

ISUG-TECH 2015 Conference

ASE tempdb performance & tuning
Joe Woodhouse

Agenda

- ❖ **Welcome**
- ❖ **Speaker Introduction**
- ❖ **ASE tempdb performance & tuning**
- ❖ **Q&A**

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Agenda

Tempdb Overview

SAP Sybase ASE server-wide tuning that affects tempdb

Tempdb-specific tuning

Factors external to ASE

Tempdb SQL and per-object tuning measures

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Tempdb Overview

- Structure & approach of this session.
- Overview of tempdb.
- Motivation for tuning tempdb specifically.

SAP Sybase ASE server-wide tuning that affects tempdb

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Structure and Approach of this Session

- Most DBAs easily can think of a half-dozen or more ideas for tuning tempdb
 - But we don't usually think of the **same** ideas
- This presentation collects **all** tempdb tuning ideas (currently 64!)
 - From the literature (manuals, white papers, release notes)
 - From “the wild”
 - From attendees of previous versions of this presentation
- Some ideas presented here are obvious
 - Some are very obscure
 - Prizes are available if you think of a tempdb tuning idea I missed!
 - (Note prizes were handed out at three previous conferences for suggestions.)

Overview of Tempdb

- A tempdb database (at least one) exists in every SAP Sybase ASE
- Multiple tempdb databases are possible since SAP Sybase ASE 12.5.0.3
- Commonly used for temporary tables
 - Create table #temptable ...
 - Create table tempdb..temptable ...
 - Select ... group by ...
- Also used for other temporary objects

Motivation for Tuning Tempdb Specifically

- Not unusual to see tempdb be the busiest database
 - Sometimes busier than all other databases combined
 - Check the I/Os per database; you might be surprised
- Tempdb is usually smaller than largest user database(s)
 - Suggests opportunity for good “bang-for-the-buck” cost-benefits

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Tempdb Overview

SAP Sybase ASE server-wide tuning that affects tempdb

- 28 ideas for tuning tempdb performance.

Tempdb-specific tuning

Factors external to ASE

Tempdb SQL and per-object tuning measures

28 Ideas: ASE server-wide

- (#1) ASE version: Upgrade to at least ASE 12.5.0.3
 - Multiple tempdb databases (more on this later)
- (#2, #3, #4) ASE version: Upgrade to at least ASE 12.5.1
 - Derived tables vs. temp tables (more on this later)
 - Enhancements to select into
 - Lazy I/O in tempdb

28 Ideas: ASE server-wide

- (#5) ASE version: Upgrade to at least ASE 15
 - Directio (Not on ZFS until SAP Sybase ASE 15.0.3 ESD #2+)
- (#6, #7, #8) ASE version: Upgrade to at least ASE 15.0.2
 - Row-level locked system tables
 - Tempdb-specific ULC
 - Asynchronous page splits
- (#9) ASE version: Upgrade to at least ASE 15.0.3
 - Deferred compilation (more on this later)

28 Ideas: ASE server-wide

- (#10) ASE version: Upgrade to at least ASE 15.0.3 ESD #1
 - ASE optimizer level
 - 71 documented options that affect optimizer behaviour as of SAP Sybase ASE 15.7 ESD #1
 - Most were introduced after ASE 15.0.3 ESD #1 and are *disabled by default!*
 - Allows you to disable ones you don't trust or haven't tested
 - But you miss out on many important tempdb-related ones
 - Better to use "ase_current" than "ase_default"
 - Can disable specific ones if required

28 Ideas: ASE server-wide

- (#11, #12, #13) ASE version: Upgrade to at least ASE 15.5
 - Relaxed durability tempdb databases
 - Minimal logging in tempdb
 - In-memory tempdb (more on all these later)
- (#14, #15) ASE version: Upgrade to at least ASE 15.5 ESD #3
 - Deferred parallel optimization...parallel query often reduced by run-time adjustments
 - Relevant to many worktables (e.g., REFORMATTING)

28 Ideas: ASE server-wide

- (#16, #17, #18) ASE version: Upgrade to at least ASE 15.7
 - Row and page compression in tempdb; fewer I/Os for CPU trade-off?
 - Note: premium and separately licensed option
 - MERGE command!
 - Used properly, could remove need entirely for many temp tables
 - Text parameters to stored procedures!
 - Likewise, could replace many current temp tables

28 Ideas: ASE server-wide

- (#19, #20) ASE version: Upgrade to at least ASE 15.7 ESD #2
 - Precompiled result sets, CREATE/ALTER/REFRESH
 - Likewise, could replace many current temp tables
 - Hash-based update statistics
 - No sorting required on disk, only in memory
 - Sorting on disk = tempdb
 - Much less tempdb space required for this version of update stats

28 Ideas: ASE server-wide

- (#21, #22, #23) ASE version: Upgrade to at least ASE 15.7 SP100
 - In all previous versions, using IMDB tempdb performed sorting in IMDB
 - As of SP100, update stats always uses default data cache
 - sp_configure “max util parallel degree”
 - Controls parallelism for update statistics and create index
 - Can use to hit tempdb harder... or to be kind to it
 - sp_configure “optimize temp table resolution”
 - When disabled, procs that reference temp tables created elsewhere recompile with every execution
 - Disabled by default!
 - In previous versions use boot-time traceflag –T299

28 Ideas: ASE server-wide

- (#24) sp_configure “number of sort buffers”
 - Query-based sorting usually done in tempdb
 - Stolen from procedure cache
- (#25) sp_configure “maximum buffers per lava operator” (SAP Sybase ASE 15.0+)
 - Helps sorts and hashes
 - Stolen from data cache
- (#26) sp_configure “user log cache size” (if SAP Sybase ASE pre-15.0)
 - Even with lazy I/O, tempdb log is very busy
 - ULC helps log performance
 - Affects all databases server-wide
 - If SAP Sybase ASE 15.0+, use another parameter instead for tempdb (discussed later)

28 Ideas: ASE server-wide

- (#27) Resource governor
 - Limiting tempdb use is not a tuning measure specifically, but it may help prioritize and allocate limited resources for performance
 - May make things worse overall!
- (#28) Metadata cache
 - Make sure “open objects” and “open indexes” are large enough
 - If SAP Sybase ASE 15.0+, also “open partitions”
 - Using “sp_countmetadata” will tell you
 - Slightly oversize beyond what it reports

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- 17 ideas for tuning tempdb performance.

Factors external to ASE

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17 Ideas: tempdb-specific

- (#29) Nail tempdb into memory: tmpfs
 - Build tempdb devices on tmpfs (platform-specific)
 - Tmpfs is *not* true RAMdisk!
 - Not preferred:
 - Double buffering (O/S and SAP Sybase ASE memory)
 - tmpfs is just a swap on some platforms
 - Creating devices in /tmp is not the same!
 - If swap space is low, your tempdb device(s) may be eaten!
 - Still looks like physical I/Os to SAP Sybase ASE...implications for context switch

17 Ideas: tempdb-specific

- (#30) Nail tempdb into memory: true RAMdisk
 - Build tempdb devices on ramfs (platform-specific)
 - Still not preferred:
 - Double buffering (O/S and SAP Sybase ASE memory)
 - Avoids problems with swap scavenging, but...
 - Still looks like physical I/Os to SAP Sybase ASE...implications for context switch
- (#31) Nail tempdb into memory: SAP Sybase ASE named cache
 - Can work very well; can go very wrong
 - Best when there is plenty of memory
 - Note: don't have to size cache to fit all of tempdb
 - SAP Sybase ASE kernel knows whether there is any genuine physical I/O now
 - Test carefully, monitor with "sp_sysmon" and/or MDA

17 Ideas: tempdb-specific

- (#32) Nail *some* of tempdb into memory: syslogs named cache
 - Log caches can be very good for performance...most motivations for log caches apply to tempdb, too
 - “But you can’t bind individual system tables in tempdb!”
 - Bind model..syslogs to “tempdb_log_cache”
 - Will rebind tempdb..syslogs with every SAP Sybase ASE restart
 - Will also bind syslogs in every new database from now on!
- (#33, #34) Reduce tempdb named cache contention and overhead
 - SAP Sybase ASE cache partitioning useful for tempdb cache (SAP Sybase ASE 12.5+)
 - Can also disable housekeeper per cache (SAP Sybase ASE 15+)
 - Best if tempdb fits entirely in case, as checkpoints will be slower otherwise
 - Edit SAP Sybase ASE <server>.CFG file
 - Set cache status to “HK ignore cache”

17 Ideas: tempdb-specific

- (*) Nail tempdb into memory: IMDB (SAP Sybase ASE 15.5+)
 - Not the same as tempdb fitted entirely into named cache
 - No MRU-LRU chain! No wash area! No multiple buffer pools! No asynchronous prefetch!
 - Log overhead greatly reduced...if a transaction fits in ULC, it effectively doesn't write to log
 - Premium option, separately licensed
- (*) Can't fit tempdb in memory? Relaxed durability! (SAP Sybase ASE 15.5+)
 - Stored on regular devices in the regular way
 - Log overhead greatly reduced...if a transaction fits in ULC, it effectively doesn't write to log
 - Cannot be done for built-in tempdb, only for additionally created tempdb databases (needs IMDB option)

(*) *already counted*

17 Ideas: tempdb-specific

- (#35) Tempdb segments: remove all segments from master device
 - Do not remove the *fragment*! Maintain a row in sysusages on master device, but with segmap = “0”
 - Tempdb devices and disks more likely to be set up for performance; master not so much
 - If using file system devices, master device will have dsync = “true” and you cannot change this
- (#36) Tempdb segments: logically separate data and log
 - Critical SAP Sybase ASE pre-11.9.2 as no ULC in tempdb otherwise
 - Even SAP Sybase ASE post-11.9.2, still improves I/O streaming
 - Better results from data caching if data pages not interleaved with log pages
 - Note this is *logical* separation; can still be on same *physical* device(s) and disk(s)

17 Ideas: tempdb-specific

- (#37) Tempdb segments: physically separate data and log
 - Tempdb log will do mostly writes
 - Tempdb data will do both, but probably more reads
 - Separate devices allow h/w and O/S optimizations for each
 - If using a platform where f/s reads are synchronous, put tempdb data on raw and tempdb log on file (dsync and directio both false)
- (#38) Multiple tempdb devices for data segments
 - User-created temporary objects placed in *default* segment
 - System-created worktables placed in *system* segment
 - For both, some internal parallelism decisions are made based on the number of devices
 - You may have 20 spindles in RAID 10, but if SAP Sybase ASE only sees one tempdb device, some parallelism is disabled
 - Only some of this can be overridden

17 Ideas: tempdb-specific

- (*) Multiple tempdb databases (ASE 12.5.0.3+)
 - Multiple tempdb system tables (useful even with ASE 15.0.2+)
 - Multiple tempdb logs!
 - Separate users and applications into specifically optimized tempdbs
 - OLTP vs. reporting vs. batch?
 - Reserve one for DBAs?
 - Very useful with IMDB tempdbs
 - User-defined tempdb *groups* now possible in ASE 15.5

(*) *already counted*

17 Ideas: tempdb-specific

- (#39) sp_configure “session tempdb log cache size” (ASE 15+)
 - ULC just for tempdb
 - Can set very large without implications for user databases
- (#40) Tempdb device attributes
 - dsync = “false” (always!)
 - directio = “false” (probably – test and time this)
- (#41) Tempdb logging: delayed commit db option (ASE 15+)
 - Return when log write starts, don’t wait until it completes

17 Ideas: tempdb-specific

- (#42) Tempdb logging: enable minimal logging (SAP Sybase ASE 15.5+)
 - Try to avoid flushing log records to transaction log
 - Needs IMDB or Rddb
- (#43) Tempdb logging: sp_logiosize
 - Set to size of 8 SAP Sybase ASE pages
- (#44) dbcc tune (deviochar, [...])
 - If special h/w has been used for tempdb (i.e., SSD), effectively increases I/O batch size for that device
- (#45) CIS proxy tables: relocated joins (SAP Sybase ASE 15.0.2+)
 - CIS proxy tables to another SAP Sybase ASE
 - If both are SAP Sybase ASE version 15.0.2+, significantly fewer tempdb I/Os
 - Set with “sp_serveroption”

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- 6 ideas for tuning tempdb performance

Tempdb SQL and per-object tuning measures

6 Ideas: External to ASE

- (#46) Disk hardware type and speed
 - RAMdisk > tmpfs > SSD > “tier one” storage (even if not otherwise a tier-one app)
- (#47) Disk location
 - Co-location; separate LUNs
 - Consider local disk for tempdb rather than SAN
- (#48) Disk partition type: file system vs. raw partition
 - Raw partition vs. file system
 - Synchronous vs. asynchronous reads
 - Raw partition on ZFS only supported in SAP Sybase ASE 15.0.3 ESD #2+

6 Ideas: External to ASE

- (#49) O/S tuning for I/O on tempdb LUNs
 - Very platform-dependent
 - Talk to your sysadmins
 - Examples: I/O fencing; SAN controller cache; file system mount options; O/S polling for completed I/Os
- (#50) Disable SAN replication and snapshots for tempdb disks
 - No recoverability requirement for tempdb
 - Note: there is an *availability* requirement!
- (#51) Appropriate RAID for tempdb disks
 - RAID 10 > RAID 0+1 > RAID 5 > RAID 0 > RAID 1 > JBOD

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•13 ideas for tuning tempdb performance

13 Ideas: SQL and object-specific

- (#52) Work less: set-based SQL
 - Avoid row-based logic (cursors, WHILE loops)
- (#53) Work less: temp table rows and columns
 - Only write rows into tempdb if you will use them more than once
 - May be an argument for avoiding locking in base tables
 - Only write columns into tempdb if you will use them at all
- (#54) Work less: truncate temp tables before drop
 - There is an implicit drop temp table at the end of its session context (connection or procedure)
 - Good practice – explicitly truncate tables before they are dropped
 - SAP Sybase ASE does this for you in all modern versions, but arguably good practice regardless

13 Ideas: SQL and object-specific

- (#55) Work less: multiple inserts to same temp table
 - Worst: create table, insert [...] select, insert [...] select
 - Still bad: select into, insert [...] select
 - Better: select into [...] union select
- (#56) Work less: use select into, not create table
 - Myth 1: “select into holds locks on system tables” BUSTED!
 - Myth 2: “needed so procedures know about #tables” BUSTED!
- (#57) Work less: derived tables (SAP Sybase ASE 12.5.1+)
 - If using temp rows only once, why use temp table at all?
 - Consider a view or derived tables

13 Ideas: SQL and object-specific

- (#58) Work smarter: create indexes on temp tables
 - Obvious but often overlooked
 - All normal rules and tuning measures apply
 - “But SAP Sybase ASE won’t know about these indexes!”
 - Hold that thought...
- (#59) “But the optimiser doesn’t know...”
 - Workaround 1: create proc...with recompile
 - Workaround 2: exec proc...with recompile
 - Workaround 3: update (index) statistics #temptable
 - Workaround 4: create in parent proc, call in sub-proc
 - Workaround 5: delayed compilation (SAP Sybase ASE 15.0.3+)

13 Ideas: SQL and object-specific

- (#60) Global shareable temp tables
 - Uses spid as leading column in PK, locked datarows
 - Users only see rows where spid = “@ @spid”
 - Enforced in SQL or FGAC logic
- (#61) Temp table isolation levels
 - Not needed for #tables!
 - For any shareable temp tables, use the least restrictive isolation level required by business rules
 - Don't forget “readpast” locking – perfect for queues!

13 Ideas: SQL and object-specific

- (#62) Temp table locking schemes
 - Also relevant only for shareable temp tables
- (#63) Temp table partitions (SAP Sybase ASE 15.0+)
 - select [...] into [...] partition [...]
 - May still be useful for private #temp tables – parallel query
- (#64) Set exp_row_size on DOL temp tables
 - Can make significant difference to size and hence I/Os!
- (*) Compressed temp tables (SAP ASE 15.5+)
 - Permanent shareable tables only, not #temp tables
 - Requires separate (paid) license
 - Fewer I/Os (maybe more CPU use)

(*) *already counted*

Questions and Answers

Thank You for Attending

Please complete your session feedback form