What’s new in SQL Server 2022

Gianluca Hotz - President UGISS.ORG - Data Platform MVP - @glhotz

Who am I?

- Gianluca Hotz | @glhotz | ghotz@ugiss.org
- Independent Consultant
  - 25+ years on SQL Server (from 4.21 back in 1996)
  - Database modeling & development, sizing & administration, modernization (upgrades & migrations), performance tuning, security
- Community
  - 24 years Microsoft MVP SQL Server/Data Platform (from 1998)
  - VMware Experts SQL Server
  - Founder and president UGISS (ex «PASS Chapter»)

Sponsor & Org


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QUANTUMDATIS

Agenda

- Configuration
- Administration
- Programmability
- Performance
- Security
- Availability
- Hybrid Cloud

Configuration

What’s New in SQL Server 2022

Deploying SQL Server 2

SQL Server Instance

Supported OS

Same upgrade options as in previous releases

dbcompat 160

older dbcompat supported

Side by side

Windows GUI or command line

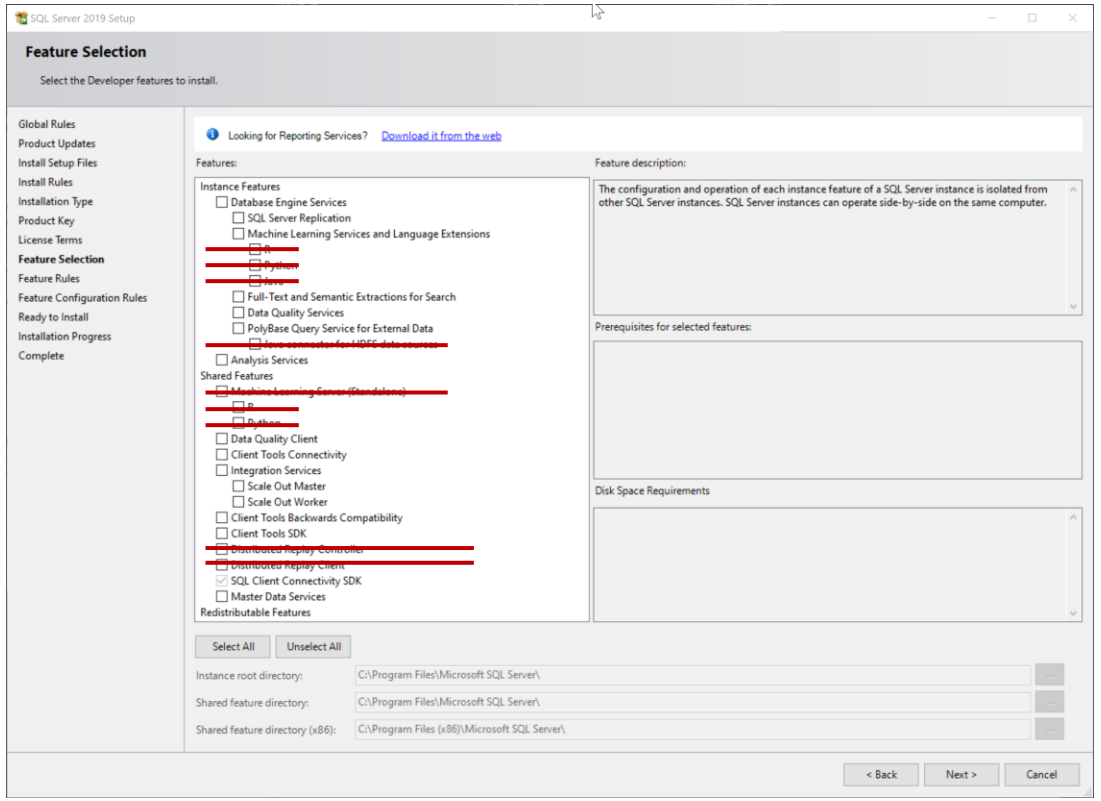
RHEL, Ubuntu, SLES package managers

Pre-installed container images

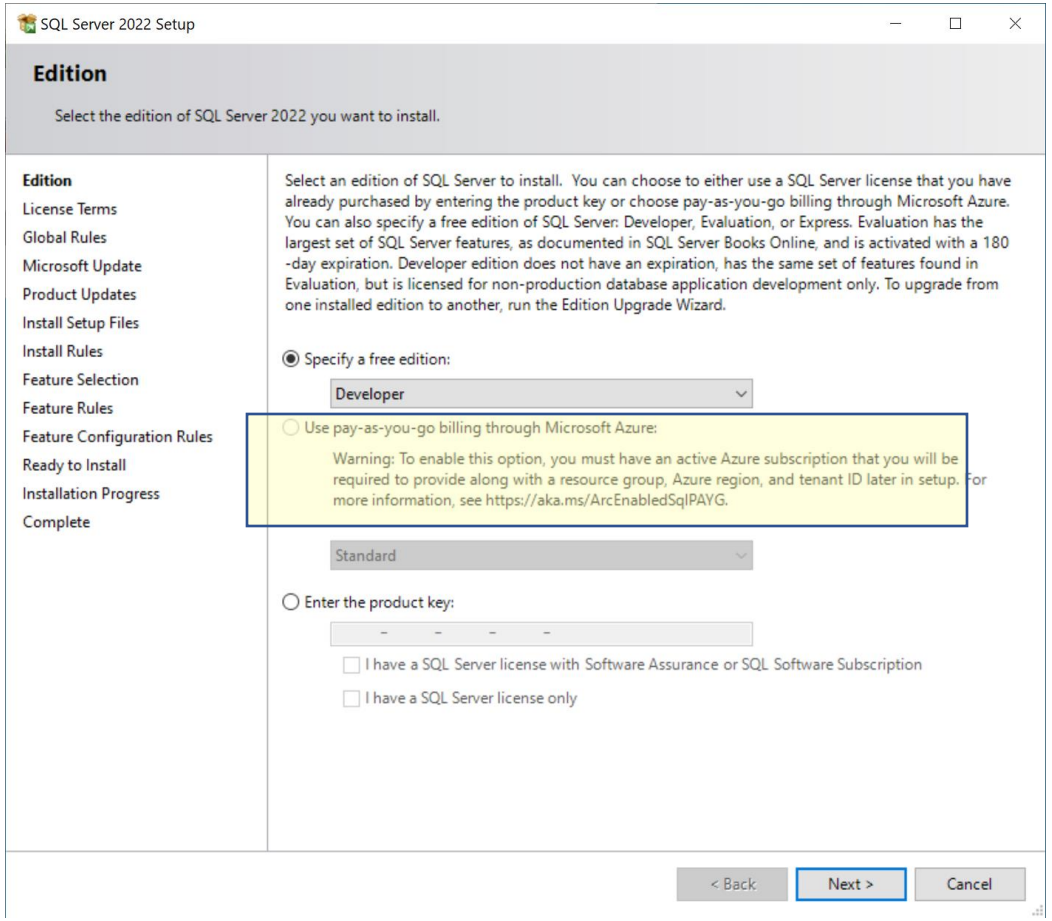
Azure marketplace images for Virtual Machines

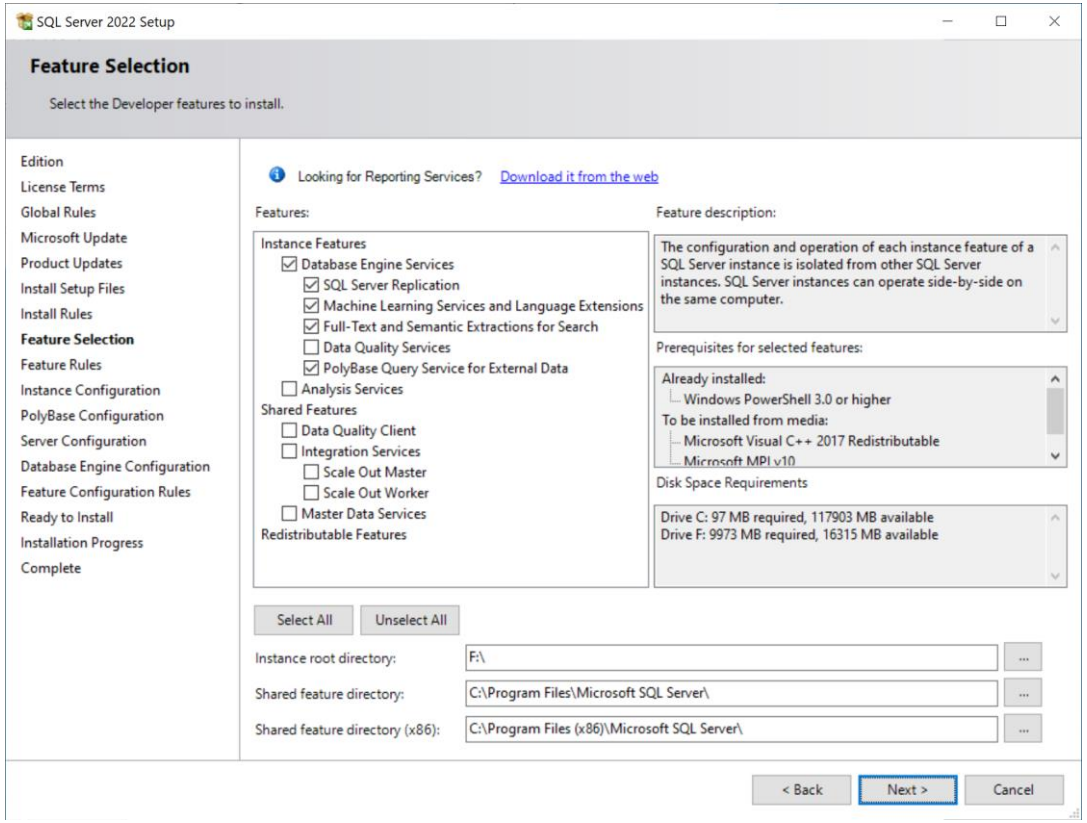
What is different in setup?

- Removed
  - R, Python, Java Packages
    - Bring your own package
  - PolyBase HDFS Java connectivity
  - PolyBase scale out groups ☹
  - Machine learning server
  - Distributed replay
    - Separate download (soon)
    - Get [WorkloadTools]
- Deprecated
  - Stretch database



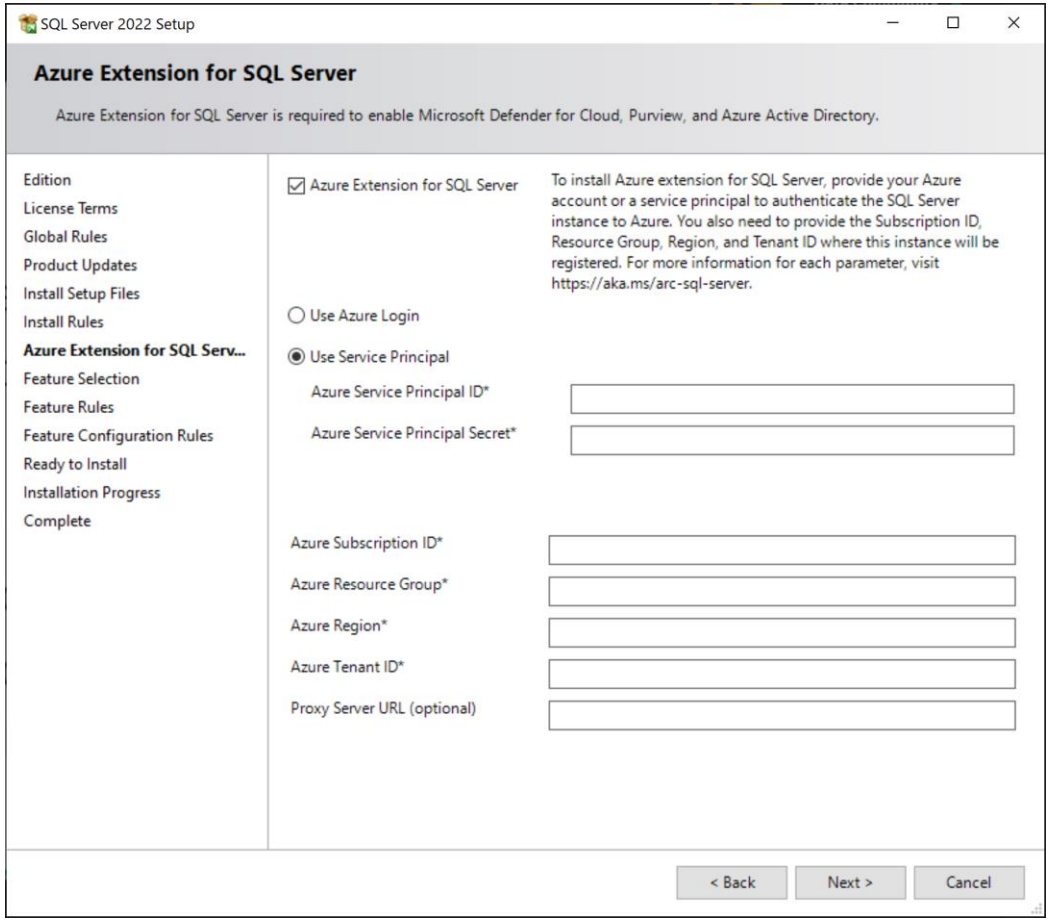
SQL Server 2022 Setup





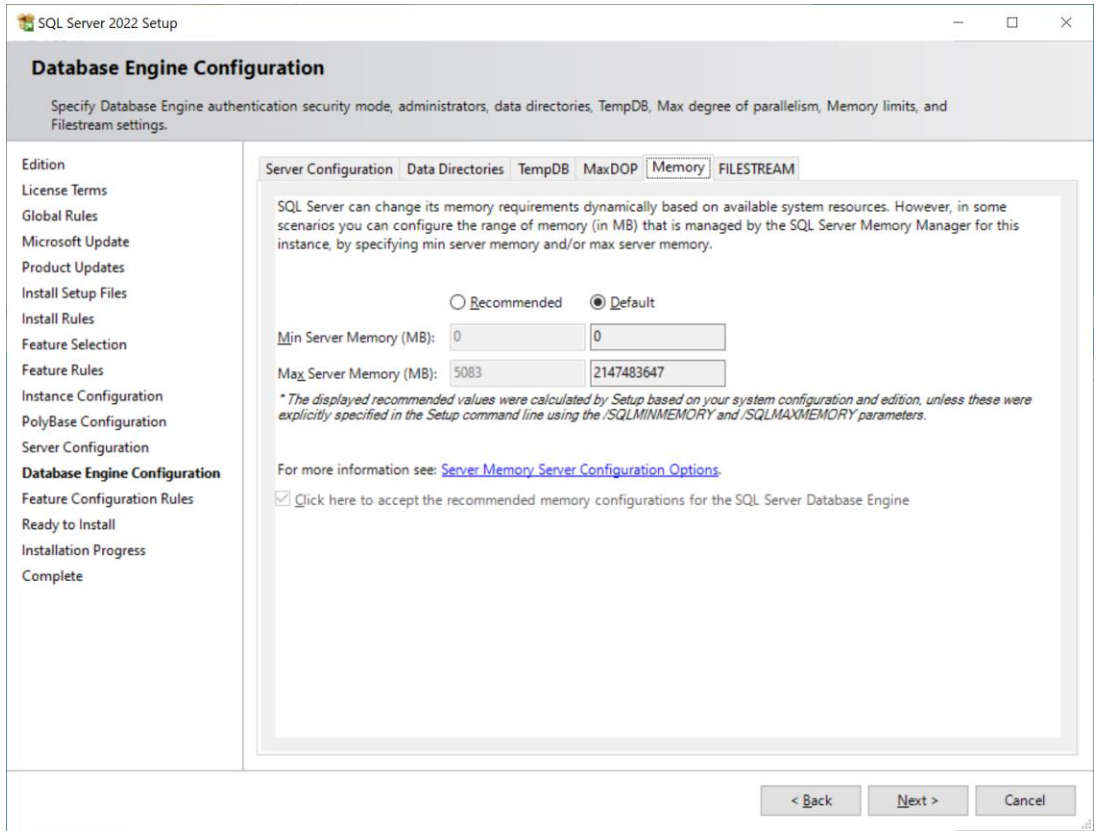
Azure Extensions

- Microsoft Defender for SQL
- SQL Assessment
- View instance in Azure Portal
- Azure AD authentication
- Purview access policies
  - Requires Azure AD
- Not supported on Azure VMs
  - Use IaaS Agent Estension



Memory recommendations

- Different from 2019
  - Now ~75% available memory
- Doesn’t consider
  - multiple instances
  - other components
    - 1e.g. SSIS, SSRS, SSAS
  - other applications



New cloud billing model for SQL Server (available Dec 2022)

Better cost efficiency when paying only for what you use

SQL Server pay-as-you-go billing enabled by Azure Arc

Price per core	Monthly rate	Hourly rate
Standard Edition	$73	$0.100
Enterprise Edition	$274	$0.375

Flexible billing options

Choose from consumption-based licensing or perpetual SQL Server license

Lower TCO

Pay by the hour for spikes and ad-hoc usage.
No need for full upfront investment

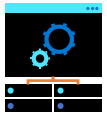
Supports hybrid deployment

Consistent purchasing option across on-premise and in 3rd party cloud

SQL Server 2022 editions

https://aka.ms/sql2022editions

Azure-enabled with continued performance and security innovation



Express
Free, entry-level database for small web and mobile apps

Feature highlights

- Up to 4 cores of CPU
- Up to 1410 MBs of memory
- Microsoft Purview Policies
- Azure AD authentication
- Built-in query intelligence: PSP Optimization, Optimized plan forcing
- Query store on by default for new databases
- Data Lake Virtualization
- Ledger
- Timeseries support

Standard
Full featured database with for mid-tier applications and data marts

Feature highlights

- Up to 24 cores of CPU
- Up to 128 GBs of memory
- Azure Synapse Link for SQL
- Link feature for Azure SQL Managed Instance (basic availability groups)
- Buffer Pool Parallel Scan
- Backups to S3-compatible object storage

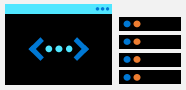
+ Express features

Enterprise
Mission-critical performance and intelligence for tier 1 databases

Feature highlights

- Unlimited cores of CPU
- Unlimited memory
- Azure Synapse Link for SQL (multi-threaded snapshot)
- Link feature for Azure SQL Managed Instance
- Built-in query intelligence: DOP feedback, CE Feedback, Memory Grant Feedback
- Contained Availability Group
- AVX 512 extension for batch mode

+ Standard features
+ Express features



Developer
Free to use with all the features of Enterprise Edition specifically for dev/test in non-production environments

Build once and deploy across any SQL Server edition without changing your app

What's new in SQL Server 2022

SQL Server 2022 new features		Express	Standard	Enterprise
Compute and storage	Maximum number of cores	4	24	OS Max
	Maximum memory utilized per instance	1410 MB	128 GB	OS Max
	Maximum relational database size	10 GB	524 PB	524 PB
Azure-enabled	Azure Synapse Link for SQL		✕	✕
	Ledger	✕	✕	✕
	Link feature for Azure SQL Managed Instance			✕
	Link feature for Azure SQL Managed Instance (basic availability groups)		✕	
Choice of language and platform	Microsoft Purview policies	✕	✕	✕
	JSON T-SQL Enhancements	✕	✕	✕
	Modern T-SQL surface area	✕	✕	✕
	Query Store by default for new databases	✕	✕	✕
	Query Store: Read-replica support			✕
Industry-leading performance and availability	Built-in query intelligence: Parameter Sensitive Plan (PSP) Optimization, Optimized plan forcing	✕	✕	✕
	Built-in query intelligence: CE Feedback, DOP Feedback, Memory Grant Feedback			✕
	Contained Availability Group			✕
	Buffer Pool Parallel Scan		✕ (limited to 2 threads, over 64GB Mem only)	✕
	AVX 512 extension for batch mode			✕
	Intel QAT Enhancements for Backup		✕ (SW only)	✕ (HW + SW)
Secure and reliable	Timeseries support	✕	✕	✕
	Always Encrypted with secure enclaves - new features	✕	✕	✕
	Granular permissions for Dynamic Data Masking	✕	✕	✕
Analytics	Data Lake Virtualization	✕	✕	✕
	Object Storage Integration with S3-compatible storage		✕	✕

Editions and supported features

- SQL Server 2022 on Windows
  - https://learn.microsoft.com/sql/sql-server/editions-and-components-of-sql-server-2022
- SQL Server 2022 on Linux
  - https://learn.microsoft.com/sql/linux/sql-server-linux-editions-and-components-2022

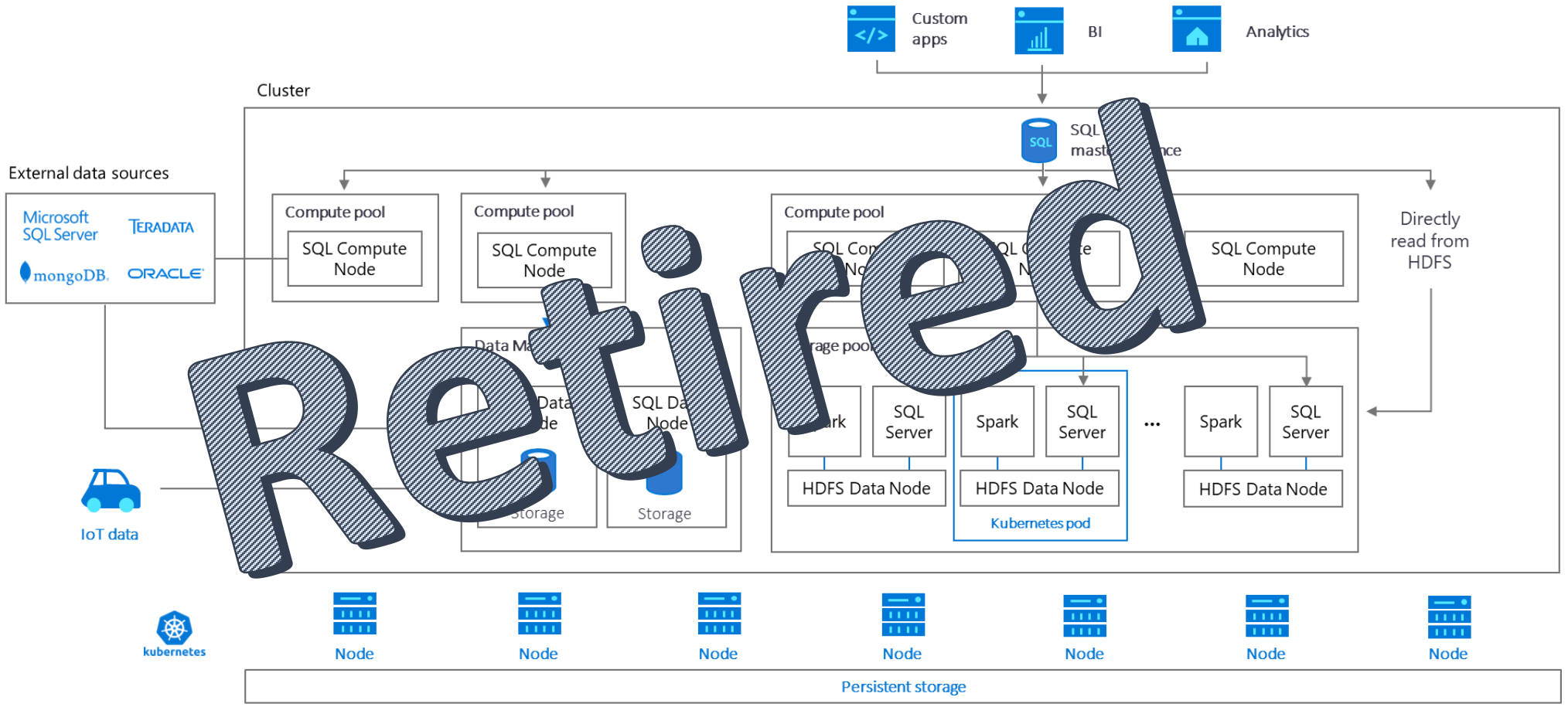
Resources setup

- https://aka.ms/deploysqlserver2022
- ML packages installation
  - https://docs.microsoft.com/sql/machine-learning/install/sql-machine-learning-services-windows-install
  - https://docs.microsoft.com/sql/language-extensions/install/windows-java
- Azure Extension
  - https://docs.microsoft.com/sql/sql-server/azure-arc/assess
  - https://docs.microsoft.com/azure/azure-sql/virtual-machines/windows/sql-server-iaas-agent-extension-automate-management
  - https://learn.microsoft.com/sql/sql-server/azure-arc/connect#delete-your-arc-enabled-sql-server-resource
- Memory configuration
  - https://learn.microsoft.com/sql/database-engine/configure-windows/server-memory-server-configuration-options

Resources deploy on other platforms

- SQL Server on Linux
  - https://aka.ms/sqllinux
- SQL Server on Containers
  - https://aka.ms/sqlcontainers
- SQL Server on Kubernetes
  - https://aka.ms/sqlk8s

SQL Server Big Data Cluster



https://docs.microsoft.com/en-us/sql/big-data-cluster/big-data-cluster-overview

https://docs.microsoft.com/en-us/sql/big-data-cluster/big-data-options

Resources features removed

- PolyBase HDFS connectivity and scale out groups
  - https://cloudblogs.microsoft.com/sqlserver/2022/02/25/the-path-forward-for-sql-server-analytics
- Machine Learning Services
  - https://docs.microsoft.com/lifecycle/announcements/microsoft-machine-learning-server-retiring

Administration

What’s New in SQL Server 2022

Index creation concurrency

- New option for **online** index creation
  - **WAIT_AT_LOW_PRIORITY (**
    MAX_DURATION = <time> [MINUTES],
    ABORT_AFTER_WAIT = NONE|SELF|BLOCKERS)
- Low priority queue wait for **Sch-M** lock similar to rebuild online
- More info
  - https://learn.microsoft.com/sql/t-sql/statements/create-index-transact-sql#wait-at-low-priority

Shrink database concurrency

- New **DBCC SHRINKDATABASE/SHRINKFILE** option
  - **WAIT_AT_LOW_PRIORITY(ABORT_AFTER_WAIT = SELF|BLOCKERS)**
- Low priority queue wait for **Sch-M** lock similar to rebuild online but
  - Can't specify **MAX_DURATION**, defaults to 1 minute
  - Can't wait forever (i.e. **ABORT_AFTER_WAIT = NONE**)
- More info
  - https://learn.microsoft.com/sql/t-sql/database-console-commands/dbcc-shrinkdatabase-transact-sql#wait_at_low_priority

Async auto-update statistics concurrency

- New database scoped configuration option
  - **ASYNC_STATS_UPDATE_WAIT_AT_LOW_PRIORITY**
- Low priority queue wait for **Sch-M** lock similar to rebuild online
  - Meanwhile, other queries use previous statistics
  - Timeouts after a certain amount of time
- Not enabled by default
- More info
  - https://learn.microsoft.com/sql/relational-databases/statistics/statistics#auto_update_statistics_async

Auto-drop statistics

- Previously, statistics interfered with schema changes
- **`UPDATE/CREATE […] WITH AUTO_DROP = ON`**
- Enabled by default in new/migrated database
- Remember to run **`sp_updatestats`** after migration
- More info
  - https://learn.microsoft.com/sql/relational-databases/statistics/statistics#auto_drop-option

Resumable add table constraints

- Built on top of resumable index rebuild (2017) and create (2019)
- Online operation
- Planned pause/resume e.g. maintenance window
- Resume after failover or system failure
- Truncate transaction log during operation
- Applies only to **PRIMARY KEY** and **UNIQUE** constraints
- More info
  - https://learn.microsoft.com/sql/relational-databases/security/resumable-add-table-constraints

Accelerated Database Recovery (ADR)

- Reduced PVS page tracker memory footprint and growth
- Version cleaner more efficient
- User transaction cleanup
- Multi-threaded version cleanup
  - New option **`sp_configure 'ADR Cleaner Thread Count'`**
  - New extended event **`tx_mtvc2_sweep_stats`**
- More info
  - https://learn.microsoft.com/sql/relational-databases/accelerated-database-recovery-concepts#adr-improvements-in-

XML Compression

- Finally!!! ☺
- New **CREATE/ALTER TABLE** or **CREATE/ALTER INDEX** option
  - **`XML_COMPRESSION = ON|OFF [ON PARTITIONS(…)]`**
- More info
  - https://learn.microsoft.com/sql/t-sql/statements/create-index-transact-sql#xml_compression

Multi-write replication

- Last Writer Wins (LWW) in Peer-to-peer transactional replication
  - Introduced in SQL Server 2019 CU13
  - Previously manual resolution in case of conflict and replication paused
- Enterprise Edition only
- More info
  - https://learn.microsoft.com/sql/relational-databases/replication/transactional/peer-to-peer-conflict-detection-in-peer-to-peer-replication#automatically-handle-conflicts-with-last-write-wins
  - https://techcommunity.microsoft.com/t5/sql-server-blog/replication-enhancements-in-the-sql-server-2019-cu13-release/ba-p/2814727

Other engine stuff

- Over 300 new Wait Types in SQL Server 2022 vs 2019
  - E.g.
    - PREEMPTIVE_SYNAPSESTREAMING_HTTP_EVENT_WAIT (Synapse Link related)
    - PREEMPTIVE_AAD_HTTP_EVENT_WAIT (Azure Active Directory related)
- Many new extended events
  - E.g. query_abort fires whenever a query is aborted for any reason
    - includes session, input buffer and callstack

Programmability

What’s New in SQL Server 2022

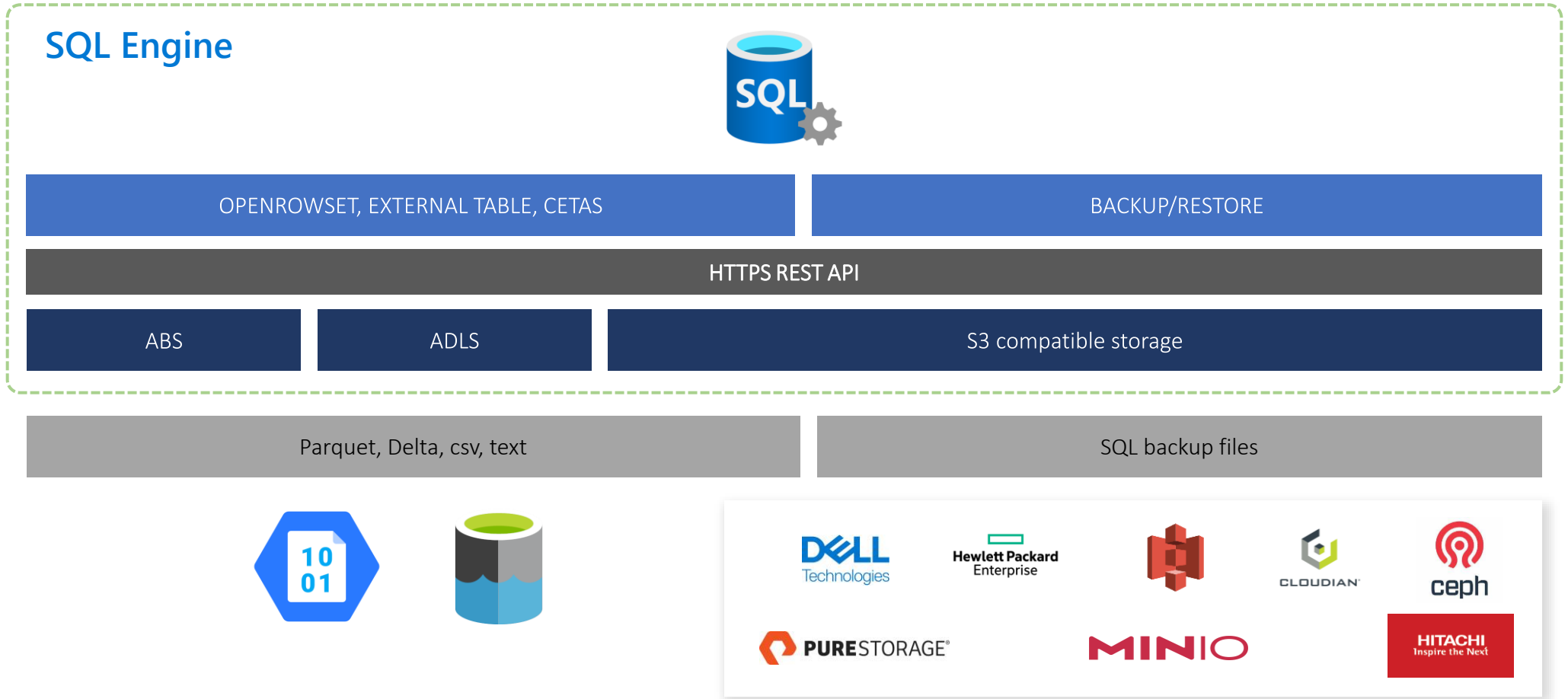
Programmability enhancements

T-SQL	JSON	Time Series
• GREATEST • LEAST • STRING_SPLIT • TRIM functions • DATETRUNC • IS [NOT] DISTINCT FROM • WINDOW clause • LEFT_SHIFT • RIGHT_SHIFT • BIT_COUNT • GET_BIT • SET_BIT	• ISJSON • JSON_PATH_EXISTS • JSON_OBJECT • JSON_ARRAY	• DATE_BUCKET • GENERATE_SERIES • FIRST_VALUE • LAST_VALUE

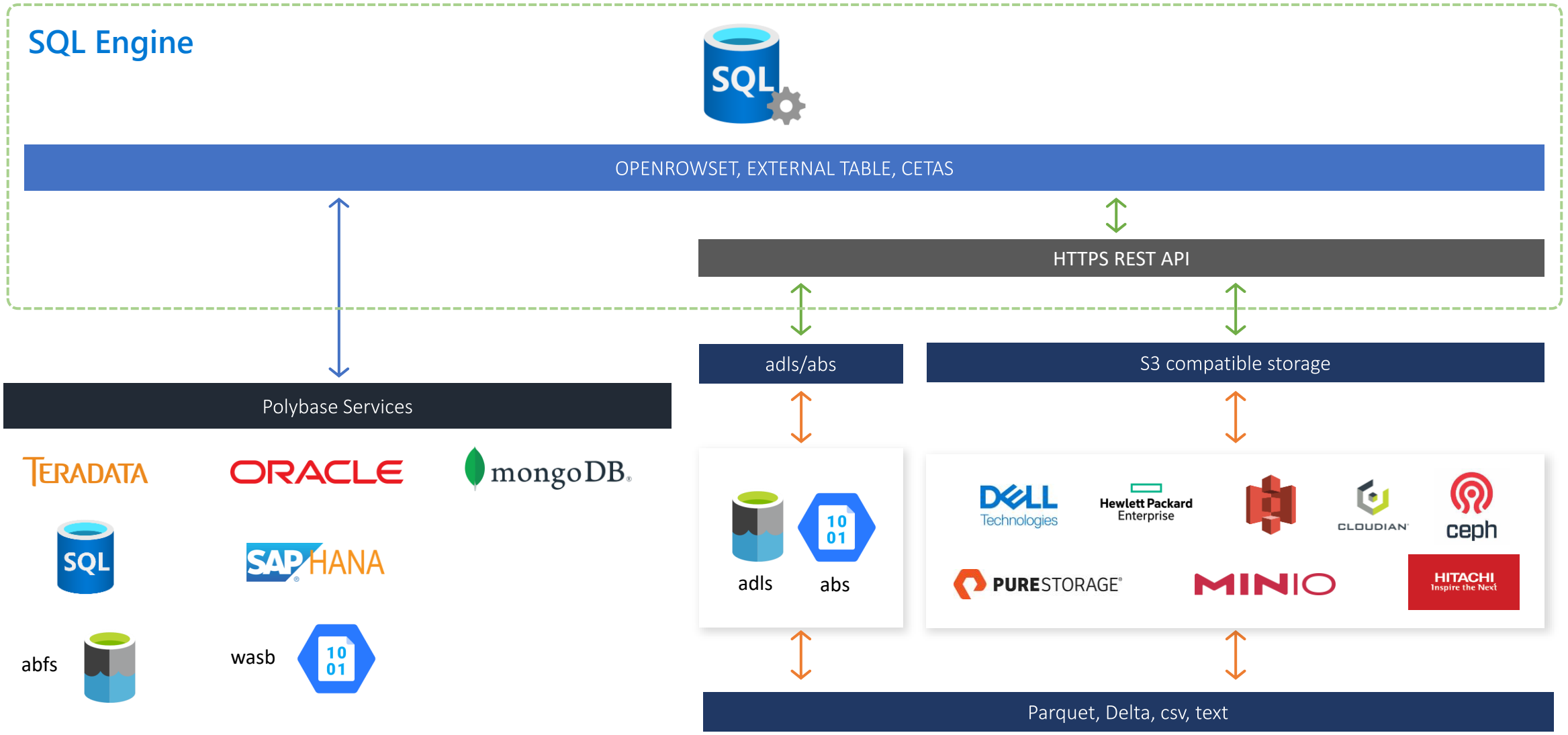
Data virtualization and object storage

Directly access any data on object storage

Challenge: I need to access data on modern object storage systems through SQL



Data virtualization in SQL Server 2022



Performance

What’s New in SQL Server 2022

Buffer Pool parallel scans

- BP operations use hash tables (BUF structures to find pages)
- Some operations still needs to scan all BUF structures
  - Problem on systems with large amount of memory e.g. 1TB+
  - SQL Server warning in ERRORLOG
  - https://docs.microsoft.com/troubleshoot/sql/performance/buffer-pool-scan-runs-slowly-large-memory-machines
- SQL Server 2012 introduces buffer pool parallel scan
  - Enabled by default (available in Standard and Enterprise editions)
  - Standard Edition limited to 2 threads on 64GB
- More info
  - https://cloudblogs.microsoft.com/sqlserver/2022/07/07/improve-scalability-with-buffer-pool-parallel-scan-in-sql-server-2022
  - https://youtu.be/4GvU106Xiag

“Hands-free” tempdb

Pre SQL Server 2019

- 1 file = PFS, GAM, SGAM contention
- Add multiple files
- Trace flags 1117 and 1118
- SQL 2016 setup auto adds multiple files
- Trace flags not required by SQL Server 2016

SQL Server 2019

- PFS concurrency
- Autogrow and uniform default for tempdb
- Now system table pages become hotspot
- Tempdb metadata optimization ON
- SGAM and GAM contention remain

SQL Server 2022

- SGAM and GAM concurrency
- Latch contention gone

“Purvi’s list”

- Reduced buffer pool I/O promotions
  - Tuned read-ahead to avoid single page promotions to 8 pages I/Os
- Enhanced spinlock algorithms
  - No details, internal adjustments make spinlocks more efficient…
- Improved Virtual Log File (VLF) algorithms
  - If growth > 1/8 current size, if < 64MB creates 1 VLF instead of 4
  - https://learn.microsoft.comsql/relational-databases/sql-server-transaction-log-architecture-and-management-guide#virtual-log-files-vlfs
- Instant file initialization (IFI) for transaction log file growth events!!!
  - Only growth events up to 64MB!

Columnstore enhancements

- Ordered Clustered Columnstore Index!
  - https://docs.microsoft.com/azure/synapse-analytics/sql-data-warehouse/performance-tuning-ordered-cci
- Columnstore string enhancements
  - Deep data (e.g. char, binary, guid) min/max maintained when rebuilding
  - Fast string-equal operation
  - LIKE pushdown (RG elimination only for prefix searches i.e. str% not %str)
- Segment elimination
  - Extends to string, binary, guid data types and datetimeoffset w/ scale > 2
  - Was only numeric, date, time data types and datetimeoffset w/ scale <= 2

Batch mode enhancements

- Processor Advanced Vector Extension (AVX) 512
- Some operations faster for Columnstore and Rowstore batch mode
- Recommended for the following processors
  - Intel Ice Lake and later
  - AMD EYPC Genoa and later
- Currently enabled by trace flag 15097
  - https://learn.microsoft.com/sql/t-sql/database-console-commands/dbcc-traceon-trace-flags-transact-sql#tf15097

Hybrid Buffer Pool

- SQL Server 2019
  - Clean pages direct referenced on PMEM devices without copy
  - Dirty pages still kept in DRAM
- SQL Server 2022
  - Direct write, reduces number of memcpy operations
  - Currently enabled by trace flag 809
    - https://learn.microsoft.com/sql/t-sql/database-console-commands/dbcc-traceon-trace-flags-transact-sql#tf809
- More info
  - https://learn.microsoft.com/sql/database-engine/configure-windows/hybrid-buffer-pool#hybrid-buffer-pool-with-direct-write

Query Store enhancements

- On by default (migrated databases retain original configuration)
- Query Store Hints (shape plans with no code changes)
- Query Store support for AG secondary replicas
- Now used also by Intelligent Query Processing

Query Store hints

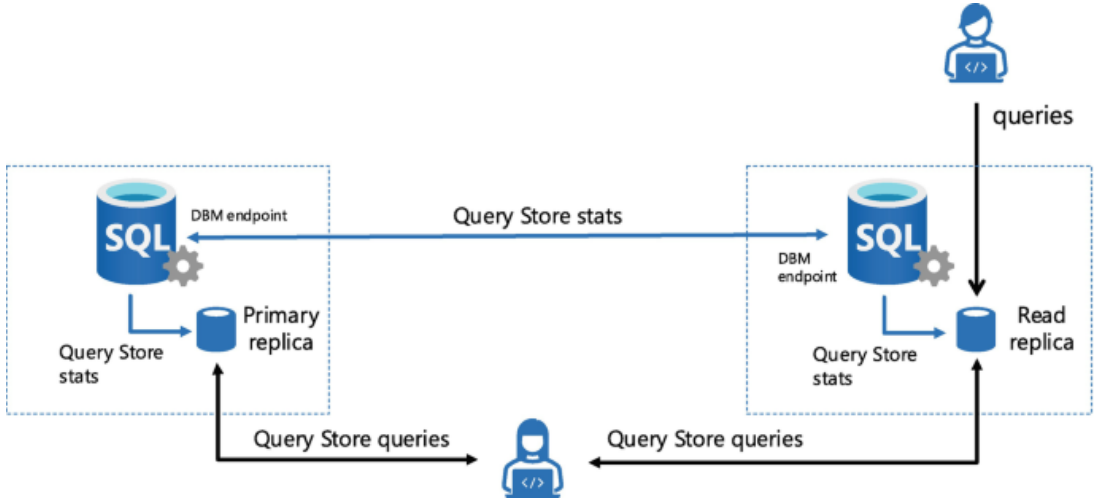
- Process much simpler than *Plan Guides*
  - Find query id in Query Store
  - Use **`sys.sp_query_store_set_hints`** to apply hint
  - Check for hint failures in **`sys.query_store_query_hints`**
- Hints survive plan cache eviction and restart!
- More info
  - https://learn.microsoft.com/sql/relational-databases/performance/query-store-hints

Query Store hints support

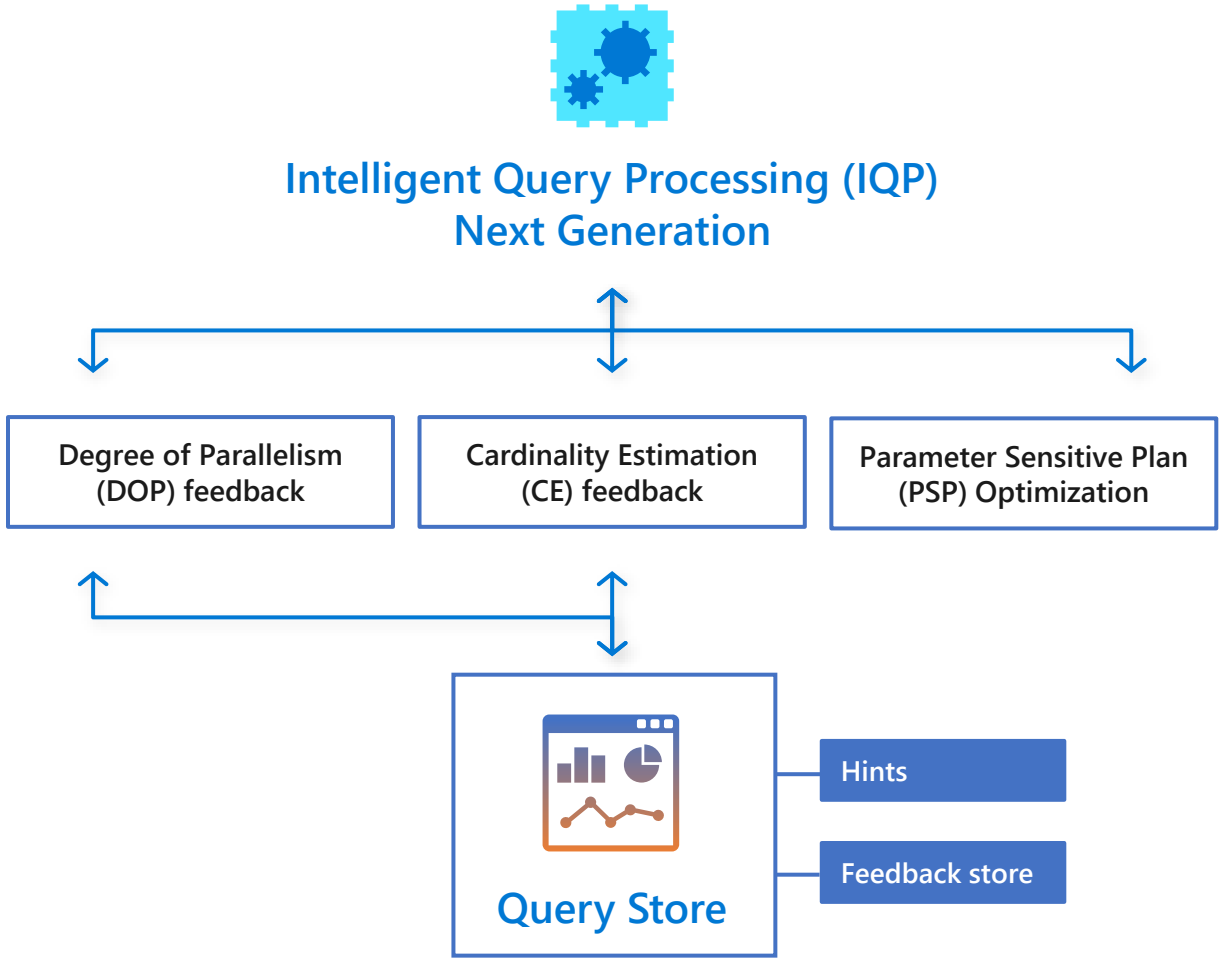
- **Supported hints**
  - { HASH | ORDER } GROUP
  - { CONCAT | HASH | MERGE } UNION
  - { LOOP | MERGE | HASH } JOIN
  - EXPAND VIEWS
  - FAST number_rows
  - FORCE ORDER
  - IGNORE_NONCLUSTERED_COLUMNSTORE_INDEX
  - KEEP PLAN
  - KEEPFIXED PLAN
  - MAX_GRANT_PERCENT = percent
  - MIN_GRANT_PERCENT = percent
  - **MAXDOP** number_of_processors
  - NO_PERFORMANCE_SPOOL
  - OPTIMIZE FOR UNKNOWN
  - PARAMETERIZATION { SIMPLE | FORCED }
  - **RECOMPILE**
  - ROBUST PLAN
  - **USE HINT** ('<hint_name>' [, ...n])
- **Unsupported hints**
  - OPTIMIZE FOR(@var = val)
  - MAXRECURSION
  - USE PLAN
    - consider QP original plan forcing
  - DISABLE_DEFERRED_COMPILATION_TV
  - DISABLE_TSQL_SCALAR_UDF_INLINING
  - Table hints
    - E.g. FORCESEEK, READUNCOMMITTED, INDEX
- **Feature interoperability**
  - https://learn.microsoft.com/sql/relational-databases/performance/query-store-hints#query-store-hints-and-feature-interoperability

Query Store for AG secondary replicas

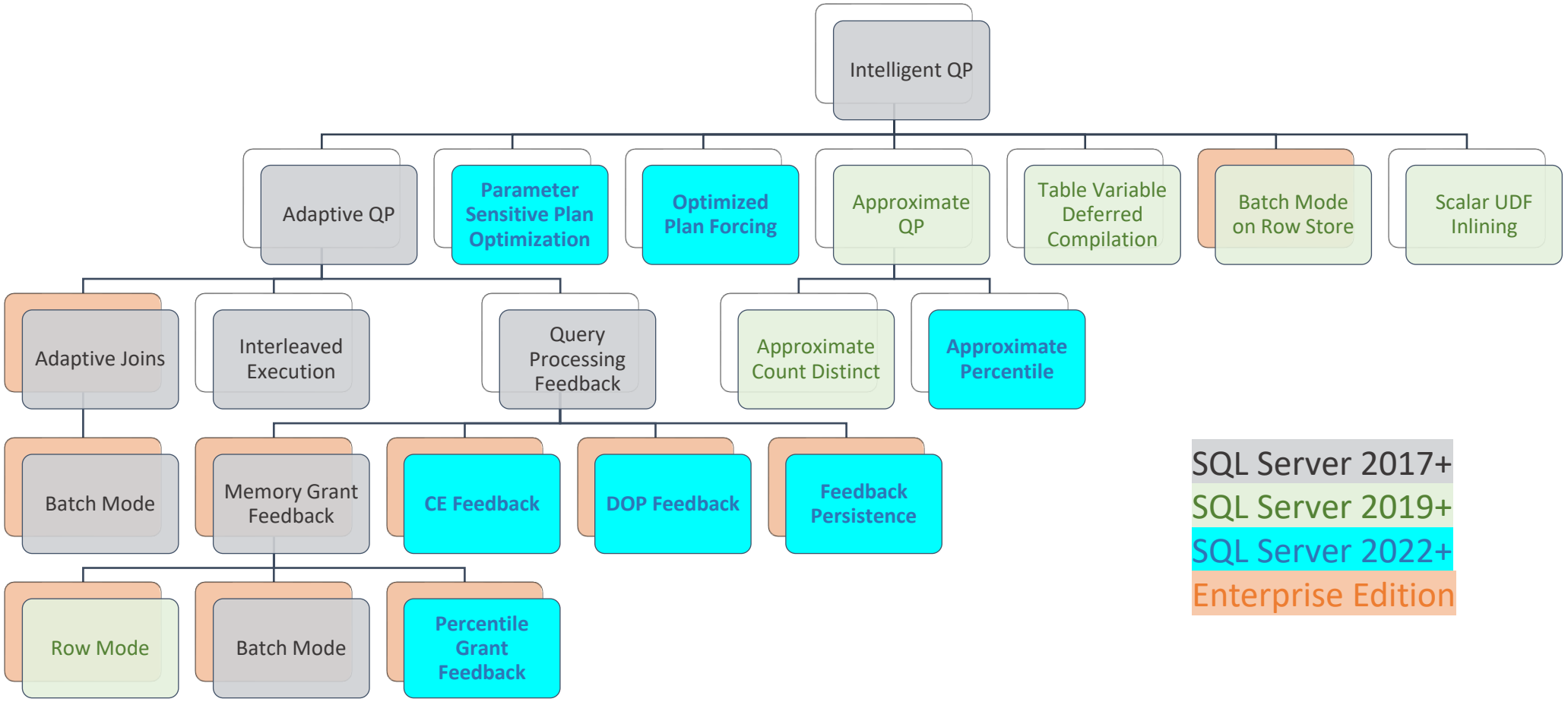
- Primary replica stores data
  - For all replicas
  - Column **`replica_group_id`** only in
    - **`sys.query_store_replicas`**
    - **`sys.query_store_runtime_stats`**
    - **`sys.query_store_wait_stats`**
- Enabled by trace flag 12606
- More info
  - https://learn.microsoft.com/sql/relational-databases/performance/query-store-for-secondary-replicas



Query Store and IQP



Intelligent Query Processing Gen 3



IPQ changes not gated by dbcompat…

SQL Server 2022

- Approximate Percentile
  - PERCENTILE_CONT
  - PERCENTILE_DISC
- Optimized Plan Forcing
  - Persists compile steps
  - Reduce compilation overhead

dbcompat 140+

- Memory Grant Percentiles
  - Smooth oscillation
- Memory Grant Feedback Persistence
  - Survive cache eviction and restart

dbcompat 160

- Parameter Sensitive Plan (PSP) Optimization
- Cardinality Estimation (CE) Feedback
- Degree of Parallelism (DOP) feedback

Security

What’s New in SQL Server 2022

Encryption Enhancements

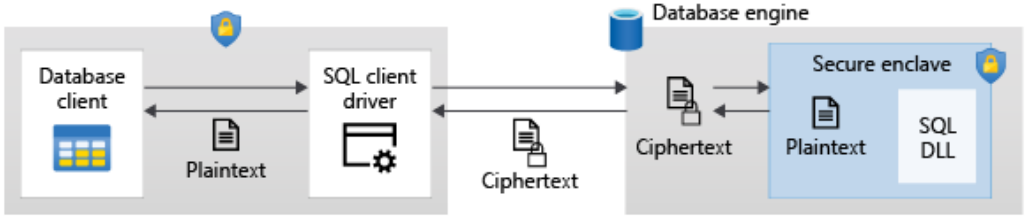
- Certificates
  - Support for import/export PKCS #12 or PFX file format
  - Certificates new default 3072-bits RSA key
- Backup/restore in Azure Blob Storage
  - Master keys
  - Symmetric keys
- Support for TLS 1.3 and TDS 8.0
  - New connection string option to force tighter TLS
    - **Encrypt=Strict** uses TDS 8 and **TrustServerCertificate** must point to certificate
    - **Encrypt=mandatory|true|yes** uses TDS 7.x and can still use **TrustServerCertificate=true**
  - https://learn.microsoft.com/sql/relational-databases/security/networking/tds-8-and-tls-1-3

Permission Enhancements

- 10 new fixed Server Roles
  - Example
    - **##MS_DefinitionReader##** has **VIEW ANY DEFINITION**
    - **##MS_ServerStateReader##** has **VIEW SERVER STATE** and **VIEW DATABASE STATE**
  - https://learn.microsoft.com/sql/relational-databases/security/authentication-access/server-level-roles#fixed-server-level-roles-introduced-in-sql-server-2022
- New granular permissions
  - https://techcommunity.microsoft.com/t5/azure-sql-blog/revamped-sql-permission-system-for-principle-of-least-privilege/ba-p/3639399
- Dynamic Data Masking
  - **UNMASK** permission now also at schema, table and column level!

Always Encrypted with Secure Enclaves

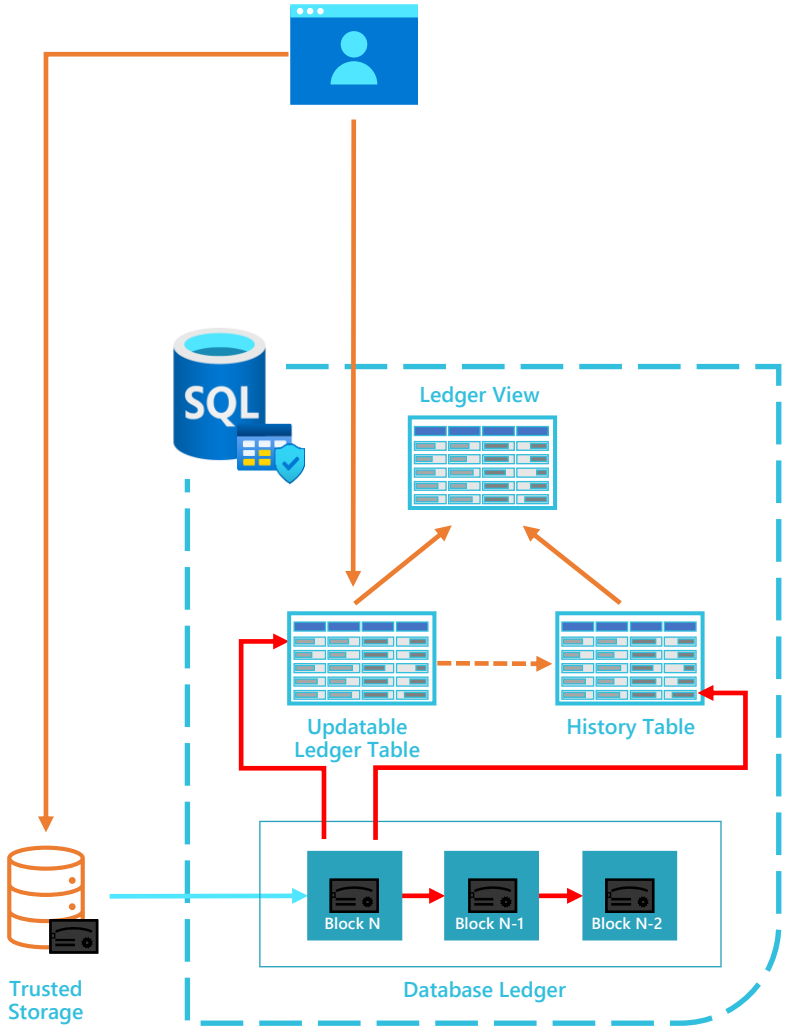
- Enhancements inside enclave
  - Multiple threads and key caching
  - More operations supported
- More info
  - https://learn.microsoft.com/sql/relational-databases/security/encryption/always-encrypted-enclaves



Operation/ Support	Azure SQL Database	SQL Server 2022	SQL Server 2019
Comparison operators	Yes	Yes	Yes
BETWEEN	Yes	Yes	Yes
IN	Yes	Yes	Yes
LIKE	Yes	Yes	Yes
DISTINCT	Yes	Yes	Yes
Joins	Yes	Yes	Only nested loops
ORDER BY	Yes	Yes	No
GROUP BY	Yes	Yes	No

Ledger Tables

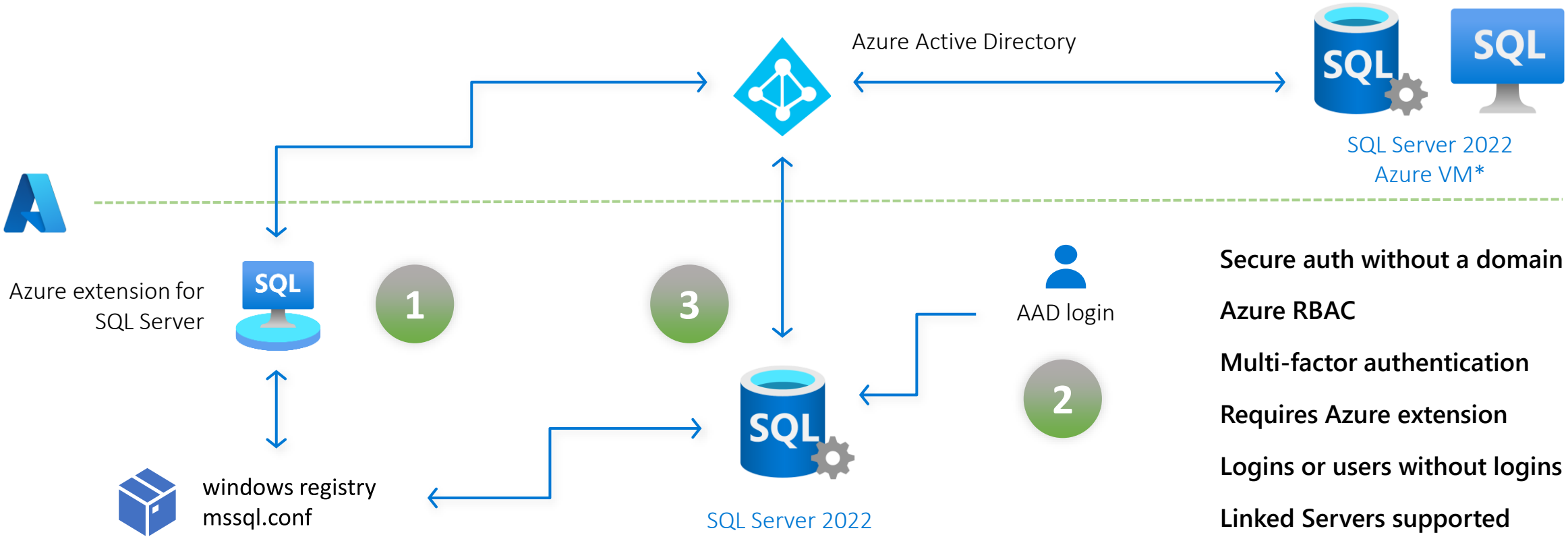
- **Updatable** allow insert/update/delete
- History of updated/deleted rows preserved in history table and easy-to-query Ledger View
- Integrity of updatable/history tables maintained through cryptographic links of the Database Ledger
- System can periodically upload digital receipts to a customer-configured trusted storage service
- Customer can use digital receipts to verify the integrity of the data
- **Append-Only** allow only insert
  - no need for a history table



https://aka.ms/aadsqlserver

Azure Active Directory for SQL Server

Challenge: I need an alternative for authentication than SQL and Windows domains



Secure auth without a domain

Azure RBAC

Multi-factor authentication

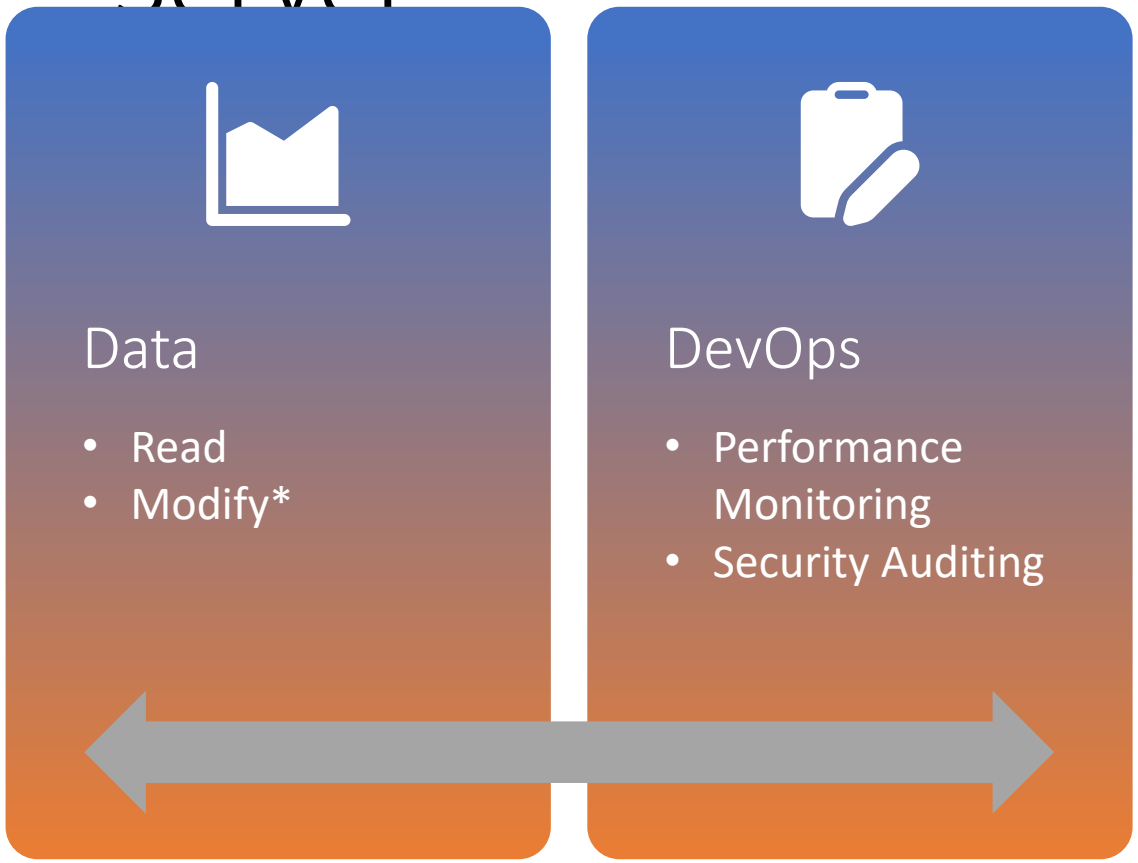
Requires Azure extension

Logins or users without logins

Linked Servers supported

* Public Preview

Microsoft Purview access policies for SQL Server



- [ ] Publish a policy from Purview
- [ ] Works only with AAD accounts
- [ ] No explicit login required
- [ ] Engine understands policies to grant login and specific permissions
- [ ] Engine integrates policies with standard logins and permissions
- [ ] Works across multiple SQL instances
- [ ] Remove policy removes authentication

Futures:

More granular scope

New policies

Self-service access

*Coming soon

https://aka.ms/purviewsqlaccesspolicies

Security resources for hybrid scenarios

- Azure Active Directory authentication
  - https://learn.microsoft.com/sql/relational-databases/security/authentication-access/azure-ad-authentication-sql-server-overview
- Microsoft Defender for Cloud integration
  - https://learn.microsoft.com/azure/defender-for-cloud/defender-for-sql-introduction
- Microsoft Purview integration (preview)
  - https://learn.microsoft.com/azure/purview/how-to-policies-data-owner-arc-sql-server

Availability

What’s New in SQL Server 2022

Backup metadata

- Last valid restore time
  - Latest point-in-time to which a backup can be restored
  - Column **`last_valid_restore_time`** in table **`msdb.dbo.backupset`**
- More info
  - https://docs.microsoft.com/sql/relational-databases/system-tables/backupset-transact-sql

Backup to S3 object storage

- Extends **`BACKUP/RESTORE … TO/FROM URL`** to S3 object storage
  - Similar to backup to URL to Azure Blob Storage
  - URL beginning with **`s3://`**
- Lot of details
  - Options, prerequisites, optimizations and some limitations
- More info
  - https://learn.microsoft.com/sql/relational-databases/backup-restore/sql-server-backup-to-url-s3-compatible-object-storage

Improved snapshot backup support

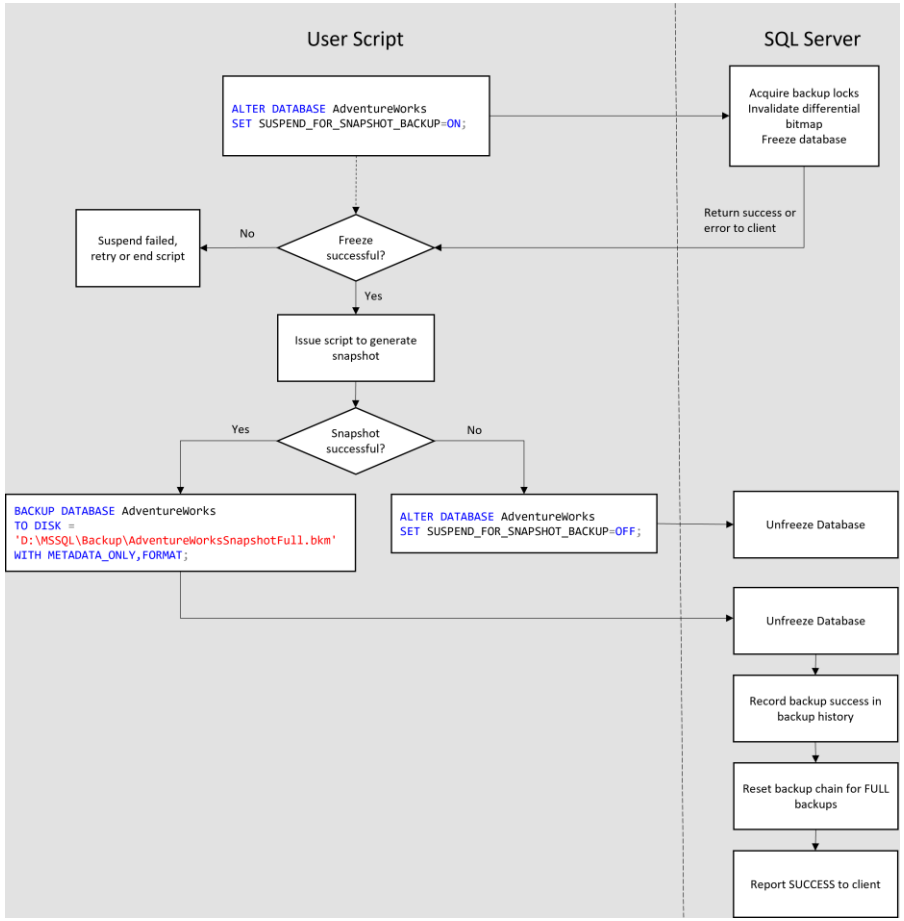
- Allow to orchestrate snapshot backup through T-SQL
  - Doesn't rely on SQL Writer, Windows VSS and SQL Server VDI
- All databases on server
  - **ALTER SERVER CONFIGURATION SET SUSPEND_FOR_SNAPSHOT_BACKUP = ON|OFF**
  - (initiate storage snapshot)
  - **BACKUP SERVER TO DISK= … WITH METADATA_ONLY, FORMAT**
- Group of database
  - **ALTER SERVER CONFIGURATION SET SUSPEND_FOR_SNAPSHOT_BACKUP = ON|OFF (GROUP=(db1,db2))**
  - (initiate storage snapshot)
  - **BACKUP GROUP db1,db2 TO DISK= … WITH METADATA_ONLY, FORMAT**
- Single database
  - **ALTER DATABASE … SET SUSPEND_FOR_SNAPSHOT_BACKUP = ON|OFF**
  - (initiate storage snapshot)
  - **BACKUP DATABASE … TO DISK= … WITH METADATA_ONLY, FORMAT**
- More info
  - https://learn.microsoft.com/sql/relational-databases/backup-restore/create-a-transact-sql-snapshot-backup

T-SQL snapshot backup process

Suspend
- Acquire locks
- Invalidate differential bitmap
- Freeze database(s)

Snapshot
- User initiates snapshot
- Storage performs snapshot

Backup
- Thaw database(s)
- Record backup
- Release backup locks



Hardware offloaded backup compression

- Currently only Intel QuickAssist (QAT) supported
  - Install drivers
    - Diagnostic DMV `sys.dm_server_accelerator_status`
  - Enable functionality
    - `sp_configure 'hardware offload enabled'`
  - Enable specific accelerator
    - `ALTER SERVER CONFIGURATION SET HARDWARE_OFFLOAD = ON|OFF (ACCELERATOR = QAT[, MODE = SOFTWARE])`
  - Backup
    - `COMPRESSION ALGORITHM = MS_XPRESS|other_algorithm`
- Usually, good performance with concurrent intensive workload
- More info
  - https://docs.microsoft.com/sql/relational-databases/system-tables/backupset-transact-sql

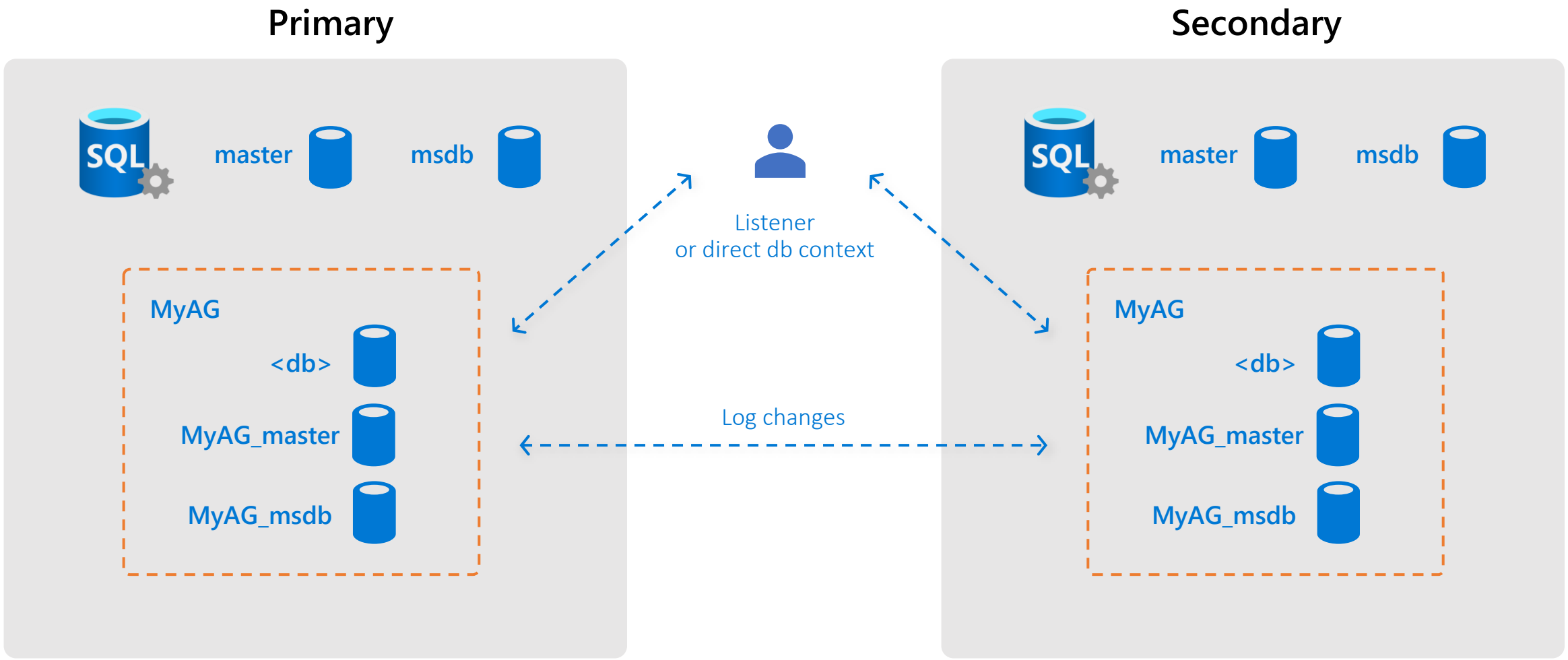
Parallel Redo Enhancements

- Removed thread pool limit for parallel redo (was 100)
- Red log records batched under a single latch improve speed of
  - Recovery, crash recovery and “catchup” redo

Contained Availability Groups

- Solution to avoid synchronizing instance level artifacts
  - E.g. logins, certificates, jobs, alerts etc.
- Copies of **`master`** and **`msdb`** in contained Ags
  - Always empty when creating AG
  - Use listener, direct connections see instance-level system databases!
- More info
  - https://docs.microsoft.com/sql/database-engine/availability-groups/windows/contained-availability-groups-overview

How Contained AGs work



Other Availability Groups Enhancements

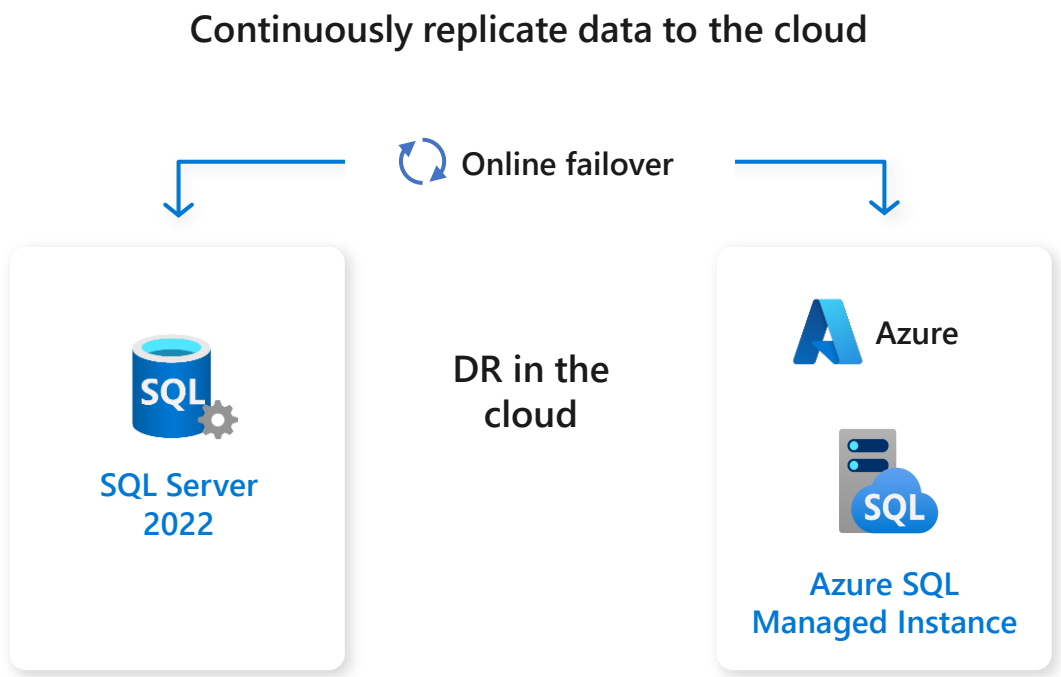
- Distributed Availability Groups
  - **REQUIRED_SYNCHRONIZED_SECONDARIES_TO_COMMIT**
- General reliability and supportability
  - Database recovery task run at higher deadlock priority
  - Fixed problem with replicas stuck recovery pending
  - Ensure data movement not paused on internal log block errors
  - Many other diagnostic changes backported also to latest SQL Server 2019 CU

Business continuity through Azure SQL Managed Instance

Disaster recovery in the cloud with link feature for Azure SQL Managed Instance

Challenge: Difficult to setup and maintain a DR site

- Use PaaS for managed disaster recovery
- Don't have an AG? We will build one for you with no replica or clustering required
- Built-in distributed availability group (DAG)
- Offline Disaster Recovery using backup/restore
- Online Disaster Recovery in preview



SQL License free DR (coming)

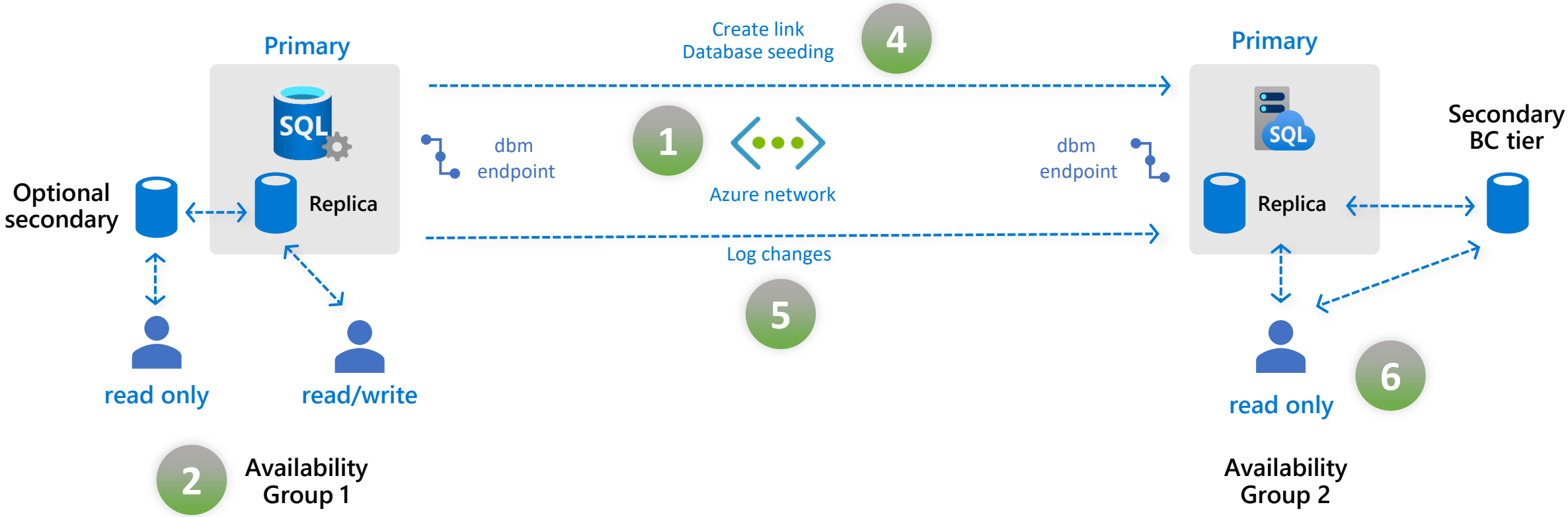
https:/aka.ms/milink

< SQL Server 2022 → Migration
SQL Server 2022 → DR

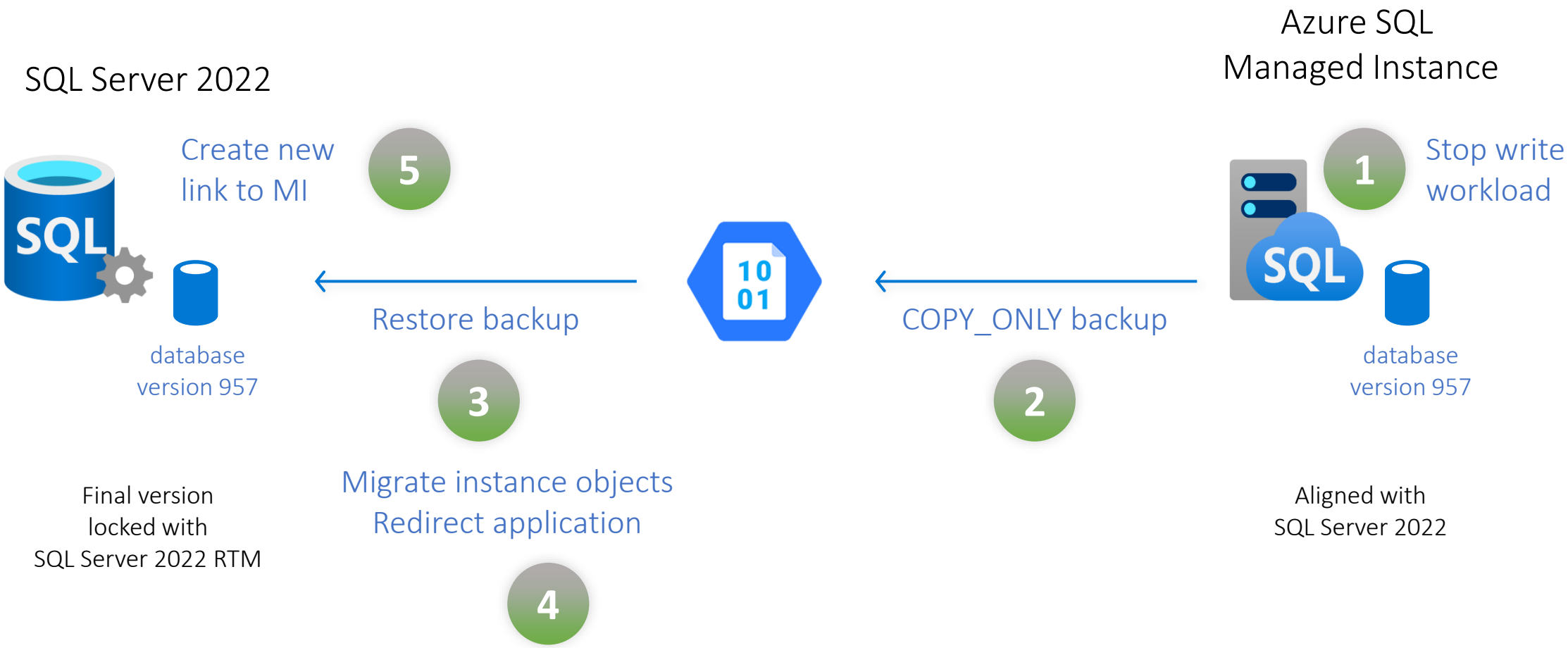
Link feature for Managed Instance

Distributed Availability Group (DAG) async 3

Single step with SSMS
using the replicate wizard



Offline Disaster Recovery with SQL Server 2022



Hybrid Cloud

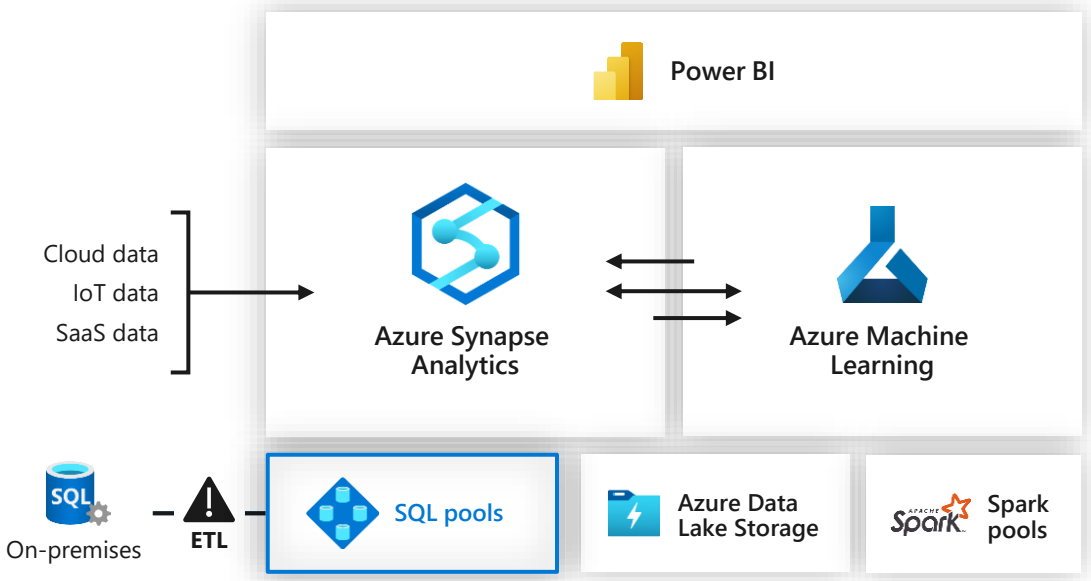
What’s New in SQL Server 2022

Azure Synapse Link for SQL Server

Seamless analytics over on-prem operational data

Challenge: ETL expensive, out of date, and affects operational workloads

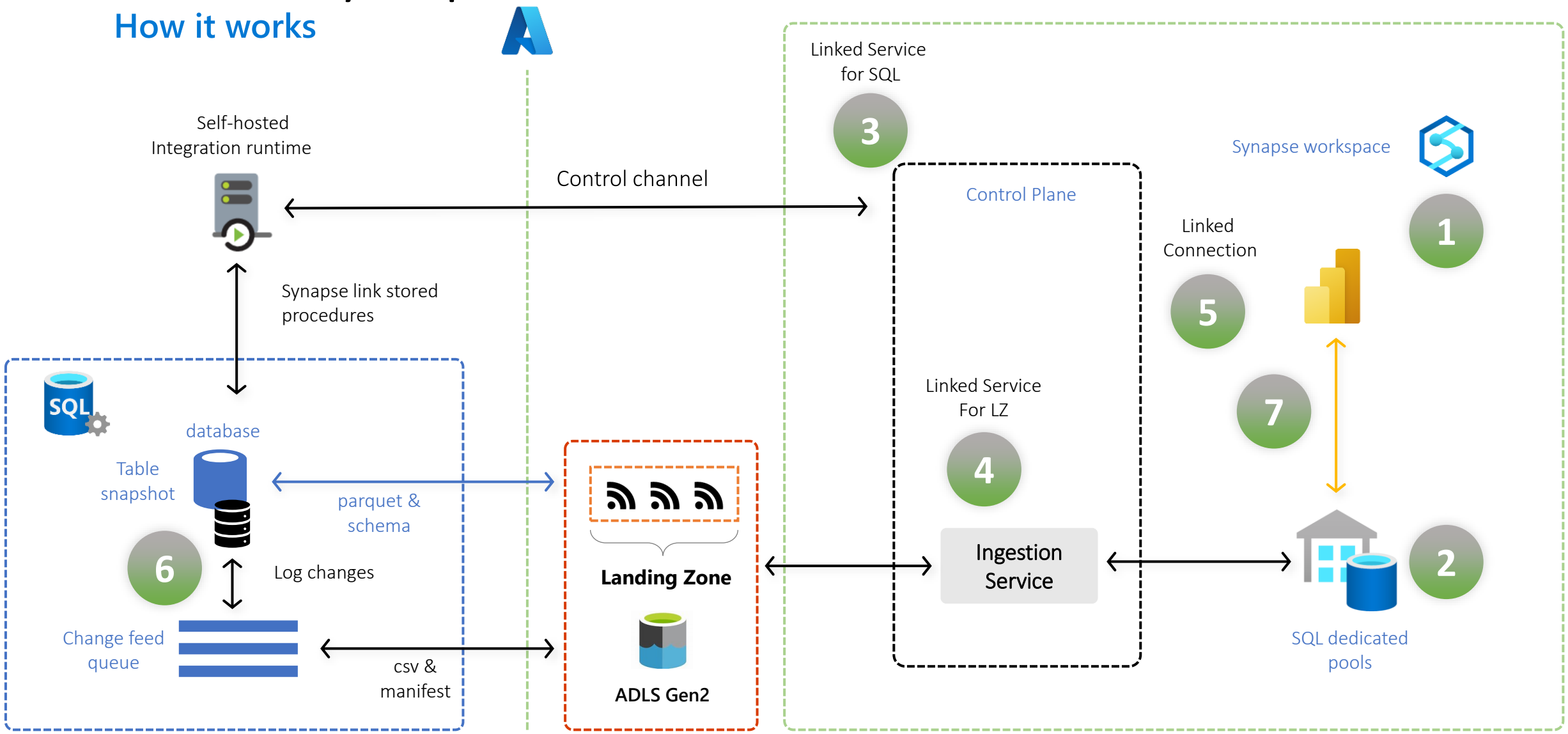
- **Break the wall between operational and analytical stores**
- **New change feed capability reduces impact on OLTP workloads**
- **Near real-time latency between SQL Server and Synapse Analytics**
- **Use SQL pools so harness the full power of a scalable warehouse solution**
- **Analyze all your data using both Spark and SQL runtimes in Synapse**



https:/aka.ms/synapselinksql

Azure Synapse Link for SQL Server

How it works



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Grazie!!!