



DB2 9 for z/OS

Data On Demand

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Contents

Executive Summary	3
Introduction	5
DB2 9 – Data On Demand.....	6
DB2 9 Customer Case Studies.....	24
Summary	28
Appendix A – DB2 V8 Review	29
Appendix B – Acknowledgements	30
Bibliography	30

Abstract

This paper provides a high-level overview of the major new features of IBM DB2 9 for z/OS from an IT Executive's perspective, with the emphasis on the underlying business value that the new release can deliver.

N/B. Unless otherwise stated, all references to "Version 8" within this document refer to IBM DB2 UDB for z/OS Version 8, and references to "Version 9" or "DB2 9" refer to IBM DB2 9 for z/OS.

About The Author

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Julian has lectured widely on DB2 subjects, both in the UK and Europe, and won the "Best Overall Speaker" award at the 2000 International DB2 User Group European Conference. He is a co-author of an IBM Redbook on Java Stored Procedures, and a frequent contributor to industry publications such as DB2 Times and DBAZine.

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Executive Summary

DB2 9 for z/OS is the latest release of IBM's flagship database. This paper provides a high-level overview of the major new features from an IT Executive's perspective, with the emphasis on the underlying business value that DB2 9 can deliver.

Business Benefit Summary

The following table summarises the business benefits associated with the move to DB2 9.

Feature	Business Benefit
Integrated XML Support	The availability of pureXML features in DB2 9 represents the beginning of the next major step in the product's evolution. It is now possible to build a whole new class of XML-based enterprise applications without the performance and flexibility compromises inherent in previous implementations.
Improved Large Object Support	DB2 9 is a more attractive host for LOB data, allowing a greater range of applications to take advantage of the resilience and security offered by DB2.
Native SQL Procedures	DB2 9 significantly broadens both the scope and appeal of SQL procedures, allowing them to be deployed more efficiently and executed more quickly and at lower cost than before.
Enhanced ERP Support	DB2 for z/OS is well established as the premier data server for high-end ERP systems such as SAP. DB2 9 contains a large number of new features and enhancements to improve the performance and reduce the costs associated with these demanding applications.
Business Intelligence	The availability of timely and accurate Business Intelligence can be a key factor in the success of any enterprise. A number of significant BI-related enhancements in DB2 9 reinforce its BI credentials on the System z platform, improving performance and reducing operating costs.
Improved Security & Auditing	The System z platform has a long history of providing a safe and secure environment for data, but tough new regulations have raised requirements for new features within the operating system and other system software. DB2 9 has responded to these requirements with enhancements designed to significantly improve security and auditability in several key areas.
Enhanced Developer & DBA Productivity	As overall IT costs are driven down, people costs are becoming an increasingly large proportion of the total. DB2 9 contains a number of features that should improve the productivity of DB2 developers and support staff, yielding significant cost savings while improving business agility.

Feature	Business Benefit
Improved Performance	<p>Improved performance translates directly to better customer service, reduced resource utilisation and lower operating costs.</p> <p>Despite several key performance enhancements delivered in DB2 Version 8, some customers saw little or no overall improvement due to the overheads inherent in the move to a 64-bit architecture and other architectural changes. DB2 9 reverses this trend, delivering another set of significant performance enhancements without any associated overheads.</p>

“DB2 9 builds on the core strengths of Version 8 in the areas of performance and availability while introducing meaningful new functionality. From traditional transaction processing to data warehousing and Web applications, DB2 9 for z/OS promises to be an exciting release”

Kevin Campbell, Application Architect, Univar USA

Conclusion

DB2 9 for z/OS is one of the first of a new breed of hybrid relational database management systems, optimised for today’s highly demanding and complex IT systems and able to seamlessly integrate relational and XML data.

The new features within DB2 9 represent yet another significant advancement in DB2’s capabilities. The product offers real financial and technical benefits, free from major challenges such as CCSID issues or Unicode conversions.

Introduction

It is tempting to think of the data server as a commodity item: a dumb database engine responsible only for performing simple queries in a reasonable time. In reality, nothing could be further from the truth.

Many of today's enterprise IT systems are comprised of a bewildering array of technologies. The advent of Service Oriented Architectures and "loosely coupled" systems means that it is often impossible for the end-user to tell which back-end systems are being used.

In such an environment, it is tempting to think of the data server as a commodity item: a dumb database engine responsible only for performing simple queries in a reasonable time. In reality, nothing could be further from the truth.

As IT systems continue to evolve and expand beyond their traditional boundaries, so too must their data search and retrieval capabilities. The database is being asked to form the core of a true "information server", able to seamlessly integrate traditional data and new structures such as XML documents. At the same time, security and regulatory compliance remain key issues, with ever-more demanding standards being set.

DB2 9 for z/OS is the latest release of IBM's flagship relational database, and seeks to address these and other challenges. A wealth of material exists on the technical changes within DB2 9, but finding information about how those new features will improve your business results can be a challenge. This paper provides a high-level overview of the major new features from an IT Executive's perspective, with the emphasis on the underlying business value that DB2 9 can deliver.

A brief summary of the business benefits offered by the previous release of DB2 (Version 8) is provided in Appendix A – DB2 V8 Review on page 29.

DB2 9 – Data On Demand

“DB2 9 for z/OS builds on the core strengths of Version 8 in the areas of performance and availability while introducing meaningful new functionality. From traditional transaction processing to data warehousing and Web applications, DB2 9 for z/OS promises to be an exciting release.”

Kevin Campbell, Chief Application Architect, Univar USA.

In this section, we'll take a detailed look at the major features of Version 9, and how many of IBM's largest enterprise customers are intending to use them to deliver an enhanced IT service to the business.

This section is organised around the key DB2 9 themes:

- **Support for new workloads**
- **Streamlined security and compliance**
- **Reducing total cost of ownership (TCO)**

Support For New Workloads

The demands being placed upon enterprise data stores are continually expanding. Many modern business applications have moved beyond the processing of traditional “structured” data, and now have to deal with new types such as XML and binary data (including images, audio and video). Databases have to handle these new data types while continuing to provide the same level of performance, resilience and security that customers have come to rely on.

At the same time, IBM continues to evolve the mainframe platform and extend the range of applications it is able to efficiently support. Running ERP and Business Intelligence applications on the System z platform is becoming increasingly popular as specific new function is added to DB2 (and other System z software) to support them.

Integrated XML Support

XML is becoming increasingly important as the de facto standard for information exchange between IT systems. Technology initiatives such as Service-oriented architectures (SOA), enterprise application integration (EAI), enterprise information integration (EII) and Web services all rely on XML to some extent. XML offers the promise of reduced development costs, increased business agility and improved standards compliance.

As XML becomes ever more pervasive, the need to efficiently store, secure and retrieve these vital business documents increases. Until now enterprise relational databases have found it difficult to efficiently store hierarchical XML data.

As XML becomes more pervasive, the need to efficiently store, secure and retrieve vital business documents increases. Databases are the obvious solution to this problem, but until now enterprise relational databases have found it difficult to efficiently store hierarchical XML data.

Previous versions of DB2 for z/OS offered two alternatives to store of XML data, using the XML Extender feature:

- **Shredding.** This involved decomposing an XML document and storing the individual values in columns within a DB2 table. This requires a fixed (and often complex) mapping from the XML structure to the DB2 columns, making it difficult to accommodate changes to the incoming XML. The XML document also has to be reconstructed again for publishing purposes and may not be identical to the original – a potential compliance issue.

- **CLOBs.** This option simply stored the XML data as a single Character Large Object (CLOB) within a DB2 table. This avoids the flexibility and compliance issues associated with shredding, but makes it very difficult to navigate the internal structure of the XML document and efficiently retrieve information within it.

DB2 9 for z/OS addresses these limitations through the introduction of pureXML – IBM’s term for the integration of a fully-fledged XML storage engine within DB2. pureXML was recently implemented within DB2 9 for Linux, Unix and Windows, and the z/OS implementation is functionally very similar¹.

As shown in the diagram below, DB2 9 is actually a hybrid SQL/XML database, with a complete XML storage engine implemented alongside DB2’s traditional relational engine. Special XML columns can be defined as part of a normal table, allowing related structured and XML data to be stored in the same place.

pureXML allows XML documents to be easily stored in their native format, while retaining DB2’s traditional strengths for structured relational data.

“We have evaluated the new native XML support that DB2 9 provides and view this as a major technological advancement to help us to integrate XML data into a format that will allow for more robust and efficient usage by applications.”

**Bob Perih, Senior Vice President,
Citigroup**

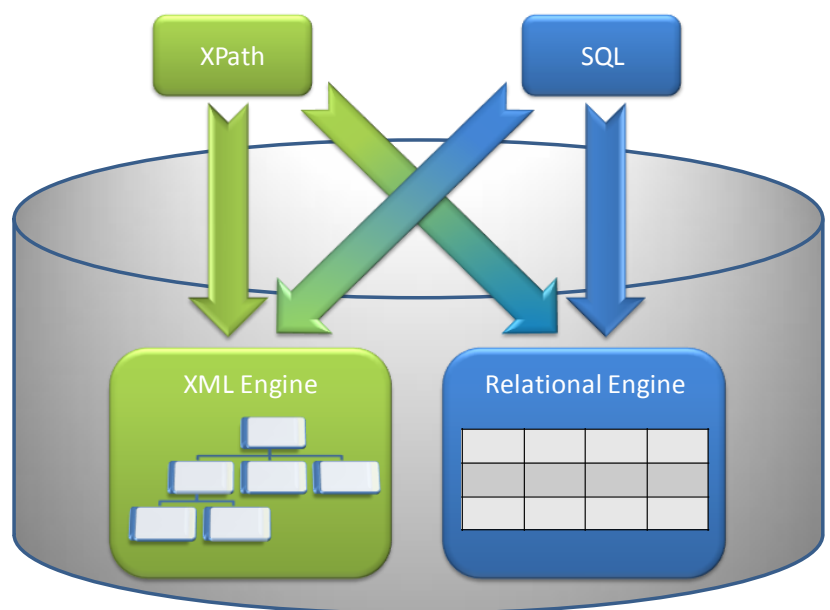


Figure 1 -pureXML Hybrid Architecture

This approach allows XML documents to be easily stored in their native format, while retaining DB2’s traditional strengths for relational data. Furthermore, XPath² and SQL can be used interchangeably (or in combination) to query XML and relational data. This provides immediate flexibility and productivity advantages, with traditional application developers able to query both relational and XML data using SQL, while XML specialists are able to use the power of XPath to access the same data.

In addition to the new storage engine, a whole host of supporting XML-related enhancements have been made within DB2 9. These include:

- XML query and indexing support, to allow efficient retrieval of XML elements
- New SQL functions to parse and serialise XML documents

“This is not a bolt-on or band-aid approach, this is XML without compromise”

**Kevin Campbell, Application
Architect, Univar USA**

¹ Please refer to the IBM Redbooks *DB2 9: pureXML Overview and Fast Start* (ITSO, 2006) and *Powering SOA with IBM Data Servers* (ITSO, 2006) for more details.

² XPath is a W3C standard for a language specifically designed for navigating through and accessing parts of an XML document.

- Utility support, to allow XML data to be efficiently loaded, unloaded, reorganised, copied and recovered.

IBM has announced³ its intention to enable certain portions of the workload associated with XML processing to be eligible for execution on zIIP and zAAP auxiliary processors. This capability will significantly reduce the costs associated with running XML workloads on System z, and may also improve overall system performance by freeing up general purpose processors so they can better handle other workloads.

The availability of pureXML features in DB2 9 represents the beginning of the next major step in the product's evolution. It is now possible to build a whole new class of XML-based enterprise applications without the performance and flexibility compromises inherent in previous implementations.

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New LOB Capabilities

Large Objects, or LOBs, allow large amounts of binary data to be stored as a special column within a DB2 table, and searched and retrieved using the power of SQL. Many newer applications need to be able to store this sort of complex data (such as images, audio, video and even PDF files) alongside more traditional data structures. Note that ERP applications such as SAP also make extensive use of database LOBs

DB2 for z/OS has supported LOBs for some time⁴, but some significant restrictions existed that made it difficult for many customers to make use of these features.

Most of these restrictions have been addressed within DB2 9, through the implementation of the following new features:

- **LOB utilities.** Prior to DB2 9, the REORG utility was not able to reclaim wasted space within the LOB table, and no access was allowed to the LOB data while it was being reorganised. DB2 9 provides an enhanced reorganisation utility that allows read access to the data and is also able to reclaim any wasted space and make it available for future insert operations. Also new in DB2 9 is the ability to execute the CHECK utility (used to validate the integrity of LOBs) without disrupting application access to the data.
- **LOB retrieval.** LOBs can vary in size from a few hundred bytes to a GB or more. Prior to DB2 9, programmers had to use different techniques to efficiently retrieve LOB data, depending on the size of the LOB. DB2 9 is able to automatically decide the best technique to pass LOB data to the client, improving efficiency and reducing the programming burden. Support for this technique has also been added to the DB2 Universal Java Driver.
- **LOB locking.** Enhancements have been made to the locking model used by LOBs, to eliminate some types of locks and to improve concurrency.

These enhancements make DB2 9 a more attractive host for LOB data, and will allow a greater range of applications to take advantage of the resilience and security offered by DB2.

³ Please refer to IBM Statement of Direction dated 18th April 2007

⁴ Please refer to IBM Redbook ***LOBs with DB2 for z/OS: Stronger and Faster*** (ITSO, 2006) for further information.

- **Large LOB handling.** A new feature allows some applications to retrieve or store large LOBs by interacting directly with the underlying file system rather than having to acquire storage to contain the LOB value within the program, making it easier and more efficient to handle large LOBs.

These enhancements make DB2 9 a more attractive host for LOB data, which allows a greater range of applications to take advantage of the resilience and security offered by DB2.

Native SQL Procedures

Stored procedures were first made available back in DB2 Version 4. They allow application logic to be encapsulated in a database object, which can then be invoked using SQL. Stored procedures can provide a number of very significant benefits, including lower maintenance costs through improved code re-use, better performance (especially for client/server applications) and enhanced security.

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Stored procedures can be written in most of the programming languages commonly in use on the mainframe, but developers and DBAs also have the option to write stored procedures in native SQL. This provides some significant benefits in application portability and maintenance. However, prior versions of DB2 were unable to natively execute SQL procedures, so they had to be internally converted to C code and compiled. This meant additional development complexity, and required a z/OS C compiler – a show-stopper for many DB2 customers.

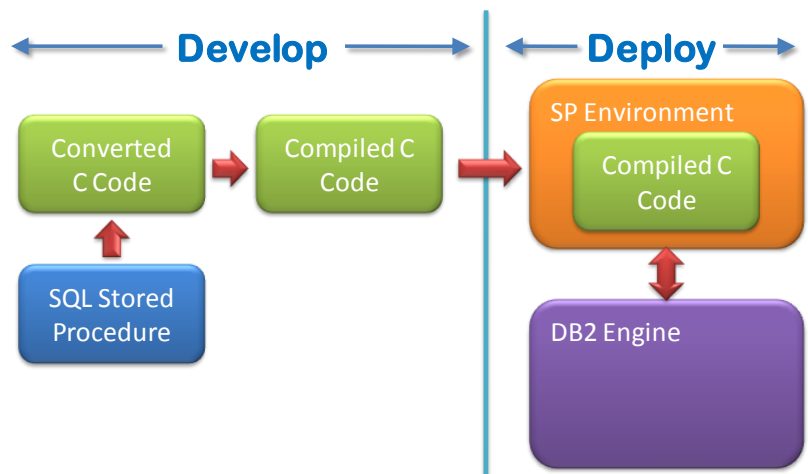


Figure 2 - Traditional SQL Procedure Deployment

DB2 9 allows SQL stored procedures to be executed natively by DB2 – no compilation step is necessary, the requirement for a C compiler has been removed and performance will be enhanced by up to 80%.

DB2 9 addresses these issues by allowing SQL stored procedures to be executed natively by DB2 – no compilation step is necessary and the requirement for a C compiler has been removed. Performance will also be enhanced for many SQL procedures, as the code is executed directly within the DB2 engine. This benefits short-running procedures more than long-running ones, but performance can be boosted by up to 80% compared to Version 8.

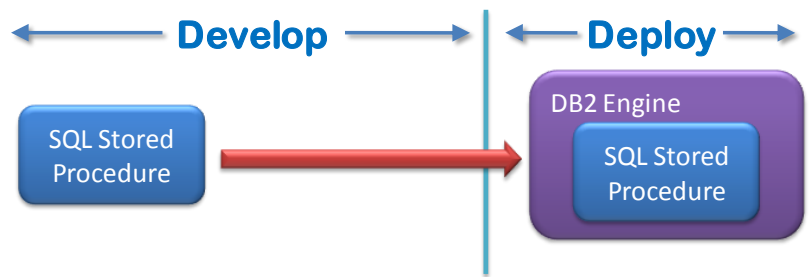


Figure 3 - DB2 9 SQL Procedure Deployment

Two more valuable enhancements have been made to SQL procedure support in DB2 9:

- **Versioning.** Additional support has been provided to allow multiple versions of a given SQL procedure to be more easily managed. This allows new versions of an SQL procedure to be implemented and/or backed out with a single command, increasing responsiveness and improving DBA productivity.
- **Deployment to multiple servers.** This enhancement allows a new version of an SQL procedure to be simultaneously deployed to multiple DB2 servers with a single command, improving DBA productivity and decreasing the amount of time required to deploy new applications.

Customers with a significant SQL procedure workload and a zIIP engine could see a significant reduction in the cost of running that workload.

The enhancements delivered in DB2 9 significantly broaden both the scope and appeal of SQL procedures. Customers who have not previously implemented them should re-evaluate that decision in light of these changes.

"IBM and SAP have cooperated very closely on DB2 9 for z/OS and we look forward to supporting our customers with these new capabilities."

Torsten Wittkugel, Vice President of Database and Operating System Platform Development, SAP

Finally, DB2 9 allows part of the work associated with SQL procedure execution to become eligible for zIIP⁵ processing. Customers with a significant SQL procedure workload that also have one or more zIIP processors installed within their System z environment could see in a significant reduction in the cost of running that workload.

In summary, the enhancements delivered in DB2 9 significantly broaden both the scope and appeal of SQL procedures, allowing them to be deployed more efficiently and executed more quickly and at lower cost than before. Customers who have not previously implemented SQL procedures should re-evaluate that decision in light of these changes.

Enhanced ERP Support

DB2 for z/OS is well established as the premier data server for high-end ERP systems such as SAP, and IBM continues to enhance DB2 to better support the needs of these demanding applications.

The following new features will benefit a wide range of DB2 applications, but will be of particular value within large DB2 for z/OS ERP environments. Please refer to the IBM Redbook **DB2 9 and SAP enhancements** (SG24-7239: DB2 9 and SAP enhancements) for further information on pureXML.

- **Not logged tables.** For some high-volume ERP operations, the overhead associated with logging inserts or updates made to DB2 data can become a bottleneck. DB2 9 provides a new option to selectively disable logging for certain tables where

⁵ zIIP processors (z9 Integrated Information Processors) were introduced by IBM in 2006. They are "speciality processors", able to offload some of the workload normally executed by general purpose System z processors (known as CPs) without the software charges normally associated with an additional CPU. Customers can purchase as many zIIP processors as they have general purpose CPs. DB2 for z/OS V8 was the first System z product to make use of these new engines, with the ability to offload some of the work associated with certain distributed SQL, utility and parallel processing.

Volume-based utilities can reduce overall operating costs and speed up data recovery in the event of a hardware failure

“We will be able restructure our processes to reduce or eliminate some backups. That will help us operationally with batch schedules, but will also save CPU cycles, DASD space and tapes which all help to reduce cost.”

DB2 9 for z/OS Beta Customer

The partition by growth feature greatly simplifies space management, improving both DBA productivity and data availability.

“We’ll be able to convert to partition by growth tablespaces and deliver some significant data availability and DBA productivity benefits.”

DB2 9 for z/OS Beta Customer

absolute recoverability of the data is not required. This has to be used with care, but can provide performance benefits where the data can be recovered or recreated outside of DB2.

- Volume-based utilities.** DB2 Version 8 introduced some powerful new facilities to backup or restore an entire DB2 system using a single command – especially valuable where a subsystem supports a single large application such as SAP. DB2 9 further enhances these facilities by supporting backup and recovery operations to tape as well as disk, and allowing specific objects to be recovered from a system backup. These enhancements can reduce overall operating costs and speed up SAP data recovery in the event of a hardware failure.
- Partition by Growth.** Many ERP applications have to deal with large and unpredictable data volumes. One of the challenges this brings is how to physically store the data, as many tables are too large to fit into a single physical file. DB2 allows the DBA to “partition” the table data across multiple files, but often there is no convenient “key” to tell DB2 which partition to place a given row into.

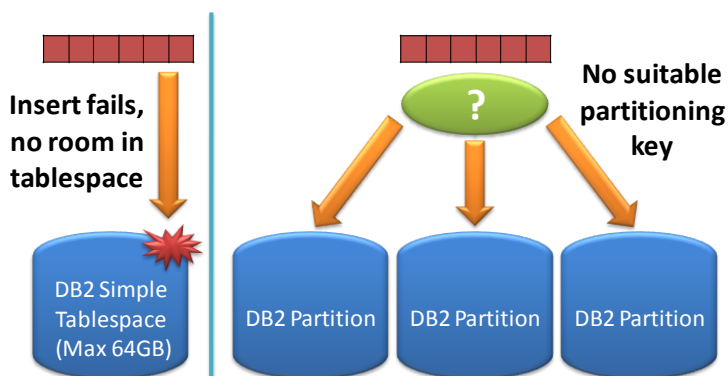


Figure 4 – ERP Space Management Challenges

DB2 9 introduces a new “partition by growth” feature, which instructs DB2 to insert new rows into the last partition, and automatically create new partitions as necessary (up to a total size of 128 TB). This greatly simplifies space management, improving both DBA productivity and data availability.

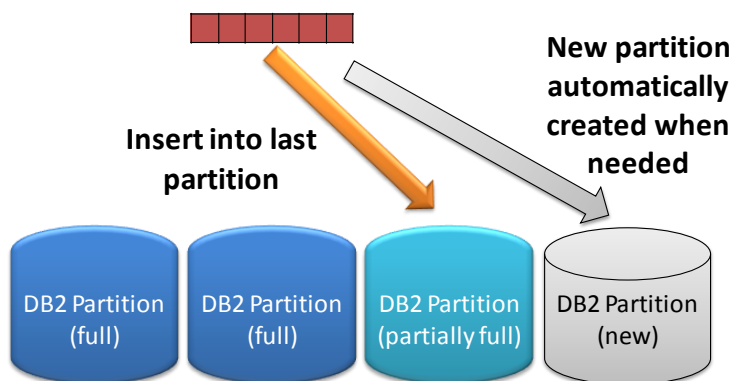


Figure 5 – Partition By Growth

- Reordered row format.** Many ERP systems make extensive use of varying-length columns within DB2, as this gave ERP

vendors the ability to easily expand column sizes before the advent of DB2's dynamic schema change facilities..

Prior to DB29, the existence of a varying-length column in a table created more work for DB2, as each time a row was accessed it had to calculate the position of all columns after the first varying length one (see Figure 6).

Basic Row Format

The new reordered row format in DB2 9 can dramatically reduce the CPU requirements for some large queries

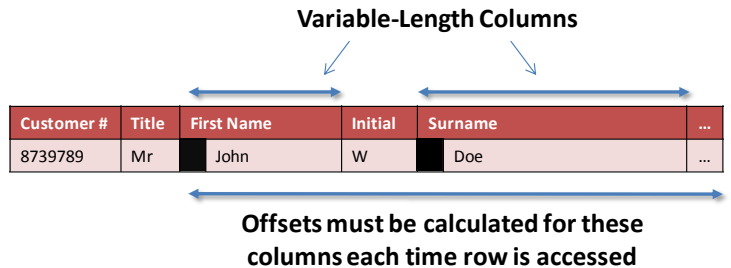


Figure 6 – Basic Row Format

A new “reordered row format” introduced in DB2 9 automatically places all variable-length columns at the end of the table and stores their offsets within a hidden area in the row (see Figure 7). This can dramatically reduce the CPU requirements for some queries, with up to 50% savings where large numbers of varying length rows are retrieved.

Reordered Row Format

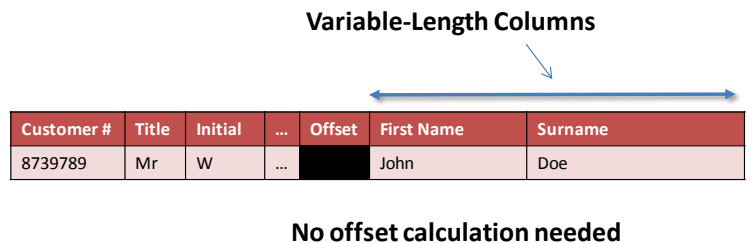


Figure 7 – Reordered Row Format

- Virtual Storage Improvements.** As described in Appendix A – DB2 V8 Review on page 29, the previous release of DB2 fundamentally re-architected many system components to take advantage of the 64-bit memory model and improve system scalability. DB2 9 introduces a number additional changes to further exploit the new architecture, with some SAP SD benchmarks showing performance improvements of up to 60% compared to DB2 for z/OS Version 8.
- LOB Enhancements.** ERP systems make extensive use of Large Object (LOB) columns within DB2, so the enhancements previously described in the section on New LOB Capabilities on page 8 are especially important for ERP applications.

Together, these enhancements further consolidate DB2's position as the preferred database for ERP applications such as SAP.

Together, these enhancements reduce DB2 CPU usage and improve DBA productivity and data availability. They further consolidate DB2's position as the preferred database for ERP applications such as SAP.

Business Intelligence Support

When it was first commercially released, DB2 for z/OS was initially positioned by IBM as a business information / data warehousing server – high-volume OLTP capabilities were only added in later releases.

Today, DB2 for z/OS is considered to be primarily an OLTP data server, with the DB2 for Linux, Unix and Windows variant (or other vendor's databases) being a more common choice for BI and data warehousing duties. This approach is often dictated by cost concerns or historical inertia, but there are some good reasons for customers to re-consider this position:

- **Resilience.** Many customers are finding that access to their data warehouse is every bit as critical as their operational systems, making the availability of such systems a major business concern. System z offers unparalleled resilience, with sophisticated security facilities to prevent unauthorised access and a mean time between failure (MTBF) unmatched by other platform.
- **Scalability.** Businesses are collecting more and more information about their customers and their buying habits, resulting in an explosion in the volume of data available for analysis. The System z environment is one of the most highly scalable platforms available, and established DB2 features such as Sysplex query parallelism (which allows multiple DB2 systems to share the work required to execute a large or complex query) enable the full power of the System z architecture to be used for BI queries.
- **Real-time data.** A major trend in the use of business intelligence is the move to real-time warehousing. Many customers can no longer afford to wait weeks or even days to analyse and react to changes in their business: they need instant analysis in real time. Placing the warehouse adjacent to the operational systems – or even making them part of the same database – can significantly reduce the lag between operational data changes and business insight, while improving the consistency and integrity of the warehouse data.

For these and other reasons, IBM is renewing the emphasis on DB2 for z/OS as a BI server. DB2 9 significantly enhances DB2's capabilities in this area, with a number of important enhancements:

- **Indexing Improvements.** A number of very significant improvements have been made to the way in which DB2 indexes data. Indexes can now be compressed, with space savings of around 50% being observed by most beta test customers. Given that most BI environments are typified by a very large number of indexes to improve query performance, this enhancement will constitute a major cost saving for most BI applications.

DB2 9 also extends the capabilities of indexes to allow them to be created on SQL "expressions" as well as base columns. In the example below, an index has been created on the expression "salary + commission" to save the expression from having to be evaluated for every row in the table when running the simple query shown. This ability can dramatically reduce the

Today, DB2 for z/OS is considered to be primarily an OLTP data server, with other databases being a more common choice for data warehousing duties. There are some good reasons for customers to re-consider this position.

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CPU required to satisfy complex BI queries, as DB2 needs to evaluate the expression only once when each index entry is created, rather than each time the query is executed.

DB2 9 extends the capabilities of indexes to allow them to be created on SQL “expressions” as well as base columns. This ability can dramatically reduce the CPU required to satisfy complex BI queries.

Employee_No	Title	...	Salary	Commission
868763	Mr	...	\$50,500	\$10,000
748939	Miss	...	\$55,000	\$4,300
...

```
SELECT EMPLOYEE_NO
FROM EMPLOYEE_TABLE
WHERE SALARY + COMMISSION > 60,000
```

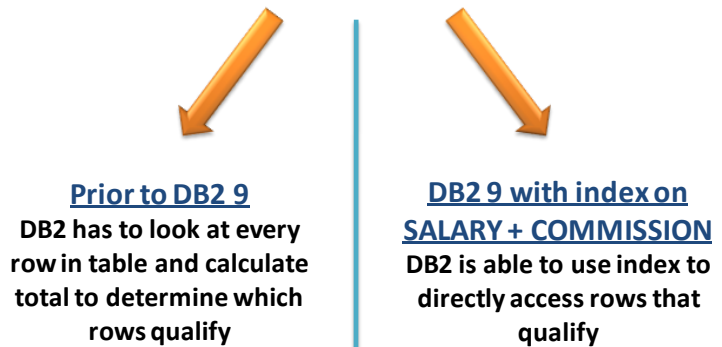


Figure 8 – Index On Expression

- **SQL Enhancements.** DB2 9 includes a large number of SQL enhancements aimed specifically at OLAP (Online Analytical Processing) applications, including the RANK, DENSE_RANK and ROW_NUMBER functions. These new capabilities can reduce development time and improve performance for key queries.
- **Optimisation Enhancements.** DB2 9 includes a number of enhancements to DB2’s industry-leading optimiser – the key component that allows DB2 to pick the most efficient access path for a given query. DB2 9 is better able to deal with non-uniform data by allowing the DBA to collect “histogram statistics” so it can make more intelligent access path decisions. Optimisation of complex queries involving multiple “query blocks” has also been improved, allowing DB2 to consider the best access path for the entire query rather than looking at each block separately.
- **Not logged tables.** This feature (previously described in the section on Enhanced ERP Support on page 10) will also be of benefit for many data warehousing applications, which require large volumes of data to be loaded quickly.

These enhancements significantly enhance DB2’s BI credentials on the System z platform, and underline IBM’s renewed emphasis in this area.

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Streamlined Security and Compliance

Regulatory compliance is one of the major business challenges facing today’s enterprises, and nowhere is that challenge more keenly felt than within IT. Regulations such as the Sarbanes-Oxley

The System z platform has a long history of providing a safe and secure environment for data, but new compliance regulations have raised requirements for new features within the operating system and other system software. DB2 9 has responded to these requirements.

Act, HIPAA and Basel II place serious and demanding obligations on a company to protect and secure the sensitive information held within its IT systems, and to be able to prove that they have done so.

The System z platform has a long history of providing a safe and secure environment for data, but these new regulations have raised requirements for new features within the operating system and other system software. DB2 9 has responded to these requirements with the following enhancements. For further technical details, please refer to the IBM Redbook **Securing DB2 and Implementing MLS on z/OS** (ITSO, 2007).

Network Trusted Contexts and Roles

Many of today’s applications (such as those based on Websphere Application Server and SAP NetWeaver) use a 3-tier architecture. Using this approach, the middle-tier application server is usually responsible for authenticating the end-user before passing data access requests to the database on the third tier.

For performance reasons, access to the back-end database is normally performed using a user and password provided by the application server. Unfortunately, this introduces a number of security concerns including the loss of the end-user identity for database access requests (with the associated loss of accountability) and the potential for weakened security due to the middle-tier user having to possess a superset of all authorities required by all application processes.

Network trusted contexts provide the best of both worlds, with robust security for non-trusted connections and good accountability with no performance compromises for trusted connections.

DB2 9 introduces the concept of network trusted contexts: pre-defined incoming connections which originate from a trusted location and are therefore not subject to normal authentication checks. As these checks can be bypassed, the application server can switch the user associated with the connection while avoiding many of the overheads that would previously have been incurred. In the meantime, normal DB2 security rules remain in place for non-trusted connections, as shown in the diagram below.

“Network trusted contexts is a very big deal for us. It will allow us to lock in access permissions to the Websphere servers and prevent the application user from being used elsewhere.”

Kevin Campbell, Application Architect, Univar USA

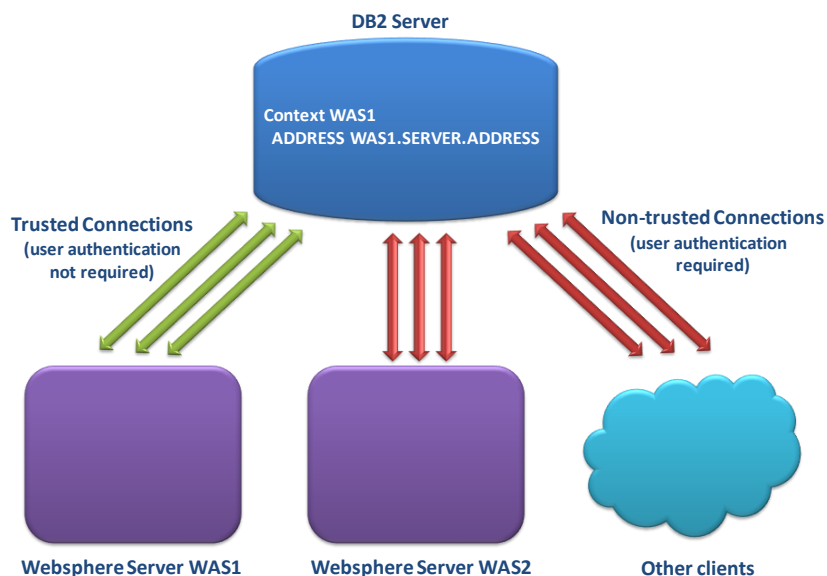


Figure 9 – Network Trusted Contexts

This approach provides the best of both worlds, with robust security for non-trusted connections and good accountability with no performance compromises for trusted connections.

Another new DB2 9 feature allows a set of DB2 privileges to be grouped into a construct known as a role. Roles are only available via a trusted context, so for the first time it is possible for the DB2 authorities held by a developer, DBA or user to be dependent upon their physical location. For example, a DBA may be able to view the contents of a sensitive table only while within an organisation's offices.

The combination of these two new features provides significantly enhanced security, better auditability and improved performance when compared to previous versions of DB2.

Enhanced Auditing

The ability to audit changes made to data, and to the access given to that data, is a key aspect of many compliance regulations.

DB2's audit capabilities have also been enhanced to encompass the role concept described above. DB2 9 also makes it possible to be much more selective when starting audit (and other) traces, allowing tracing to be confined to those areas where it is required and reducing the volume and overhead of trace data.

Instead Of triggers

A commonly-used technique for limiting application access to sensitive tables in DB2 is to use a view on the table that excludes the sensitive information, and only provide the application with access to the view (see diagram below).

"Instead-of triggers allow us make more database changes with less impact on existing code"
 Kevin Campbell, Application Architect, Univar USA

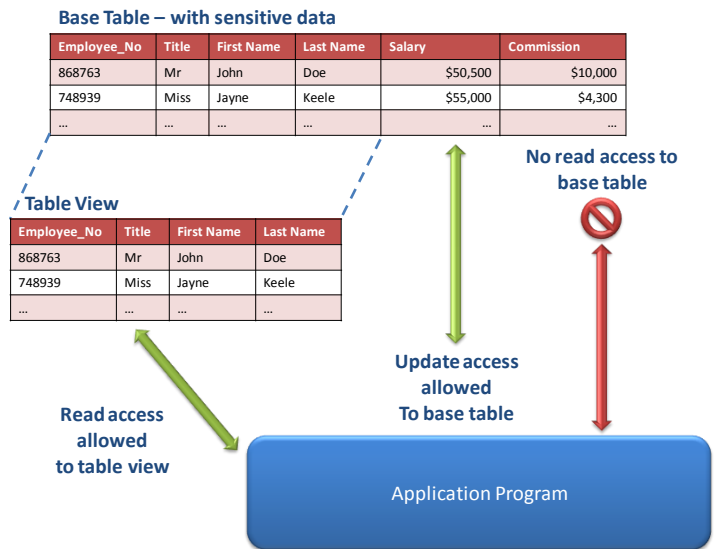


Figure 10 – Using Views to Hide Sensitive Data

This approach works well for read access, but under some conditions it is not possible to perform inserts, updates or deletes through a view (when the view references more than one table, for example). Previously, this restriction meant that applications would read data though a view, but perform updates on the base table. This makes application development, compliance and audit checks more complex.

Instead of triggers avoid this issue, by allowing an alternative action to be specified when an update operation is attempted against a view. In this way, previously illegal operations are allowed against the view, so application programs can use the view to both read and update the table. This in turn removes the requirement to allow any sort of direct access to the sensitive table, thereby improving security.

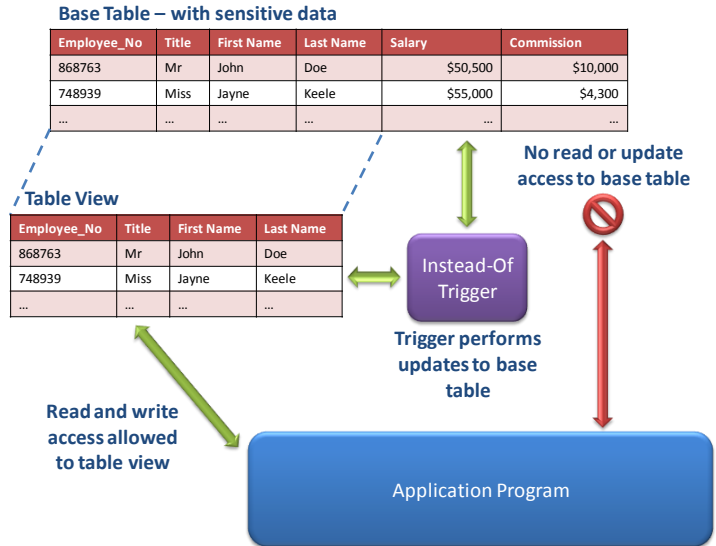


Figure 11 – Using Instead Of Triggers to Hide Sensitive Data

SSL Support and Encryption

One of the great strengths of DB2 for z/OS has always been its ability to rapidly exploit advances in the underlying hardware and operating system.

DB2 9 continues this trend by supporting the use of System z disk and tape controllers to encrypt data. Many organisations are required to encrypt their DB2 data for compliance reasons. Using the intelligence built into the new generation of storage hardware⁶ to perform these encryption functions can significantly reduce mainframe CPU costs for many clients.

DB2 Version 8 introduced the ability to encrypt data passed to and from remote requestors, and this has been enhanced in DB2 9 to support SSL (Secure Socket Layer) protocols. This further strengthens DB2's security credentials, making it even more difficult to eavesdrop on, tamper with or forge messages passing to and from DB2 from a remote location.

Reducing Total Cost of Ownership

Despite its well-understood scalability and resilience advantages, the System z platform needs to continue to demonstrate that it is cost-effective in today's competitive IT environment. Reducing the total cost of ownership (TCO) for System z applications is therefore an ongoing theme, and DB2 9 has a number of important advances in this area.

SSL support and encryption enhancements further strengthen DB2's security credentials, making it even more difficult to eavesdrop on, tamper with or forge messages passing to and from DB2 from a remote location.

⁶ Please refer to the statement of direction on "IBM TotalStorage Encryption" contained in the IBM System z9 109 announcement 105-241, dated July 27 2005.

Developer & DBA Productivity

As overall IT costs are driven down, people costs are becoming an increasingly large proportion of the total. Improving the productivity of DB2 developers and support staff can therefore yield significant cost savings, in addition to increased business agility.

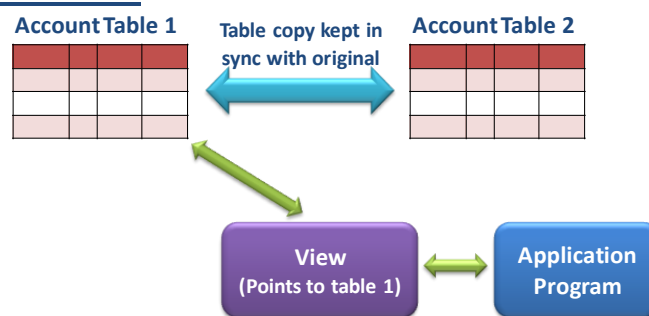
- Clone tables.** In today's high-availability environments, some processes (such as complete table refresh operations) can cause an unacceptable amount of disruption to applications that need to access the data. One solution to this problem is to create a copy of the table, keep it in sync with the original and temporarily allow applications to access the table copy when disruptive operations are being run against the original (see diagram below). When the disruptive operations are complete, the application can switch back to the original table. This process is effective, but requires a large amount of design and implementation effort on behalf of the application developer and DBA. It also typically involves dropping and re-creating of DB2 objects to perform the switch, which can result in brief periods of data unavailability.

The DB2 9 introduces support for "cloned" tables. Executing a simple command will cause DB2 to transparently redirect all application access to a cloned table, allowing other operations to be executed against the original with no impact to application tasks.

Converting to clone tables will effectively remove an outage and allow us to keep the data available at all times. And of course, we can dispense with the tricks and use a well-documented DB2 function which makes our environment easier and cheaper to support

DB2 9 for z/OS beta customer

Before Switch



Switch

Drop/recreate view, etc 

After Switch

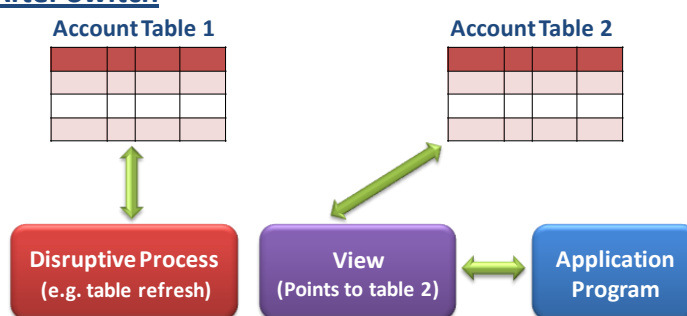


Figure 12 – Manually Cloning Tables Prior To DB2 9

DB2 9 introduces direct support for "cloned" tables, allowing the DBA to create an exact copy of a table with a simple command. Executing the EXCHANGE DATA statement will then cause DB2 to transparently redirect all application access to the cloned table, allowing other operations to be executed against the original with no impact to the application (see diagram below). As before, applications can be redirected back to the original copy by executing a second EXCHANGE DATA statement.

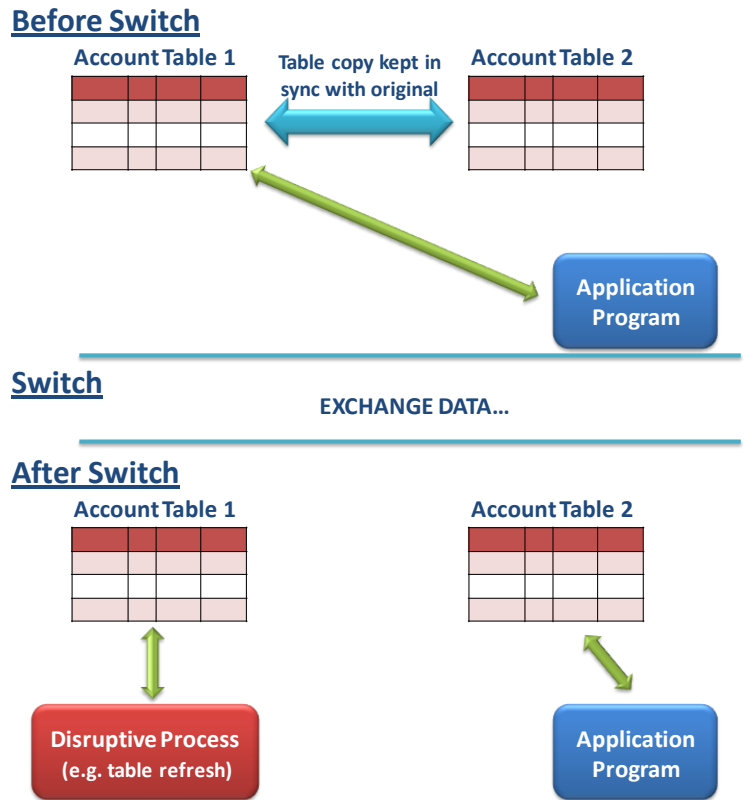


Figure 13 – DB2 9 Clone Table Support

The Optimization Service Center is a no-charge GUI workstation tool that provides a host of facilities to allow a DBA to identify and analyse problem SQL statements and perform various tuning tasks

- Optimization Service Center.** Business pressures often lead to applications being written and implemented very quickly, with little time available for performance testing and tuning. Even when time is available, the task of evaluating the performance of an entire application, isolating poorly performing components and tuning them can be highly complex and the necessary skills are in short supply within most organisations.

The Optimization Service Center (OSC) is a no-charge GUI workstation tool that is offered as part of the optional DB2 Accessories Suite for z/OS. It provides a host of facilities to allow a DBA to identify and analyse problem SQL statements and perform various tuning tasks.

The OSC is a highly sophisticated tool that has the potential to make DB2 performance specialists significantly more effective and productive.

- Universal table spaces.** The “partition by growth” feature described earlier (see Enhanced ERP Support on page 10) allows DB2 to manage disk space growth for some tables, removing the requirement for the database administrator to closely monitor and manage it themselves.
- Automatic object creation.** Unlike many other database implementations, prior versions of DB2 for z/OS used to insist on the DBA explicitly creating all of the pre-requisite DB2 objects (such as databases as table spaces) before a table could be created. DB2 9 improves compatibility with other database systems and reduces DBA workload by allowing these objects to be automatically created by DB2.

While this feature is unlikely to be used for production objects, it could save significant amounts of DBA time in development and ad-hoc query environments.

To ability to dynamically alter database structures significantly improves data availability, but also improves DBA productivity. DB2 9 allows yet more changes to be made online, such as renaming tables and columns.

- **Database roles.** This new feature (described earlier in the section on Network Trusted Contexts and Roles on page 15) will allow a pre-defined set of DB2 authorities to be easily allocated to individuals and removed when no longer required, with associated savings in security administration effort.
- **Dynamic schema change.** DB2 Version 8 introduced some major enhancements to allow database structures to be altered dynamically. This significantly improves data availability, but also improves DBA productivity as complex scripts to drop and recreate database objects can be replaced by a single command. DB2 9 further enhances these abilities by allowing more changes to be made dynamically. For example, it is now possible for both table and column names to be changed while retaining access to the data.
- **Recover to consistent point.** DBA productivity is a critical factor during application or DB2 system recovery, where every minute taken to recover can translate directly into lost revenue. One of the most time-consuming tasks during the recovery process is to identify a “consistent point” to recover to – a moment in time when no updates were pending.

DB2 9 includes some enhancements to the recover utility to allow a consistent recovery point to be automatically selected by DB2 when the DBA requests a data recovery. This speeds up the recovery process and makes it less prone to error.

DB2 9 extends the capabilities of the template command to allow different output locations to be specified based on the size of the dataset. This will reduce the ongoing effort required to monitor and maintain backup jobs.

- **Utility template enhancements.** The DB2 COPY utility⁷ allows the DBA to avoid writing many hundreds of lines of similar JCL (Job Control Language) using templates to refer to the various output files. While this can save a significant amount of time and effort, previous versions of DB2 did not take into account the size of the output files.

A common requirement is for small copy files to be placed on disk, while larger ones are written directly to tape. A new DB2 9 feature extends the capabilities of the template command to allow different output locations to be specified based on the size of the file. This will reduce the ongoing effort required to monitor and maintain backup jobs by automatically selecting the correct output location as DB2 tables grow over time.

- **SQL merge.** A common requirement when updating a database is to perform a merge operation, where source data is used to either update an existing record in the database if it already exists, or to insert a new record if it does not (this is also known as an “upsert” – a combination of update and insert).

⁷ The COPY utility allows the DBA to make a backup copy of a DB2 table, for use in the event of a recovery being required.

This process requires specific program code and database accesses, and can therefore be expensive in terms of development time and run-time performance.

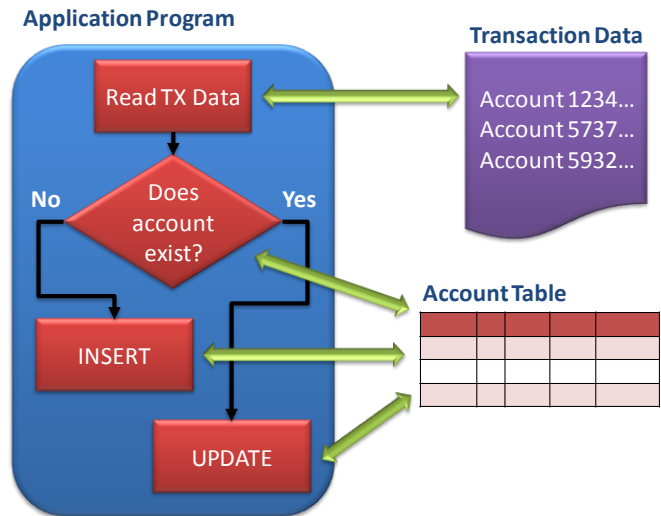


Figure 14 – Traditional Merge Processing

The new MERGE SQL statement introduced in DB2 9 will improve developer productivity and enhance the performance of many applications.

The new MERGE SQL statement introduced in DB2 9 performs this process entirely within DB2, improving developer productivity and enhancing the performance of the application, as shown in the figure below.

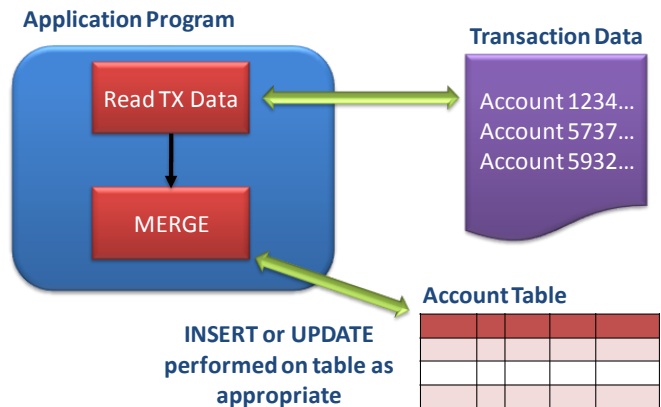


Figure 15 – DB2 9 MERGE SQL Usage

The MERGE statement can also be used in situations where the source data to be merged is also in a DB2 table rather than a flat file as shown in the figures above.

- **Volume based utilities.** The enhanced options to back-up an entire DB2 system described earlier (see Enhanced ERP Support on page 10) will allow this feature to be used in a wider variety of situations, saving significant amounts of DBA time that would otherwise be spent in creating and maintaining manual backup processes.
- **Truncate table.** Under some circumstances, it is necessary for an administrator to remove all data from a DB2 table. The new TRUNCATE TABLE statement allows this to be done more efficiently than before.

- **SQL procedures.** The enhancements to SQL procedures (described in Native SQL Procedures on page 9) will make it feasible for many more clients to begin writing their stored procedures in this language. As SQL procedures do not need any form of program preparation, they are quicker to prepare and prototype than those written in conventional languages.

Performance

Improving response time for critical business processes and reducing the mainframe resource used to execute them remain important priorities for most enterprises. Despite several key performance enhancements delivered in DB2 Version 8, some customers saw little or no overall improvement due to the overheads inherent in the move to a 64-bit architecture and other architectural changes.

DB2 9 reverses this trend, delivering another set of significant performance enhancements without any associated overheads.

Despite several key performance enhancements delivered in DB2 Version 8, some customers saw little or no overall improvement due to the overheads inherent in the move to a 64-bit architecture. DB2 9 is set to reverse this trend, delivering another set of significant performance enhancements without any associated overheads

"Someone must have put a turbo burner into DB2 9. Our LOB test case under DB2 9 takes only 50 to 60% of the CPU time DB2 V8 needs for the same work, and I see also big improvement in elapsed time"

DB2 9 Beta Customer

- **Index on expression.** As explained in Business Intelligence Support on page 13, the new ability to create an index on an SQL expression has the potential to transform the performance of many queries, and is expected to be one of the most valuable performance enhancements within DB2 9.
- **Large Object enhancements.** The use of large objects (LOBs) within DB2 for z/OS is increasing rapidly, and there are significant improvements to the performance of queries that access LOBs in DB2 9.

The way in which LOBs are locked to enforce consistency has been completely overhauled, and some other enhancements have been implemented to make the handling of large LOBs much more efficient. Several DB2 9 beta customers reported major overall performance improvements as result of these new features.

- **Optimisation enhancements.** The optimiser enhancements described in the section on Business Intelligence Support on page 13 will result in significant performance benefits for other types of applications too.
- **INSERT enhancements.** Many applications need to be able to insert large volumes of data into DB2 tables in a limited amount of time. Several enhancements have been made to DB2 index structures and insert processing to speed up mass insert operations. Initial IBM testing has shown CPU reductions of up to 20% as a result of these changes,
- **Utility enhancements.** Utilities are a mundane but vital part of DB2, allowing the DBA to backup, restore, reorganise and maintain critical business data. IBM has enhanced most of these utilities in DB2 9, with CPU reduction of between 10% and 70% being measured by IBM.
- **pureXML.** The pureXML support described in the section on Integrated XML Support on page 6 represents a major performance opportunity for applications that need to efficiently store and retrieve XML objects. The hybrid data

store avoids the overhead associated with shredding XML documents, while also providing highly efficient access using the XPath query language.

- **SQL merge.** As previously described, the new MERGE statement is expected to yield major performance benefits due to its ability to push the merge processing into the database engine.
- **System z synergy.** Many of the new features in DB2 9 exploit underlying features of the System z hardware or z/OS operating system in order to deliver improved performance. Both the SSL support and the encryption described previously make use of hardware specifically designed to accelerate such operations⁸.

Although primarily implemented to reduce total cost of ownership, the wider use of zIIP processors for SQL procedures and XML processing⁹ should also have a positive performance impact on heavily loaded systems, by offloading some work to the zIIP processor.

- **Sort enhancements.** Several improvements have been made to various sorting operations within DB2. Depending upon the workload, these have reduced CPU by up to 50% for some IBM test queries.
- **Reordered row format.** The reordered row format described in the section on Enhanced ERP Support on page 10 is expected to yield significant performance benefits when large queries are performed against tables with varying-length columns. Although of limited value for most typical online applications, some more intensive queries have shown a performance boost of up to 50% as a result of this feature.

⁸ It should be noted that hardware acceleration is dependent upon the model of System z server being used. The statements above apply to z990 and z9 processors, but older systems such as the z900 class machines do not support these features. In these cases, some performance degradation may be observed as the hardware features must be simulated by microcode.

⁹ IBM statement of direction.

DB2 9 Customer Case Studies

The section that follows is based upon interviews with several organisations that participated in the DB2 9 beta programme. Based on their early experiences with the product, they outline the business benefits they expect by exploiting the features in the new release.

Case Study 1 – Univar USA

Univar USA is the leading chemical distributor in the United States, providing more industrial chemical products and related services than any other company in the marketplace.

Univar was an early adopter of DB2 for z/OS Version 8, which allowed them to convert existing VSAM and Oracle applications to use DB2 while making significant cost savings¹⁰. A large and imminent DB2 workload integration project with Univar USA's Canadian sister company and the recent acquisition ChemCentral (the 4th largest US chemical distributor) means that rolling out DB2 9 will have to wait a while, but this hasn't stopped Univar from participating fully in the DB2 9 beta programme and evaluating the many business benefits that it can bring.

Kevin Campbell is Univar's Application Architect, and more recently has acquired a secondary role as the organisation's DB2 evangelist. He can see a number of areas where DB2 9 will deliver compelling new function that will translate into bottom-line business benefits, including the new pureXML capabilities. "We already use XSLT to transform XML documents such as debit memos, invoices and customer communications for presentation to our users. So we have an ever-increasing library of XSL templates (themselves XML documents) that we need to store and manage".

But Univar has shied away from XML database solutions in the past. "I have tried to explore the XML functionality in DB2 and competing database products, but just when it began to look interesting I came up against some sort of compromise with the performance, functionality or administration involved", said Kevin. "So, although we had requirements from the business to store and handle XML data, we found other ways of dealing with them because none of the database solutions seemed robust enough for what we wanted to do".

DB2 9's pureXML capabilities have changed Kevin's opinion. "This is not a bolt-on or band-aid approach, this is XML without compromise", he said. pureXML will allow Univar to easily create, manage and report upon XML documents with significantly less development effort than was previously possible. Kevin also expects to see major benefits for audit and regulatory compliance, where there is a requirement to store copies of documents exactly as they were presented to the user. "We have several projects under way right now which could make good use of pureXML. It is certainly one of the features we expect to use very quickly once DB2 9 is installed".

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¹⁰ For more details, please refer to section entitled "A DB2 for z/OS Version 8 Customer Case Study: Univar USA" in the 2004 Triton White Paper **DB2 for z/OS Version 8.1 - Driving Business Value** (Stuhler, 2004)

“Cultural sort will allow us to save development time and expense”

Another area where Kevin expects to see major business benefits with the move to DB2 9 is the new cultural sort capability. “Historically, we haven’t done a very good job in supporting multi-lingual characters within our applications, because the demand wasn’t there”, explained Kevin. “With the integration of our Canadian systems, suddenly we’re faced with that requirement. DB2 9’s cultural sort feature will allow us to sort results for presentation to our users and have both accented and non-accented names appear next to each other in the result list, rather than at opposite ends as they would have done previously, saving development time and expense”.

“Indexed Soundex functions will make it easier for employees to find the customer records they are looking for, and easier for our customers to find our products”

The addition of several hundred new Canadian users to Univar’s IT systems also poses other issues. “One of the major challenges for new users is learning the syntactical conventions for product and customer names when searching for information”, Kevin said. DB2 9 introduces a Soundex function to allow phonetic searching within SQL queries, and the ability to create an index on that function (another new DB2 9 feature) will be a major benefit for Univar. “This will make it easier for employees to find the customer records they are looking for, and easier for our customers to find our products. If we mis-spell a search word in Google, we take it for granted that it will suggest the correct word. This allows us to do the same”.

“Instead-of triggers allow us make more database changes with less impact on existing code”

But for Univar DB2 9 isn’t only about coping with new workloads – it also has the potential to make more mundane operations more efficient. “Application modernisation often involves amending the physical database design, but this can result in us having to change to existing application code to reflect the new database schema”, explained Kevin. Univar attempted to minimise the application impact of database changes by defining views on their DB2 tables and having their applications access the view rather than the underlying table. This worked well for reading data, but wouldn’t work for data updates when the view accessed more than one table. “Instead-of triggers allow us to update through the view as well, further insulating the programs from the data structure. That means that we can make more database changes with less impact on existing code”.

“DB2 9 builds on the core strengths of Version 8 in the areas of performance and availability while introducing meaningful new functionality. From traditional transaction processing to data warehousing and Web applications, DB2 9 for z/OS promises to be an exciting release”

Many organisations have had to spend significant amounts of time and money to deal with the implications of compliance legislation in recent years, and Univar is no exception. “Our Websphere application server environment has consistently been a focus area for our IT auditors, because any privileges given to the user that the application runs under could also be used to access the data from outside the application. Network trusted contexts is a very big deal for us. It will allow us to lock in access permissions to the Websphere servers and prevent the application user from being used elsewhere”.

So how would Kevin sum up the anticipated benefits of DB2 9? “We have been very pleased with the efficiencies and performance improvements that DB2 Version 8 has provided to Univar USA. DB2 9 builds on the core strengths of Version 8 in the areas of performance and availability while introducing meaningful new functionality. From traditional transaction processing to data warehousing and Web applications, DB2 9 for z/OS promises to be an exciting release”.

Case Study 2 – Large IT Services Provider

This global IT services provider joined the DB2 9 for z/OS extended beta programme in early 2007, as they can see some major potential business benefits in the new release. “There are some very interesting new features which could help to deliver major cost savings,” said their North American DB2 TP Team Leader.

“Many of our systems have to run with true 24x7 availability, with any outages costing thousands of dollars per minute in service level penalties” explained the DB2 TP Team Leader. “We simply do not have the luxury of scheduling any planned outages.”

In that sort of environment, routine operations that require even minimal outage such as database reorganisations can become a major issue. The online REORG utility in DB2 V8 still needs to make the data unavailable for a short period of time, known as the ‘BUILD2’ phase. “We were forced to use a third-party vendor’s reorganisation utility to avoid the outage,” said the DB2 TP Team Leader. “DB2 9’s enhanced utilities eliminate the BUILD2 phase, so we will be able to revert to IBM’s utilities which will save us licensing fees and also reduce the complexity of our DB2 infrastructure.”

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Another area affected by the company’s requirement for ultra high availability is database backups. “The last time we took an offline backup was over two years ago!” said a Lead Data Architect with the company. “For many of our tables, even making them read-only for a while would be considered an outage.” DB2 9’s enhancements to the system backup and restore facilities will therefore be warmly welcomed. “We will be able restructure our processes to reduce or eliminate some backups”, continued the DB2 TP Team Leader. “That will help us operationally with batch schedules, but will also save CPU cycles, DASD space and tapes which all help to reduce cost.”

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The organisation can also see some major financial benefits in the new network trusted context capabilities introduced in DB2 9. Like many other organisations, they run a lot of distributed application servers which use a single user-id to identify themselves to DB2. “This approach provides some performance advantages, but also raises some compliance issues for us” said DB2 TP Team Leader. “Network trusted contexts will allow us to impose restrictions on which SQL processes can be run from given servers and provide increased accountability. It will also allow us to make another major cost saving, as we currently use another third-party product to provide equivalent capabilities and that can be dropped once network trusted contexts have been implemented.”

So the company can see some significant cost savings on the system side, but what about application-related benefits? The Lead Data Architect takes up the story again: “We are a major user of DB2 stored procedures, with over one thousand of them in production today. Previously, we used C as our main stored procedure language, due to the performance benefits. Some of the less performance-critical procedures have been written in (or converted to) Java to allow us to take advantage of our zAAP speciality processor, but we can see major potential for the new native SQL procedures in DB2 9”.

"Eventually, we expect up to 10% of our stored procedures to be written in SQL. They will then be eligible for execution on our zIIP speciality processor, which will allow us to make better use of our existing mainframe capacity and therefore reduce operating costs."

"The new buffer management capabilities will allow us to reclaim wasted memory. That means we get better utilisation out of our existing System z investment"

"Eventually, we expect up to 10% of our stored procedures to be written in SQL," said the Lead Data Architect. "They will then be eligible for execution on our zIIP speciality processor, which will allow us to make better use of our existing mainframe capacity and therefore reduce operating costs."

The Lead Data Architect is also looking forward to the automatic buffer management capabilities included in DB2 9 for z/OS. Buffer pools allow DB2 data to be stored in memory to avoid costly I/O operations, and are a major factor in DB2 performance. "We currently run a 4-way data sharing environment, with two DB2 subsystems predominantly handling our CICS workload and the other two handling distributed requests," explained the Lead Data Architect. "If we need to take one or more DB2 systems out for whatever reason, the other ones will take on the associated workload. This means that we need to ensure that there is sufficient buffer pool capacity in each subsystem for that additional load, even though it won't be used most of the time".

"The new buffer management capabilities will allow us to reclaim some of that wasted memory, secure in the knowledge that the system can automatically resize the pools if the workload requires it to do so", said the Lead Data Architect. "That means we get better utilisation out of our existing System z investment."

So, this large IT services provider can see some compelling reasons to move to DB2 9 quickly. "We're in the process of quantifying all of these benefits before finalising our migration plan, but we intend to move to the new release sooner rather than later", said the DB2 TP Team Leader.

Summary

DB2 9 for z/OS is one of the first of a new breed of hybrid relational database management systems, optimised for today's highly demanding and complex IT systems and able to seamlessly integrate relational and XML data.

DB2 9 continues to justify its position as the premier data store for ERP applications such as SAP, with a host of new features designed to improve performance and reduce operating costs for these critical systems. It also makes significant progress in further strengthening its credentials as a robust and cost-efficient platform for Business Intelligence and Data Warehousing.

The System z platform has a long history of providing a safe and secure environment for data, but tough new regulations have raised requirements for new features within the operating system and other system software. DB2 9 has responded to these requirements with enhancements designed to significantly improve security and auditability in several key areas.

Further advances in performance within the new release underline IBM's determination to keep System z price-competitive with other platforms, and most customers should see significant improvements to their bottom line CPU costs once the new features are fully implemented. Enhanced facilities to improve developer and DBA productivity will also translate into bottom-line TCO savings.

In combination, these new features represent yet another significant advancement in DB2's capabilities. DB2 9 offers real financial and technical benefits, free from major challenges such as CCSID issues or Unicode conversions.

Appendix A – DB2 V8 Review

DB2 is universally accepted as the premier database system for IBM's System z mainframe architecture.

More than half of the worldwide DB2 workload now runs on Version 8.

The ability to be able to expand the processing capabilities of core infrastructure components such as the database system in a rapid and cost-effective manner is critical. Version 8 delivered a number of key enhancements in this area.

Today, DB2 is universally accepted as the premier database system for IBM's System z mainframe architecture. Although other products do exist for this platform, DB2 sits at the heart of most of the business-critical mainframe IT applications that have been written during the last 20 years.

DB2 Version 8 has been generally available since March 2004, and more than half of the DB2 worldwide workload is now running on that release. The scalability and reliability of IBM's System z platform makes it a very attractive choice for customer's high-volume, mission-critical applications. It should also be noted that Version 8 is a vital stepping-stone for those customers on previous releases of DB2 that wish to take advantage of the new features in Version 9, as migration from releases prior to Version 8 is not supported by IBM.

In this section, we'll briefly review DB2 Version 8 and look at some of the ways in which it helps to deliver competitive edge. For a more detailed look at DB2 Version 8, please see the 2004 Triton White Paper ***DB2 for z/OS Version 8.1 - Driving Business Value*** (DB2 for z/OS Version 8.1 - Driving Business Value, 2004).

Scalability and System z Synergy

Scalability – the ability to easily increase the capacity of a system to cope with increased demand – has never been more important. Today's IT systems are typically highly integrated with an organisation's partners, suppliers and customers, and must be able to quickly respond to customer demands, new market opportunities or competitive threats.

In this sort of environment, the ability to be able to expand the processing capabilities of core infrastructure components such as the database system in a rapid and cost-effective manner is critical. Version 8 delivered a number of key enhancements in this area, including:

- **64 bit support.** Version 8 allowed customers who invested in IBM's latest generation of hardware to fully exploit the immense storage capabilities of the 64-bit memory model, with no changes being required to their applications. This in turn allowed DB2 systems to cache significantly more data and to vertically scale higher than was previously possible, resulting in a reduction in system overheads and more efficient use of limited machine resources.
- **Partitioning Enhancements.** Version 8 provided some major enhancements to the partitioning options available to DB2 database designers, allowing them to create more efficient designs able to support higher transaction loads for a given amount of machine resource.
- **Recovery Log Enhancements.** Version 8 allowed significantly more recovery log data to be held both online and offline, allowing a DB2 system to handle larger workloads while maintaining the recoverability of the data.

- **System z Synergy.** Version 8 exploits specific features in z/OS and the System z hardware to deliver highly efficient character conversion and encryption services.

Data Availability

The resilience and reliability offered by the System z platform is a major reason for its use in so many mission-critical applications. Unfortunately, although this allows *unplanned* outages to be minimised, there are still situations where a *planned* outage is necessary to perform essential system maintenance. These planned outages are becoming increasingly painful – batch windows are shrinking or disappearing altogether, and maintenance windows are a precious commodity that many customers simply cannot afford.

DB2 Version 8 made some important advancements in reducing or eliminating planned outages.

DB2 Version 8 made some important advancements in reducing or eliminating planned outages in the following areas:

- **Dynamic Schema Change.** One of the most common reasons for planned outage is the requirement to change database structures. Version 8 provided a good initial set of capabilities for making these changes while retaining application access to the data. Customers have been able to use these features to implement changes more frequently, allowing them to react more rapidly to changing market conditions or unexpected performance issues. Database administrator productivity has also been improved (and the risks associated with the change reduced), due to the significantly simpler change process
- **Partitioning Enhancements.** The new partitioning model introduced in Version 8 allows true partition independence for the first time. This reduces the availability impact of some table reorganisations, allowing the administrator to keep the data better organised and therefore potentially improving the performance of the application.
- **Dynamic System Parameters.** The additional dynamic system parameters in Version 8 decrease the likelihood of the entire DB2 system having to be made unavailable while configuration parameters are changed, which improves overall availability and allows system administrators to be more responsive to changing application demands.
- **System Wide Backup & Recovery.** The system-wide backup and recovery capabilities introduced in V8 can reduce the time that DB2 data has to be unavailable due to system backups. Perhaps more importantly, the ability to rapidly restore a system to a given point in time means that applications can be made available again in the minimum possible time in the event of a major problem.

Application Porting

As the hardware, software and environmental costs associated with the mainframe continue to decrease, the System z is becoming an increasingly attractive place to host applications originally designed and developed for other platforms. ERP and CRM vendors are also interested in the potential for porting their existing application code to run against DB2 on the mainframe platform.

The System z is becoming an increasingly attractive place to host applications originally designed and developed for other platforms.

Version 8 introduced a number of new features designed to improve application portability. These included:

- **SQL Enhancements.** Compatibility with other RDBMS systems was significantly increased with the introduction of a large number of SQL enhancements such as support for long table names and recursive SQL. Together, these enhancements have reduced the effort, complexity, risk and cost of porting database definitions and application code to DB2 Version 8, making it an even more attractive platform for vendor application porting infrastructure consolidation projects and development on Windows, Unix or Linux.
- **DB2 Universal Java Driver.** The new Universal Driver removes yet another set of code changes needed when porting Java applications to the System z by delivering a single driver on all platforms (including DB2 for z/OS V7 and V8), while also providing useful performance and functionality enhancements.

Web Enablement

As customers embrace the many opportunities offered by e-business, more and more of their traditional mainframe production workload is being web-enabled. However, for all its benefits, exploitation of web technology brings its own challenges:

The V8 added some key new capabilities in this area:

- **Java Enhancements.** New Java functions such as support for scrollable cursors and batched updates provide valuable productivity and performance enhancements, consolidating Java's position as a primary System z programming language.
- **XML Enhancements.** XML is becoming increasingly important as the de facto standard for information exchange between internal and external IT systems. Version 8 introduced a number of built-in XML publishing functions which offered some welcome performance improvements over the previous XML Extender and point the way for the much more extensive native XML support in DB2 9.

Enhancing Performance & Reducing Operating Costs

Every release of DB2 delivers significant performance enhancements designed to drive down the resource required for a given DB2 transaction, and Version 8 was no different:

- **Multi-Row Insert & Fetch.** The insert and fetch operations are two of the most common activities performed against a DB2 table. Version 8 introduced the capability of fetching or inserting multiple rows in a single SQL operation, with CPU savings of 30-50%. Distributed applications saw even bigger improvements due to the ability to replace multiple (and time consuming) trips across the network with a single call.
- **Optimisation Enhancements.** The optimiser is the component responsible for selecting the most efficient way to execute a given SQL statement. DB2's industry-leading optimiser was further enhanced in a number of areas within Version 8.

Every release of DB2 delivers significant performance enhancements designed to drive down the resource required for a given DB2 transaction, and Version 8 was no different

Together, these performance enhancements provide considerable scope for reducing the CPU requirements and increasing the throughput of customer workloads.

- **Other Enhancements.** V8 introduced a number of other enhancements, such as bi-directional indexing and page-fixing of buffer pools. Together, these performance enhancements provided considerable scope for reducing the CPU requirements and increasing the throughput of customer workloads

Developer / DBA Productivity

As the costs of hardware and software continue to decrease, IT staff costs are becoming relatively more expensive. Improving productivity and managing more systems with the same number of people is therefore a key requirement if IT is to continue to deliver value to the business.

New productivity features delivered within Version 8 include:

- **Dynamic schema change.** The dynamic schema enhancements described earlier dramatically reduce the amount of effort required to make changes to the structure of DB2 objects.
- **Automatic secondary space allocation.** Space management – the process of monitoring the amount of disk space used by tables and manually resizing them when necessary – is a major part of the effort expended by a database administrator on a day-to-day basis. This enhancement allowed the administrator to instruct DB2 to automatically deal with tables that are nearing their maximum size, reducing the time required to manage a busy development or production environment.
- **Partition rebalancing.** New capabilities within the data reorganisation utility allowed the administrator to evenly rebalance the amount of data in each partition of a partitioned table with a single command. This would previously have required a large degree of manual effort on behalf of the administrator.
- **System level backup and recovery.** New options allowed entire DB2 systems to be backed up and recovered using a small number of commands. As well as the obvious advantages for system and disaster recovery scenarios, these facilities also offered some useful productivity savings in development environments, where they can be used to very rapidly clone development systems – a task that can otherwise require many hours of dedicated effort to accomplish.
- **Recursive SQL.** Many applications require the ability to recursively execute an SQL statement against a given table (commonly known as a “bill of materials” queries). Previously, such requirements could only be satisfied through relatively complex application coding and/or database design techniques, which required a large amount of developer and administrator effort to build and maintain. Version 8 introduced support for recursive SQL, allowing such queries to be handled directly by DB2.

Global Integration and Deployment

Version 8 removed many of the restrictions preventing customers from fully exploiting Unicode's considerable benefits in a multi-national application environment.

An On Demand business is blind to national boundaries, and in today's global economy an increasing number of DB2 customers have IT systems which are used all around the world. This globalisation introduces some obvious availability challenges due to time zone differences, but there are some more fundamental issues to be faced in the way in which individual characters are represented on the client systems spread around the various geographies.

Unicode was introduced to solve these problems, by providing a representation for every character regardless of the platform and language. Version 8 built upon the initial Unicode support implemented within the previous release, removing many of the restrictions that were preventing customers from fully exploiting Unicode's considerable benefits in a multi-national application environment.

Data Security

If data is one of your organisation's most valuable assets, then protecting and securing that data must be one of your most important priorities. DB2 has always had a very robust security implementation, which is generally well suited to the requirements of traditional OLTP workloads.

Version 8's multi-level security features customers a greater level of control and capability in security management and access to data.

Version 8's multi-level security features fundamentally changed the way in which DB2 access privileges are managed. Implementing them required careful planning and analysis, but the vastly increased flexibility made the effort worthwhile for many customers who required a greater level of control and capability in security management and access to data.

Appendix B – Acknowledgements

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