SAP – SQL Server Development

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Development Manager, SAP Labs
Introduction

- Architecture
- Database performance
- High availability
- Table partitioning
- Database tuning
- The new face of DB13
- Release planning
SAP NetWeaver 2004

ONE PLATFORM – ONE PRODUCT

Open integration and application platform that enables change!

1 Platform
Synchronized release dates

1 Foundation
SAP Web AS 6.40

1 Package
Coherent installation process

1 Set of scenarios
Integrated components

All Apps
Business Suite, partner solutions and xApps developed on NetWeaver
Operating system and database abstraction

Microsoft platform group
- Windows
- SQL Server

SQL Server group
- Walldorf, Baden
- Cleveland, OH
- Redmond, WA

Responsibilities
- Development support
- Release tests and integration
- Database interface
- Database monitor and administration tools
# Architecture

- Database performance
- High availability
- Table partitioning
- Database tuning
- The new face of DB13
- Release planning
SAP Web Application Server Architecture

Client (Web Browser) → Internet → HTTP(S) Requests → SAP J2EE Engine

Internet

Message-server

Dispatcher

Task-handler

ABAP

Work process

SAP J2EE Engine

DB

DBMS related

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Architecture of the ABAP DB Interface

**RSQL**
- DBMS independent stack for Open SQL
- Access of data caches
- Implementation of array interfaces

**DSQL**
- Host variable handling
- Cursor handling

**DbSI**
- DBMS dependent DLL
- Oracle : mapping to OCI calls
- Microsoft SQL Server : OLEDB
- Mainframe DB/2 : DB2 Connect
- . . .
Stored Procedures – Past and Present

SAP kernel 4.6D and earlier

- Permanent stored procedures Y... for SQL statements with ABAP statement ID
- Temporary stored procedures ##Y... for complex statements and dynamic statements without statement ID

Kernel release 6.20 and SAP NetWeaver 2004

- Permanent stored procedures Y... for SQL statements with ABAP statement ID
- Direct execution of complex statements and dynamic statements via sp_executesql

SAP NetWeaver 2004s

- Statement prepare and direct execution for all statement types

SAP delivered stored procedures and other TSQL objects

- Performance monitor, database administration, alert monitor, ABAP Data Dictionary
Database Connections – Past and Present

DbSI

Committed Read

Singleton select & stored proc creation

“Firehose” connections

SQL Server

Committed Read

Singleton select & stored proc creation

“Firehose” connections

SQL Server 2000 using SQLOLEDB

5 – 8 SPIDs

SQL Server 2005 using SQLNCLI

2 sessions
Enterprise-scaled Persistence Layer - I

Major requirements
- Conformance to Java standards
- Transparent data access where possible
- Portable, DB independent data access
- High performance

Transparent data access
- Entity Beans with CMP
- JDO is more attractive for developers
- Support both and base implementation on common simple persistence manager

Relational data access
- JDBC
- SQLJ is more attractive for developers
  - Easier to use than JDBC, enables syntax checking and statement analysis at compile time
  - But: restricted to static SQL
- Support both
  - Open SQL for Java, DB independent
  - Table buffer and statement cache

Connection sharing between CMP, JDO, SQLJ and JDBC
Enterprise-scaled Persistence Layer - II

Meta Data Repository

Open JDBC

Direct JDBC

Vendor A JDBC

Database A

Vendor B JDBC

Database B

Open SQLJ

JDO

JDO Manager

Persistence Manager

CMP Manager

Open JDBC

Table Buffer

Statement Cache

SQL Trace

<table>
<thead>
<tr>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
</tr>
<tr>
<td><strong>Database performance</strong></td>
</tr>
<tr>
<td>High availability</td>
</tr>
<tr>
<td>Table partitioning</td>
</tr>
<tr>
<td>Database tuning</td>
</tr>
<tr>
<td>The new face of DB13</td>
</tr>
<tr>
<td>Release planning</td>
</tr>
</tbody>
</table>
Scalability of the Microsoft Platform

SAP SD Benchmark Users

### Standard SD Benchmark Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R/3 release</strong></td>
<td>4.70</td>
<td>4.70</td>
<td>4.6C</td>
</tr>
<tr>
<td><strong>Vendor</strong></td>
<td>HP</td>
<td>HP</td>
<td>Unisys</td>
</tr>
<tr>
<td><strong>Database server</strong></td>
<td>ProLiant DL580 G2 4 * 3.0 GHz 4MB L3 Cache</td>
<td>ProLiant DL760 8 * 2.87 GHz 2 MB L3 Cache</td>
<td>e-@action ES7000PD2 32 * 900 MHZ 2 MB L2 Cache</td>
</tr>
<tr>
<td><strong>Operating system</strong></td>
<td>Windows 2003</td>
<td>Windows 2003</td>
<td>Windows Datacenter</td>
</tr>
<tr>
<td><strong>Database system</strong></td>
<td>SQL Server 2000</td>
<td>SQL Server 2000</td>
<td>SQL Server 2000</td>
</tr>
<tr>
<td><strong>Certification number</strong></td>
<td>2004017</td>
<td>2003039</td>
<td>2002007</td>
</tr>
<tr>
<td><strong>Benchmark users</strong></td>
<td>8,016</td>
<td>11,200</td>
<td>26,000</td>
</tr>
</tbody>
</table>

Disk Layout

Hardware and hardware configuration

- RAID 0+1 offers better throughput than RAID 5
- At least the log file(s) should be RAID 1 or RAID 0+1
- Caching boosts performance

Separation of log files and data files

- Data access patterns are completely different
- Data and log should reside on physically separate disks
- This is also true for storage systems with hypervolumes and other complex methods of mapping Windows drives to physical spindles

Filegroups

- Similar to Oracle’s tablespaces
- We believe that the administrative overhead outweighs the potential benefit
- Not supported by SAP DDIC and database tools
Multiple datafiles

- Start with a sufficient number of files
- 3 for small SAP systems, up to 12 for large ones
- Do not add files at a later point in time

Avoid autogrowth of datafiles

- Autogrowth can help you avoid downtimes …
- … but it prevents “proportional fill” from balancing the I/O load
- You should monitor the net growth of your database and manually increase the size of all files by the same amount
High availability
High Availability Basics

- Use RAID 0+1 for all database files
- Full database backup once a day
- Log backup every 10 to 15 minutes
- Regular restore and disaster recovery tests
- Tape re-use schedule
- Regular backups of master and msdb
- Off-site storage of backup tapes
Microsoft Cluster Server

Virtual 1: Cluster administration 1.1.1.3
Virtual 2: SQL Server 1.1.1.4
Virtual 3: R/3 application server 1.1.1.5
Standby Database

Production Database

Backup Log

File Copy

Standby Database

Restore Log
Database Mirroring

- Principal database
- Mirror database
- Log records
- Witness server instance

Required only for automatic failover
High Availability Scenarios – Pros and Cons

Cluster Server
- Easy failover of SQL Server or the SAP Web Application Server to the other node
- Shared storage leads to single points of failure

Standby Database
- Redundant storage
- Log file consistency check comes for free
- Window of vulnerability between log backups

Database Mirroring
- Tight coupling between primary and secondary database

Advanced High Availability scenarios should be implemented in addition to, rather than instead of a robust backup strategy!
Database snapshots allow you to quickly reset to a “known good state” of your database.

Example: safeguard against problems during SAP support package application.

Remember to drop obsolete snapshots!
Table partitioning
CREATE TABLE
  [ database_name . [ schema_name ] . [ schema_name . ] table_name
  ( { <column_definition> | <computed_column_definition> } 
  [ <table_constraint> ] [ ,...n ] ) 
[ ON { partition_scheme_name ( partition_column_name ) ... } ]

- Range partitioning horizontally divides a table by the values of a single column

Table [table_name]

CREATE PARTITION FUNCTION
partition_function_name(input_parameter_type)
AS RANGE [ LEFT | RIGHT ] FOR VALUES ( [ boundary_value [ ,...n ] ] )

CREATE PARTITION SCHEME partition_scheme_name
AS PARTITION partition_function_name
[ ALL ] TO ( { file_group_name | [PRIMARY] } [ ,...n ] )

SAP continues to support only one filegroup (primary filegroup).
This is also true for partitioned tables.
SQL 2005 table partitioning for BW

F-fact tables will be always partitioned
- Request ID is used as partition column
- Index handling during data load becomes more efficient
- Removal of requests (usually during roll-up) becomes more efficient

E-fact tables can be partitioned
- Time dimension is used as partition column
- Easier administration
- “Query pruning”

PSA tables can be partitioned

Release support
- NetWeaver 2004s
- NetWeaver 2004
- To be decided: BW 3.0B and 3.1
### ST04: “SQL Requests” (dm_exec_query_stats)

#### SQL requests sorted by TTL_LOGICAL_READS: 50 entries

<table>
<thead>
<tr>
<th>TTL Log Rd</th>
<th>SQL Statement</th>
<th>ExecCnt</th>
<th>Total CPU</th>
<th>Last CPU</th>
<th>Min CPU</th>
<th>Max CPU</th>
<th>Til Phy Rd</th>
<th>Lst Phy Rd</th>
<th>Min I</th>
</tr>
</thead>
<tbody>
<tr>
<td>915</td>
<td>insert into #myConnections -- Connections that</td>
<td>3</td>
<td>6,757,182</td>
<td>2,255,886</td>
<td>2,249,804</td>
<td>2,255,886</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>608</td>
<td>SELECT NAME AS c,SQLX AS c,EDTX AS c,VAR</td>
<td>152</td>
<td>42,797</td>
<td>217</td>
<td>116</td>
<td>960</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>452</td>
<td>insert into #ai_indexes exec sp_executesql @</td>
<td>3</td>
<td>142,683</td>
<td>9,359</td>
<td>8,618</td>
<td>124,506</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>SELECT INST_NAME AS c,LAST_TIME AS c,LAST_D</td>
<td>60</td>
<td>47,746</td>
<td>640</td>
<td>622</td>
<td>1,171</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>228</td>
<td>SELECT JOENAME AS c,JOBCOUNT AS c,BTCSYSTEM</td>
<td>76</td>
<td>23,517</td>
<td>319</td>
<td>188</td>
<td>664</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>select name, case when 1 then 1 else</td>
<td>3</td>
<td>26,818</td>
<td>6,075</td>
<td>6,075</td>
<td>14,463</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>164</td>
<td>UPDATE BTCCTL WITH (UPDLOCK) SET BTCSYSTEM =</td>
<td>82</td>
<td>35,802</td>
<td>349</td>
<td>255</td>
<td>915</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>164</td>
<td>SELECT BTCSERVER AS c,CTLOBJ AS c,BTCSYSTEM</td>
<td>82</td>
<td>22,663</td>
<td>266</td>
<td>142</td>
<td>705</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>select @index_id = i.indid from YTS.sys.objects o,</td>
<td>15</td>
<td>9,057</td>
<td>240</td>
<td>240</td>
<td>4,533</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>select name, case when exists (select name from</td>
<td>3</td>
<td>10,424</td>
<td>1,661</td>
<td>1,661</td>
<td>6,955</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>fetch next from all_indexes into @ndname, @indid</td>
<td>15</td>
<td>3,958</td>
<td>204</td>
<td>198</td>
<td>503</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>UPDATE ALTST_OLD WITH (UPDLOCK) SET LAST_TIME</td>
<td>60</td>
<td>13,653</td>
<td>116</td>
<td>110</td>
<td>587</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>select o.name as tabname, o.name as indname, i.ind</td>
<td>3</td>
<td>9,268</td>
<td>1,550</td>
<td>1,418</td>
<td>6,301</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>SELECT TABNAME AS c, BLOCKNR AS c, FIELDS AS c,</td>
<td>24</td>
<td>3,812</td>
<td>361</td>
<td>147</td>
<td>1,250</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>SELECT ROLLNAME, AS4_LOCAL, AS4VERS, DOCNAME</td>
<td>6</td>
<td>7,244</td>
<td>714</td>
<td>714</td>
<td>2,708</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
XML showplan format

```sql
SELECT T_00.PARAMID, T_00.SPRACHE, T_00.PARTEXT
FROM TPARAT T_00,
     (SELECT C_01 = @P1 UNION
      SELECT @P2 ) T_01
WHERE T_00.PARAMID = T_01.C_01 AND T_00.SPRACHE = @P3
/* R3:SAPLSUU1:4546 T:TPARAT 40402*/
```
XML to ABAP transformation

Display Transformation MSS_SHOWPLANXML2ABAP

Transformation MSS_SHOWPLANXML2ABAP Active

Properties SourceCode

```xml
<!-- StmtCursor produces a row, increments the level and applies the templates -->
<?xml template matches="sp:StmtCursor">
    <xml:param name="level"/>
    <MSSXPLAN>
        <STMTEXT>
            <xml:value-of select="substring(@StatementText,1,2048)"/>
        </STMTEXT>
        <STMID>
            <xml:value-of select="@StatementId"/>
        </STMID>
        <NODEID>
            <xml:value-of select="@rowId"/>
        </NODEID>
        <PARENT>
            <xml:value-of select="@level"/>
        </PARENT>
        <PHYSICALOP/>
        <LOGICALOP/>
        <ARGS>
            <xml:value-of select="@StmtorgCompId"/>
        </ARGS>
        <DEFVAL> <DEFVAL>
            <ESIFUN>
                <xml:value-of select="@StatementEstRows"/>
            </ESIFUN>
        </DEFVAL>
    </MSSXPLAN>
```

Li1,Co1 Ln 462 - Ln 466 of 816 lines
### Explain plan in cache - independent of parameter values:

#### SQL Code

```
(@P1 nvarchar(40),@P2 nvarchar(40),@P3 nvarchar(40))
```

#### Explain Tree

```
<table>
<thead>
<tr>
<th>Statement Text</th>
<th>Argument</th>
<th>Est. I/O Cost</th>
<th>Logical Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Plan</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nested Loops</td>
<td>OUTER REFERENCES: Union1002</td>
<td>Inner Join</td>
<td></td>
</tr>
<tr>
<td>Merge Join</td>
<td>Union</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant Scan</td>
<td>Constant Scan</td>
<td>Constant Scan</td>
<td></td>
</tr>
<tr>
<td>Constant Scan</td>
<td>FTARAT TPARAT~0</td>
<td>0,003125000</td>
<td>Clustered Index Seek</td>
</tr>
</tbody>
</table>

#### Properties

```
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement Text</td>
<td>(@P1 nvarchar(40),@P2 nvarchar(40),@P3 nvarchar(40))</td>
</tr>
<tr>
<td>Argument</td>
<td>2</td>
</tr>
<tr>
<td>Estimated Rows</td>
<td>2,0000000000300000</td>
</tr>
<tr>
<td>Average Row Size</td>
<td>0</td>
</tr>
<tr>
<td>Total Subtree Cost</td>
<td>0,0106057000000</td>
</tr>
<tr>
<td>Operation Type</td>
<td>SELECT</td>
</tr>
<tr>
<td>Estimated Executions</td>
<td>0</td>
</tr>
</tbody>
</table>
```

```
(.SELECT T..00."PARAMID", T..00."SPRACHE", T..00."PARTEXT" FROM "TPARAT" T..00, (SELECT C..01 = @P1 UNION SELECT @P2) T..01 WHERE T..00."PARAMID" = T..01.C..01 AND T..00."SPRACHE" = @P3) R3 SAP\LSU1:4543 TTPARAT 40402
```
Volatility of SQL execution plans

Compilation of execution plans
- SQL statements are compiled “on the fly”.
- The resulting execution plan will be cached, but it is not persisted.

Dependency on WHERE parameter values
- SQL Server considers the actual values in the WHERE condition when it optimizes the execution plan.
- By default, the cached execution plan will be re-used, disregarding the parameter values in the WHERE condition.

SQL handles and plan handles
- Some “dynamic management views” in SQL 2005 expose SQL handles and plan handles.
- Plan handles can be used to retrieve the cached execution plan.

“Explain plan” in ST04 and ST05
- Whenever possible, ST04 and ST05 access the “real” plan.
- If the plan is no longer available, a new one is created.
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SAP WAS – SQL Server Support

<table>
<thead>
<tr>
<th>R/3 4.6C</th>
<th>6.20</th>
<th>NW ’04</th>
<th>NW ’04 s</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL 2000 + Windows 2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQL 2000 + Windows 2003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQL 2005 + Windows 2003</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DRAFT — Subject to change
Advantages

- Tearing down the 32-bit wall
- Hardware is downward compatible to i386
- Win64 on x64 offers excellent Win32 WoW support
- x64 is quickly becoming a mass product

Native 64-bit support

- Windows 2003 SP1
- SQL Server 2005
- Plans for SAP NetWeaver …

Issues

- At this time, no native Java VM 1.4 support
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