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Key Enhancements in SQL Server 2025 for AG / High Availability

These are the major improvements specific to AGs / HA & DR in SQL Server 2025:

1. **Backups on Secondary**

   You can now offload *all types of backups* (full, differential, and transaction log backups) to a secondary replica. Previously (up to SQL Server 2022), secondary replicas could only perform copy-only full backups and log backups. (TECHCOMMUNITY.MICROSOFT.COM)

2. **Query Store & Readable Secondaries**
   - Query Store is now enabled **by default** on readable secondary replicas to allow performance telemetry / diagnostics there. (TECHCOMMUNITY.MICROSOFT.COM)
   - Persisted temporary statistics on readable secondaries now saved back to the primary, so behavior doesn't degrade after restarts. (TECHCOMMUNITY.MICROSOFT.COM)

3. **Failover / Recovery Improvements**
   - **Fast failover for persistent health issues**: New configuration that lets Windows Server Failover Clustering (WSFC) immediately fail over if continuous unhealthy signals are detected (for example, sustained I/O issues). (gethynellis.com)
   - **Asynchronous page request dispatching** during redo recovery: improves speed and throughput during failover recovery to async replicas. (gethynellis.com)
   - Better diagnostics around health timeouts and communication lag between primary & secondary, especially in asynchronous commit modes. (gethynellis.com)

4. **Flexible Configuration & Routing**
   - Ability to remove listener IP addresses without having to delete the listener, or setting routing URLs to NONE to revert to primary routing. Helps in scenarios like multi-subnet changes or network topologies. (gethynellis.com)
   - Improvements in distributed availability groups (AGs) between *contained availability groups* and better sync for distributed AGs. (gethynellis.com)

5. **Backup Compression & Storage Enhancements**
   - New choice of compression algorithm: **Zstandard (ZSTD)** to get more effective compression with better performance. (gethynellis.com)
   - Support for immutable storage when backing up to **Azure Blob Storage**, improving tamper resistance and compliance. (gethynellis.com)

6. **Engine & Performance Enhancements Relating to AGs**
   - Improvements to internal synchronization mechanisms to reduce network saturation when primary and forwarder replicas are in async commit modes. (gethynellis.com)
   - Enhanced health-check diagnostics (better timeout behavior, more granular monitoring) so DBAs can pinpoint lag / failures earlier. (gethynellis.com)

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🔍 How These Enhancements Work & What You Need to Do

Here are detailed mechanics and implications, and some of the configuration / operational changes you need to consider.

Feature	Mechanism / Behavior	What To Configure / Enable
Backups on Secondary (Full, Diff, Log)	The AG metadata now supports backup preference settings to direct all backup types to a secondary replica (not just copy-only). Under the hood, APIs and T-SQL for backups check whether backup preference / priority settings allow secondary backups. (TECHCOMMUNITY.MICROSOFT.COM)	You'll need to set AG configuration: AUTOMATED_BACKUP_PREFERENCE and possibly new/updated parameters like BACKUP_PRIORITY. Alter availability group properties. Ensure secondaries are set up with enough I/O, storage, and permissions to do backups. Validate network capacity, the backup directory, etc.
Query Store on Secondaries	With Query Store enabled on readable secondaries, telemetry (query performance, wait stats, plan changes) is captured there. Also, temporary statistics on secondaries now are persisted so restart doesn't lose them. This helps read workload performance stability. (TECHCOMMUNITY.MICROSOFT.COM)	Validate that readable secondary replicas are configured (allow read access). Check compatibility levels (some features need higher compatibility). Monitor space usage for Query Store on each replica. Review settings for persisting stats.
Failover / Recovery Enhancements	Persistent health checks: WSFC (or the cluster service) can trigger failovers faster when certain thresholds are breached. Asynchronous page request dispatching reduces bottlenecks during redo (i.e. when secondary is catching up or becoming primary). Better diagnostics help you see lag, which replicas are falling behind. (gethynellis.com)	Ensure that health checks thresholds are configured appropriately. Monitor redo queue sizes. Test failover behavior under load. Possibly tune cluster settings. Confirm documentation / prerequisites.
Flexible AG Configuration	You can adjust network/listener configuration more flexibly — e.g. remove IPs without deleting objects, switch routing more easily. Distributed AGs between contained AGs better synchronized. (gethynellis.com)	Review your listener / DNS / network architecture. If operating across multiple subnets or data centers, ensure you test listener behavior. For distributed AGs, plan replication / synchronization accordingly.
Compression & Storage Improvements	ZSTD offers better (usually) compression ratio and possibly faster compression/decompression, reducing storage costs and potentially improving backup times. Immutable storage (Azure Blob) ensures backups cannot be altered after being written. (gethynellis.com)	When creating backup jobs, test ZSTD vs existing compression for your data (because results vary). Ensure your backup targets support immutable storage if you choose that path. Adjust backup scripts and policies. Possibly update your monitoring / retention for backups accordingly.
Network / Sync Improvements	Reducing network saturation means better throttle / flow control when data movement is heavy (e.g. during log send/redo), especially in async mode. Diagnostics enhancements help spot lagging replicas early. (gethynellis.com)	Establish baseline metrics for your AGs (log send queue, redo queue, network utilization). Monitor new diagnostics. Adjust bandwidth / latency between replicas. Ensure secondaries are capable (hardware / storage) to keep up.

✅ Implications / Best Practices

Given the enhancements, here are what you likely want to change or verify in your environment:

- **Backup strategy revision**: With full/differential/log backups allowed on secondaries, you can offload more work from your primary. But ensure that secondaries are capable (disk speed, I/O, bandwidth).

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- **Capacity / hardware on secondaries**: Because secondaries will now be doing more than just read-only workloads, they need to be sized for backup I/O, redo operations, etc.
- **Network and latency considerations**: If secondaries are remote (across region or data centers), backups and log sends/redo need reliable high throughput. You'll need to validate bandwidth and latency.
- **Monitoring and alerting**: Use the improved diagnostics to set alerts for lagging replicas, redo backlog, health issues. New metrics should be incorporated.
- **Failover testing**: Test behavior under failure, including when persistent health triggers failover, or when async replicas need to become primary.
- **Backup verification / restore practice**: Even if backups run on secondaries, ensure that restores from these backups are working as expected (especially for full & differential).
- **Compatibility level & feature prerequisites**: Some of these new features require a minimum database compatibility level (e.g. JSON enhancements, query store behavior). Confirm version / patching status.
- **Security / compliance**: Using immutable storage for backups helps with compliance. Offloading backups to secondaries may involve different security boundaries, so ensure permissions, encryption, etc. are properly managed.

📊 **Always On Availability Groups – Feature Comparison (2019 → 2022 → 2025)**

Feature / Area	SQL Server 2019	SQL Server 2022	SQL Server 2025
Basic AG Support	Up to 8 secondary replicas (readable secondaries supported)	Same as 2019	Same as 2022
Contained Availability Groups	❌ Not supported	✅ Introduced (system databases in AG, simplified DR)	✅ Improved (better integration with distributed AGs)
Distributed Availability Groups	✅ Supported	✅ Improved, easier failover	✅ Further enhanced (better sync with contained AGs)
Backups on Secondary	❌ Only log backups and copy-only full allowed	❌ Same as 2019	✅ **Full, Differential, and Log backups supported** on secondaries (major offload improvement)
Backup Compression	✅ Native compression (LZ77)	✅ Improved performance	✅ New **ZSTD compression** option (better ratio & speed)
Immutable Backup Storage	❌ Not available	❌ Not available	✅ **Azure Blob immutable storage support** for tamper-proof backups
Read-scale Routing	✅ Supported	✅ Improved load balancing	✅ Enhanced routing (e.g., listener IPs removable, route reset options)
Query Store on Secondary	❌ Not available	✅ Query Store on primaries only	✅ **Query Store on readable secondaries**, plus persisted stats across restarts
Failover Detection / Recovery	✅ Basic WSFC health checks	✅ Faster failover detection, better diagnostics	✅ **Persistent health checks**, **async page request dispatching** for faster redo during failover
Health Diagnostics	Limited DMV diagnostics	✅ Better monitoring for lag, sync state	✅ **Granular diagnostics** (network lag, redo bottlenecks, health timeout visibility)

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Feature / Area	SQL Server 2019	SQL Server 2022	SQL Server 2025
Contained Users & Authentication	❌ Not in AG context	✅ Contained AGs support contained logins	✅ Same, but with more maturity and Azure AD integration
Cloud Integration	✅ Supported for Azure SQL MI, hybrid scenarios	✅ Better integration with Azure Arc	✅ **Closer alignment with Azure SQL HA/DR**, cloud-first parity
Automatic Seeding	✅ Supported (direct seeding)	✅ Improved reliability	✅ Same, but with more monitoring enhancements
Sync / Network Performance	Standard sync (sync/async)	✅ Improved redo performance	✅ **Reduced network saturation**, better async commit performance
Security / Compliance	✅ TDE, backup encryption	✅ TDE/backup encryption improved	✅ Immutable backups + extended auditing + better failover security controls

What's Most Impactful for DBAs in SQL Server 2025

1. **Backup Enhancements** – finally you can offload *all backup types* (FULL, DIFF, LOG) to secondaries, not just log + copy-only. This is huge for reducing load on primaries.
2. **ZSTD Compression** – potentially lowers backup size/cost, especially for cloud storage.
3. **Immutable Storage** – compliance, ransomware protection.
4. **Query Store & Stats on Secondaries** – read workloads are now easier to tune and keep stable.
5. **Failover Speed & Diagnostics** – more predictable recovery, less time in limbo during outages.
6. **Network & Sync Optimizations** – async replicas behave more reliably, especially over WAN/multi-region.