SAP HANA workloads available today, there are a number of recent developments that will make IBM Power Systems even better suited to support
SAP HANA and S/4HANA.

About the IBM-SAP Alliance

The SAP HANA capabilities outlined in this document are the product of a long and close working relationship between SAP and IBM. This partnership stretches back several decades, and is still shaping the direction of SAP HANA on IBM Power Systems environments today.

IBM is a multifaceted SAP partner, with over 30,000 employees specifically supporting SAP projects. There are currently over 6000 successful SAP implementations running on IBM Power Systems worldwide.

Organizations that choose to work with IBM to support their SAP HANA implementation will get the benefit of our many years of SAP experience, as well as a single point of contact and end-to-end support for all SAP implementations. In addition to hardware and software offerings, IBM also has an SAP Consulting Practice that offers customers a variety of technical services, such as discovery, assessment, benchmarking, proofs of concept, and express deployment.

Final thoughts

Whether you're looking to move your SAP HANA workloads to a better platform, or make the move to SAP HANA for the first time, IBM Power Systems are the right choice for you. With its flexibility to deploy the way you want to deploy, resilience to keep your SAP HANA workloads up and running, and proven unmatched performance, no other hardware platform is as well suited for SAP HANA workloads as
IBM Power Systems.

For more information

To learn more about IBM Power Systems for SAP HANA, contact your IBM representative or IBM Business Partner, or visit the following website: **ibm.com/power/saphana**

IBM Corporation IBM Systems
Route 100
Somers, NY 10589
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