Performance Monitoring
AlwaysOn Availability
Groups

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Overview

• Motivation
• How availability groups move data
• Impact of replication latency on availability
• Monitoring techniques
• Demo
• Dealing with replication latency
Why is this important?

- Recovery Objectives
  - Recovery Point Objective - RPO
  - Recovery Time Objective - RTO
- Availability
  - How much data can we lose?
  - How fast will the system fail over?
- Monitoring and Trending
  - Establish a baseline for analysis - are we meeting those objectives?
  - Impact on resources
- Ownership
  - All of the components are monitored by the DBA
Data Movement In Availability Groups

- Transaction log blocks are replicated to secondaries
- Replication mode
  - Synchronous
  - Asynchronous
- Database mirroring endpoint
Network Based Replication

- Strong working relationship with network team
- Maintenance - patching, network outages, database
- Network conditions can impact your AG’s availability
  - Latency - how long it takes for a packet of data to traverse the network from source to destination.
  - Bandwidth - how much data can be moved in a time interval
Database Synchronization States

- Not synchronizing
- Synchronized
- Synchronizing
- Reverting
- Initializing

Failover Modes

• Automatic
  • Synchronous mode only
  • Commonly used within a data center
  • Synchronization state must be synchronized

• Manual
  • Synchronous or Asynchronous
  • Commonly used between data centers

Send Queue

- Queues log blocks to be sent to the secondaries
- Each replica maintains its own view of the send queue
- Queued data is at risk to data loss in the event of a primary failure
- The send queue can grow due to an unreachable secondary, network outage, network latency and large amount of data change
Redo Queue

- Queues log blocks received on the secondary
- Each replica has its own redo queue
- On failover, the redo queue must be completely processed
- The redo queue can grow due to a slow disk subsystem or resource contention or sustained outage and subsequent reconnection of a secondary
Send Queue Impact on Availability

- When log generation on primary exceeds the rate they can be sent to the secondaries…
  - No automatic failover
  - Data loss
  - Stale data for reporting from secondaries
  - Stale data for off-loaded backups on secondaries
  - Off-loaded log backups can fail
  - Transaction delay
  - Fill up transaction logs
  - Even in synchronous mode!
Redo Queue Impact on Availability

- When log blocks received on the secondary exceed the rate they can be processed by the redo thread…
  - Delayed failover
    - Detect failure
    - Process Redo Queue
    - Crash recover database
  - Stale data for reporting from secondaries
  - Stale data for off-loaded backups on secondaries
  - Off-loaded log backups can fail
  - Transaction delay
Maintenance Events That Can Impact Availability

- Bulk data modifications
- Database maintenance
- Network or server maintenance
- Unplanned outages

- Carefully plan maintenance
- Collaborate with other teams!
Monitoring AG Performance

- Dynamic Management Views
  - `sys.dm_hadr_database_replica_states`

- Perfmon Counters
  - SQL Server: Availability Replica
    - Replication data - messages sent, bytes sent, flow control
  - SQL Server: Database Replica
    - Database data - log bytes sent, queue sizes, transaction delay per database
Measuring Replication Latency

- `sys.dm_hadr_database_replica_states`
  - `log_send_queue_size`
  - `log_send_rate`
  - `redo_queue_size`
  - `redo_queue_rate`

- On the primary there’s a row for each database on each replica
- On the secondaries there’s a row for each database on that replica
- Pull replication
- Offline
  - `log_send_queue_size` changes to NULL
Measuring Replication Latency - *ugh***!!*

- Well, it looks like `sys.dm_hadr_database_replica_states` doesn’t report the correct values for `log_send_rate` and `redo_queue_rate`
  - Documented as KB
  - Reported on Connect
  - Known bug in SQL Server 2012 or 2014
    - [https://support.microsoft.com/en-us/kb/3012182](https://support.microsoft.com/en-us/kb/3012182)
  - Cumulative Update 5 or better
  - Observed in SQL 2016 RC3 - just increases
    - Perfmon!
Monitoring Tools

- Build your own
- AlwaysOn Dashboard
- Third Party Tool
  - SQL Sentry Performance Advisor
  - Redgate SQL Monitor
Demo

Availability Group – AG1

DC1

SQL14-A
Primary

SQL14-B
Secondary
Synchronous

Simulated 1 Gb WAN
Availability Group

DC2

SQL14-C
Secondary
Asynchronous
Demo
Real World Example
Dealing With Slow Replication Latency

- Identify your bottleneck and mitigate it
  - Minimize log generation
    - Use smart index maintenance
  - More bandwidth
    - Perhaps a dedicated network connection
  - Better hardware
    - Log throughput on secondaries needs to be equal to primary
- Upgrade SQL Server
  - 2012 single threaded redo - ~45MB/sec
  - 2016 multi-threaded redo - ~600MB/sec
Key Takeaways

- It is imperative to track and trend replication latency in your Availability Groups so you can answer the questions
  - How much data can I lose?
  - How long it will take to failover?
- Monitor and trend `send_queue` and `redo_queue` in `sys.dm_hadr_database_replica_states` on replicas to measure availability impact
- Understand how much log is generated in your databases
- Understand your system’s operations, consider downtime for patching and network maintenance
Key Takeaways

- Plan database maintenance
- Use a smart index maintenance strategy!
- Offloaded backups
  - If availability is most important, backup on primary
Need more data?

http://www.centinosystems.com/blog/talks/

Links to resources
  Demos
  Presentation

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Thank You!

Thanks to the HADR VC - John and David!
Questions?
References

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