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First SAP BW Version 2.0 B Benchmark with AlphaServer GS 320 and Alpha Tru64 Unix

Abstract: Compaq has announced a record-breaking result for the SAP BW Application Benchmark SAP BW, Version 2.0 B, positioning the Compaq Alpha platform far ahead of the competition. The system configuration consisted of an AlphaServer GS 320 with 32 processors, 32 GB of memory, and 1,308 GB of disk space, running Alpha Tru64 UNIX Version 5.1 and Oracle8i release 8.1.6 as database. Compaq's Performance Engineering Team in Walldorf, Germany, produced benchmark results with an average throughput of 175 million rows per hour for the load phase (step 1), more than 418 million rows per hour for the realignment phase (step 2), and more than 207,000 query navigation steps per hour.

For all phases of the benchmark, the Compaq system set new records that outperform any vendor's previous numbers. Key to this success story are the Compaq Alpha architecture as well as Compaq's StorageWorks technology, both of which are ideally suited to satisfy the benchmark's requirements regarding parallel processing capabilities, I/O speed, and CPU power. Applied to the real-world example of a retailer who processes 40,000 sales orders per day, the Compaq AlphaServer configuration is able to load and prepare for query the data of 32 years in only 4 hours and 4 minutes.

This result demonstrates the superiority of Compaq Alpha and StorageWorks technology as well as Compaq Tru64 UNIX leadership for Business Intelligence Applications, which are critical for the future and success of e-business.

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First SAP BW Version 2.0 B Benchmark with AlphaServer GS 320 and Alpha Tru64 Unix
White Paper prepared by Global SAP Solution Center

First Edition (January 2001)

Compaq Announces First SAP BW Version 2.0 B Benchmark with AlphaServer GS 320 and Alpha Tru64 UNIX

Compaq has announced the first Compaq AlphaServer GS series benchmark on SAP Business Information Warehouse™ (SAP BW) Version 2.0 B. The central system configuration consisting of an AlphaServer GS 320 with 32 Alpha 21264 EV67 processors and 32 GB of memory connected to a Compaq StorageWorks storage subsystem with 1,308 GB of disk space, running Alpha Tru64 UNIX Version 5.1 and Oracle8i release 8.1.6 as DBMS achieved top ranking.

For all phases of the SAP BW benchmark test, the Compaq system exceeded expectations and set new records that outperform any vendor's previous numbers. In the benchmark test, Compaq produced an average throughput of 114,509,804 rows/hour for the load phase (step 1), 313,849,599 rows per hour for the realignment phase (step 2), and 207,323 query navigation steps (throughput per hour). The query navigation step simulates users making queries on the SAP BW system. This number means the lead for high-end BW benchmarks on BW 2.0 B and demonstrates Compaq's competency and commitment to SAP BW.

Table 1. SAP BW Version 2.0 B Standard Application Benchmark Results

	Compaq AlphaServer GS 320
No. of processors	32 (Alpha 21264 EV67)
Memory	32 GB
Operating System	Alpha Tru64 UNIX 5.1
DBMS	Oracle8i 8.1.6
Storage	1,308 GB on StorageWorks subsystem
Load phase	114,509,804 rows per hour
Realignment phase	313,849,599 rows per hour
Query phase	207,323 rows per hour

Benchmark Results

Compaq achieved the new benchmark on an AlphaServer GS 320 running Alpha Tru64 Unix, version 5.1, with the following hardware and software configuration:

- 32 Alpha 21264 EV67 processors
- 32 GB Memory
- 1,308 GB of disk storage on connected StorageWorks subsystem
- Oracle8i 8.1.6 DBMS

The NUMA architecture of the GS 320 (Non-Uniform Memory Architecture) in combination with the StorageWorks subsystem forms the foundation for the exceptional I/O throughput exhibited in this benchmark. Existing conventional systems with a bus architecture, such as SUN or IBM systems, are generally not able to achieve comparable results.

When applied to a more easily accessible, real-world example of a retailer who processes 40,000 sales orders per day, this Compaq AlphaServer configuration is able to load and prepare for query the data of 32 years in only 4 hours and 4 minutes.

SAP BW

SAP Business Information Warehouse is a key business component of the SAP framework. It allows business reporting and decision support that is both user-friendly and sophisticated. The objective of the benchmark was to prove the excellent implementation and scalability of SAP BW on the Alpha / Oracle platform.

A joint team performed the SAP BW benchmark project:

- Compaq CRM/BI Engineering in Walldorf, Germany
- Compaq Global SAP Solutions in Walldorf
- ORACLE SAP Global Technology Center in Walldorf
- SAP BW Development Team in Walldorf

Load phase results

Table 2. Load Phase Results

	Number of rows	Runtime (hh:mm:ss)	Throughput rows per hour
Load from ODS into InfoCube and create statistics on fact table	467,200,000	02:39:19	175,951,459
Repair 2 nd indices on fact table	467,200,000	00:18:26	1,520,723,327
Create statistics on fact table	467,200,000	00:12:22	2,266,738,544
Rollup of aggregates	467,200,000	01:07:03	418,076,062
Total average throughput	467,200,000	04:04:48	114,509,803

Change run results

Table 3. Change Run Results

	Number of rows	Runtime (hh:mm:ss)
Change Run	467,200,000	01:29:19

Query phase results

Table 4. Query Phase

	Number of simulated benchmark users	Number of dialog steps per hour	Average dialog response time	Average CPU utilization of central system
BW	1,000	207,323	2.14 seconds	92%

Procedure of the BW Benchmark

Benchmark scenario

The goal of SAP BW is to free the information locked up in a myriad of computer systems and operational databases, and to mix it with information from other, often external, sources of data. Fully integrated with mySAP.com™ Marketplace and Workplace, SAP BW enables companies to maximize their return on their information investment by putting business intelligence to work.

The SAP BW benchmark 2.0 B is based on the business content delivered with the SAP BW standard functionality in the area of sales & distribution. The InfoCube is populated with data coming from flat file data sources. The master and transactional data are generated at operating system level by a program which is delivered with the SAP BW benchmark environment. The SAP BW benchmark is designed to avoid the possibility to store the complete contents of the fact and dimension tables as well as the necessary master data tables in main memory of the database server. The number of rows in the fact table is defined as a fixed number to be used as a scaling factor. The underlying assumption of the benchmark is that the amount of data processed should be 1.5 times the size of the physical memory configured in the benchmark system.

In this benchmark a scenario for 32 GB of configured main memory was used, and 467,200,000 rows are stored in the fact table (corresponding to a fact table size of approx. 40 GB). The SAP BW benchmark checks the performance aspects of the standard functionality within SAP BW, which is realistic for customer scenarios.

The benchmark comprises three major measurement parts:

1. Load phase
2. Change run
3. User queries

Preparation phase at operating system level

The benchmark program generates 40,000 incoming orders per day. 70% of the products are sold by 20% of the distribution-channels. 2% of the products are returned. This generates a data volume of approximately 15 million incoming orders per year:

- 50,000 products
- 10,000 customers
- 5 divisions
- 5 distribution channels
- 40,000 incoming orders per day
- 70% of the products are sold by 20% of the distribution channels
- 2% of the products are returned
- 12 files (one for each month) for mass data (transactional data)

For the selected scenario (parameter: 32 GB main memory configured in the database server), data are created for 32 years.

Load phase

The objective of the load phase is to determine the possible number of records loaded into the InfoCube with the given hardware configuration. In this step data is prepared to be available for reporting. The required steps are:

1. Load mass data out of operational data store into InfoCube.
2. Create/repair secondary indices on the fact table of the InfoCube.
3. Calculate the statistics for the database optimizer on the fact table of the InfoCube.
4. Rollup the 10 predefined aggregates.

Change run

As soon as master data is loaded from the transactional mySAP.com™ or R/3® backend system, typically the navigational aspects are changed as well. Therefore, it is necessary to recreate the aggregates, which contain the changed navigation attributes or hierarchies. This step is called “realignment” in the benchmark certification document.

Query phase

In this last phase of the benchmark, users who perform a variety of reports and queries against the data that was just loaded and aggregated are simulated. Queries vary in complexity and some use aggregates while others may read detail fact table data directly. The simulated users start a new query navigational step every 15 seconds. The measurement time requires a minimum 15-minute high load phase. This period starts after the login of the last user and ends before the first user logs off. The average response time for all queries must be less than 5 seconds in this benchmark.

Just for a comparison, typical SAP BW users start a new query or query navigational step every three to five minutes.

Applying the Benchmark Results to Business Environments

This section offers a perspective on how the results of the SAP BW benchmark relate to a typical business environment. Bear in mind that in general, benchmark results do not have a one-to-one relationship with any specific business environment, or “live” scenario. Relative to other SAP standard application benchmarks that the reader may already be familiar with, it may be more challenging to relate SAP BW Standard Application Benchmark results to a specific installation scenario. This is because SAP BW solutions are generally customized for specific business requirements. Other SAP standard application benchmarks may be easier to correlate with installation scenarios because of the defined structure of the application software. The number of variables for SAP BW solutions is very large; the selection and number of InfoCubes and their data models only begins the list of variations from installation to installation.

For example, the SAP BW benchmark for Version 2.0 B uses one InfoCube. However, many – if not most – installations will have multiple InfoCubes, if not with the initial “go live” scenario, then with a later design iteration.

The SAP BW Standard Application Benchmark simulates three typical operational steps of SAP BW (load data, realign data, and queries) which in turn provide answers to two basic questions:

1. How long will it take to prepare new data (“updates”) for access?
2. How will the system perform in supporting reporting and query access by users?

Preparing data for access (updates)

The update process, represented in the benchmark by the combination of the load and change runs, has significant impact on usage of the system, because the system is not available for user access. The frequency of the update process will depend upon many factors, with user requirements having highest significance. A typical update cycle may be daily; however, some business environments may have compelling requirements which require that more recent data be available. Also, Internet access, perhaps as part of providing content for roles within mySAP.com™, may increase the priority of expanding access to the solutions. This in turn means that the “time window” for updates must be as short as possible.

Therefore, the throughput rate of the benchmark results for the load and change runs will be relevant for planning the length of the update or load “window” for specific installation scenarios. Again, there are many variables which impact “real world” throughput; examples include the number of InfoCubes, the amount of data being added to each InfoCube, and the number of aggregates in each InfoCube which must be changed.

Query performance

Query performance for most installations will have the highest priority because of the “visibility” of user satisfaction and productivity. The most obvious question is probably “How many concurrent users can SAP BW support?” The results of the SAP BW benchmark help answer this question. Most SAP BW installations will have a variety of classes of queries; and these classes of queries may be performed by users in a variety of roles with different needs. In the Compaq white paper “Sizing Compaq ProLiant Servers for SAP BW” (posted in Compaq’s free information repository, ActiveAnswers <<http://www.compaq.com/activeanswers>> in the CRM/Business Intelligence section) the following query classes are defined:

- **Class 1** – Simple queries look at small amounts of data in the database. Most of the time, they will analyze business information available in an InfoCube aggregate (Example: How many products were sold in a specific quarter?).
- **Class 2** – Medium queries demand more resources from the database (Example: Which product contributed most to last month’s revenue in a particular region?).
- **Class 3** – Complex queries are the most demanding (Example: What is the business trend for specific products for the last three years?). These queries often involve large data volumes, which create a substantial burden on database resources.

A specific user may utilize queries from only one class, or even all classes during the course of the user’s work.

It may be possible to identify categories of users, based on their roles and perhaps their work style. The following categories can be defined with an example of a usage mix scenario:

Table 5: Scenario for different usage patterns

Usage pattern	Class 1 queries	Class 2 queries	Class 3 queries
Light (ad-hoc)	80%	20%	0%
Moderate (analyst)	50%	50%	0%
Complex (tactical)	20%	70%	10%
Complex (strategic)	0%	10%	90%

While many variables come into play, as a general rule a specific decision support installation can support a lot more users in the light (ad-hoc) category compared to users in the complex (strategic) category. A “real world” scenario will be a combination of all categories, with perhaps a majority of users in the light (ad-hoc) category.

In the benchmark results reported in this paper, the benchmark simulated 1,000 users performing a series of repeated query steps. These users performed a total of 207,323 query navigation steps per hour with an average response time per query step of 2.14 seconds. Perhaps the most important factor is that each query step in the benchmark is requested every 15 seconds, simulating think time. The think time and required response time are very significant factors in system resource utilization, and may be much more demanding than that required of many real-world users. The queries access an InfoCube using the standard business content delivered in the Sales and Distribution InfoCube for SAP BW 2.0 B. The total database size in this benchmark test is approximately 40 GB, with 467,200,000 rows in the InfoCube fact table (for the 32 GB memory scenario used).

The query step sequence includes requesting a query and then navigating (sometimes called “slice and dice”) within the initial query, for example by selecting a specific division, selecting a country, selecting a specific “sold-to” customer, etc. The load imposed on the system through the sequence of eight query steps varies, sometimes requiring accesses back to the InfoCube fact table and sometimes using aggregates. In general, the query steps seem to be most similar to the Class 2 query type discussed above. The behavior of the simulated user can be seen as similar to the complex (tactical explorer) user category.

As previously stated, each installation scenario and its user requirements will be unique. However, it is very likely that many installations will have users who are in the light and moderate categories discussed above, and who will most frequently require Class 1 and Class 2 queries. A light (ad-hoc) user might have a query frequency of 5 minutes or longer. A user in this class will typically access only standard reports and small queries. Thanks to the use of aggregates, these have relatively short response times. When the resource requirements of this situation are compared to the scenario simulated in the benchmark, the difference is significant. If all other factors could be maintained at a constant rate, the number of users who will have their requirements met increases as the query frequency lengthens, the response time requirement expands, and the query complexity is simpler. This might be the case when many of the concurrent users are in the light (ad-hoc) category with a relatively low query frequency and primarily simple queries. However, there are many factors in an installation scenario, which also will tend to require more system resources. Examples of these factors are more complex InfoCube data models and larger fact tables.

The implication of this discussion is that the configuration tested in this benchmark report may support many more users than the 1,000 users simulated in the standard benchmark test in some installation scenarios. Ultimately, each SAP BW installation will need to determine the possible performance through experience. Sound decision support design methodology suggests that solutions start small and expand through “design-implement-test” iterations. During these iterations, the platform environment can be scaled to meet the user requirements. Scaling options include more memory, additional CPUs, and adding application servers (the SAP BW Standard Application Benchmark is a central instance environment). The option of creating multiple SAP BW instances (“data marts”) is supported more robustly in SAP BW Version 2.0 B than in earlier versions, thus providing another path for responding to growing user requirements.

Significance of Benchmark Components

The following table outlines the significance of the different components tested in the benchmark. A higher number of X marks indicates increased criticality of the specified component.

Table 6: Significance of Benchmark Components

Benchmark Phase	Processor	R/3 Kernel	BW Release	Oracle(DB)	I/O
1.1 Load	XXX	XX	XXX	XX	
1.2 Index repair	XX			XXX	XXX
1.3 Statistics creation	XX			XXX	X
1.4 Roll-up of aggregates	XX			XXX	XXX
2. Realignment	XX			XXX	XXX
3. Query multi-user	XX	XX	XXX	XXX	XX

This gives a very interesting profile of the benchmark that goes beyond the BW features and clearly demonstrates the advantages of the AlphaServer GS 320 system used for this benchmark.

StorageWorks

The majority of large business operating environments today requires nearly linear scalability for very large database and messaging applications that adhere to non-proprietary, open standards.

Compaq's Fibre Channel-based Storage Area Networks (SAN) technology has emerged as the data communications environment that features the highest performance available today to connect servers with storage systems. Running at gigabit speeds and built using open standards, SANworks solutions offer superior scalability, advanced fault recovery and more concise data manageability than current client/server LAN-based approaches. When applied to data-intensive applications, such as those found in this SAP BW benchmark as well as other mySAP.com™ solutions, whether working in a shared-access or switched environment, SANworks solutions provide these features:

- Server-to-server and server-to-client gigabit-rated data management, sharing, and protection without bogging down the SAP enterprise software solutions environment.
- Scalability – Customers will typically store data in their data warehouse for 1 to 3 years, consequently, scalable platforms which can scale up and out are needed.
- I/O bandwidth – High bandwidth is needed because SAP BW is highly read/write-intensive. In this benchmark, even higher results would have been possible with more controllers in the storage systems. At 92%, the CPU load was not full.
- Manageability – Some customers will see huge increases in storage requirements, which have to be organized and managed. Compaq delivers extensive software solutions for storage management, backup/restore, and high availability.
- SnapShot Cloning and Mirroring solutions for SAP BW.
- Consistent storage components in all Compaq storage systems. Customers can reuse their components if they change storage platforms, resulting in an improved return on investment.

Compaq SANworks solution suites now feature enhanced scaling capabilities that go beyond the capabilities of other vendors. Supporting thousands of online transaction-processing users, mail client and messaging client systems, as well as dynamically flexible large database environments, SANworks storage solutions scale from 35 GB to multiple terabytes of fully protected information storage; and in some cases exceed 100,000 users across multiple servers.

In addition, Compaq storage solutions create a true storage utility that makes the concept of ubiquitously accessing virtual storage a reality. Based on an Open SAN approach, the utility delivers two unprecedented capabilities:

1. “Any-to-any” connectivity, allowing the connection of heterogeneous systems running different operating systems to storage products from multiple vendors.
2. The ability to deliver data to anyone, anytime, anywhere – while offering innovative ways to manage change and growth in applications, databases, and enterprise configurations, that have a direct impact on solving a customer's strategic business requirements.

The NUMA architecture of the AlphaServer GS 320 in combination with the StorageWorks subsystem forms the foundation for the exceptional I/O throughput exhibited in this benchmark.

The Compaq / SAP Partnership

Compaq has been a long-term technology partner of SAP and has demonstrated its leadership in the application of SAP solutions several times before. Since 1988, Compaq Tru64Unix has been a key development platform for SAP. During that time, extensive know-how has been built. This demonstrated leadership role is also reflected in this benchmark.

Compaq's solutions and market experience has been very well received by SAP and its partners. A very dominant market position for SAP BW, with a share of more than 30%, shows that customers also believe in this outstanding partnership and the resulting solutions.

Both Compaq and SAP continue to be committed to their investments in technological engineering projects such as this benchmark in order to be able to deliver state-of-the-art SAP BW solutions to their customers.

The Compaq / Oracle Partnership

This benchmark is yet another success story in the long cooperation between Compaq and Oracle. Compaq has chosen the Oracle 8.i DBRMS as a key database platform for Compaq Alpha Servers. Oracle's database systems in combination with Compaq's Tru64 Unix operating system deliver a platform with full scalability, manageability, and reliability options.

For a long time, both partners have worked together to deliver 64 bit-capable system architectures and solutions which quite often not only meet, but outperform customer expectations.