SAP Business Suite Benchmark Performance on Cisco Unified Computing System

White Paper
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What You Will Learn

With more than 23,000 Cisco Unified Computing System™ (Cisco UCS®) customers worldwide, Cisco UCS is a major platform for enterprise computing and has demonstrated its robustness, flexibility, and cost effectiveness. Any Cisco customer who is already using Cisco UCS and enjoying the benefits of true stateless computing with unified (and redundant) fabric for the LAN and SAN and a single point of management for the entire system can also embed any new or extending SAP solution in the data center.

This document presents the procedures and benchmarks that Cisco and any other SAP hardware partner must meet to become and remain certified for SAP solutions and to maintain this status.

This document also describes the importance of benchmarks (especially SAP Sales and Distribution [SD]) and how they are used in hardware sizing for this important segment of business computing.

History and Platforms

SAP's first business process solution (later known as SAP Real-Time System 2 [R/2]) was deployed on mainframe computers. As SAP R/3, it was ported first to UNIX and later (in 1994) to Microsoft Windows, followed by Linux in 1999, thereby enabling it to run on x86 hardware for a lower-cost platform. Big iron is still supported today for IBM zSeries as well as for iOS on IBM iSeries, AIX on IBM pSeries, HP-UX on Intel Itanium, and Solaris on Sun SPARC CPUs. However, the proprietary operating systems are slowly becoming a niche market.

Mainstream x86 hardware (for both SAP on Microsoft Windows and SAP on Linux) is offered from a variety of vendors, including Cisco, but hardware offered for SAP use must be certified by SAP rules.

SAP Basic Architecture

From the beginning, SAP was designed to run in multitier environments. Application servers can run together with the database on a single server with sufficient resources (two-tier design; Figure 1), but application and database tiers can also reside on dedicated servers (three-tier design; Figure 2), which allows the system to scale tremendously on low-cost commodity platforms.

Figure 1. Two-Tier Configuration

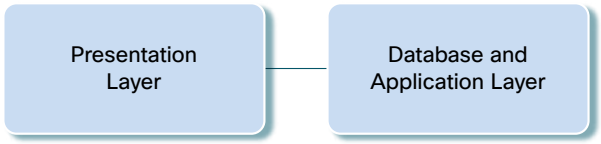
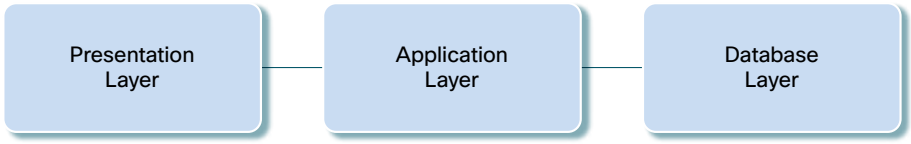


Figure 2. Three-Tier Configuration



Three-tier systems depend on an extremely low-latency, reliable, high-bandwidth network connection between the database tier and the application-server tier. The performance of the connection between the application server and the presentation layer (user) is not critical.

Hypervisors like VMware ESXi, Red Hat Kernel-Based Virtual Machine [KVM], Microsoft Hyper-V, and Citrix Xen are either fully supported by SAP or supported with restrictions (not all guests are supported). Also, some proprietary solutions such as partitions and containers are supported for certain environments only. Usually, the best approach is to deploy the application servers as virtual machines on a hypervisor. Virtualizing databases may affect performance, and this effect must be evaluated beforehand.

SAP Certifications and Benchmarks

SAP, together with its hardware partners, established a suite of SAP standard application benchmarks to help ensure that the resources necessary to run a SAP solution can be determined independently of the platform technology (processor, operating system, or database).

These benchmarks may or may not be prerequisites for a successful SAP certification, depending on the operating system.

For Microsoft Windows platforms, SAP enforces the publication of results of the SAP SD benchmark in a two-tier configuration as part of the SAP hardware certification with the following conditions:

- Only the largest server in a platform family needs to be certified.
- Smaller servers of the same platform family are included in this certification and do not require certifications of their own.
- New, larger servers than the one last certified are temporarily certified for the six months after publication.
- The server must be listed at www.saponwin.com.

For UNIX, IBM zSeries and iSeries, and Linux hosts, SAP certifies the operating system and not the hardware. The hardware partners perform the certification for SAP environments as documented in SAP Note 1403020. The publication of the results of benchmark tests with these platforms is voluntary.

All certified SAP standard application benchmarks are published at www.sap.com/benchmark.

SAP Benchmark Workloads

SAP offers a large portfolio of business solutions, including online transaction processing (OLTP) systems (SAP Enterprise Resource Planning Central Component [ECC], Customer Relationship Management [CRM], Supplier Relationship Management [SRM], etc.), online analytical processing (OLAP) systems (SAP NetWeaver Business Warehouse [BW], etc.), different basic coding technologies (SAP Advanced Business Application Programming [ABAP] and Java), and industry solutions (banking, retail, etc.). The workload characteristics of these solutions are difficult to compare, and therefore adequate benchmark tool sets had to be developed, with workloads tailored to the different use cases. For a complete overview see http://www.sap.com/campaigns/benchmark/appbm_overview.epx.

A SAP Standard Application Benchmark consists of script files that simulate the most typical transactions and workflow of a user scenario. It has a predefined SAP client database that contains sample company data against which the benchmark is run. The benchmark transactions of each component usually reflect the data throughput of an installation (for example, orders, number of goods movements, etc.). However, benchmark transactions do not reflect reporting because the resource consumption of a customer-defined report depends on the volume of data sought and is therefore not comparable. Exceptions are the BI-D, BI-XML, and BW-EML benchmarks, which are mainly (but well defined) reporting activities.

Application components are customized for a benchmark and run in such way that the system resource requirements are reduced while still representing an economic reality. Comparable customizing settings (buffer sizes, number of work processes, etc.) can be found in live customer installations that need high data throughput.

In general, all benchmark users have their own master data, such as material, vendor, or customer master data, to avoid data-locking situations. For most benchmarks, a maximum of 1000 parallel benchmark users can be simulated per client. The multitier client-server architecture consists of database, application, and presentation layers. The presentation layer—in reality, the front-end devices of the logged-in users—is handled by a server called the benchmark driver. The application layer cannot tell whether it is used by real users or a simulated environment.

The latest addition to the SAP benchmark portfolio (May 2013) is the Concurrent Benchmark. This benchmark allows the concurrent execution of other hitherto existing (dialog) benchmarks and the comparison of the summed (or averaged) result under several conditions. This scenario is realistic for a broad range of customer deployments because today's servers are so powerful that even smaller servers can easily share the load of several SAP systems running in separate virtual machines.

SAP Sales and Distribution Benchmark

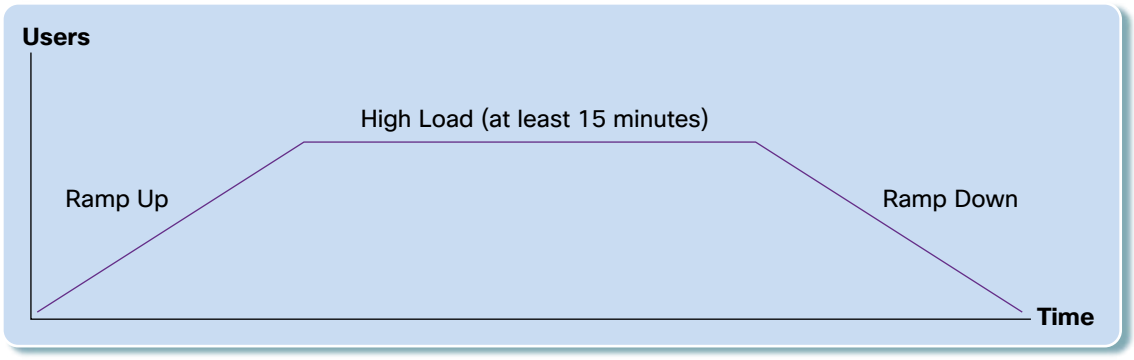
Because of the substantial effort required to run all these benchmarks and the ubiquitous distribution of the SAP Enterprise Resource Planning (ERP) system, the SAP SD benchmark in a two-tier configuration is the benchmark that all SAP hardware partners use. Additionally, the results of this benchmark can be used to size all other SAP solutions by applying conversion formulas based on measurements and experience.

The SAP SD benchmark simulates a sell-from-stock scenario (including customer order creation, the corresponding delivery and subsequent goods movement, and creation of the invoice) and consists of the following SAP transactions:

- Create an order with five line items (SAP transaction VA01).
- Create a delivery for this order (SAP transaction VL01N).
- Display the customer order (SAP transaction VA03).
- Change the delivery (SAP transaction VL02N) and post the goods issue.
- List 40 orders for one sold-to party (SAP transaction VA05).
- Create an invoice (SAP transaction VF01).

Each simulated user repeats this series of transactions from the start to the end of a benchmark run. During the ramp-up phase, the number of concurrently working users is increased until the set number (for example, 10,000) is reached. When all users are active, the test interval starts. This load level must be maintained for at least 15 minutes (a benchmark rule). After at least 5 minutes of the high-load phase, one or more database checkpoints must be enforced (that is, all log file data is flushed back to the database within the high-load phase) to stress the I/O subsystem in a realistic way (a benchmark rule). At the end of the high-load phase, users are gradually taken off the system until none is active. When the test concludes, all relevant data is then transferred to the presentation server for further evaluation (Figure 3).

Figure 3. Benchmark Phases



The SAP SD benchmark is one of the most CPU-intensive and memory-demanding benchmarks available. It has essentially become a standard for SAP's platform partners and in the SAP ERP environment, and it measures the maximum number of supported users satisfying a certain average dialog response time in a SAP SD scenario. It comes in two – and three-tier versions and a parallel version using multiple database nodes.

To provide a benchmark environment that can be fairly easily applied and that achieves reproducible results, a continuously maintained and updated toolkit is available for certified hardware partners. It makes heavy use of Perl scripts plus some standard C code that is either precompiled by SAP or compiled by the user for the specific target platform.

To adapt the benchmark to the evolving requirements of SAP ERP releases, careful changes are applied from time to time. The biggest changes have been the mandatory use of the Unicode code page, use of the New General Ledger feature, and activation of the Credit Limit Check function with the addition of Enhancement Pack 4 to SAP ERP 6.0. Additionally, the response-time limit was lowered from 2 seconds to 1 second. As a result of these changes, the SAP SD benchmark has become more resource intensive, and the resulting (lower) user numbers cannot be directly compared with user numbers from pre-2009 benchmarks.

Since June 2012, Enhancement Pack 5 and use of Microsoft SQL Server 2012 (in a Microsoft Windows environment) has been compulsory.

With the upcoming introduction of the Intel Xeon E7 Version 2 line of processors, an operating system switch from Microsoft Windows Server 2008 R2 to Microsoft Windows Server 2012 will be enforced by SAP technology partner Microsoft.

Audit and Publication

The SAP Benchmark Council was established in April 1995 and consists of representatives of SAP as well as hardware and technology partners involved in benchmarking. This body defines and controls the content of the benchmarks and establishes the rules that encompass the testing procedures. The procedures involve the hardware companies running most of the benchmarks and sending the results (including detailed data) to SAP. On request, SAP certifies the results and gets them published on its website: www.sap.com/benchmark.

The SAP Standard Application Benchmarks measure all relevant performance metrics such as database request times, wait times, CPU utilization, average dialog response times by a given number of benchmark users, and achieved throughput. The most significant parameters (key performance indicators [KPIs]) must be part of every publication about SAP Standard Application Benchmarks initiated by the platform partners.

The following information must be part of a benchmark press release:

- SAP Business Suite component
- Relational database management system (RDBMS) and operating system release
- Tested standard SAP Business Suite components
- Number of tested benchmark users (if applicable)
- Average dialog response time in "n.nn sec" format (if applicable)
- Achieved throughput in dialog steps per hour or business numbers
- Type of client-server configuration
- Detailed description of hardware configuration
- Confirmation that the benchmark is certified by SAP
- Reference where readers can get more information

Analysis and Comparison

A benchmark can be certified only if the imposed constraints for this benchmark are met (for example, for the SAP SD benchmark, the average dialog response time must be less than a fixed amount of time—think about it as the system reaction time to finish a defined number of transactions—currently defined as 1 second).

Only benchmarks audited and certified by SAP can be published by partners to help ensure results that can be fairly compared with each other. A typical result would be, for example, "10,000 SD benchmark users with an average dialog response time of 0.99 second." According to SAP's full-disclosure policy, the detailed data set is available upon request either from SAP or the hardware partner who conducted the benchmark test.

SAP has defined a unit for measuring throughput in a SAP Business Suite environment: SAP Application Benchmark Performance Standard (SAPS). One hundred SAPS are defined as 2000 fully processed business line items per hour in the standard SAP SD application benchmark. This throughput is achieved by processing 6000 dialog steps (screen changes) and 2000 postings per hour in the SAP SD benchmark or by processing 2400 SAP transactions. In the SAP SD standard application benchmark, "fully business processed" means that the full business workflow for an order line item (creating the order, creating a delivery note for this order, displaying the order, changing the delivery, posting a goods issue, listing orders, and creating an invoice) has been completed.

Using Benchmark Numbers for Sizing

SAP offers an online sizing tool, Quick Sizer, that transforms a given workload (expressed in numbers of users or transactions per second) into a number of SAPS. Therefore, the SAPS values derived in the SAP SD benchmark for a given server can be used to determine whether this server is sufficient to run this workload for nearly all solutions in the SAP portfolio. Because SAPS numbers can be summed, the workload can be distributed over multiple servers as long as the sum of their SAPS values exceeds the SAPS demand of the solution (if the load of the database instance exceeds the capabilities of a single server, you have to use a database that can be distributed over multiple nodes). Conversely, multiple SAP solutions can be run together on a given server as long as the concurrent cumulative SAPS values for the various solutions do not exceed the SAPS value for the server.

SAP on Cisco

Cisco plays a major role in SAP business computing, and a Cisco customer can enjoy all the benefits of Cisco UCS: deployment, management, and scaling of the complete infrastructure. Even rack-mount servers transparently integrate into the unified management system, which differs dramatically from the cumbersome software stacks of other vendors. All the solutions in the SAP portfolio are supported.

The Cisco® Fabric Extender Technology (FEX Technology) is an important part of the unified access architecture and helps enable operation simplicity at scale with a single point of management and policy enforcement on the access-layer parent switch across a multitude of 10 Gigabit Ethernet ports.

Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) is the next step in fabric extender evolution. It extends port extender technology to virtual machines, eliminating the need for hypervisor-embedded Layer 2 software switches and simplifying management and administration by consolidating virtual and physical switching into a single switching infrastructure with a single management point. Cisco Data Center VM-FEX can relieve hypervisor CPU cycles from Layer 2 virtual machine switching. It also can improve performance by making the host CPU cycles available for data processing needs and increase I/O throughput through less latency for network traffic.

Adding Cisco Data Center VM-FEX to a Red Hat KVM setup (see the white paper "Virtualized SAP: Optimize Performance with Cisco Data Center Virtual Machine Fabric Extender and Red Hat Enterprise Linux and Kernel-Based Virtual Machine" listed at the end of this document) and maintaining the user load reduced database request times (latency for database access) by 29 percent. This lower latency results in an improved user experience while working with this system; the SAP system response time, comparable to the response time from the user perspective, dropped from 0.9 second to 0.2 second, a difference very noticeable to the user. In addition, by sacrificing the improved system latency for an optimized system load, 11 percent more users could be supported by the system by employing Cisco Data Center VM-FEX, without additional hardware expenses.

The measurements showed that Red Hat Enterprise Linux and Cisco Data Center VM-FEX technology together improve throughput and latency in today's virtualized SAP environments in the data center. At the time of this writing, VMware and Microsoft Hyper-V, in addition to Red Hat KVM, are supported hypervisors. Without upgrading or modifying existing hardware, improvements in SAP user numbers are possible, leading to a more economical use of infrastructure or leaving more headroom for future growth.

To date Cisco has published:

- SAP SD benchmarks with Microsoft Windows SQL Server on SAP ERP6 EHP4
- SAP SD benchmarks with Linux and SAP MaxDB on SAP ERP6 EHP4 with KVM virtualization
- SAP SD benchmarks with Microsoft Windows SQL Server on SAP ERP6 EHP5
- SAP SD benchmarks with Linux and Sybase on SAP ERP6 EHP5
- SAP SD benchmarks with Linux and Sybase and SAP ERP6 EHP5 virtualized

SAP HANA on Cisco

Unlike its classic business solutions, SAP's new in-memory database, SAP HANA, has different characteristics that do not allow sizing with SAPS. For obvious reasons, sizing is based on the volume of data to be kept in memory. On the basis of practical experiences, SAP postulates a certain ratio of main memory to the number of processor cores. For the current Intel Xeon E7 10-core processors, this ratio is 12.8 GB of memory per core (128 GB per Intel Xeon E7 processor) for SAP NetWeaver BW on SAP HANA, and 25.6 GB of memory per core (256 GB per processor) for SAP Business Suite on SAP HANA (SAP ECC, SCM, and CRM). For the next-generation Intel Xeon E7 v2 processors, a higher ratio is to be expected. Be aware that only the SAP HANA database is covered by this sizing; the servers running the SAP ECC, SCM, and CRM applications for SAP NetWeaver BW business transactions have to be added using the traditional sizing mechanism.

To cover the size and performance for all customer SAP HANA scenarios, Cisco offers preconfigured small, medium-sized, and large solutions, called S-Size, M-Size, and L-Size, for rack systems, and an extra-large solution, called XL-Size, which is a full scale-out solution for blade systems.

Conclusion

Cisco UCS has revolutionized computing through the introduction of unified fabric and unified management, and customers have responded to the architecture by making it one of the fastest growing technologies in history (see the E-3 cover story referenced at the end of this document). Cisco's commitment to support for the complete SAP portfolio makes basing SAP solutions on Cisco UCS an easy choice for any customer.

Through rigorous testing and use of benchmark scenarios approved by SAP, Cisco helps ensure that new servers (both blade and rack servers) work together with the existing data center infrastructure and that organizations can effectively size hardware to meet customers' business needs.

For More Information

- SAP benchmark workloads overview, at http://www.sap.com/campaigns/benchmark/appbm_overview.epx
- Virtualized SAP: Optimize Performance with Cisco Data Center Virtual Machine Fabric Extender and Red Hat Enterprise Linux and Kernel-Based Virtual Machine, at http://www.cisco.com/en/US/solutions/collateral/ns340/ns517/ns224/ns944/whitepaper_c11_703103.pdf
- E-3 cover story, at http://www.cisco.com/web/strategy/docs/manufacturing/cisco_engl_coverstory.pdf
- Michael Missbach, George Anderson, Josef Stelzel, Cameron Gardiner, and Mark Tempes, SAP on the Cloud (see Chapter 3, Service-Level Agreements: Performance and SAPS from a Practical Perspective), Springer Scientific 2012, ISBN 978-3-642-31210-6
- SAP on Cisco UCS, at http://www.cisco.com/go/sap
- Cisco UCS performance benchmarks, at http://www.cisco.com/go/ucsbenchmarks

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