Future Directions in DB2 for OS/390

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- DB2 on the OS/390 platform has grown and changed dramatically over the past few years. Version 6 has changed significantly since it was originally released. Version 7 has been announced.
- Even more is coming. Roger Miller, lead strategist on DB2 for OS/390 will discuss new plans that IBM has for the product. Roger will cover delivery plans, new developments in transaction processing, data warehousing, e-business, and new application areas that DB2 capabilities will open up in the future.

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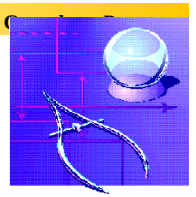
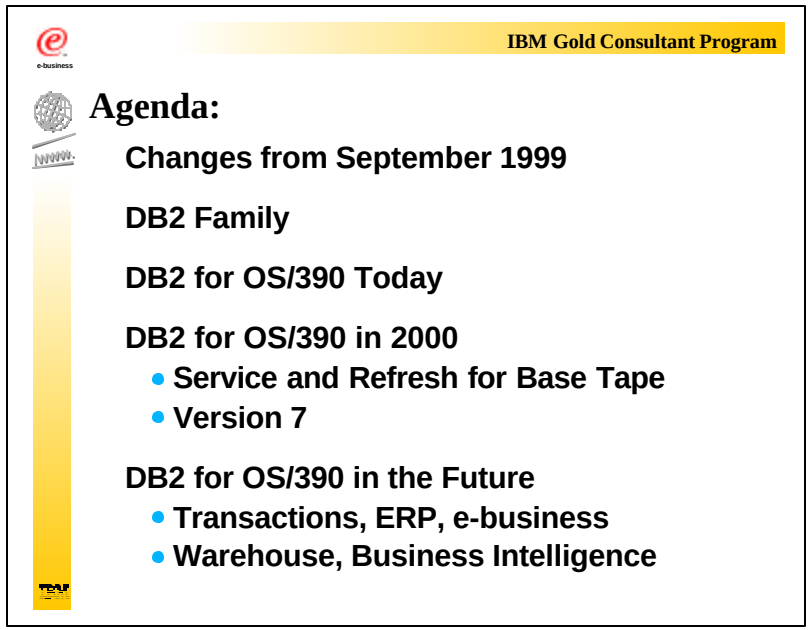
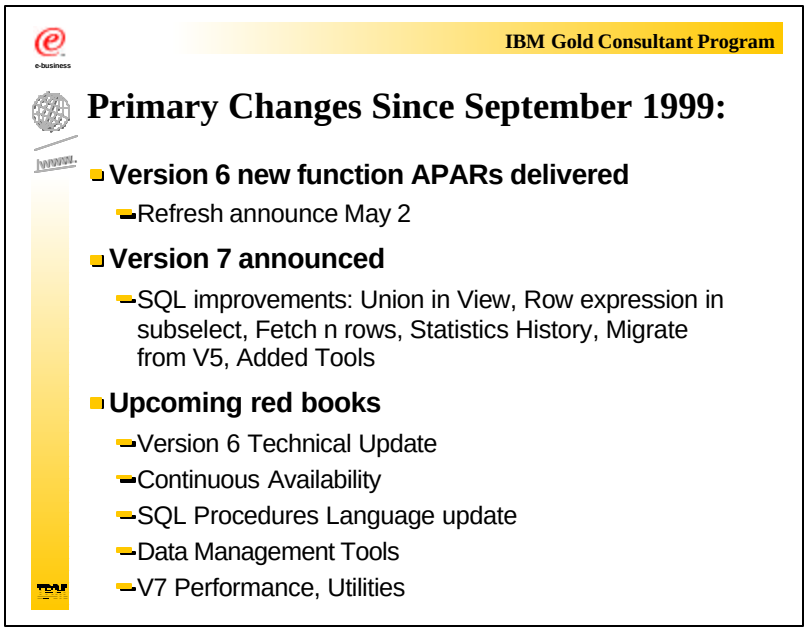


Information in this presentation about IBM's future plans reflect current thinking and is subject to change at IBM's business discretion. You should not rely on such information to make business plans. Any discussion of OEM products is based upon information which has been publicly available and is subject to change.

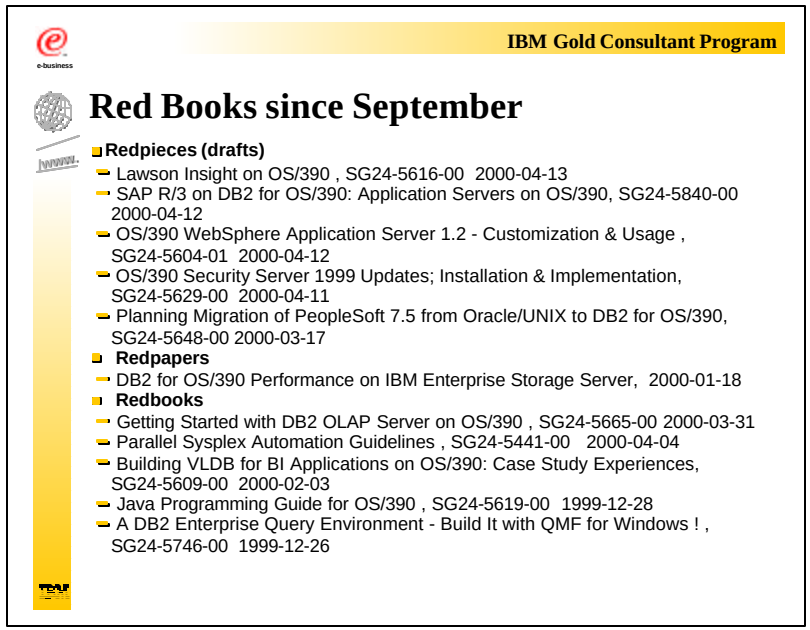
- This presentation is more like looking into a crystal ball than at measurements. This crystal ball is cloudy, and gets fuzzier the farther we look into the future. Our plans include much more change and much more risk than ever before. We are stretching the vision.
- The only near certainty is that there will be changes. My best guess is that fewer than 10% of the items will change their delivery time. I would expect some new items to come in, some to come early, and others to deliver in stages. More will have major changes in their design.

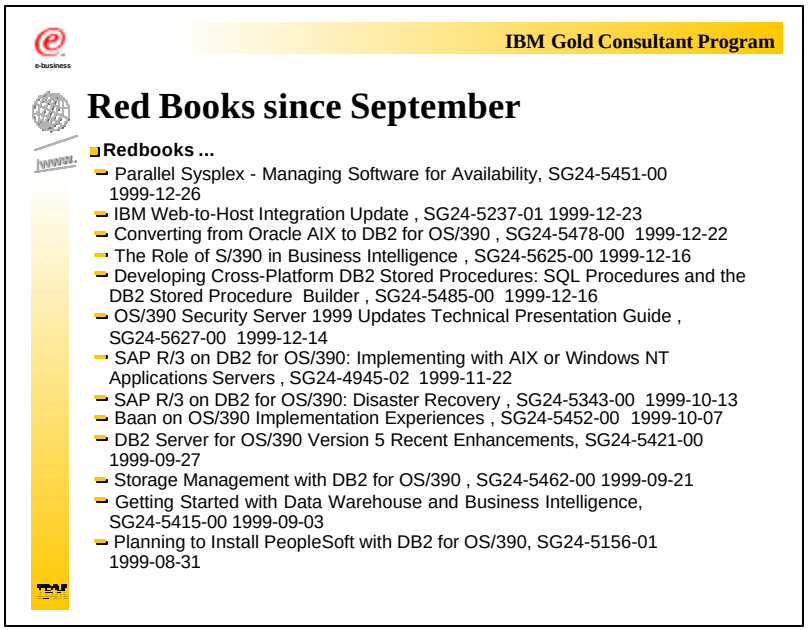


- This is the outline for the presentation, starting with DB2 family perspective. Then we'll cover changes in the product we have in the field today, noting the changes we just delivered and those we expect to deliver in the next few months.
- Then we'll outline work for this year, with some changes in service and another release or version.
- Finally we'll sketch in the DB2 future beyond the year 2000 with a broader brush.



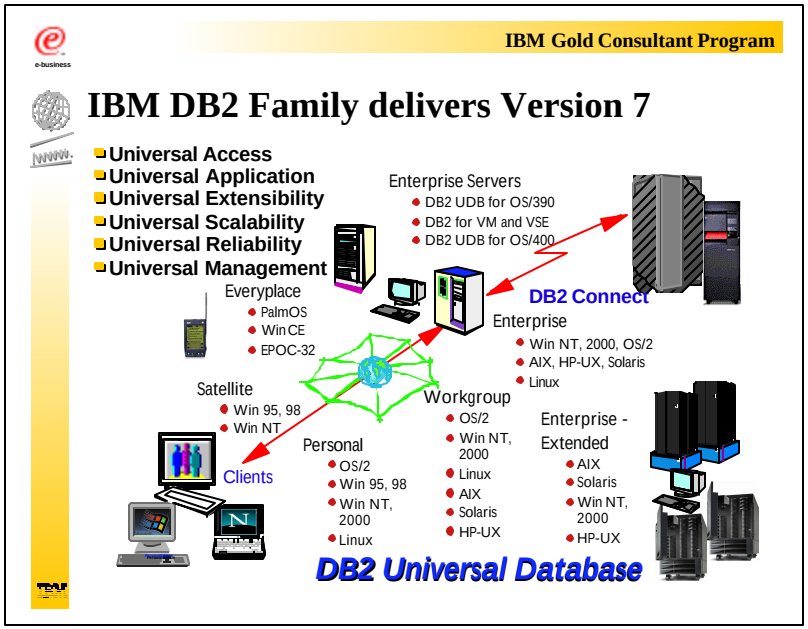
- The biggest changes since September 1999 are that almost all of the Version 6 new function APARs have been closed and Version 7 is announced.
- The refresh will be announced by the time we talk, so it is easier to discuss how to migrate to Version 6.
- Some new Version 7 items have been added, and we have more details available now.
- See the What's New? book on the web for additional detail. We expect the book to change.
- Some of the red books delivered, and more are in progress.

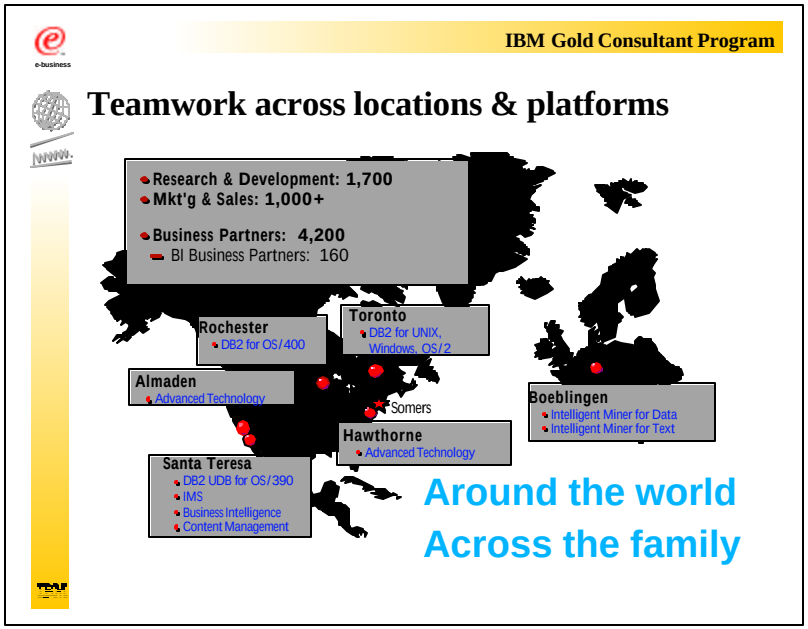




- You can check for all of these on the web:
  - www.ibm.com/redbooks
  - Put DB2 in the Search and click Go.
  - The books come up with the latest first in each category.
- Residencies are the invitations for new books.
- The red pieces are the newest red books, drafts that are being reviewed. They will be red books when finished.
- Red papers will not become red books.
- Red books are the completed books.

- I selected books from the web with the search criteria, trying to keep this to a few pages.
- There are more.





- Please see the web for our Version 7 announcements:
- www.ibm.com/software/data/launch/
- The DB2 family is central in our work, and delivering across the family is always key. In our family we have two major objectives that are not completely compatible:
  - Make the DB2 family identical, from the palm top to massively parallel processing.
  - Optimize each member of the family to the platforms it runs on. Use every square micron of the silicon and operating system for performance & availability advantages.
- The next slides will show how we address DB2 commonality and platforms. This is a busy slide, because it includes all of the DB2 family members and their roles. The term DB2 UDB is now part of the Unix, Windows, OS/2, Linux, OS/390 and OS/400 product names. So when there is a distinction, we'll often just indicate the platform. This page also

- The IBM Research and Development team is large and talented. With over 1700 in all of data management, we have more than 1000 people working in database across IBM. One good example of the talent is the number of patents. Look on www.patents.ibm.com/ibm.html to see the most recent information.
- Our work is increasingly across the DB2 family, rather than just on one set of platforms. While we have shared technology, designs and code where possible for a long time, we are increasingly developing components for all of the DB2 family.

REXX with DB2 for OS/390

Issue dynamic SQL from REXX

No precompile or link

Interpreted language

REXX language stored procedures

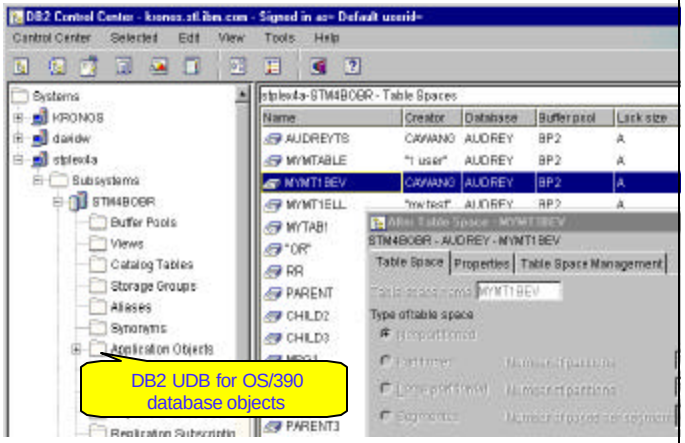
Improved DB2 Family Consistency

V5 Recent Enhancements red book
Rexx Language Support book on web

- REXX Support in DB2 for OS/390
- With this enhancement, application programmers who are familiar with the REXX language can issue SQL statements from REXX programs. The SQL statements can be anywhere a REXX command can be. Programmers can also write DB2 stored procedures in REXX. The SQL interface to REXX supports all SQL statements that DB2 for OS/390 supports, except for a few statements that cannot be dynamically prepared such as the VALUES INTO statement.
- This change improves our DB2 family consistency, giving us REXX support on all platforms.

IBM Gold Consultant Program

Control Center



- IBM DB2® Control Center provides a common interface for managing DB2 databases on different platforms. You can run DB2 commands, create DDL statements and execute DB2 utilities. DB2 Control Center's point-and-click navigation capabilities make it easy to find objects.
- DB2 Control Center comes with features that equip you to perform myriad management tasks on DB2 subsystems, including:
  - Pre-filtering a large number of objects
  - Locating objects in a subsystem
  - Creating a customized control center
  - Providing maintenance support recommendations.
- www.ibm.com/software/db2os390/v6facts/db2cc.html

SQL Procedures Language

Standard SQL programming language

SQL3 defines control statements for use in SQL functions

- **BEGIN . . . END**
- **Local variable declarations**
- **Assignments, GOTO**
- **CASE statements**
- **IF statements**
- **Loops: WHILE, REPEAT, FOR, LEAVE**
- **RETURN statements**

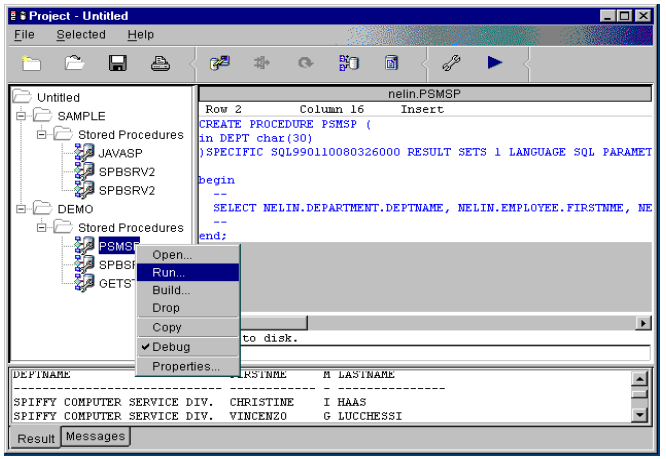
Standards call this Persistent Stored Modules (PSM)

Compiled into C stored procedures

Stored Procedure Builder for fast development

www.ibm.com/software/db2os390/sqlproc

Stored Procedure Builder



- DB2 for OS/390 V5 & 6 offer a new stored procedure programming language. This programming language permits users to create stored procedures quickly and simply. Users need not know, as in regular languages, how to embed SQL statements and how to prepare the source code for use in conjunction with DB2. Rather, users can use only one programming interface, that is, SQL, and, therefore, need only one set of programming manuals. This language is useful for migration from some other DBMS products to DB2 and will be implemented across the DB2 family.
- SQL Procedures allow users to create business rules, and functions in an extended SQL language.
- See V5 Recent Enhancements or www.ibm.com/software/db2os390/sqlproc

- IBM DB2 Stored Procedure Builder (SPB) assists you with creating a stored procedure that runs on a database server. You write the client application separately.
- SPB is a graphical application that supports rapid development of DB2 stored procedures. Using SPB, you can perform the following tasks:
  - Create new stored procedures
  - Build stored procedures on DB2 servers
  - Modify & rebuild existing stored procedures
  - Test & debug execution of installed stored procedures
- SPB provides a development environment that supports the entire DB2 family. You launch SPB from DB2 UDB program group, or you can launch SPB from Microsoft Visual Studio, Microsoft Visual Basic or IBM VisualAge for Java.

Improved family compatibility & porting

Features	Unix & Win	OS/390
Stored procedure language	V7	V5
Java stored procedures	V5	V5
Stored Procedure Builder	V6	V5
declared temporary tables	V7	V6
savepoints	V7	V6
identity columns	V7	V6
item in order by, but not select list	V2	V5
more than 15 tables in join	V2	V6
Rexx language interface	V1	V5
Page sizes 4K, 8K, 16K, 32K	V6	V6 base
DCLGEN and structures	V6	V1
Utility improvements	V6	V2

See DB2 for OS/390 Version 7 items later.

- We work across the DB2 family to improve family compatibility and the ability to port applications to DB2 from other vendors. Many of the differences in timing are only a few months apart.
- These are some key items, with notes about which DB2 for OS/390 and which Unix & Windows Version are first expected to have the function. Changes may occur without notification.
- All listed OS/390 V5 items delivered as APARs. DB2 for OS/390 V6 items are also APARs except for additional page sizes. See DB2 for OS/390 V7 items later in this handout.
- DB2 for Unix, Windows, OS/2 items deliver in the base. Timing & releases differ, but family consistency is improving, with key items generally within a step or two.

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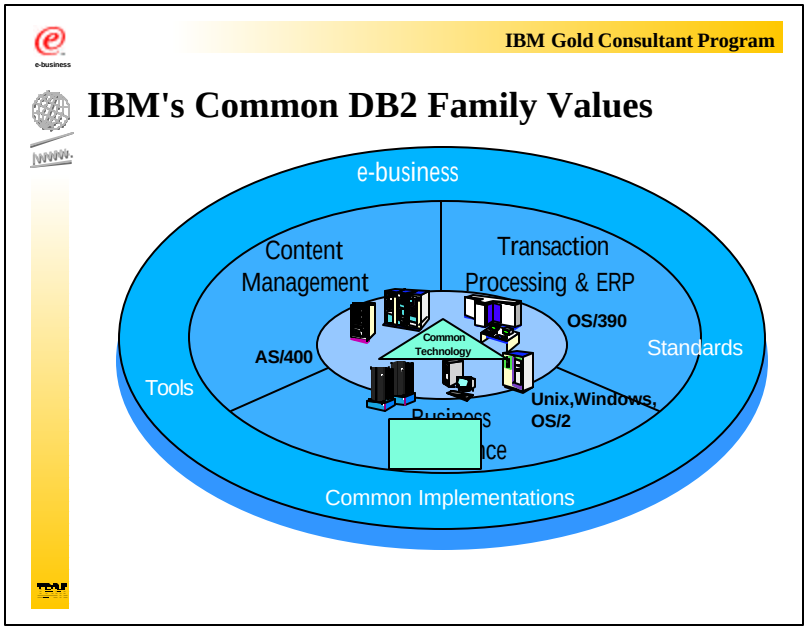
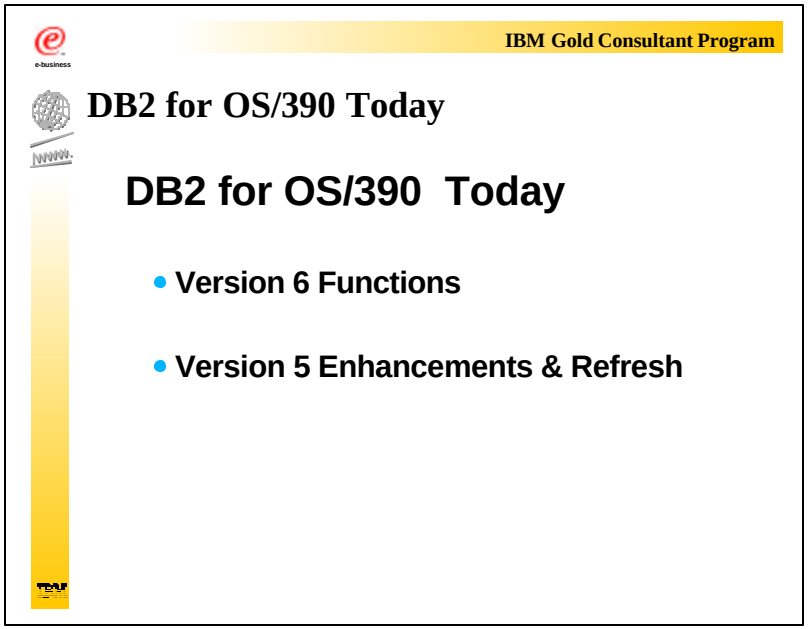
DB2 Family Partners

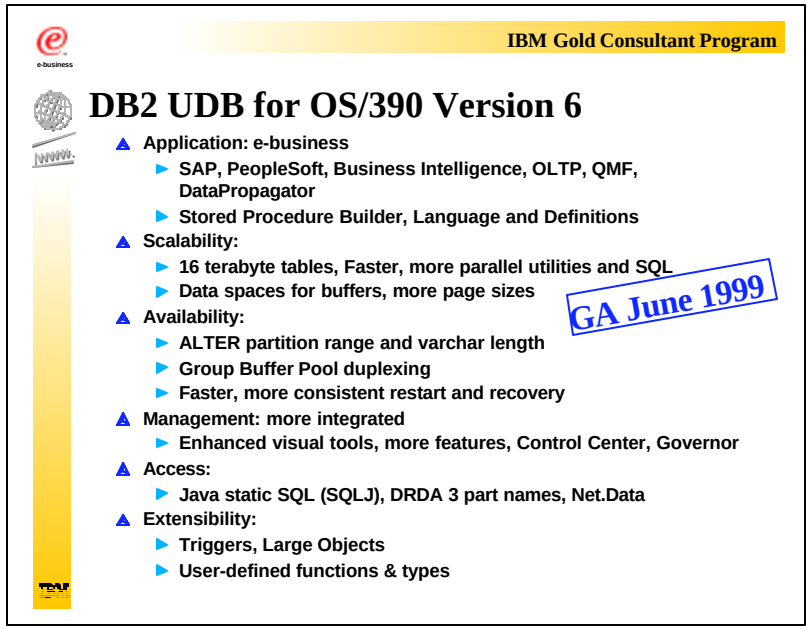
- If DB2 does not run your application well, you may not care about any of the other strengths. We focus on key vendors, application development and upon the fastest growing application areas and application development, like e-business and business intelligence. Here are some of the vendors you will recognize, for more specifics, we suggest searching with our web tools:
- DB2 Solutions Directory - DB2 Applications and Tools
- www.ibm.com/ibmlink/cgi-bin/s390sasw
- www.ibm.com/software/partners/
- www.ibm.com/solutions/businessintelligence/partners/index.htm

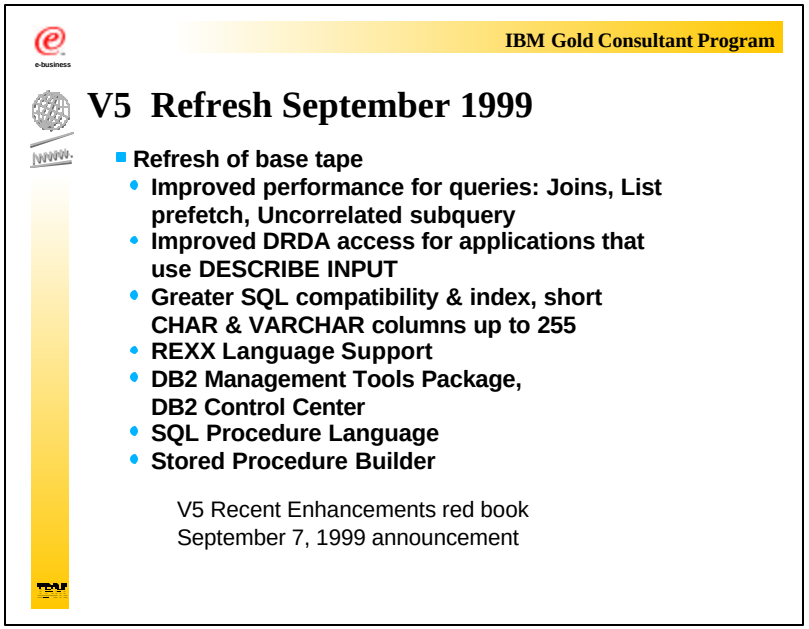




- This diagram begins in the center, with common technology developed by our Research Division and Database Technology Institute (DBTI). Our techology focus is across the key platforms and types of business, driving towaqrd consistency with standards and common values.
- Transaction processing has evolved into e-business on the Web, ERP, CRM and SCM applications.
- Query processing has been extended to include a broader set of applications, ranging from OLAP to data mining.
- Content management and portals have extended the capability to manage and use non-structured data.

- I'll start with DB2 Version 6 and the functions we delivered at general availability. There were not many surprises, so we'll move along quickly.
- We made many more improvements in DB2 Version 5 in the past half year, and rolled up the changes into a refresh that was announced September 7, 1999.
- I will include many e-pointers. I often will introduce the subject in a few minutes, while the web will cover the topic more thoroughly.





- These are some of the key highlights of DB2 Version 6, under each category. See the web, What's New? book or Release Guide for details.
- There are many improvements for the applications which use DB2. Our scalability and availability improve dramatically..
- The architectural limit for a table is now 16 terabytes, and the improvements in utilities and queries make that limit more practical. The availability improvements help with planned and unplanned outages. The visual tools are enhanced and more information is provided.
- Java with static SQL improves performance and usability, while the object-relational functions improve family consistency.

- The detail for this Refresh is the announcement you can get from www.ibm.com/ibmlink or www.ibm.com/isource
- DB2 delivered many new functions as APARs between February 1999 and June 1999 and rolled them up into the base tape. Others deliver as new features (non-priced) or on the web.
- Improved performance for SQL queries that we often seen in warehouses and in PeopleSoft: Joins with CHAR data types of unequal length, List prefetch with index screening, Uncorrelated subquery with indexable predicates
- Improved DRDA access, Control Center, REXX Language and more.

DB2 Utilities and Tools

Much stronger utilities
- Performance improved dramatically
- Availability & online function
- Usability

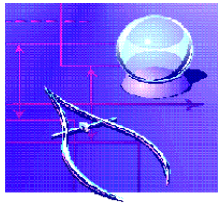
Increasing variety of tools to address
- Database management tasks
- Availability
- Performance

- With DB2 Versions 5, 6, 7 and beyond, we increased the focus on utilities and tools, for instance:
- Performance improvements in V6 utilities:
  - LOAD: Up to 6 times faster ET
  - REORG:
    - Standard Up to 2 1/2 times Elapsed Time
    - Online 2+ times reload phase ET
  - REBUILD: Up to 8 times faster ET
  - RECOVER: Up to 12 times faster ET
- These performance improvements often translate into availability. We are also making the functions less disruptive, more online & easier to use.
- We are investing in a broad range of tools to help customers address the needs of database, availability & performance management.

DB2 for OS/390 in 2000

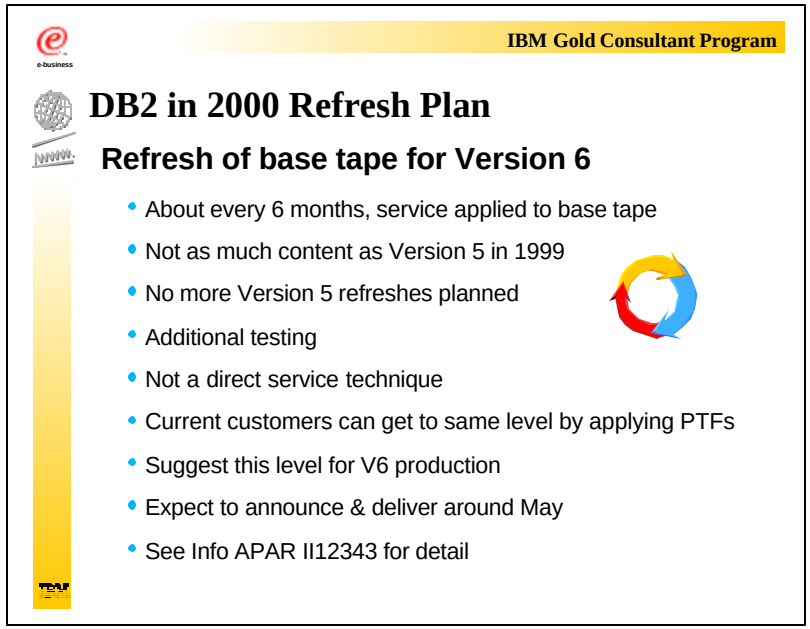
DB2 for OS/390 in 2000

- Refresh for Version 6
- Version 7

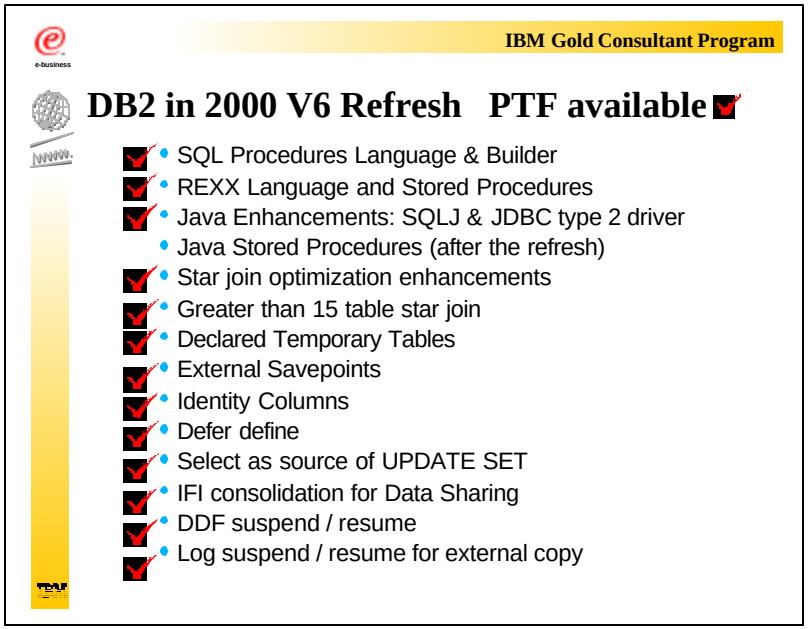


The crystal ball gets cloudier as we proceed into the future.

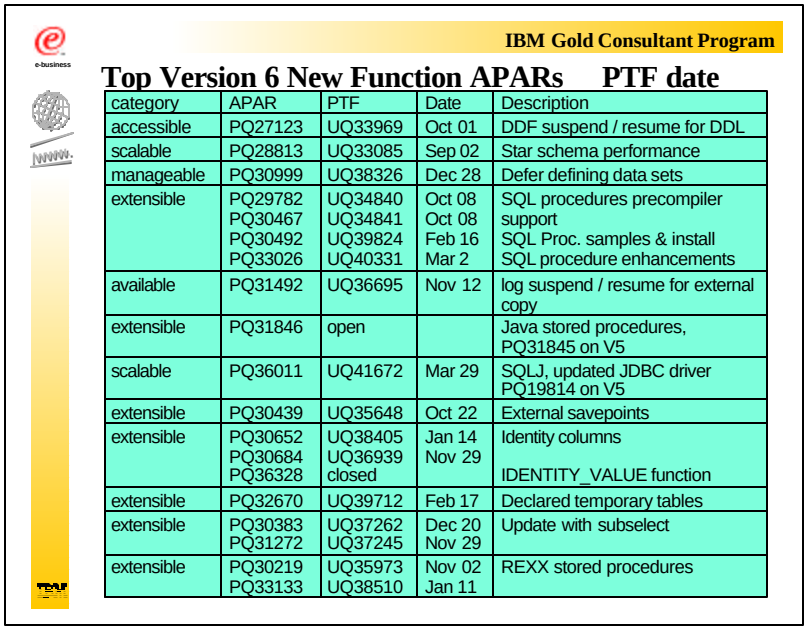
- The first section was relatively easy. We talked about what the developers consider the recent past. Predicting the past is not too difficult. Predicting the future is much more prone to error. Now we'll move into next year - beyond the Y2K crunch. First we'll talk about the delivery plan, then a refresh for Version 6, and then Version 7.



- The base tape refresh process provides a base V6 that is current. The primary help is when customers install a release for the first time. Customers who have V6 installed can put on PTFs to match this level, but the refresh is not a service technique. We do not expect to have any more V5 refreshes.
- With the significant function being delivered in the V6 service stream, we recommend that customers test, but plan for production on a DB2 maintenance level that has had the additional testing done in a refresh. We plan to deliver a refresh for DB2 V6 around the end of May. In addition to the new function, it incorporates many fixes.
- If you already have V6, then apply through ESO 0003 and the APARs identified in Info APAR II12343.

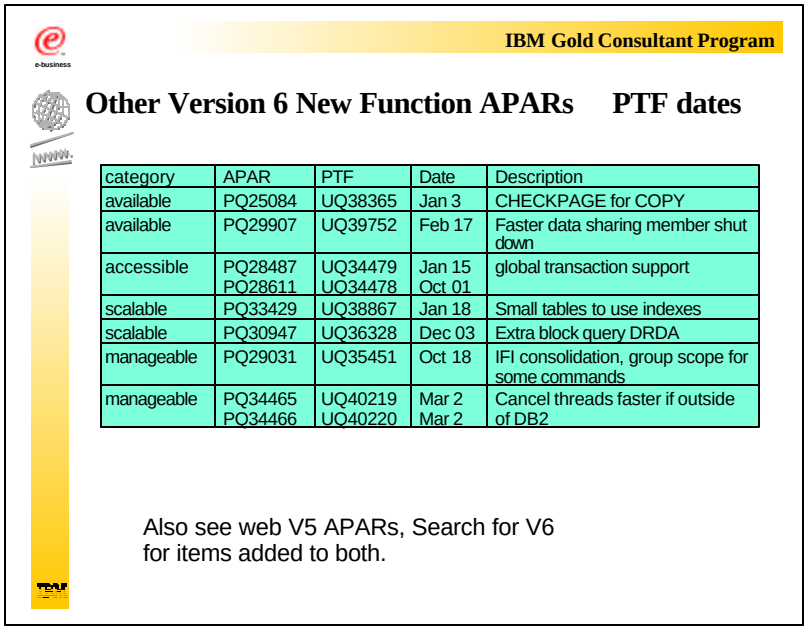


- These are the major changes that we anticipate as APARs in Version 6. Some of them were just announced in Version 5, and we need to move them to Version 6 as well (SQL procedures and REXX). SQLJ has been in beta for some time now, and the rewrite of the JDBC work along with SQLJ and Java stored procedures are moving.
- Most of these items have delivered now, so you can get the details from the APAR cover letter on the web.
- Go to www.ibm.com/software/db2os390
- Click on New functions in Version 6 under the News.
- Click on a specific APAR for the details.



category	APAR	PTF	Date	Description
accessible	PQ27123	UQ33969	Oct 01	DDF suspend / resume for DDL
scalable	PQ28813	UQ33085	Sep 02	Star schema performance
manageable	PQ30999	UQ38326	Dec 28	Defer defining data sets
extensible	PQ29782 PQ30467 PQ30492 PQ33026	UQ34840 UQ34841 UQ39824 UQ40331	Oct 08 Oct 08 Feb 16 Mar 2	SQL procedures precompiler support SQL Proc. samples & install SQL procedure enhancements
available	PQ31492	UQ36695	Nov 12	log suspend / resume for external copy
extensible	PQ31846	open		Java stored procedures, PQ31845 on V5
scalable	PQ36011	UQ41672	Mar 29	SQLJ, updated JDBC driver PQ19814 on V5
extensible	PQ30439	UQ35648	Oct 22	External savepoints
extensible	PQ30652 PQ30684 PQ36328	UQ38405 UQ36939 closed	Jan 14 Nov 29	Identity columns IDENTITY_VALUE function
extensible	PQ32670	UQ39712	Feb 17	Declared temporary tables
extensible	PQ30383 PQ31272	UQ37262 UQ37245	Dec 20 Nov 29	Update with subselect
extensible	PQ30219 PQ33133	UQ35973 UQ38510	Nov 02 Jan 11	REXX stored procedures

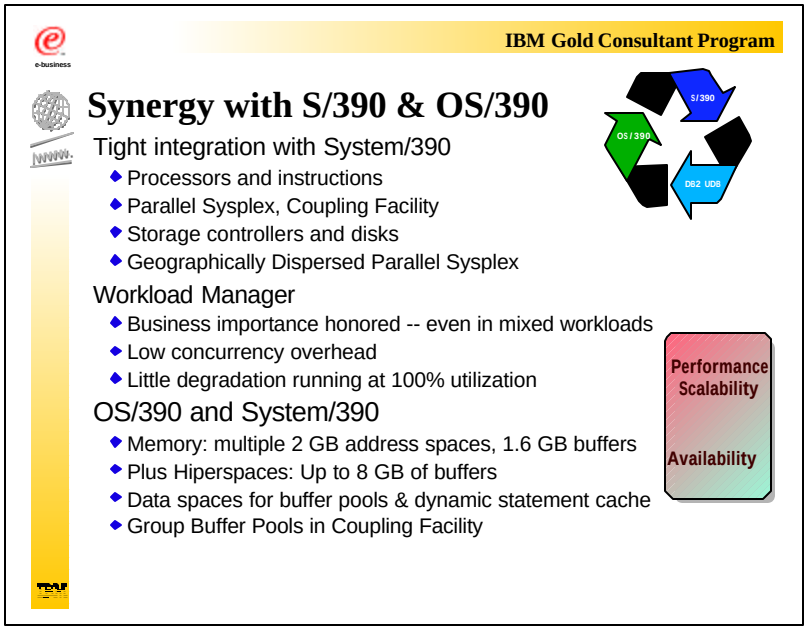
- Here are the most important new function V6 APARs to watch for, with status as of Feb 12, 2000. When the PTF is available, you can pull the APAR from the web. When the APAR is closed, the APAR cover letter has the information in it.



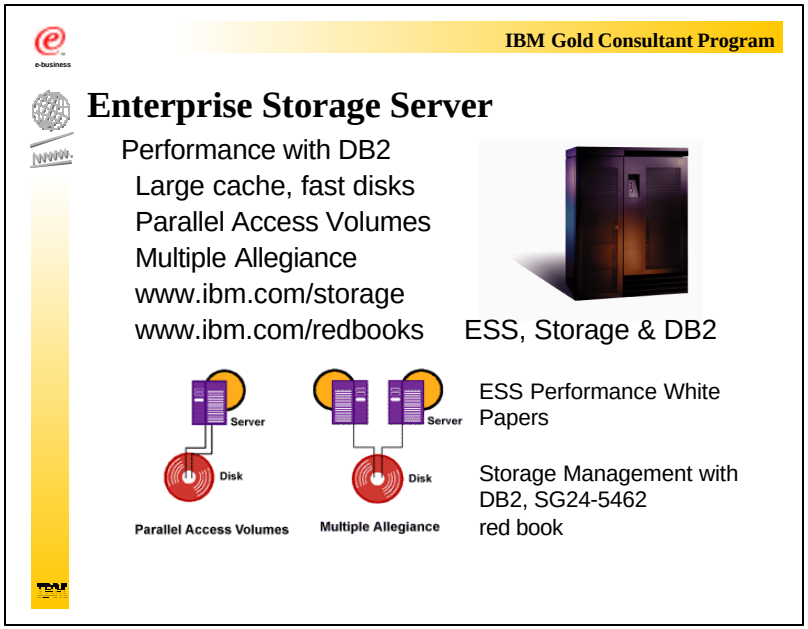
category	APAR	PTF	Date	Description
available	PQ25084	UQ38365	Jan 3	CHECKPAGE for COPY
available	PQ29907	UQ39752	Feb 17	Faster data sharing member shut down
accessible	PQ28487 PQ28611	UQ34479 UQ34478	Jan 15 Oct 01	global transaction support
scalable	PQ33429	UQ38867	Jan 18	Small tables to use indexes
scalable	PQ30947	UQ36328	Dec 03	Extra block query DRDA
manageable	PQ29031	UQ35451	Oct 18	IFI consolidation, group scope for some commands
manageable	PQ34465 PQ34466	UQ40219 UQ40220	Mar 2 Mar 2	Cancel threads faster if outside of DB2

Also see web V5 APARs, Search for V6 for items added to both.

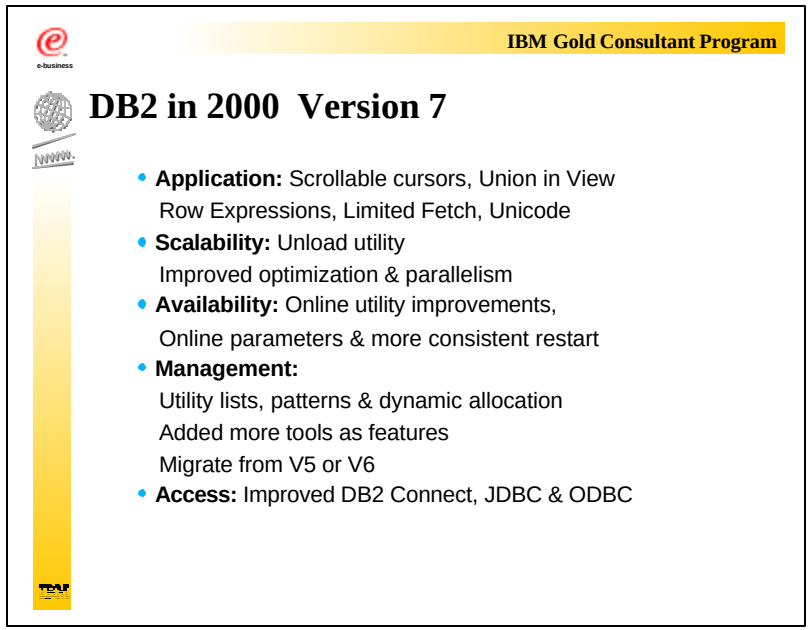
- Here are some additional APARs that are smaller or interest a smaller group.

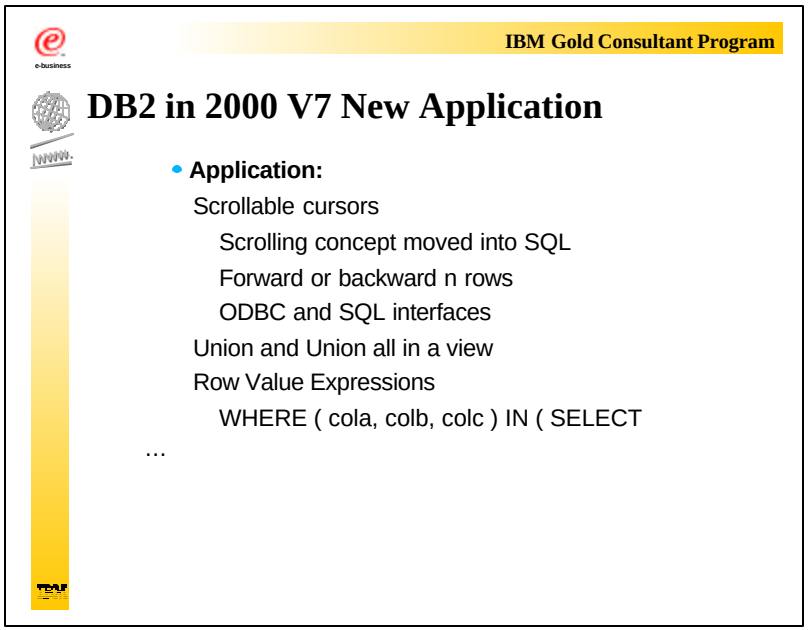


- DB2 is deeply integrated into its hardware and operating system environment. This sets the DB2 family apart from other DBMS and is especially true on S/390. Instructions were added to the machine for DB2 to use. DB2's ability to use advanced S/390 and OS/390 capabilities make DB2 the DBMS of choice to deliver the necessary performance, reliability, scalability, and high availability for today's demanding BI, e-business, OLTP and ERP applications. A key example is the WLM. DB2 work can be managed by the advanced resource management of WLM goal mode, so DB2 work can be selectivity placed into appropriate priority classes to achieve business goals. This can be achieved with minimum impact to total system performance, even when running near full capacity. See GF22-5025 for more.



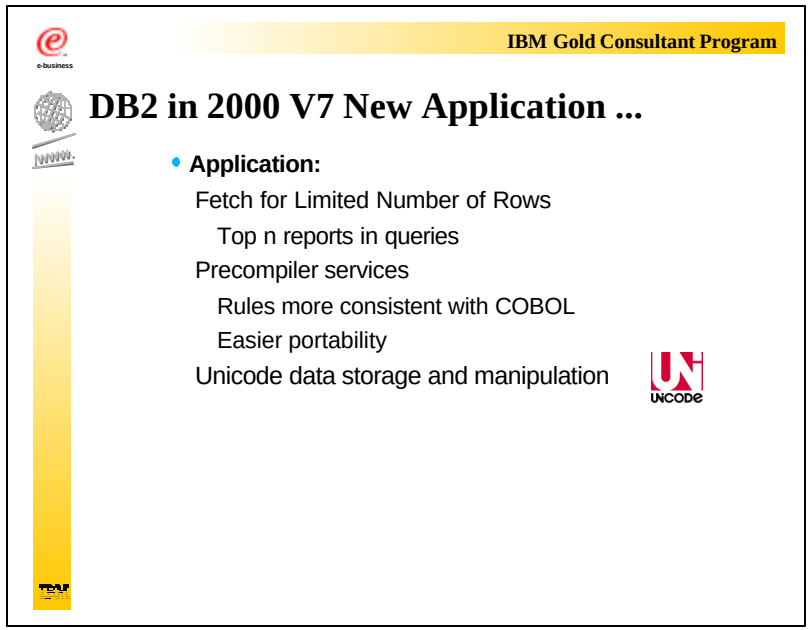
- We are delivering new disks, and the latest version is called the Enterprise Storage Server, code named Shark. The performance from the new Shark is outstanding. We have had early units in our DB2 lab for some time, and we have some results in the ESS Performance White Paper. We have a white paper about DB2 performance on the web to describe our results in more detail. See the DB2 for OS/390 home page or the red books page for the red paper.
- We just recently published a new red book about Storage Management with DB2 for OS/390 to help storage specialists and database specialists communicate better.



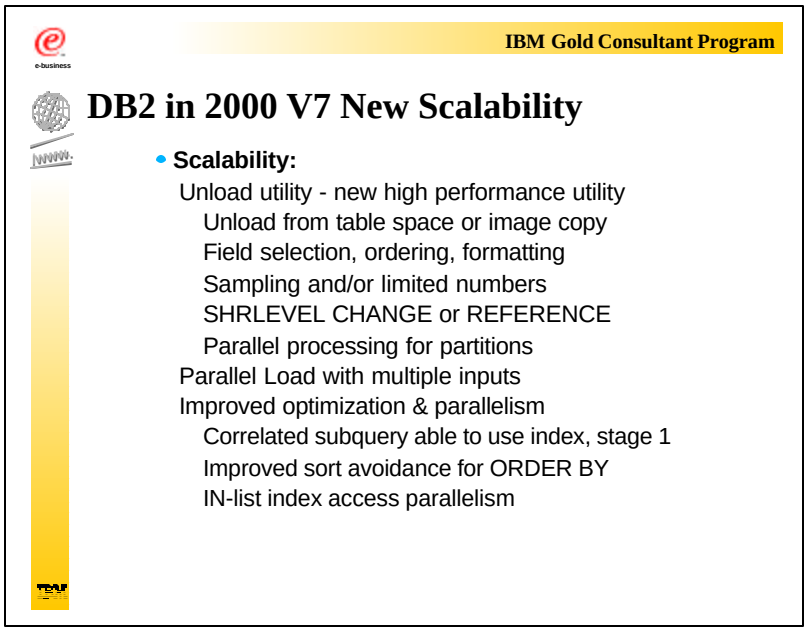


- We will be looking at these items in more depth on the next few pages. You will see themes continuing from prior releases:
  - Improving the power of SQL, DB2 family compatibility and standards
  - more performance & parallel processing for SQL and utilities
  - Continuous availability and ease of use
- The biggest business drivers for our work continue to be e-business, ERP, CRM and business intelligence.
- This Version will allow you to migrate to it from either V5 or V6. The ability to skip a release may help your work load.

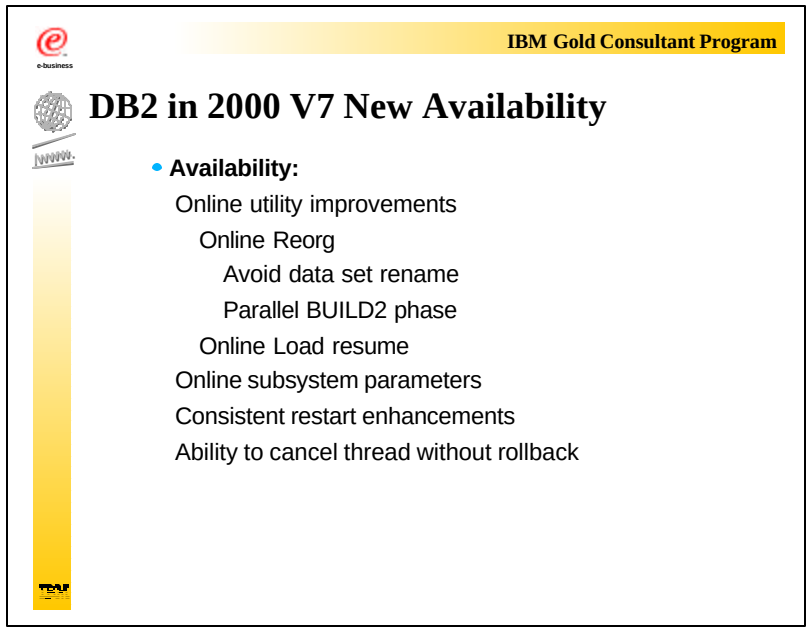
- Applications have been scrolling forward and backward in data for a very long time. The scrollable cursor will move more of the work into SQL. You can ask to move the cursor forward or backward so many rows, with absolute or relative positioning. We will have both the standard SQL and ODBC interfaces for the scrolling. We are also implementing the ability to use one index instead of two to be able to scroll forwards and backwards efficiently.
- We also expect to remove one of the longest standing needs to allow a union in a view. This will allow customers to put more in views once and less in every application cursor.

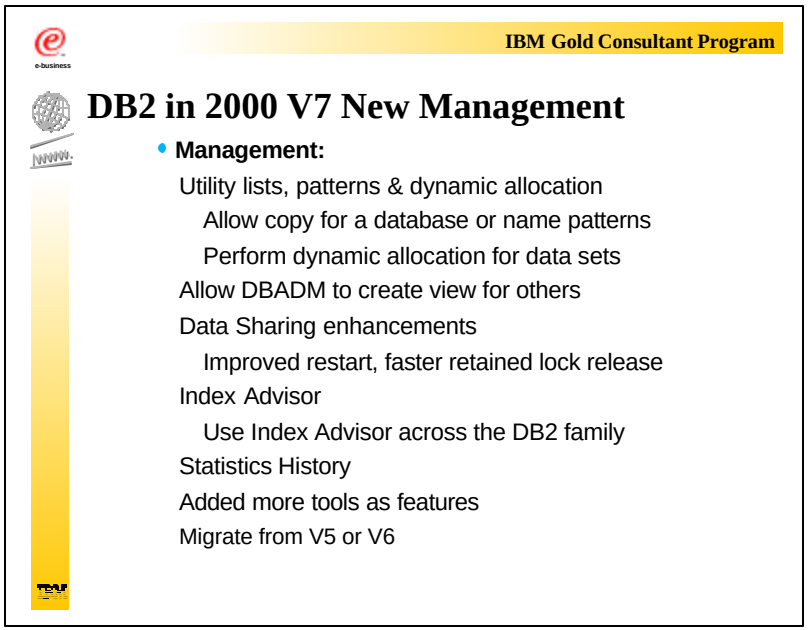


- Being able to provide a limit for the number of rows returned is helpful in queries and can improve performance.
- We are implementing precompiler services - so that we can precompile and compile in one step. The improved integration will let us support COBOL better and remove some of the restrictive rules, like nested programs, give better flexibility for declarations and generally provide better portability from other platforms.
- Unicode is an encoding scheme that is able to represent the codepoints and characters of many different geographies and languages. Our support helps cross the multinational boundaries.



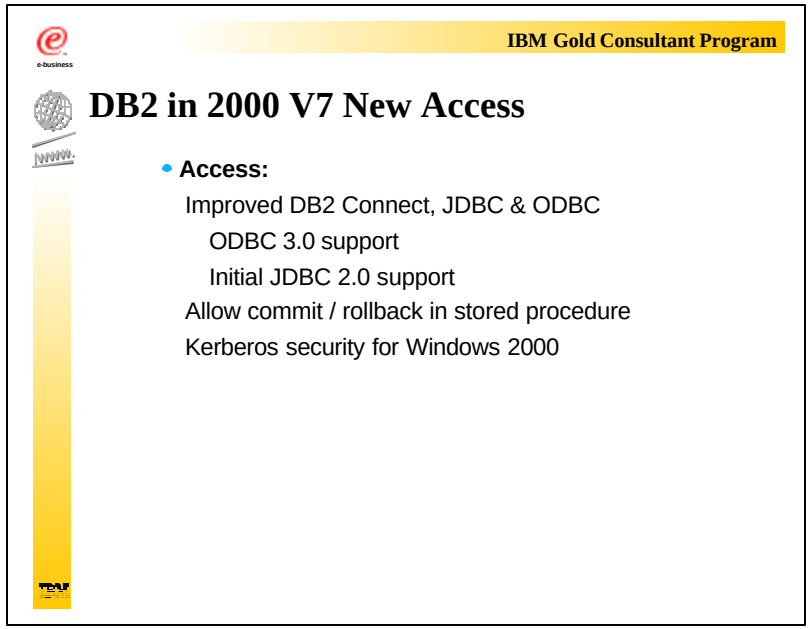
- We have had an unload sample program for a long time. We added the capability to unload data in an external format in a V5 APAR. Next we will add an unload utility with more flexibility and performance for a wider mixture of needs.
- Parallel load with multiple inputs will be able to run in a single step, rather than in different jobs.
- We made the uncorrelated subquery able to be stage 1 and use indexes in a V5 APAR. The next effort is for the correlated subquery. Both optimization improvements are very important for PeopleSoft.
- We remove one more restriction for parallel processing in an in list with index access.



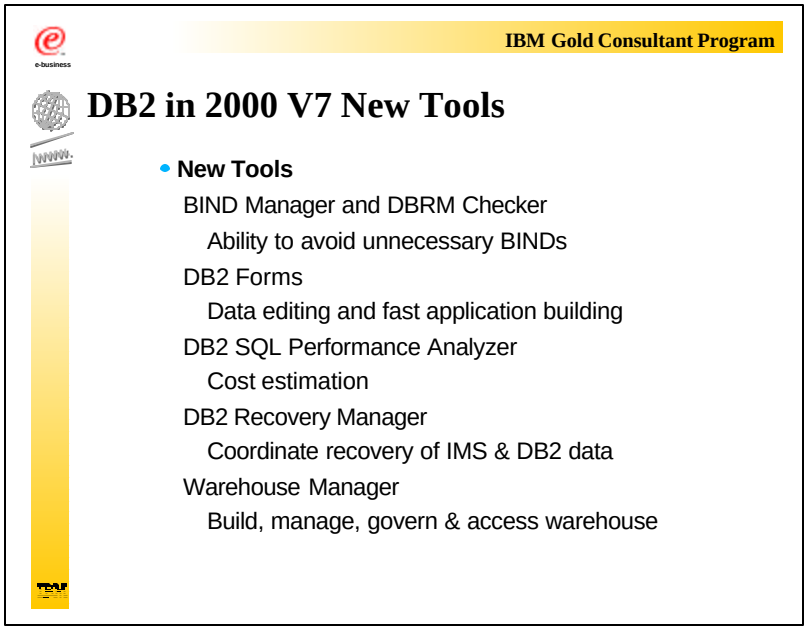


- The switch phase of online reorg renames data sets now. We will use two sets of names and record the current one in the catalog. Preliminary performance measurements showed the elapsed time improved by a factor of 10 to 15.
- Being able to use LOAD instead of INSERT and still have access to all of the partitions will allow customers more choices when the need for availability is very high.
- Customers can change many system parameters or Zparms without restarting the DB2 subsystem.
- The key improvement in consistent restart is the ability to cancel the thread and recover, instead of waiting for rollback of long jobs. Many customers want to cancel a thread without the rollback.

- Making DB2 easier to manage is another key theme, so that performance and availability are not compromised due to usability.
- You can define a list of table spaces to use multiple times, specify all table spaces in a database or use patterns for the names. You can have DB2 use dynamic allocation instead of JCL.
- We will allow a DBADM to define a view for another user, if you choose this install option.
- The faster restart work, called restart light, reduces the memory & time to free retained locks when a member fails.
- Keeping a history for statistics will help customers analyze their information to manage more effectively.

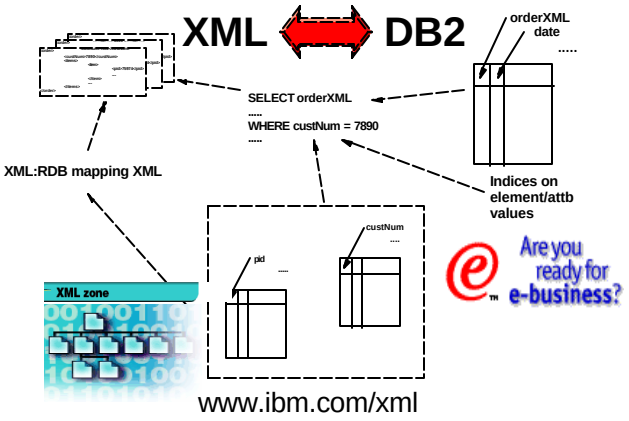


- The improvements in e-business connectivity include functional enhancements with new levels of support for both ODBC and JDBC, and the ability to commit and roll back in a stored procedure.
- Kerberos security is provided for Windows 2000 clients.



- We have also added substantially to the DB2 tool set that comes as optional features with DB2 Version 7. The overview information on these tools is provided in the What's New? book now.

Content Management: XML

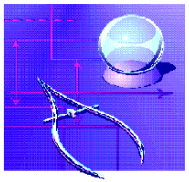


- XML has become a key enabler for e-business. DB2's XML Extender provides new data types that let you store XML documents in DB2 databases and new functions that assist you in working with these structured documents. Entire XML documents can be stored in DB2 databases as character data or stored as external files but still managed by DB2. Retrieval functions allow you to retrieve either the entire XML document or individual elements or attibutes.
- For much more on XML, see
  - www.ibm.com/developer/
  - www.ibm.com/xml
  - www.ibm.com/software/data/db2/extenders/xmlext/index.html

DB2 Future

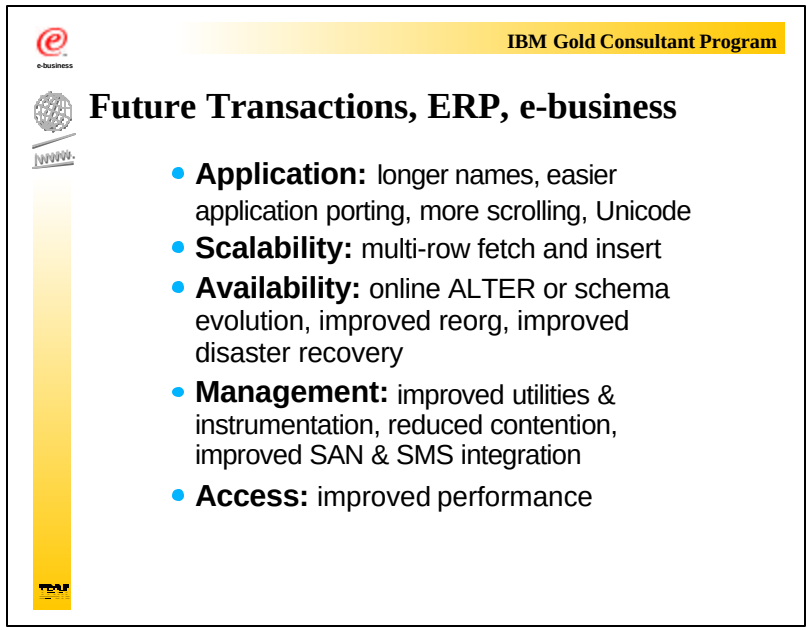
Transactions, ERP, e-business

Warehouse, Business Intelligence

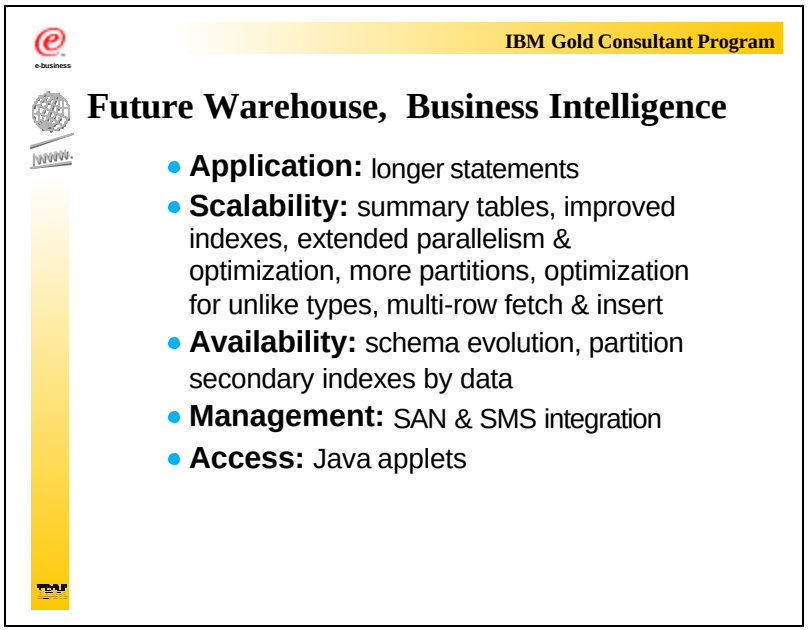


The crystal ball gets cloudier as we proceed into the future.

- This is the future beyond the year 2000. Some of the work is useful in more than one category.
- Once again, we will show the driving areas. Transactions have evolved to support much more of the major ERP vendor applications and the shift to e-business.
- Our work on queries and decision support from the early DB2 years has moved into building the large warehouses and into more and more intelligence in the engine and surrounding products.
- Note that we are moving farther into the future, so the picture is a little cloudier. There will probably be more differences in timing and deliveries.



- Standards and DB2 family consistency drive the application items. As you saw in other DB2 family members, longer names for tables, columns and longer SQL statements will help application portability. We will continue with more work on cursor scrolling and Unicode.
- Multi-row fetch & insert reduce cpu time, especially when there are many rows & columns. We will improve optimization for cases where data types do not match, including having long host variables, matching smallint, integer & decimal.
- The most important change for many customers is the ability to use ALTER in many places instead of needing to drop and redefine. We will continue to enhance online reorganization. We will be helping with the process for disaster recovery.



- The current limit of 32K bytes in a statement becomes more and more of a limit that needs to be increased.
- Summary tables are crucial to business intelligence performance.
- Allowing more partitions is important for customers who need to have a partition for each day and keep the data for years.
- Storage Area Network (SAN) and System Managed Storage (SMS) integration will be improved by allowing definition of the data class, management class and storage class in DDL.

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Red Books www.ibm.com/redbooks
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DB2 User Groups
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www.share.org
developerWorks
www.ibm.com/developer/



- Here are the primary sources for DB2 information on the web. My favorite ones have the arrows.
- You will notice the wealth of application development opportunities customers enjoy with the rapid rise of newer AD solutions such as C++, Java, and the VisualAge family.
- Another theme you will see is the interconnectivity within the DB2 Family and the use of DB2 for OS/390 as an enterprise server to multiple client opportunities.

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Information on DB2 Customers


DB2 Case Studies
www.ibm.com/software/db2os390/casestudy.html
www.ibm.com/s390/customer/success_industry.html
or start on the DB2 or S/390 home page and click on
Case Studies or Success Stories
Richard Winter Very Large Database (VLDB) Survey
www.wintercorp.com
DB2 Solutions Directory - DB2 Applications and Tools
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www.ibm.com/software/solutions
DB2 Magazine
www.db2mag.com
IDUG Solutions Journal
www.idug.org/journal/index.html

- Notes: Information on DB2 Customer Usage
- Here are websites to get information on what our customer are doing with DB2. You will see the full range of usage for production applications in the areas of OLTP, BI, e-business, ERP, and distributed processing. Many of these applications prove how viable DB2 on the mainframe is to deliver secure, reliable, scalable and highly available applications with many concurrent user with access to very large amounts of data.