Redpaper

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SAP integration with IBM DB2 Analytics Accelerator for z/OS

Overview

This IBM® Redpaper™ publication offers a review of the SAP on IBM System z®, SAP Business Information Warehouse and the need for accelerated processing of the queries. This paper also describes the use of IBM DB2® Analytics Accelerator (Accelerator) in SAP on System z landscapes.

This IBM Redpaper contains the following sections:

- Introduction
- IBM DB2 Analytics Accelerator with SAP BW overview
- Usage scenarios
- Conclusion

Introduction

SAP AG, headquartered in Germany, is the provider of market leading business management applications. SAP supports customers worldwide and its applications are being used in almost all industries. IBM has a close, collaborative relationship with SAP that goes back to the early 1970s when SAP was founded by engineers who previously worked at IBM.

SAP applications are the principle business management systems in most companies. Because these applications support almost all the major business processes of the corporation, they also maintain and create large amounts of vital company data. This data, when mined and analyzed, can yield crucial business insight. Queries are generated to perform this analysis. Generally, these queries, generated to analyze the SAP data, are complex, access data from multiple sources, and are ad hoc in nature. Traditionally, these queries have been processed by the DBMS. This processing has been relatively slow, taking days and sometimes weeks to get the reports or results from the queries. Today's businesses need the business intelligence much quicker. Enter the IBM DB2 Analytics Accelerator!

SAP: Brief overview

SAP applications are an integrated set of business management applications that are widely used in almost all industries by small to very large enterprises. SAP supports almost all of the business processes in the enterprise. The SAP applications supporting these business processes include enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), human capital management (HCM), product lifecycle management (PLM), and others. In addition, SAP includes business intelligence solutions: the SAP Business Information Warehouse (SAP BW) and SAP Business Objects (SAP BOBJ).

In most companies, because SAP supports all of the major business processes, and is a comprehensive and highly integrated solution, it usually is a mission-critical application. SAP databases also hold large amounts of valuable corporate data. This data, if mined properly can yield a treasure trove of actionable information essential for effective decision-making and consequently for the success of the corporation.

The most common implementation model of SAP is known as the three tier model. The three tiers in the SAP landscape are the presentation, the application, and the database tier. The presentation tier includes the graphical user interface (GUI) for users to access the SAP applications. The application tier runs application programs that are mainly written in ABAP, an SAP proprietary programming language. The database tier, which is usually based on an RDBMS, stores data, ABAP programs, data dictionary and so on. In addition to these three tiers, browser-based and mobile devices can access the SAP applications and are sometimes identified as an additional tier. SAP runs on all of these IBM hardware platforms: System z, Power, IBM System i®, and IBM System x®. The architecture differs based on the type of platform and its capabilities.

SAP on System z overview and architecture

System z, is the platform of choice if high qualities of service, such as near continuous availability, advanced virtualization, mixed workload support, high scalability, high security, lower total cost of ownership (TCO), and others, are essential. In particular, if SAP landscape consolidation is the goal, System z with its mixed workload hosting capabilities, advanced virtualization, and central system management capability provides one of the best alternatives.

Within the SAP on System z deployments, the database is hosted under IBM z/OS®, as shown in Figure 1. The SAP application servers can be run on several alternative platforms, which provides much flexibility. These application servers can be on low-cost platforms and are implemented with the strategy of swapping out the active servers by using a standby server in case of an application server failure. The application server choices include servers internal to System z and also external servers. Internal to the System z options include application servers under Linux on z on the Integrated Facility for Linux (IFLs) or under zBX blades either on IBM AIX®, Linux for System x, or Windows. Externally, the application servers can run on Intel servers under Windows or Linux on z, and on Power servers under AIX. The choice of application server platform depends on specific factors of concern to the client.

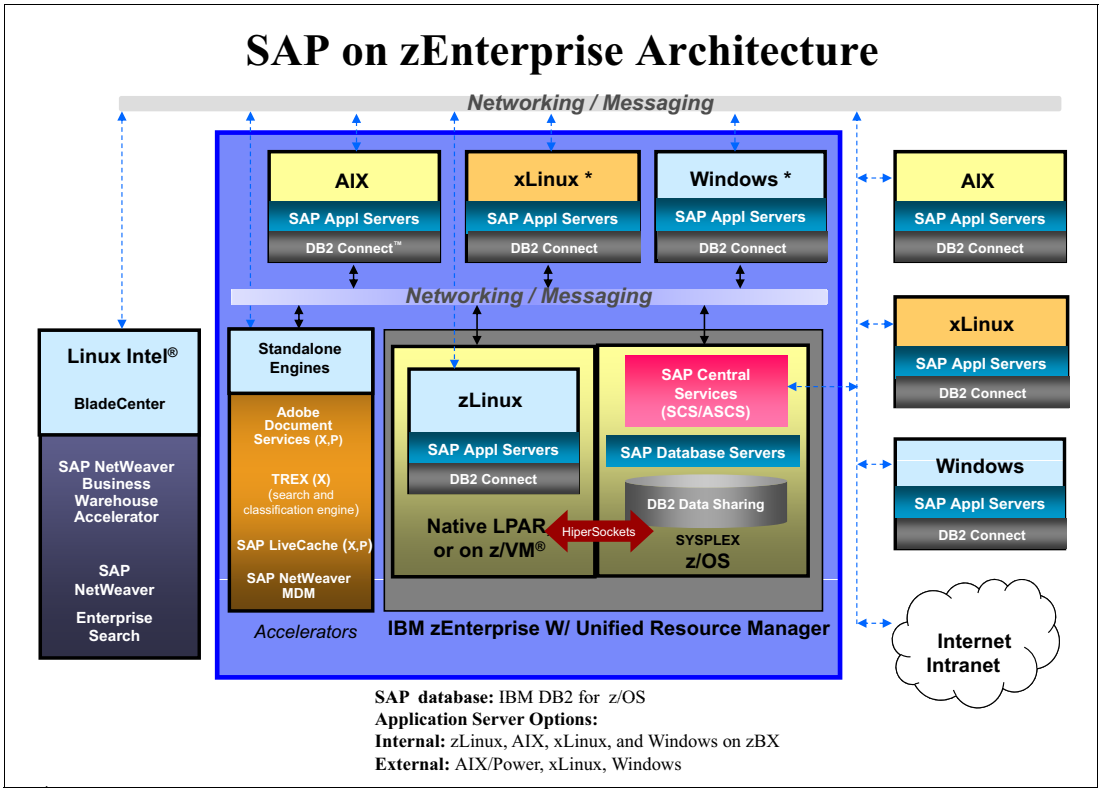

Figure 1 Deployment of SAP on System z

In SAP implementations, there are two vital components: the database and SAP Central Services (SCS). The SCS includes the message server and the enqueue server. The database and SCS are vital because if either one of these is down or inaccessible the SAP system will stop functioning. Therefore, these two components can be single points of failure in an SAP landscape. Any access interruption to or corruption of data in the database will render the SAP unusable and might bring the company business to a halt.

Similarly, if the enqueue tables that SCS holds are corrupted, the SAP applications will not run. Therefore, these two components must be hosted on platforms that provide the highest reliability possible. In SAP on System z implementations, these two components are hosted under the “vault-like” reliability of z/OS. In addition, the ‘enqueue’ tables are replicated in another location for fail over purposes. These tables are regenerated in case of corruption or failure of the original enqueue tables. Recently, implementation of enqueue tables in the System z Coupling Facility have been made available resulting in even higher reliability and other benefits. For details, see SAP Note 1753638 (you need a user name and password):

https://service.sap.com/sap/support/notes/0001753638?nlang=E

SAP on System z facilitates consolidation and centralization of SAP as no other platform can. System z advanced virtualization and mixed workload support, workload management capability, high vertical scalability, and near continuous availability make it one of the best consolidation platforms. Ability to collocate all of the SAP applications, and manage and maintain them centrally, is of tremendous benefit to enterprises. Particularly, if a company is considering a global single instance of SAP, System z should be the platform of choice.

The centralized implementation of SAP on System z simplifies the SAP landscape and also the operations. The zManager, with the Hardware Management Console (HMC) helps with hardware configuration and systems management. This SAP deployment can also use DB2 data sharing and parallel sysplex to provide near continuous availability and high scalability.

SAP Business Information Warehouse

SAP Business Warehouse (SAP BW) is the integrated data warehouse solution that is optimized for SAP. It is a comprehensive solution that includes extract, transform, and load (ETL), staging and reporting capabilities. The SAP BW is written in SAP's ABAP language and the SAP BW engines are part of the SAP NetWeaver stack. The IBM DB2 Analytics Accelerator is fully supported by SAP and is integrated in to the SAP BW support package. SAP BW's online analytical processing (OLAP) capability is available to all SAP NetWeaver applications. The vital data in the SAP database is gathered, transformed, consolidated, and stored in SAP BW. SAP BW also includes preconfigured data extractors, analysis, BI and reporting tools. Analysis and business intelligence (BI) tools help in evaluation, interpretation, and distribution of data.

SAP BW stores data in what are known as InfoProviders. These are metaobjects in the database that physically contain the data and provide a uniform view of the data for query purposes. SAP BW supports several InfoProviders. The most commonly used InfoProvider is the InfoCube.

The logical representation of the InfoCube is by what is known as the *extended star schema* or the *snowflake schema*. Figure 2 on page 5 shows a simplified view of the InfoCube star schema.

In the middle of the schema is the fact table that in turn is linked to multiple 'dimension tables. Each of these dimensions is linked to one or more SAP System ID (SID) tables, which in turn are linked to master data attribute tables. In these attribute SID tables, data is also stored redundantly to reduce the number of required joins for predicates on navigational attributes. In addition, some tables might be created and filled on demand and joined to the star schema.

The attribute SID tables and master data tables can store two types of data:

- Dependent on time
- Not dependent on time

The SID and master tables are split into two tables in order to store the time-dependent and non-time-dependent data. To retrieve all of the data from both tables an additional view is used.

The fact tables and dimension tables contain transaction data and are specific to an InfoCube. These are depicted by the yellow box in Figure 2 on page 5. All remaining tables hold master data and are shared between InfoCubes; therefore these tables are in multiple star schemas.

SAP BW implements two types of fact tables:

- The *e* fact table is optimized for reporting.
- the *f* fact table is designed for maintenance of data.

When data from an InfoCube is requested two SQL queries are performed on the star schema. One is performed on the *e fact table* and the other on the *f fact table*. The queries are identical except for the identification of the relevant fact table.

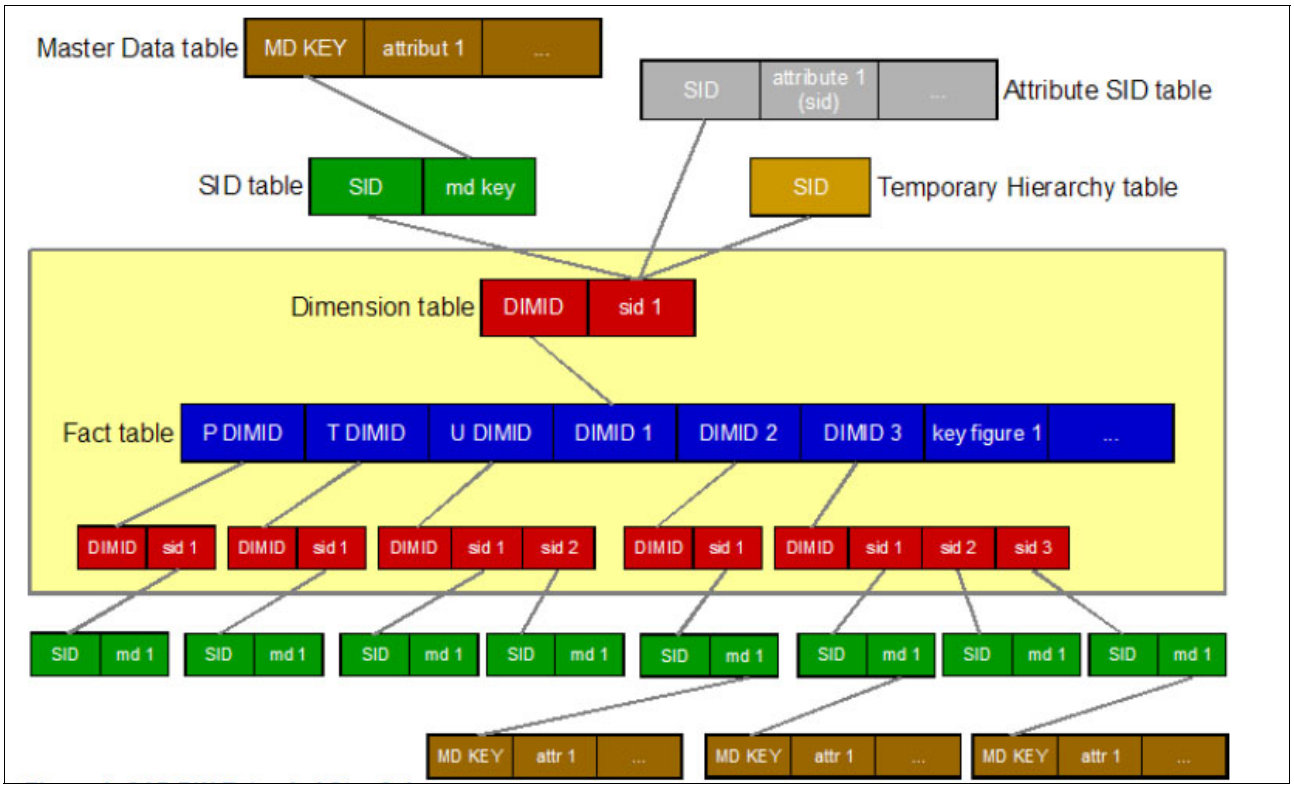

Figure 2 Star schema representation of the InfoCube

Business trends and the need for speed

Today, businesses have to contend with global competitors that might be low cost and agile, a discerning customer who has many more choices of suppliers, and a supply chain that might extend globally. These and other challenges from globalization require that companies both reduce inefficiencies and waste from their business processes, and also be innovative and agile. To stay ahead of the competition, they must make the right decisions and make them at the correct times. Now, more than ever, in many instances the best time to make the decisions is in near real time. To make these decisions in near real time, the decision maker must have the tools that provide true insight and actionable information that both can help the decision process and also ensure that the decisions are the most effective ones.

Today's businesses also generate and gather a large amount of data. The SAP customers are no exception. Actionable information for decision making is extracted by the business intelligence (BI) systems by mining and analyzing these large amounts of corporate data. Traditionally, BI systems have been relatively slow in that the queries and reports took days and maybe weeks to process. In today's dynamic business environment, which demands near real-time responses, a slow response of traditional BI is inadequate and not a formula for success. The IBM solution to solve this problem for SAP customers is the IBM DB2 Analytics Accelerator or the Accelerator. The Accelerator uses massively parallel computing technology in combination with high performance storage to deliver near real-time BI.

The accuracy of business intelligence reports depends on the integrity, accuracy, and currency of the data. The SAP BW InfoCube must be set up properly so that the updates take place in a timely and correct manner. The manual set up and procedure is complex and has potential for errors. Even if a single table is not updated correctly for any reason, the data in the InfoCube will be inconsistent and the SAP BW reports will yield incorrect results. For this reason, SAP BW is enhanced to automatically feed the InfoCube tables to the Accelerator when those are updated through the extract, transform, and load (ETL) processes.

IBM DB2 Analytics Accelerator with SAP BW overview

The Accelerator is a true appliance in that it is a “plug and play” device. The DB2 for z/OS code is enhanced to tightly integrate the Accelerator with DB2 for z/OS. See Figure 3 on page 7.

The Accelerator can be easily connected to DB2 and the DB2 data can be replicated on the Accelerator. The Accelerator acts as another virtual resource for z/OS which is neither visible nor accessible by the external world. Generally, no changes are required to z/OS, DB2, or SAP applications to exploit the Accelerator. The Accelerator extends the high qualities of service of System z such as near continuous availability, high security, and manageability to the data warehouse and BI workloads. The maintenance of data is performed by DB2 for z/OS, which can exploit DB2 data sharing and parallel sysplex technologies to provide near continuous availability and high scalability.

The DB2 optimizer is capable of intelligently routing, to the Accelerator, only the queries that will benefit from running on the Accelerator and result in online transaction processing-like (OLTP) speeds for OLAP queries. Also, the traditional BI solutions have required many performance tuning activities particularly for complex, long-running queries. At times database administrators (DBAs) have to add more indices, hints, or materialized query table (MQTs). The Accelerator eliminates the need for such tuning, additional indices, or MQTs.

SAP support for IBM DB2 Analytics Accelerator is detailed at the following location:

https://service.sap.com/sap/support/notes/0001649284?nlang=E

The Accelerator can be easily and rapidly integrated into SAP BW, running on DB2 for z/OS. This implementation maintains the data integrity between DB2 for z/OS and the Accelerator and requires minimal administrative effort. In addition, the Accelerator can continuously synchronize the tables in the Accelerator with the data in DB2. This is achieved by reading the log of the database and applying the updates incrementally to the tables in the Accelerator. As a result, when the queries are executed on the Accelerator, they will be processed against the latest, near real-time data.

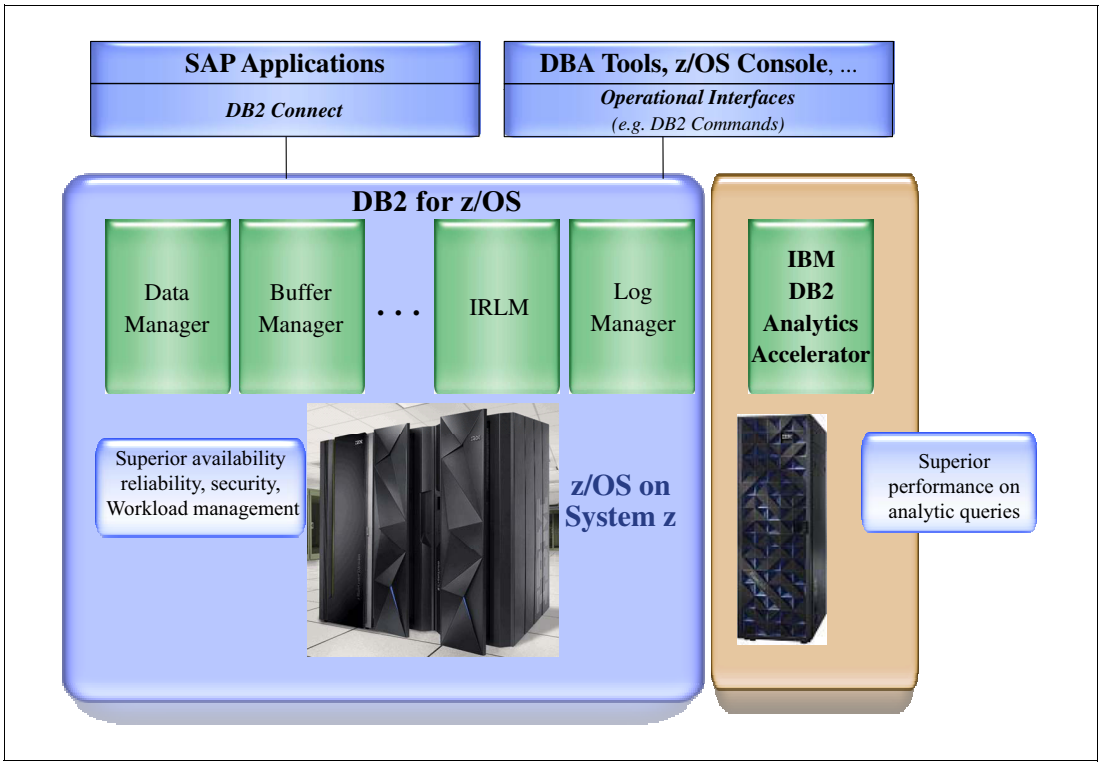

Figure 3 Integration and plug-and-play nature of the Accelerator

The maintenance of tables and InfoProviders in the Accelerator is easily administered using SAP Accelerator Control Center (Control Center). The Control Center is started by calling transaction DB2ACCEL. See Figure 4 on page 8.

The SAP system identifies all the tables that belong to an InfoProvider, loads these tables into the Accelerator, and monitors the status of aggregated data.

The main panel of the Control Center lists all the objects that have been added to the Accelerator. These objects are organized in a “tree” structure. All tables that belong to an InfoProvider are grouped under the tree node representing that InfoProvider. Additionally, folders can be added to the tree structure, which can hold the InfoProviders and subfolders facilitating the implementation of a hierarchical structure.

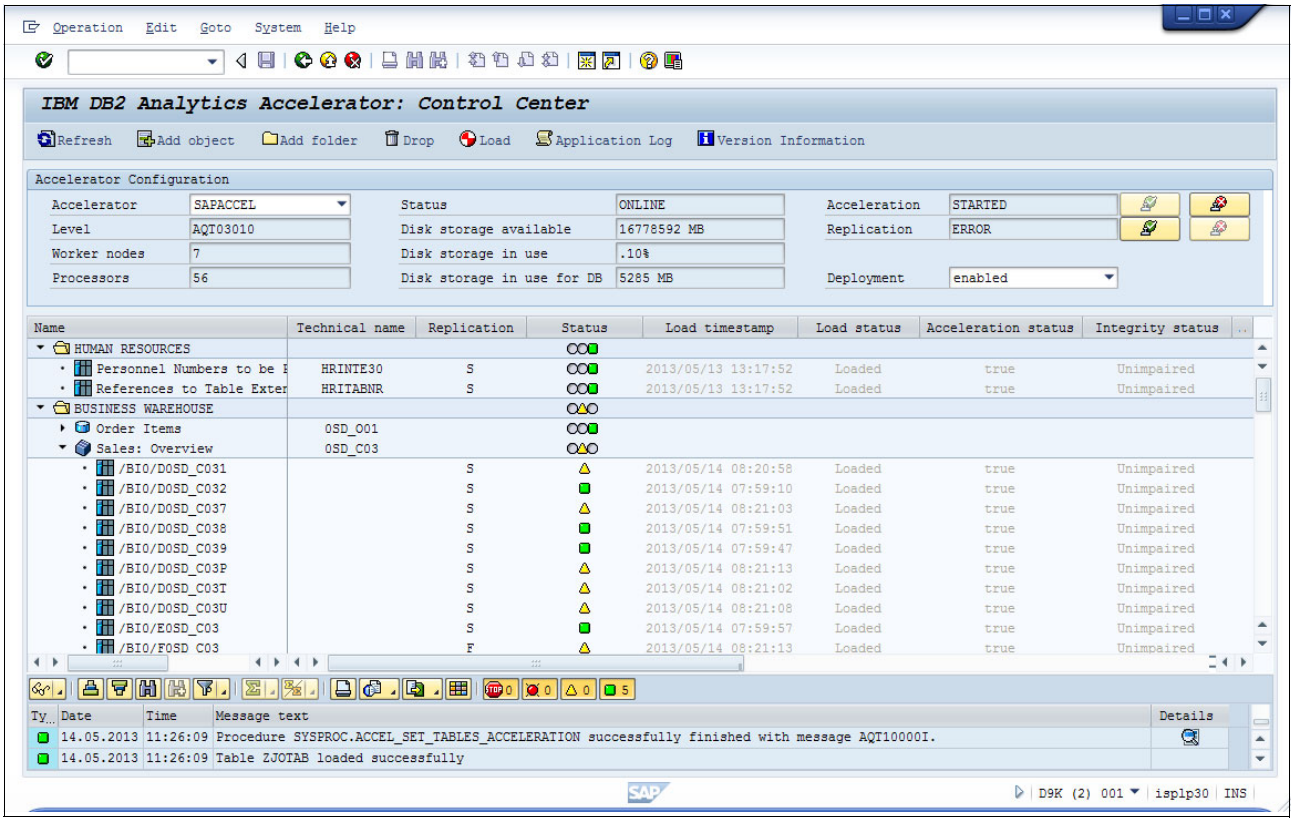

Figure 4 IBM DB2 Analytics Accelerator Control Center

SAP Business Objects

SAP Business Objects is SAP's comprehensive business intelligence (BI) solution that can provide a "complete view" of the business. It provides a set of BI and Enterprise Performance Management (EPM) tools and applications that support reporting, data querying and data analysis, interactive data visualization, data management, planning, budgeting forecasting, and more.

As the name implies, the SAP Business Objects uses the principles of object-oriented (OO) programming to deliver "black boxes" that encapsulate SAP data and business processes. These business objects hide the details such as data structure, business logic, interfaces, access or nature of implementation from the end users. By delivering these real-world business objects, such as an order or a resource, SAP Business Objects helps to make business management and getting insight logical and easy. To the applications, the SAP Business Objects offers only the interface that is defined by well-defined methods. These methods are the only way to access the business object data. The IBM DB2 Analytics Accelerator works with SAP Business Objects without any modifications, as a true appliance.

SAP support for IBM DB2 Analytics Accelerator

SAP fully supports the IBM DB2 Analytics Accelerator as an integral part of SAP BW and with similar support as is provided to any other SAP components. The SAP OLAP processor is enhanced to support the IBM DB2 Analytics Accelerator and the data update of the Accelerator is part of the standard SAP BW staging process. The Accelerator does not require any additional license. SAP also provides the standard SAP service to the Accelerator that includes support packages, SAP Notes, and so on. In addition, SAP provides standard

SAP support through the Online Service System (OSS). This is SAP's online help portal for first level support, where users can enter questions and help requests, and receive SAP's responses quickly.

For SAP service pack levels and other prerequisites, see SAP Note 1649284:

https://websmp130.sap-ag.de/sap(bD1lbiZjPTAwMQ==)/bc/bsp/spn/sapnotes/index2.htm?numm=1649284

Usage scenarios

The IBM DB2 Analytics Accelerator is designed and optimized to perform analytics computations at very high speeds. As a result, the principal use of the Accelerator is to substantially accelerate BI queries. In addition, the Accelerator contains multiple, high-speed disk drives. This allows the use of the Accelerator as High Performance Near-Line Storage, a very effective alternative to the traditional archiving solution. The Accelerator can be used in the following scenarios:

BI acceleration

System z with DB2 provides a highly reliable platform for SAP BW. Traditionally the BI queries were processed by DB2. The SAP queries tend to be complex, ad hoc, and resource intensive. Processing them usually took a relatively long time. With the recent need for near real time BI, the queries need to be processed rapidly. That is the principle use of the Accelerator. Speed of query processing by the Accelerator is increased by several factors. The Accelerator stores data that is required by frequently processed online analytics processor (OLAP) queries and uses its powerful, massively parallel computing and rapid data access capability to accelerate the queries by several factors as compared to the traditional, slower DB2 on z/OS processing.

Performance results

Query processing speed increase with the Accelerator has been substantial. Table 1 shows results from an analysis with 18 million records in the InfoCube. The query processing times include network latency also.

The results show acceleration by large factors. On average, the queries are expected to be processed 50 times faster.

Table 1 Performance test results with Accelerator on an 18 Million record InfoCube

Test case	Description	Records read	Records returned	DB2 (seconds)	Accelerator (seconds)	Acceleration factor
1	Simple mass aggregation	17116647	21	117.00	0.78	150
2	Query number 1 + 70% filter	11980812	21	94.20	0.86	110
3	Query number 1 + 30% filter	5133708	21	54.80	0.82	67
4	Query number 1 + 10% filter	1710293	21	17.60	0.87	20
5	Skewed data, low filtering	10790019	21	96.80	2.47	39
6	Skewed data, high filtering	24	14	7.28	0.83	9

Test case	Description	Records read	Records returned	DB2 (seconds)	Accelerator (seconds)	Acceleration factor
7	Many restrictions	3805941	21	128.00	7.65	17
8	Navigational attributes	823646	21	17.10	1.27	13
9	Navigational attributes and selective condition	811	21	15.80	1.17	14
10	Open value ranges	2006	21	19.60	3.52	6
11	Hierarchy	1653981	21	17.60	0.97	18
12	Hierarchy and selective condition	55068	21	38.60	0.98	39
13	Restricted key figures on two dimensions	1314964	1948	207.00	7.22	29
14	Query #13 + hierarchy	132564	1499	> 1000.00	1.27	> 787
15	Calculated key figures (OLAP)	5321586	10	57.80	2.37	24
16	OR linked values	6212609	13	40.50	0.92	44
17	Non uniform data distribution	1016253	13	31.20	0.99	32
18	Selective line item	1724	1706	0.71	1.17	0.6
19	Non-selective line item	115481	68619	33.80	1.36	25
20	All together	3087692	468	87.70	4.42	20

High performance near-line storage

Business intelligence is usually extracted by analyzing current and historical, static data. Now more than ever there is a need to keep historical data accessible for several years. Some clients may retain historical data for up to seven years. This data must be readily accessible by the BI solution. Companies have had to store the historical data online along with the current, active data. As a result, this historical data, which is static (the data is not being updated or changed any more), is taking up expensive online storage and require the same level of maintenance as the current online data. Retaining and maintaining this historical data online adds to maintenance effort, incurs higher costs, and consumes computing resources.

Near-line or near-online storage is storage that is not online, but is relatively easily and rapidly accessible. The concept here is that the data is kept in storage that is inexpensive but almost as easily, immediately, and as frequently accessible as online storage. It does not require the maintenance levels required by online data. Near-line storage provides the major benefit of offloading large amounts of data from the online storage. The main objective for using near-line storage is a substantial reduction in size of the online database. In addition, the offloading reduces the maintenance effort and saves computing resources. The smaller online database with only active data reduces time and effort for operations such as backup, reorganization, cloning, recovery, and so on, and lowers TCO.

The traditional alternative for retaining this historical data was archiving on tape or some other slower and cheaper media. This option does not allow for easy, immediate, and frequent access to this data as required by the analytics system. The data has to be restored to the online database from archive media before it can be utilized for BI. Most other near-line storage is generally cheaper but also slower than online storage. The IBM DB2 Analytics

Accelerator has high speed storage with very large capacity and allows rapid and frequent access to this data. The access is almost as fast as the online storage. Therefore, the storage on the Accelerator is called the *High Performance Near-Line Storage*.

The Accelerator's High Performance Near-Line Storage (HiPe Near-Line Storage) is tightly integrated with DB2 on z/OS at the SQL level. The SAP clients issue queries against the SAP BW OLAP processor and not DB2. Access to the HiPe Near-Line Storage is transparent to the SAP applications. The logic for the access to online as well as the near-line storage is encapsulated in the OLAP processor and is transparent to the BI application. The OLAP processor splits the queries into two subqueries: one to run against the SAP BW database and the other to run against the HiPe Near-Line Storage. It then aggregates the results returned by the two subqueries.

As shown in Figure 5, the OLAP processor uses various interfaces depending on which data must be accessed. If the query requires access to the online data, the generic database interface is used. The generic database interface invokes the SQL interface specific to the online DBMS, which in our case is DB2. If near-line data must be accessed, the OLAP processor uses a "near-line" interface. This interface has a vendor-specific access component that is used for retrieving data from the near-line storage. The online and near-line data are then merged and are made available to the Accelerator for query processing. Near-line storage supports InfoCubes and Data Store Objects. Other InfoProviders such as MultiProviders, are also supported. HiPe Near-Line storage implements the vendor-specific part of the SAP BW near-line interface. By following prescribed procedure for copying data to the High Performance Storage Saver this capability of the Accelerator is exploited. This solution substantially lowers the TCO.

This procedure is documented in the *High-Performance Near-Line Storage -User's Guide - Setup, Configuration and Operation*, which is part of SAP note 1815192; it is at the following location:

https://service.sap.com/sap/support/notes/0001815192?nlang=E

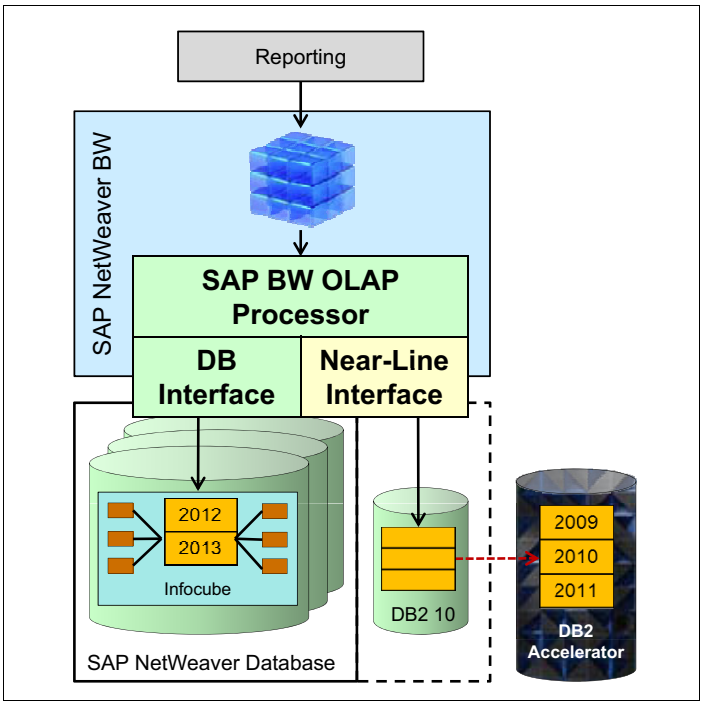

Figure 5 Integration of High-Performance Near-Line Storage in SAP NetWeaver BW

Conclusion

The IBM DB2 Analytics Accelerator is a powerful appliance that delivers near real-time analytics to SAP on System z with DB2. SAP, a highly integrated business management application, supports most of an enterprise's business processes and usually is a mission-critical application. It also holds vital company data. The Accelerator speeds up the analysis of queries against this database in enabling fast, near real-time, strategic decisions. It can also be used as a near-line storage that, unlike traditional archiving, is rapidly accessible. The near-line storage of Accelerator facilitates offloading of historical data from online storage, and saves the costs of storage and maintenance of this data. The Accelerator delivers high performance, is easy to deploy, does not require modifications to z/OS, DB2 or SAP, and delivers excellent total cost of ownership.

The IBM DB2 Analytics Accelerator provides a powerful value proposition for SAP on System z users. The Accelerator offers many benefits, in addition to this list:

- Rapid, near-real time analytics leading to fast and improved decision making.
- Savings through offloading of data from expensive online storage. Besides the savings in online storage costs it also saves maintenance effort, time and computing resources.
- True appliance functionality; no need to reconfigure z/OS, DB2 or SAP.
- Rapid and easy deployment.
- With Accelerator, the need for query tuning is minimized.
- Reduction in total cost of ownership.

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This paper was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

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