



Troubleshooting Always On Latency and Failovers

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BIOGRAPHY POINT ONE

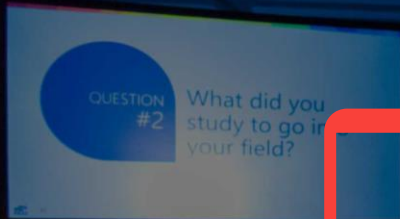
SQL Tiger PM for HADR and Data Replication for In-Market versions of database engine

BIOGRAPHY POINT TWO

Previously, with Microsoft Consulting Services, specializing in Designing and Optimizing SQL Deployments, HADR, Microsoft Azure, and PowerShell Scripting.



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Agenda

Always On Basics



What is Always On

Always On Lease Timeout

Always On Health Check

Troubleshooting
Always On Latency



Understanding Always On Data Sync Latency

Troubleshoot Latency using Extended Events

Troubleshooting Latency using SSMS

Troubleshooting
Always On Failovers



Understanding Always On Failovers

Troubleshooting Tools

Troubleshooting Automatic Failover Failures

Troubleshooting Lease Timeout

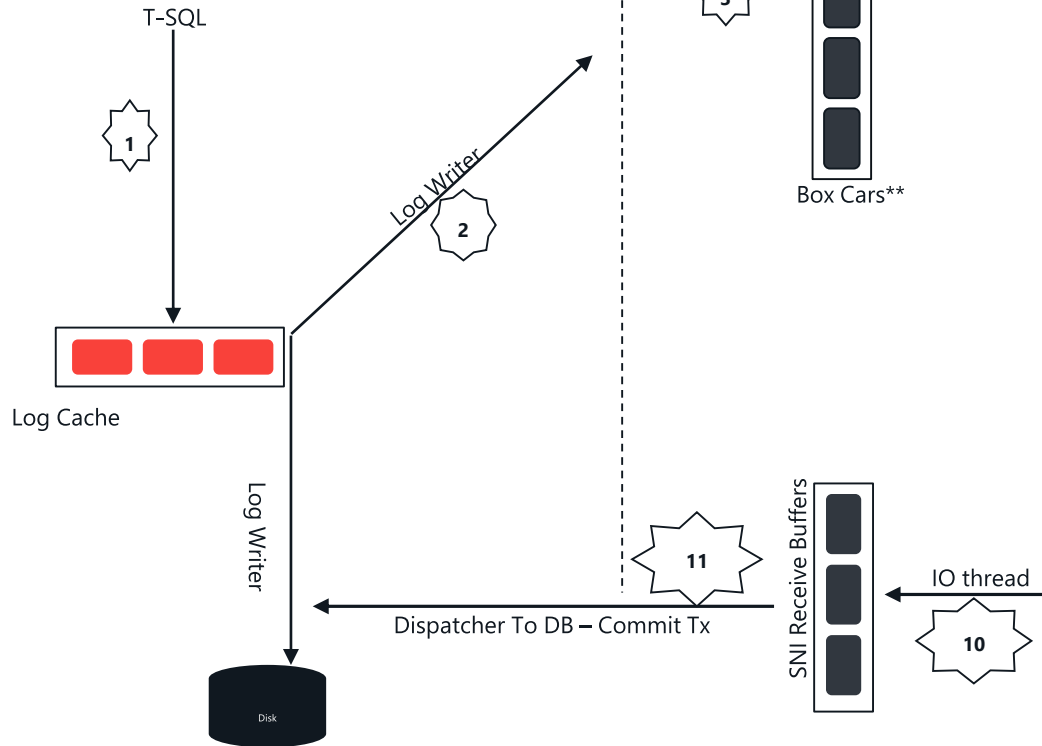
Troubleshooting Unexpected Failover

What is Always On

- Integrated, Flexible HADR solution, introduced in SQL 2012
- Up to 8 Secondary Replicas
 - Two Sync Replicas, Automatic Failovers
 - Remaining Async Replicas, Manual Failover
- Physical Data Movement
- Uses Lease Renewal system for resource ownership and eliminate split brain scenarios
- Health monitoring from both within SQL Engine and through Windows Cluster

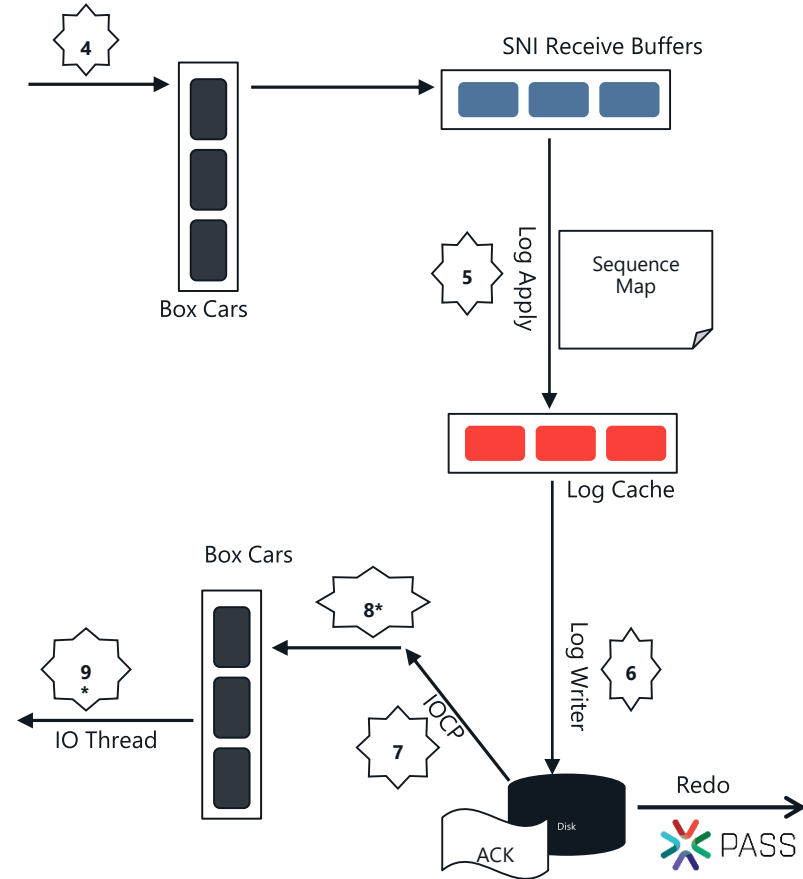
Always On Sync Log Transport (SQL 2016)

Log Block Capture Phase



Log Block Transmit Phase

Log Block Apply Phase



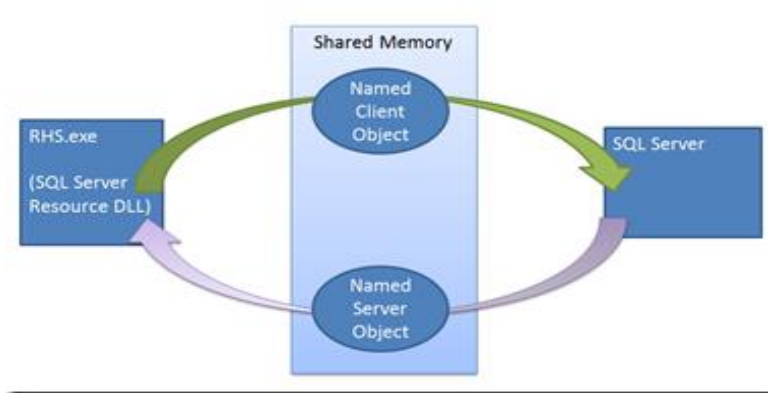
Always On Lease Renewal Process

Every $\frac{1}{4}$ of the Lease Timeout Setting

Simple handshake process between SQL and Resource DLL

Runs outside of SQLOS and at a higher priority

Enabled at Failover_Condition_Level 1



Resource DLL Lease Thread	Server Lease Worker/Thread
SetEvent(Client Event)	
	WaitForSingleObject(Client Event)
WaitForSingleObject(Server Event)	SetEvent(Server Event)
Wait for 1/4 the Lease Timeout	Repeat Loop Until Shutdown or Lease Expires

Always On Health Check

Initiated by the WSFC Resource DLL running in RHS.exe

Executes `sp_server_diagnostics` against the SQL Server

`Sp_server_diagnostics` runs every 1/3rd of Health Check Timeout setting

Two scenarios under could lead to failover

1. Failure to return `sp_server_diagnostics` within the Health Check Timeout internal (default 30 secs)
2. Output of `sp_server_diagnostics` returning an error – Failover Condition level 3-5

Troubleshooting Always On Latency



Always On Data Sync Latency

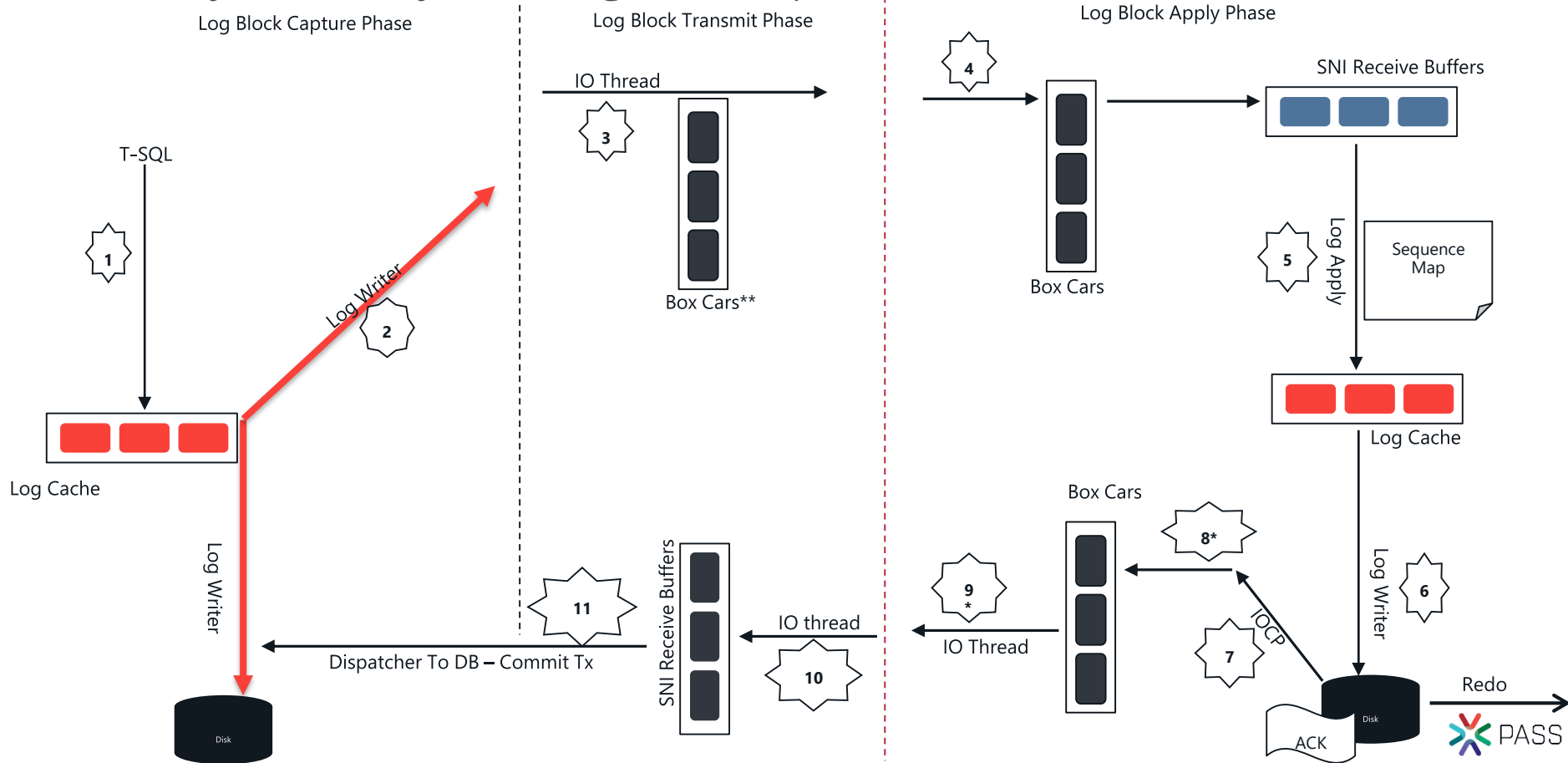
Synchronization Latency can be present because of different reasons

- Transactions committed on Primary but not visible on secondary
 - Redo Thread blocked
 - Slow Redo because of resource constraints
- Transactions appear to be slow on Primary (Sync Commit is slow)
 - Performance Issues on the Primary – Delay in Send
 - Flow Control – Delay in Transmit
 - Performance Issues on the secondary – Delay in hardening

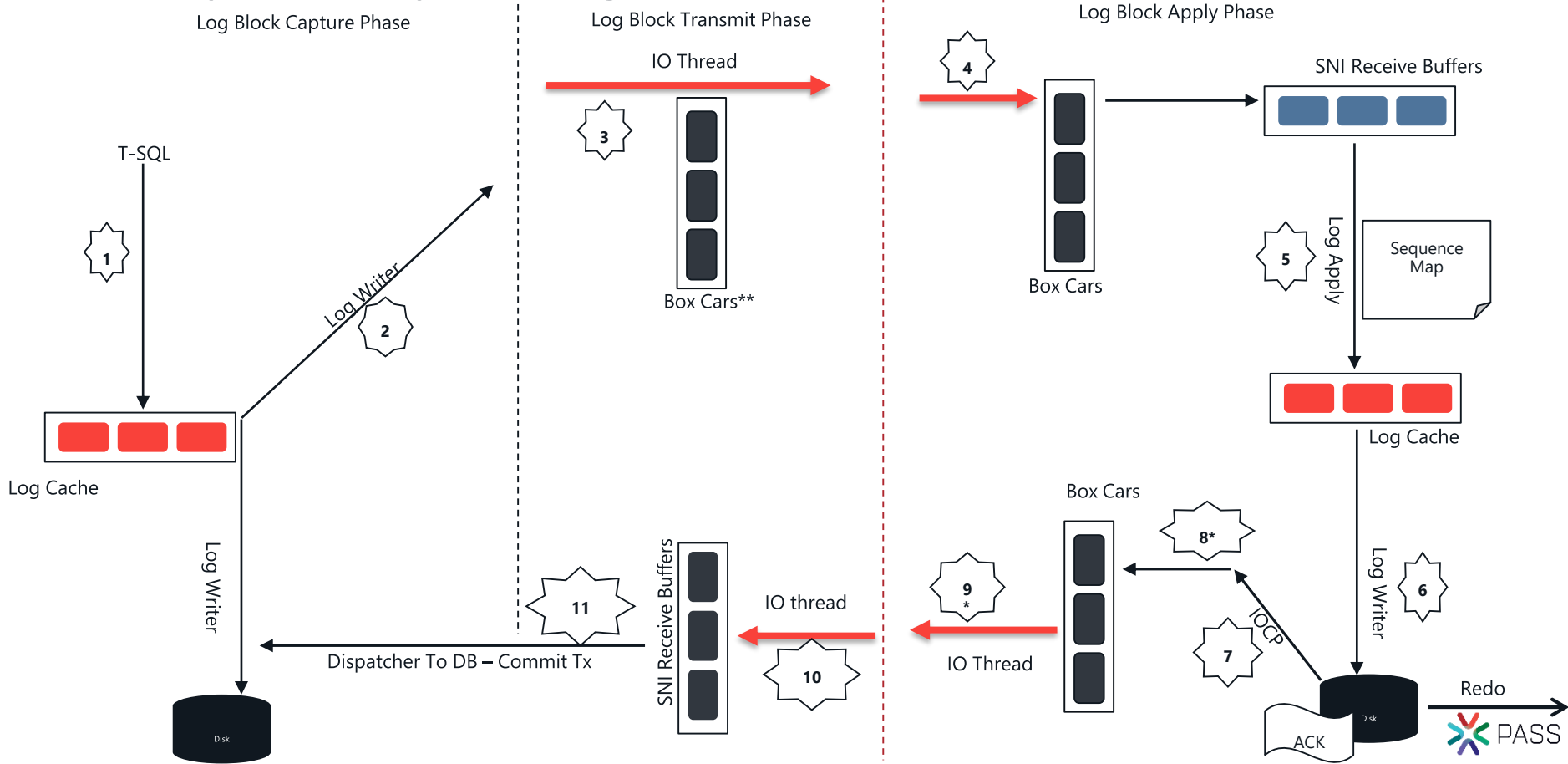
Troubleshooting Tools

- Extended Events
- Performance Counters
- SSMS
- DMV's

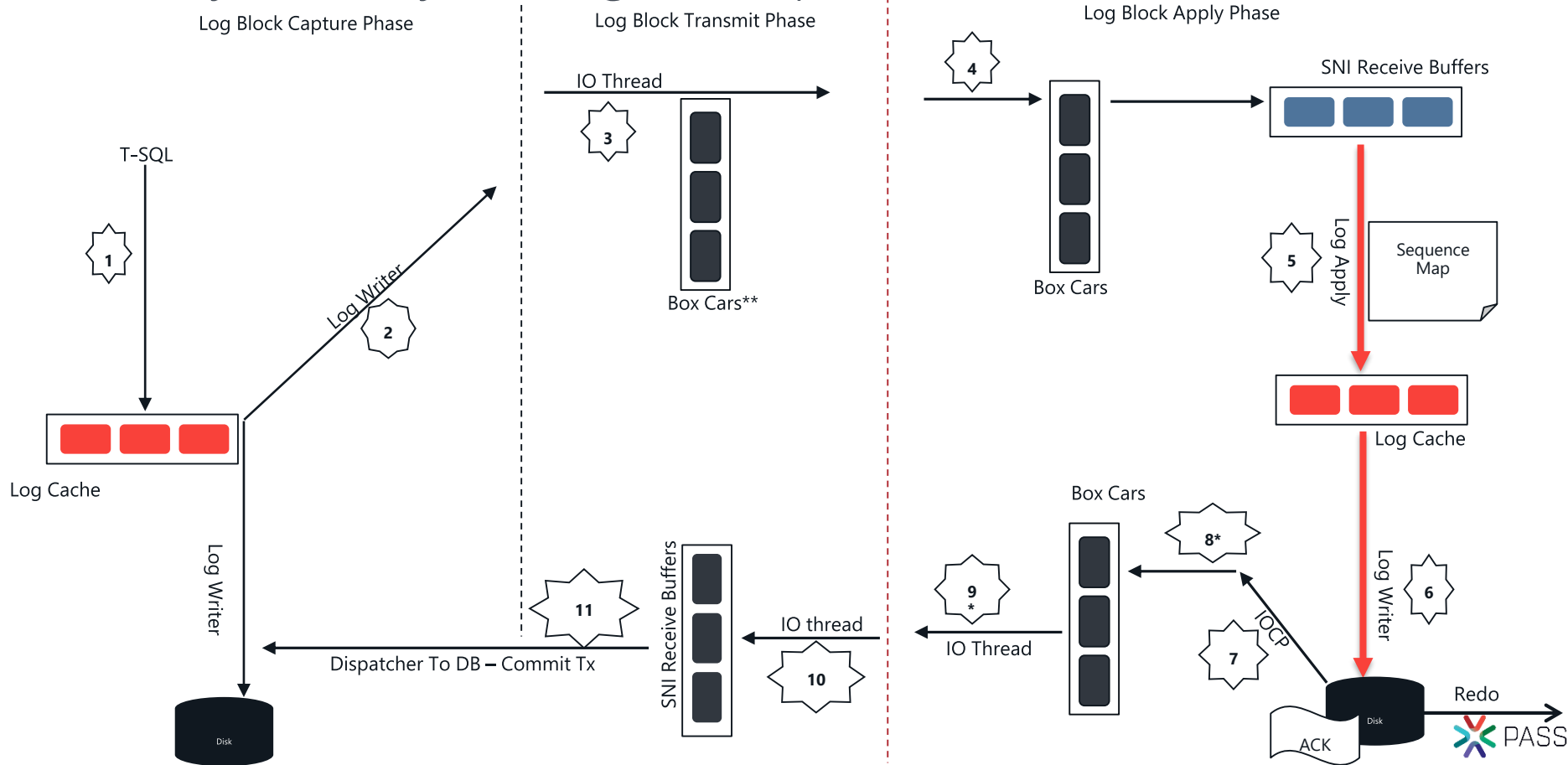
Always On Sync Log Transport (SQL 2016)



Always On Sync Log Transport (SQL 2016)

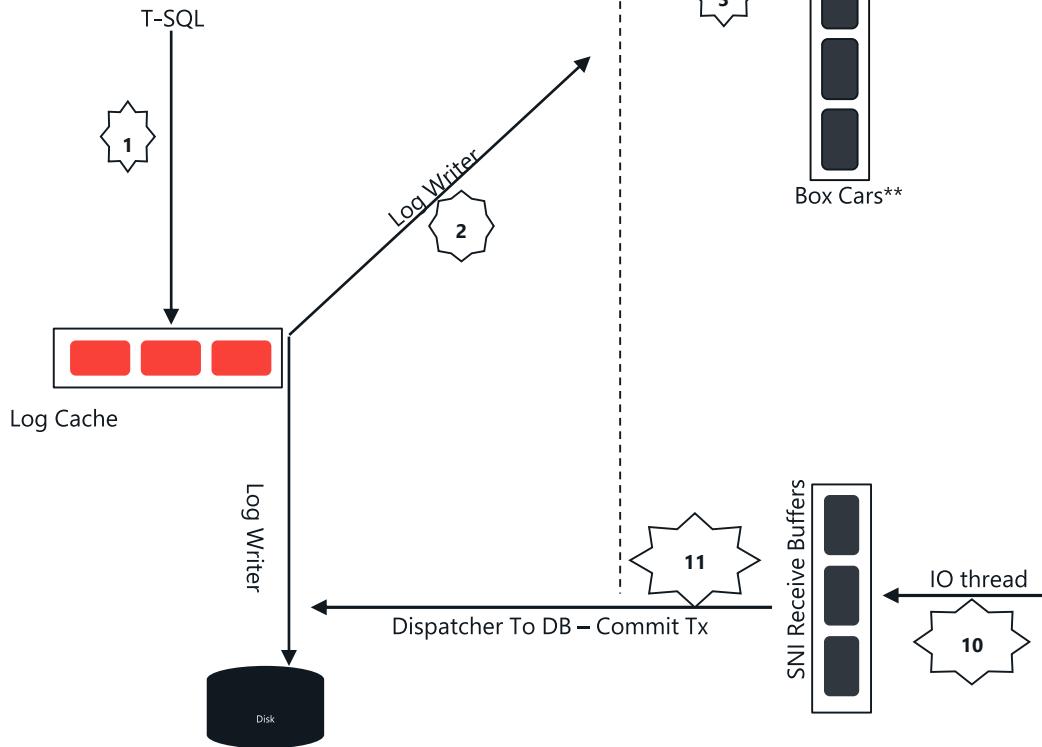


Always On Sync Log Transport (SQL 2016)

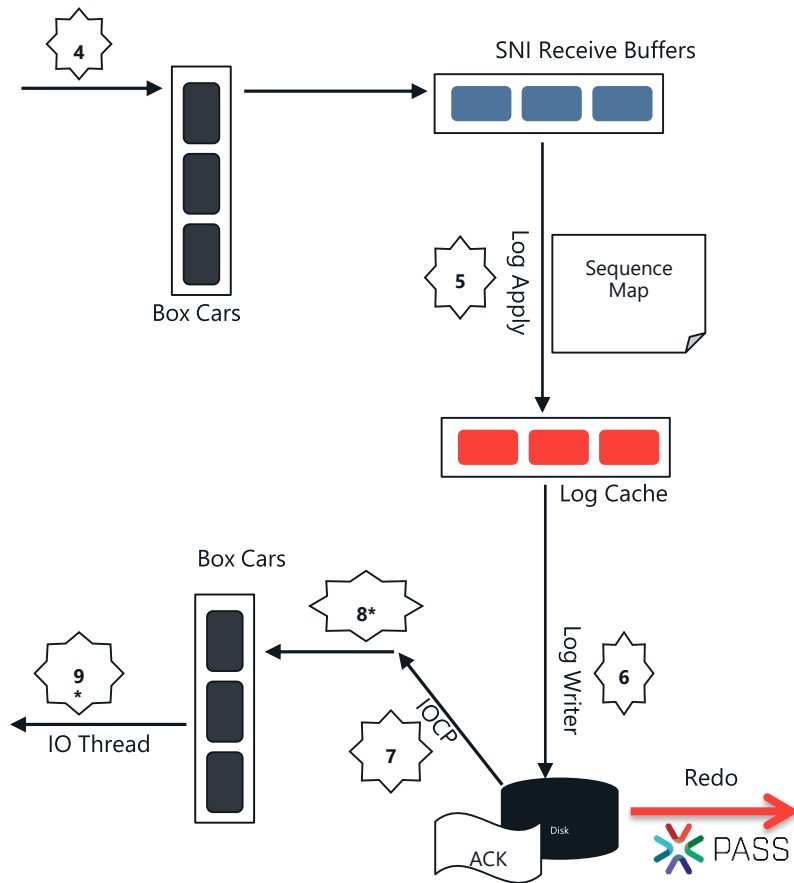


Always On Sync Log Transport (SQL 2016)

Log Block Capture Phase



Log Block Apply Phase



XEvents to Track Latency

PRIMARY
log_flush_start
log_flush_complete
hadr_capture_log_block*
hadr_log_block_compression
hadr_receive_harden_lsn_message *
hadr_db_commit_mgr_harden
hadr_db_commit_mgr_harden_still_waiting

Time

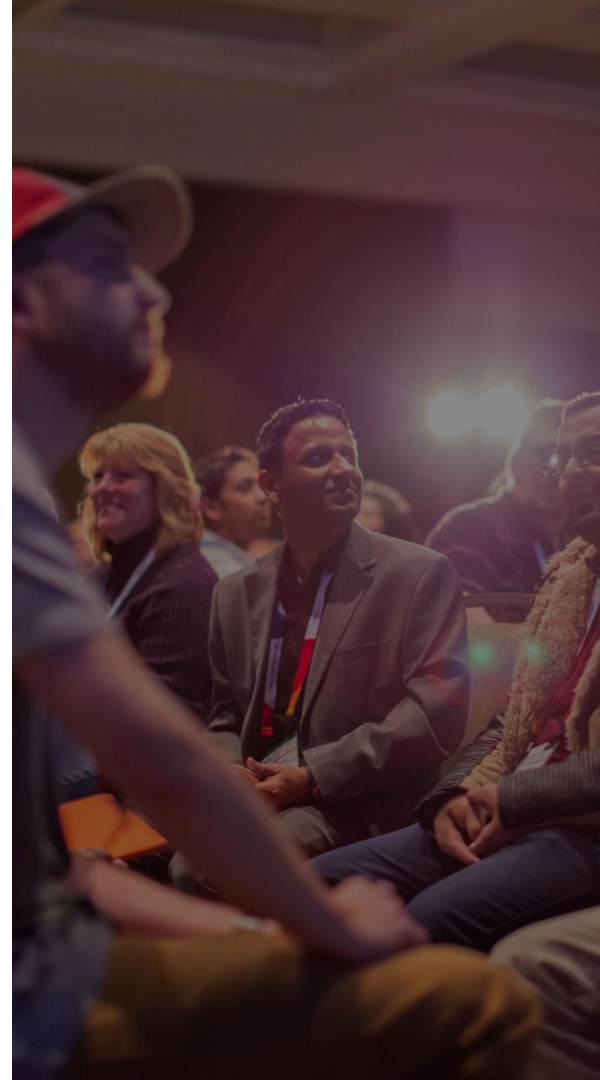
SECONDARY
hadr_transport_receive_log_block_message*
hadr_log_block_decompression
log_flush_start
log_flush_complete
hadr_apply_log_block
hadr_send_harden_lsn_message*

Performance Counters

Perf Counter	AG Replica	SQL release
Log Bytes Flushed/sec	Primary	SQL 2012+
Log Pool LogWriter Pushes/sec	Primary	SQL 2016+
Bytes Sent to Replica/sec **	Primary	SQL 2012+
Flow Control/sec	Primary	SQL 2012+
Flow Control Time (ms/sec)	Primary	SQL 2012+
Bytes Sent to Transport/sec	Primary	SQL 2012+
Bytes Received from Replica/sec	Secondary	SQL 2012+
Log Bytes Flushed/sec	Secondary	SQL 2012+
Bytes Sent to Replica/sec	Secondary	SQL 2012+
Flow Control/sec	Secondary	SQL 2012+
Flow Control Time (ms/sec)	Secondary	SQL 2012+
Bytes Sent to Transport/sec	Secondary	SQL 2012+
Bytes Received from Replica/sec	Primary	SQL 2012+

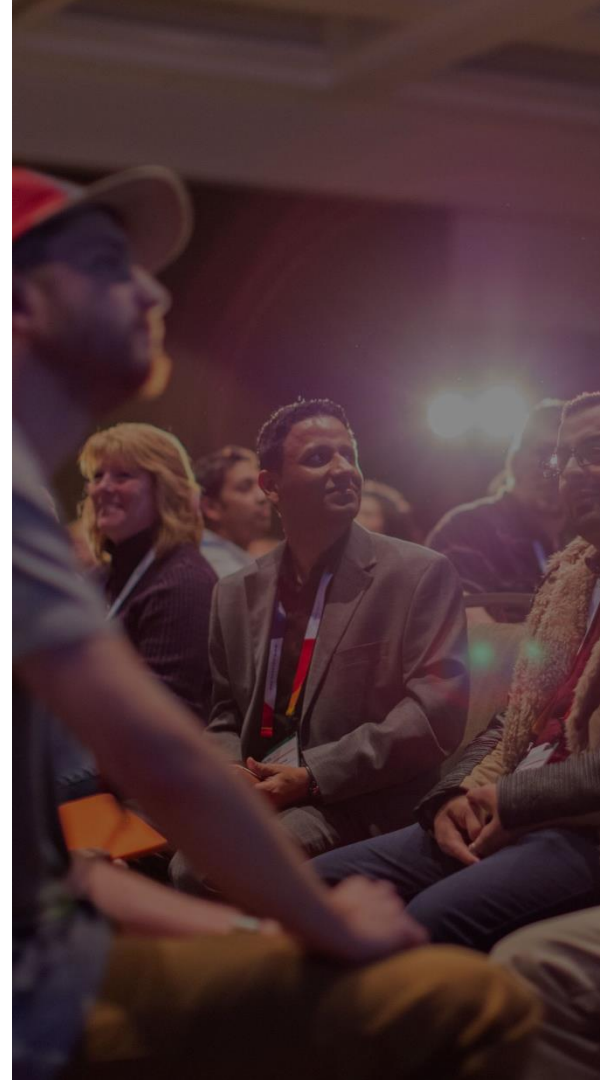
Troubleshoot Latency using XEvents

Demo



Troubleshooting Latency using SSMS

Demo



Troubleshooting Always On Failovers



Always On Failover

Failovers can be divided into two categories

Automatic Failover configured for AG, but failover was unsuccessful

- Databases in AG are not synchronized
- Cluster configuration issues
- Insufficient permissions for NT Authority/System

Unexpected Automatic failover

- SQL Server Always On detects health issue
 - Lease Timeout (System Wide Issues)
 - Health Check Timeout
 - Database Level Health Check (if enabled)
- Windows Cluster detects health issue (e.g. Loss of Cluster Quorum)

Troubleshooting Tools

1. Always On Health Session
2. SQL Server Error Logs
3. Cluster Logs
4. Failover Cluster Diagnostics Logs
5. System Event Logs

Always On Health Session

XEvents session for Always On Health

4 files of max 5 MB each

Enabled by default

Events Captured

1. availability_replica_manager_state_change
2. availability_replica_state
3. error_reported
4. availability_replica_state_change
5. Lock_redo_blocked
6. Availability_group_lease_expired
7. Availability_replica_automatic_failover_validation
8. hadr_db_partner_set_sync_state

Sp_Server_Diagnostics

Repeat interval of 1/3rd of HealthCheckTimeout setting

Persistent connection to SQL Server

Preemptive thread running on high Priority

Checks for errors in multiple components

- System

- Resource

- query_processing

- io_subsystem

- Events

- Always On Availability Group

Failover Cluster Diagnostics Logs

Information captured by sp_server_diagnostics on Primary replica

10 files of max 100 MB each

Events Captured

1. availability_group_state_change
2. info_message
3. availability_group_is_alive_failure
4. component_health_result

ALTER SERVER CONFIGURATION SET DIAGNOSTICS LOG ON

ALTER SERVER CONFIGURATION SET DIAGNOSTICS LOG OFF

Lease Timeout Improvements

New descriptive Error messages for Lease Timeout

New Lease States reported by the Extended Events:

availability_group_lease_expired

hadr_ag_lease_renewal

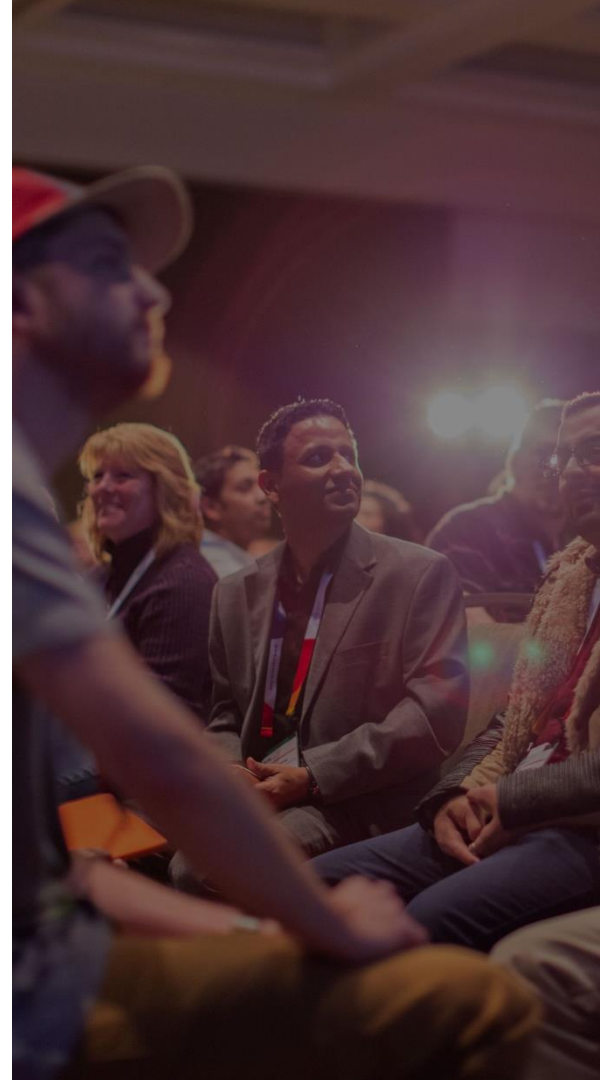
System Performance objects in Cluster Logs

<https://support.microsoft.com/en-us/help/3112363/improvements-for-sql-server-alwayson-lease-timeout-supportability-in-s>

<https://blogs.msdn.microsoft.com/alwaysonpro/2016/02/23/improved-alwayson-availability-group-lease-timeout-diagnostics/>

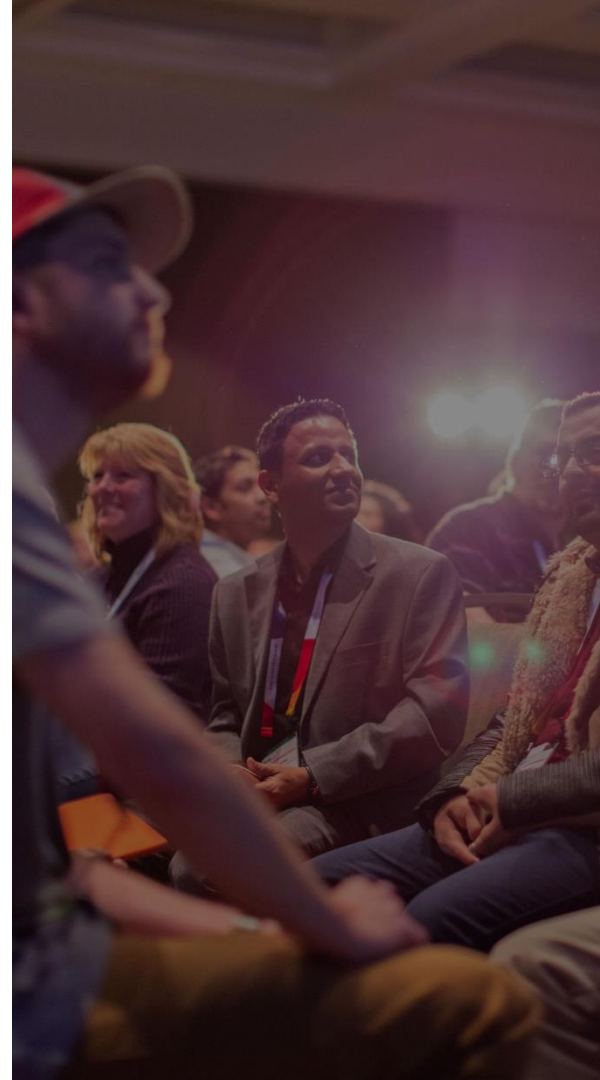
Troubleshooting Lease Timeout

Demo



Always On Unexpected Failover

Demo



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