TempDB: Performance and Manageability
Who am I?

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It depends?

- How many data files?
- Should I separate the log and data files?
- What RAID level?
- What about RAM drives or SSDs?
- Is there such a thing as too many data files?
What is tempDB?

• Well organized junk drawer of SQL Server
  – Temporary objects
  – Internal objects (work tables)
  – Version store
    • Snapshot isolation
    • Read committed snapshot isolation
    • Online index operations
    • MARS
    • After Triggers
  – Trigger virtual tables
How many data files? 1:1?

• Official Microsoft recommendation still 1:1
  – Tested by PSS/SQL team on SQL 2008 R2 on SQL Server with > 64 logical CPUs
  – Actual need: 1 per concurrent process using tempDB

• Is this a realistic recommendation?
How many data files, really?

- Systems that need 1:1 data files are few
- Evidence indicates that performance does degrade somewhat with more files
  - Average I/O block size decreased
  - Data access patterns appear random
- Most SQL Servers may not need more than 1:4 or 1:2 data files per logical CPUs
  - This is only a starting point
Start with 1:4 or 1:2 data files?

• It depends!
• What is your comfort level with dealing with tempDB contention?
• Can you recognize it?
• Do you know how to fix it?
• Are you actively monitoring for it?
• If it occurs, are you okay with the time it would take to respond to and fix it?
What is tempDB contention?

• Latch contention on allocation pages
  – PFS: Page Free Space
    • Page 1 and every 8088 pages
  – GAM: Global Allocation Map
    • Page 2 and every 511,232 pages
  – SGAM : Shared Global Allocation Map
    • Page 3 and every 511,232 pages
  – PAGEIOLATCH_xx waits
  – PAGELATCH_xx waits
Monitoring tempDB Contention

• Use DMV `sys.dm_os_waiting_tasks`
• Parse `resource_description` column
  – `<database ID>:<file ID>:<page number>`
  – Database ID = 2 for tempDB
  – File ID = ID of a data file
  – Page number = do the math
    • GAM: `(Page ID – 2) \% 511232`
    • SGAM: `(Page ID – 3) \% 511232`
    • PFS: `(Page ID – 1) \% 8088`
Monitoring tempDB Contention

- http://www.sqlsoldier.com/wp/sqlserver/breakingdowntempdbcontention

```sql
Select session_id,
    wait_type,
    wait_duration_ms,
    blocking_session_id,
    resource_description,
    ResourceType = Case
        When Cast(Right(resource_description, Len(resource_description)) As Int) - 1 % 8088 = 0 Then 'Is PFS Page'
        When Cast(Right(resource_description, Len(resource_description)) - 2 % 511232 = 0 Then 'Is GAM Page'
        When Cast(Right(resource_description, Len(resource_description)) As Int) - 3 % 511232 = 0 Then 'Is SGAM Page'
    Else 'Is Not PFS, GAM, or SGAM page'
    End
From sys.dm_os_waiting_tasks
Where wait_type Like 'PAGE%LATCH_%'
And resource_description Like '2:%';
```
Configuring tempDB files

• 1 log file only
• All files pre-sized to avoid data growth
• All data files the same size
  – Required for round-robin usage
• Set auto-growth on log file to hard value, not percentage
Configuring tempDB files

• Recommended (optional):
  – Set log file to double the size of a single data file
  – Disable auto-growth on the data files
Large files & tempDB startup

- Make sure instant file initialization is enabled
- TempDB reuses the existing files
  - Does not zero initialize the log file if it already exists
Large files & tempDB startup

DEMO
RAID Levels & RAM

• Disk subsystem can affect performance
• TempDB tries to maintain as much as it can in memory
• Try to avoid DDL on temporary tables after they are created
• Large sorts or hashes can spill over from memory into tempDB
• Watch for IO_COMPLETION and PAGEIOLATCH_xx waits
RAID Levels & RAM

• On a well-tuned system, RAM more important to me than RAID level
  – Statistics are important!

• If queries spill to tempDB, you will notice the difference in disk performance

• RAID 1 or RAID 10 (RAID 1,0)

• Look at the whole disk subsystem, not just RAID level
Where are my tempDB objects?

RAM disk & SSDs

• Yes, the fastest disk subsystems (to date)
• Will you need that level of disk performance?
• RAM disk – You will have to recreate the tempDB files are startup
• A large log file will delay tempDB startup
TempDB on FusionIO

- WP: Performance Evaluation of Hosting TempDB on FusionIO
  - http://www.sqlsoldier.com/wp/sqlserver/performanceevaluationofhostingtempdbonfusionio
- Saw great increases in performance metrics
- Saw minimal increase in actual throughput
Final thoughts!

• Configuration is key
  – Data files 1:1 vs 1:2 or 1:4
  – Data files all the same size and settings
• Monitor for tempDB contention
• RAM and disk subsystem
• RAM Disk & SSDs
Thanks!

- Thanks for joining!
- Thanks to Idera and MSSQLTips for sponsoring!
- Session files will be available at http://www.sqlsoldier.com/tempdb

- My blog: www.sqlsoldier.com
- Twitter: twitter.com/SQLSoldier