A TECHNICAL LOOK INSIDE ASE 15.7

ENHANCING DEVELOPER / DBA PRODUCTIVITY AND OPERATIONAL SCALABILITY WHILE REDUCING TCO

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NOVEMBER 2011
The development, release, and timing on any features and functionality described for our products remains at our sole discretion. The information on roadmaps is intended to outline our general product direction and should not be relied on in making a purchasing decision.

This presentation discusses Sybase product futures and includes Sybase proprietary and confidential information.
COMMON VISION: SAP AND SYBASE ASE

CO-INNOVATION FOR SHARED CHALLENGES

Market Reach and Mind Share

Partners/Ecosystem

Investment & Co-innovation

Expanded Market Power for Sybase ASE

Packaged Apps/SAP Business Suite

- Price/performance
- Operational Scalability
- Availability/Planned Downtime
- Developer Flexibility

Custom Apps/Most Market Verticals

Custom Apps/High End

- Extreme Performance
- Extreme Scale

- Price/performance
- Availability/Planned Downtime
- Minimal/Self Management

- Market Reach and Mind Share

- Investment & Co-innovation

- Partners/Ecosystem

- Expanded Market Power for Sybase ASE
SAP AND SYBASE ASE

• ASE is now the “Database of Choice” for SAP Applications
  – Strong alignment across R&D, sales & marketing opens up huge growth opportunity for ASE
  – Strong early interest from SAP customers looking to migrate to ASE & partners

• SAP’s focus on strong business value and low TCO aligns well with Sybase ASE focus on TCO
SAP ON SYBASE ASE 15.7

QA and Rollout plan

- Very tightly knit integration teams between SAP and Sybase
- SAP Business Suite testing & certification as part of ASE GA will enhance quality for ASE releases

Bi-monthly “alpha” drops given to SAP Dev/QA
Oct ‘10

SAP on ASE Pilot
April ‘11

SAP on ASE
Release to Customers
June ‘11

SAP on ASE GA
Q4’11

ASE 15.7
R&D

ASE 15.7
GA
Sept ’11
ASE 15.7

- All ASE 15x releases part of same release family (ASE 15x).
- ASE 15.5 & ASE 15.7 are ASE 15x IRs
- ASE 15.7 is next intermediate release on ASE 15x
  - Follows ASE 15.5
  - There is no ASE 15.6
- SMP version now GA
- CE version due Q1, 2012
ASE 15.7 FEATURE SETS

- LOB Management
- Concurrency / Isolation Controls
- Language / syntax
- Scripting language drivers
- Diagnostics & MDA enhancements

Application Development /Productivity

- Performance / Scalability
- Application Development /Productivity
- Mixed Workloads
  (Transactions & ODSS)
- Operational Scalability / Lower TCO
- Security
- Large Data Sets

- Query latency reduction
- Kernel updates
- Replication performance

- Row / LOB Compression
- In-row LOBs
- DDLs with storage optimizations

- Ease of administration updates
- PCI-DSS support

- Online Utils (Reorg rebuild)
- Fully recoverable DDLs
- Increased data availability w/ DDLs

• ASE 15.7 FEATURE SETS

8 – Company Confidential – March 20, 2012
ENHANCED LOB MANAGEMENT

- Reduced Network Traffic
- Reduced Client Side Memory

T-SQL And JDBC/ODBC API
- Flexible Handling of LOBs
- Reduced Coding Complexity

LOBS as Parameters in Stored Procs
- Flexible Handling of LOBs
- Reduced Coding Complexity

In-Row Storage
- Storage Savings
- Performance Benefits for Small LOBs
ENHANCED LOB MANAGEMENT

LOB LOCATORS

<table>
<thead>
<tr>
<th>LOB locators / LOB datatype support</th>
<th>Handle to a LOB that can be referenced in T-SQL statements and can be passed between server and clients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Client applications can send and receive locators as host variables and parameter markers</td>
</tr>
</tbody>
</table>

Locator/LOB Locator

- Reference to a LOB value in ASE memory
- Can be passed between ASE and client instead of actual LOB
- Can reduce memory requirement on client side when LOB value not needed on client side
- LOB handling supported by Open Client & Open Server, ODBC, and JDBC drivers
ENHANCED LOB MANAGEMENT

T-SQL & DRIVERS SUPPORT FOR LOCATORS

T-SQL Updates

- **truncate lob <locator> [(result-length)]**
  - Truncate to a specific length or deallocate
- **return_lob (<datatype>, <locator>)**
  - Return actual LOB value
- **setdata (<locator>, <offset>, <new_value>**
  - Overwrite some or part of LOB
- **substring(<locator>, <start>, <length>)**
  - Extract a substring from the LOB and return new locator
- Also
  - concatenate two LOBs
  - Updated functions:
    - charindex, char_length, datalength, patindex

- **jConnect JDBC Driver Support**
  - Client applications access locators using Blob, Clob and Nclob classes from the java.sql package

- **Adaptive Server ODBC Driver Support**
  - ODBC API does not directly support LOB locators
  - ODBC client must use T-SQL functions on the locators and manipulate LOB values
  - ASE ODBC driver introduces several stored procedures to facilitate the use of these T-SQL functions
ENHANCED LOB MANAGEMENT
LOBS AS STORED PROCEDURE PARAMETERS

create procedure proc_name [@parameter_name LOB_datatype] as {SQL_statement}

Before
• Couldn’t declare varchar/varbinary/univarchar data exceeding ASE page size

Now
• Declare text/image/unitext LOB for local variable
• Pass local variable as input parameter to stored procedure
• Can prepare SQL statements that include LOB parameters
• Statement cache caches SQL statements with LOBs

• jConnect and ASE ODBC Driver both updated to handle LOBs as input parameters in stored procedures
ENHANCED LOB MANAGEMENT

IN-ROW & OFF-ROW LOBS

Before

• LOBs always OFF-ROW: ASE always allocates a separate page chain for LOBs regardless of LOB size.
• Can be very wasteful especially when dealing with small LOBs; mostly empty pages
• Performance penalty

Now

• IN-ROW & OFF-ROW support
• Can maintain LOBs IN-ROW for a pre-defined LOB size with automatic transfer to OFF-ROW on expansion (due to updates of LOBs exceeding threshold size or other variable length columns expanding)
• Big benefit to applications making heavy usage of small LOBs
• Relied on heavily in SAP Business Suite’s Deployments on ASE
OPTIMIZED STORAGE

- **Compression**
  - Storage Savings
  - Reduced Memory Consumption
  - Lower I/O Demands

- **ALTER TABLE w/o Data Copy**
  - Space savings
  - Performance
  - Availability

- **Deferred Table Materialization**
  - Storage Savings
  - Ease of Enterprise App. deployment & DB Provisioning

- **In-Row Storage**
  - Storage Savings when Avg LOB size is small
  - Performance Benefits for Small LOBs
OPTIMIZED STORAGE

COMPRESSION

Data Compression
- Compression of regular relational data in ASE rows and pages

LOB Compression
- Compression of LOB data

Storage
- Reduce storage costs for online data

I/O
- Savings in I/O cost when caching compressed data

Memory
- Reduces memory consumption when caching compressed data
OPTIMIZED STORAGE

DATA COMPRESSION

Row Compression
Compress Away Empty Spaces/zeros in Fixed Length Columns. Gives benefit of varchar without the programming effort

<table>
<thead>
<tr>
<th>Database</th>
<th>Table</th>
<th>Partition</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Database Attribute for default</td>
<td>• Individual Columns can be excluded</td>
<td>• Treat active partitions differently from non-active ones.</td>
</tr>
</tbody>
</table>

Page Compression

• Page Dictionary Compression
  • Repeatedly referenced data replaced by token recorded in a page dictionary
  • Similar to techniques used in Sybase IQ
• Page Index Compression (done in ASE 11.9.x)
  • Duplicate Key Suppression – Columns with duplicated values stored once and referenced by marker in row
• Suffix Compression – Higher levels in Index only store leading portion of key required to navigate to next level down
OPTIMIZED STORAGE
LOB COMPRESSION

• Each LOB can be up to 2GB! Compression can be very handy!
• ASE backups can already be compressed
  • LOB compression will follow same compression levels and algorithm choices
• Compression Techniques
  • FastLZ and ZLib - Both are dictionary based lossless compression schemes
  • FastLZ has lower CPU usage and execution times; ZLib has higher compression ratios
• Compression scheme and level can be specified for each LOB column
  • 9 compression levels overall (2 for FASTLZ and 9 for ZLib)
• LOB datatypes supported
  • Text/Image/UniText and off-row Java Object
  • XML is NOT supported yet
• Database, Table level and Column level support
DATA COMPRESSION IN ASE – STRATEGY

- Data is compressed on-disk and in-memory buffers
- Data is compressed on insert / update and uncompressed when selected
- Compression can be defined:
  - as DB-wide property (SAP Business Suite does this)
  - Per-table, for applicable columns
  - Per-partition
- Supported for APL and DOL user and #temp tables

- Implementation Note:
  - SAP Business Suite Deployments – Compression Use Mandatory
STORAGE SAVINGS – IMPACT ON TPC-H (BLIND SWITCH TO COMPRESSION – NO TUNING)

- Scale Factor 1
- 4K ASE page
- Data loaded by BCP-in
- Reorg rebuild generated page compression
- DB Size reduced from 1215 MB to 800 MB
  - 34% compression ratio

### TPC-H Space usage

**Compression Ratio**

<table>
<thead>
<tr>
<th>Uncomp</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PgComp</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>38%</td>
</tr>
<tr>
<td></td>
<td>34%</td>
</tr>
</tbody>
</table>
STORAGE IMPROVEMENTS – SAP ERP INSTALL

<table>
<thead>
<tr>
<th></th>
<th>Vanilla</th>
<th>Compressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Space</td>
<td>509.56</td>
<td>142.32</td>
</tr>
</tbody>
</table>

3.5X saving
OPTIMIZED STORAGE

ALTER TABLE W/O DATA COPY

ALTER TABLE works on copy of data for several operations, resulting in high temporary space usage.

ALTER TABLE in ASE 15.7
- Add a non-null column
- Drop a column
- Modify column type and nullability

No Data Copy

Performance (time savings)
Data availability (potentially reduced “outage” by hours depending on table size)
Temporary space / disk requirements reduced / removed (previously full table copy made)
DIAGNOSTICS & MONITORING

Analyzing QP plans: Show cached plans in XML
- See show plan output in XML for a statement in cache
- Shows execution plan, optimizer cost estimate, params at compilation, params causing lowest query performance

Analyzing QP plans: Analyze dynamic parameters
- Can analyze dynamic parameters before running a query
- Display information about parameters in dynamic sql statements

Analyze statistics & histograms
- SQL interface to statistics and histograms
- New stored procedure sp_showoptstats (similar to optdiag standalone utility) extracts and displays in an XML document statistics and histograms for various types of data objects from system tables

Field diagnostics utility
- Collects comprehensive configuration, monitoring, OS / platform environment and external ASE files data
- Generates a .zip output file with HTML and data files that can be viewed in a browser
Customer hits an issue

• Help expedite customer case management and problem diagnosis processes
• Reduces communication cycles & time burden on both customer and Sybase CS&S

Sybase CS&S Can View Diagnostics Data in Browser

Single Command Zips up Commonly Required Diagnostics and Environment Info
APPLICATION DEVELOPMENT

Scripting Language Drivers
- Sybase supported drivers

T-SQL Updates
- MERGE/UPSERT
- Sub-SELECT syntax
- Quoted Identifier
- Wider DOL rows
- No truncation of trailing 0x0 for binary data during INSERT

Concurrency Enhancements
- SELECT FOR UPDATE
- Release read locks on cursor close for Isolation level > 1
- Procedures/DDL commands in chained transaction mode
APPLICATION DEVELOPMENT

SCRIPTING LANGUAGES

Sybase PHP
(PHP v5.3.6+)

Sybase PERL
(Perl v5.14+ & DBI 1.616+)

Sybase Ruby

Sybase Python
(Python v2.6+)

DBC API

CT-Library

Sybase Django

Post ASE 15.7 GA

Sybase 15.7 GA
## Application Development

### T-SQL Updates & Concurrency Enhancements

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| **Merging data from source to target table (MERGE/UPSERT)**            | • MERGE command allows transfer of rows from a source table (table, view, derived table) to a target table  
  • Inserts rows without matching key columns in target; if matching ones found updates the target table with values from source row | • Simplify data merge use cases  
  • Easy handling of duplicate key errors                                                                 |
| **Sub-SELECT enhancements**                                            | • Allow asterisk in sub-select with single column  
  • Allow column alias in sub-select  
  • Allow multiple column names in sub-select under EXISTS | • Programming flexibility                                                                                     |
| **Quoted Identifier support**                                          | • Will work on index names, and stored proc invocation of object names (table, view, column, index) | • Programming flexibility                                                                                     |
| **No truncation of trailing 0x0 during INSERT into VarBinary columns** | • Preserve any trailing zeroes for image / binary data                       | • Maintain integrity of binary data stored in a column                                                        |
| **SELECT FOR UPDATE locking semantics**                                | • Allows selected rows to be locked for a later update                      | • Enhanced concurrency controls & isolation semantics  
  • Reduced deadlocks                                                                                       |
| **Start offset on DOL Varlen columns increased for 16K pages**         | • DOL variable length columns can begin at a larger offset (32767 vs. previous 8192) | • Can have “wider” DOL rows in schema  
  • Configurable at cursor level                                                                            |
| **Release read cursor locks at cursor close even for isolation level > 1** | • Read locks can be released on closing of a cursor at isolation level 2 & 3 for active transaction  
  • Configurable at cursor level                                                                           | • Programming flexibility  
  • Free up resources when not required                                                                       |
| **Allow procs / DDL commands in chained transaction mode**             | • All system procedures and select DDLs can run in chained transaction mode | • Programming flexibility                                                                                     |
## PERFORMANCE

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| QP Latency Reduction            | • Several individual enhancements to reduce QP latency, especially for dynamic SQL  
• Reduce overhead to prepare for query execution (optimized code path, shared query plans across sessions via dynamic global sql cache)  
• Improved performance of query execution engine  
• Reduced communication overhead between client & ASE when sending SQL statements to ASE and when ASE sends query results to client | • Application transparent changes to reduce query response times  
• **In-house tests how 2X performance improvement on JDBC / ODBC based TPCC workload**                                                                                                                                                                      |
| K$^{21}$ – Hybrid Threaded Kernel for the 21st Century | • Better utilize parallelism in modern processor H/W (cores and H/W threads/strands)  
• Lower latency and overhead for I/O event processing                                                                                                                                                                                                                   | • Performance / scaling on modern processors  
• Lower latency for users and system tasks with greater predictability & consistency                                                                                                                                  |
HYBRID THREADED KERNEL – MOTIVATIONS

What the threaded kernel brings to the table.

- Streamline I/O handling
- Reduce “wasted” CPU cycles & improve efficiency
- Improve load balancing for CIS & Rep Agent work
- Less interference between CPU & I/O bound work
- More consistent and predictable performance
ONE ADAPTIVE SERVER, TWO KERNELES

Process Kernel
- Pre-15.7 kernel (except Windows)
- Each engine is a separate process
- Retained in 15.7 for risk mitigation

Threaded Kernel
- Default kernel for 15.7
- Each engine is a thread of a single process
- Additional threads for handling I/O, etc.
- ASE on Windows has always been thread based
A NOTE ABOUT COMPATIBILITY...

The threaded kernel can be adopted without any changes to applications, and with minimal changes to configuration settings.

The new kernel was delivered to the SAP Business Suite development team midstream. **No** changes in the application layer were made to use the new K^{21} kernel!
WHY K21 WORKS FOR CMT

• Modern operating system schedulers geared toward multi-threaded process, not multi-process parallelism

• Single address space makes core - thread context switch less expensive

• Engines lighter, more efficient as they don’t spin on i/o polling

• Elimination of i/o affinity “unclogs” ASE scheduling
# Early Performance Results of K21

## Test Scenario – Contrived BCP Test to Show Extremes

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rows per Second</th>
<th>Total Time</th>
<th>vs. K21</th>
</tr>
</thead>
<tbody>
<tr>
<td>K21 – Similar to 15.0.x best case</td>
<td>15,000</td>
<td>51 sec</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No “Network Engine” dependencies now!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0.x – average case</td>
<td>2,800</td>
<td>276 sec</td>
<td>- 5 X</td>
</tr>
<tr>
<td>• Execution &amp; Network engine affinity split</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0.x – worst case</td>
<td>25</td>
<td>~10 hours</td>
<td>- 600 X</td>
</tr>
<tr>
<td>• Execution &amp; Network engine affinity intentionally split</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Kept net engine “CPU busy” to add scheduler latency</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Test Scenario – Replication Agent Thread Throughput Performance

<table>
<thead>
<tr>
<th>Scenario</th>
<th>KB’s per Second</th>
<th>Latency (µs)</th>
<th>vs. K21</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASE 15.7 Threaded Mode</td>
<td>2,000</td>
<td>200</td>
<td>n/a</td>
</tr>
<tr>
<td>ASE 15.7 Process Mode</td>
<td>160</td>
<td>9,200</td>
<td>- 12 X</td>
</tr>
</tbody>
</table>
SECURITY

- Object Ownership Change
- Login Profiles
- Dual Key Control
- Single Sign-On
- Stronger P/W & Hidden Text Encryption
SECURITY

OBJECT OWNERSHIP CHANGE

• Person who created an object may not be the person maintaining it
  • Changing employee responsibilities
  • Employees joining and leaving
  • Mergers and acquisitions
  • Outsourced development, maintenance

• Solution: A DDL Utility to Change Object Ownership conveniently

• Allows change of ownership of object(s) from one owner / login to another

• Single command to transfer all objects owned by a login
Managing large numbers logins can be difficult

- Organizational policies change and security systems need to quickly implement changes

Login Profiles are SQL-Defined containers of login attributes and their values

- Groups of logins can share login profiles
- Easier to administer
- Provides flexibility to implement security policies and comply with regulations
## SECURITY

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split knowledge &amp; dual control of keys</td>
<td>• No one person alone can enable decryption of encryption-keys</td>
<td>• Compliance with PCI DSS (Payments Card Industry Data Security Standards Section 3.5/3.6) requirements</td>
</tr>
<tr>
<td></td>
<td>• Stronger protection of encrypted data from unauthorized access</td>
<td></td>
</tr>
<tr>
<td>Stronger password and hidden text encryption</td>
<td>• Role passwords are now hashed using one-way secure hash (SHA-256); password complexity rules enforced</td>
<td>• Enhanced password security • FIPS 140-2 standards compliance</td>
</tr>
<tr>
<td></td>
<td>• Strong encryption of external passwords and hidden text (e.g. in syscomments) (using FIPS-140-2 modules)</td>
<td></td>
</tr>
<tr>
<td>Single sign-on &amp; E-2-E Kerberos credential forwarding</td>
<td>• Automatic passing of user credentials between client, mid-tier and server layers • Single sign-on ASE to ASE connection through CIS</td>
<td>• Ease of use • Single sign-on</td>
</tr>
</tbody>
</table>
OPERATIONAL SCALABILITY

Online REORG

Fully Recoverable DDLs

ALTER TABLE w/o Data Copy

Shrink Transaction Log
# OPERATIONAL SCALABILITY

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefit</th>
<th>Post ASE 15.7 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Online reorg rebuild</strong></td>
<td>• Perform reorg-rebuild online without blocking DML operations</td>
<td>• Increased data availability and decreased data disruption to business operations</td>
<td></td>
</tr>
</tbody>
</table>
| **Fully recoverable DDLs**       | • Use DUMP TRANSACTION to fully recover SELECT INTO, ALTER TABLE commands that require data movement, REORG REBUILD  
• These commands were minimally logged before  
• Use sp_dboption to fully log these commands | • Continuous & point in time recoverability of a database (even after DDL and minimally logged operations)  
• No need for DUMP DATABASE after these operations are performed  
• Operations can readily be embedded within application logic  
• Optimized logging (page vs row logging) to minimize adverse performance effect |                  |
| **ALTER TABLE operations without data copy** | • Add a non-null column to a table without data copy; allows creation of non-materialized non-null columns; table’s physical data is not changed  
• Drop a column  
• Modify column type and nullability | • Performance (huge time savings)  
• Data availability (potentially reduced “outage” by hours depending on table size)  
• Temporary space / disk requirements reduced / removed (previously full table copy made) |                  |
SHRINKING THE TRANSACTION LOG

• New syntax:

```sql
alter database db-name
log off db_device [= size ]
[ , db_device [ = size ] ]
```

– Moves the log off the specified DB device
– Without size, removes it off the entire DB device
– With a size, removes that size, starting at the end of that device

• Only possible to move the log off a DB device if that part of the log is currently empty (i.e. no allocated extents)
  – Best practice should be add/remove whole devices at a time so keep the first N devices sized accurately for normal operation
## PLATFORM AVAILABILITY

<table>
<thead>
<tr>
<th>Platform</th>
<th>ASE 15.5</th>
<th>ASE 15.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP-UX Itanium 64-bit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>IBM AIX 64-bit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Linux Power 64-bit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Linux x86-64</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Solaris SPARC 64-bit</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Solaris x86-64</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Windows x86-64</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Windows x86</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>HP-UX PA-RISC 64-bit</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Linux x86</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Solaris SPARC 32-bit</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
SUMMARY

• SAP Business Suite available on ASE Q4 2011
  – Huge opportunities for ASE growth
  – SAP and Sybase teams strongly aligned
  – SAP / ASE focus on TCO benefits custom applications and install base

• ASE 15.7 for Sybase customers now GA!
  – Continuation of ASE 15x and follow-on release to ASE 15.5
  – Major areas of focus
    ▪ Storage optimization & data and LOB compression
    ▪ Application development & application performance
    ▪ Operational scalability & TCO
  – Early and extra QA testing, especially with new kernel and compression, from SAP will pay dividends to Sybase customers