Accelerating Microsoft SQL Server 2025 Backups with Intel QuickAssist Technology on Lenovo ThinkSystem SR650 V4

Solution Brief

Microsoft SQL Server 2025 introduces integrated acceleration and offloading for backup compression with Intel QuickAssist Technology (QAT), along with a new ZSTD compression algorithm. At the same time, Intel Xeon 6 processors, DDR5 memory and PCIe 5.0 NVMe storage have raised the performance ceiling of a single 2U server. Together, these changes give database teams a practical way to shorten backup windows without adding hardware or changing their applications.

This brief features Microsoft SQL Server 2025 running on Microsoft Windows Server 2025 on the Lenovo ThinkSystem SR650 V4 and focuses on backup compression using Intel QAT.



Figure 1. Lenovo ThinkSystem SR650 V4 with security bezel

Business Challenge

Data growth and shrinking backup windows

The rapid growth of technology means the amount of available data and the ability to collect that data has increased to an unprecedented level. As the volume and velocity of data increase, protecting that data within shrinking backup windows becomes more complex. Backups must be completed faster, consume less storage, and have minimal impact on production workloads.
For database and infrastructure teams, this creates several pressures:

- **Shrinking backup windows**: databases grow every year while the time available to back them up stays the same or shrinks.
- **Compression tradeoffs**: standard backup compression saves storage but consumes CPU and extends backup time; skipping compression is faster but nearly doubles backup storage.
- **Production impact**: backups that run long compete with business workloads for CPU and I/O.
- **Recovery objectives**: slower backups and restores make recovery point and recovery time objectives harder to meet.

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Solution

Lenovo Solutions for Microsoft SQL Server on ThinkSystem SR650 V4 are optimized for both Online Transaction Processing (OLTP) and Data Warehouse (DW) or Decision Support Systems (DSS).

The ThinkSystem SR650 V4 is configured with an Intel® Xeon® 6 processor, TruDDR5 memory and NVMe storage, with support for PCIe 5.0 devices for I/O.

Enterprise database solutions with faster time-to-value

Lenovo ThinkSystem SR650 V4 systems are tested and tuned to save you time in configuration, setup, testing, and tuning. With these servers, you get the following advantages:

- Faster SQL Server backups using Intel QAT backup compression
- Improved performance of SQL Server solutions with higher core counts, DDR5 memory bandwidth and PCIe Gen 5 devices
- Improved density to support more and larger databases per host
- Simplified evaluation and fast, easy deployment with pretested and sized hardware configurations

Microsoft SQL Server 2025

SQL Server 2025 (17.x) supports integrated acceleration and offloading with Intel QAT. Backup compression can use the QAT_DEFLATE algorithm in software mode or, where a supported QAT device is present, in hardware mode.
Here are some backup-related capabilities in SQL Server 2025:

- Intel QuickAssist Technology (QAT) backup compression with software or hardware acceleration (QAT_DEFLATE algorithm)
- Selection of the compression algorithm per backup with COMPRESSION (ALGORITHM = ...), or as the instance default
- New ZSTD backup compression algorithm with selectable levels
- Backup history records the compression algorithm used for each backup

Lenovo ThinkSystem SR650 V4 servers offer the necessary performance for bare metal or virtualized SQL Server deployments. NVMe storage and Remote Direct Memory Access (RDMA) networking are natively supported in Windows Server 2025.

This configuration features the following main components:

- Server: Lenovo ThinkSystem SR650 V4
- Processor: 1x Intel Xeon 6530P, 32 cores, 2.3 GHz, 225 W
- Memory: 128 GB (2x 64 GB) TruDDR5 6400 MT/s
- DB Storage: 4x ThinkSystem U.2 VA 3.84TB Read Intensive NVMe PCIe 5.0 x4
- Log Storage: 2x ThinkSystem U.2 VA 1.6TB Mixed Use NVMe PCIe 5.0 x4
- Backup Storage: Volume D: (NVMe, no RAID)
- OS Storage: 2x M.2 drives, RAID 1 (ThinkSystem M.2 RAID B550i-2i SATA/NVMe Enablement Kit)
- Software: Microsoft Windows Server 2025; Microsoft SQL Server 2025; Intel QAT driver / QATzip library

Backup Compression and Off-Load

SQL Server supports backup compression with Intel QuickAssist Technology (QAT) using the QAT_DEFLATE algorithm. Improvements can be seen with either software-only compression or with Intel

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hardware that supports QAT offloading and acceleration.

The benefits of QAT include:

- Reduced backup capacity
- Minimal CPU impact
- Minimal workload impact
- Faster backups
- Faster restores

This brief shows the performance benefits of software mode. Software mode was tested because it is available in both the Standard and Enterprise editions of SQL Server 2025; hardware mode requires Enterprise edition. In software-only mode, SQL Server still uses the Intel QAT algorithm (QATzip with the Intel ISA-L library) to improve backup times. Table 1 in the Business Outcome section shows the test configuration and the Lenovo test results of software-only mode QAT backups. Results are expressed relative to SQL Server backup compression without QAT (MS_XPRESS = 1.00x), as shown in Table 1 and Figures 1 and 2.

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Uses Cases

Meeting backup windows for growing OLTP databases

Transactional databases grow every year, but the nightly window to protect them does not. By switching the backup compression algorithm from MS_XPRESS to QAT_DEFLATE, a database team on SQL Server 2025 can complete compressed full backups in roughly 0.39x the time with no application changes, recovering hours in the maintenance window while keeping backup storage at the same compressed size.

Faster backups without new accelerator hardware

QAT software mode uses the QATzip and Intel ISA-L libraries on the Intel Xeon 6 processor, so organizations can gain faster compressed backups on a standard ThinkSystem SR650 V4 configuration. Where a supported QAT device is present, the same configuration can move to hardware mode to offload compression from the CPU.

Consolidating more databases per host

Higher core counts, DDR5 memory bandwidth and PCIe 5.0 NVMe storage let a single SR650 V4 host more and larger SQL Server databases. Shorter backup jobs make consolidation practical, because more databases can be protected within the same window on the same server.

Workloads

The ThinkSystem SR650 V4 configuration in this brief is sized for Microsoft SQL Server OLTP and DW/DSS workloads, with database, log, backup and OS storage on separate devices. The following sections describe the workload profiles that benefit most, sizing considerations, how to enable QAT, how the backups were run, and recommended best practices.

Workload profiles

- OLTP: frequent full and differential backups that must fit within tight maintenance windows. Cutting compressed backup time to 0.39x of MS_XPRESS frees up time in the window directly.
- Data warehouse and decision support: large databases with weekly or nightly full backups. The larger the backup, the more hours a 2.6x throughput gain saves.
- Consolidated hosts: many databases on a single SR650 V4, where shorter backup jobs let more databases be protected within the same window.

Sizing considerations

- CPU headroom: software mode runs compression on the processor cores. Schedule backups outside peak hours, or plan for hardware mode in Enterprise edition to offload compression to the QAT devices in the Intel Xeon 6 processor.
- Backup target: the backup storage must sustain the higher throughput; a slow target removes the benefit.
- Data compressibility: results depend on the data. Encrypted or already compressed data compresses less, and the tested 61.7 GB database represents a single data point.
- Striping: use multiple backup files and MAXTRANSFERSIZE = 4194304, as in the tested configuration.

Enable and Configure QAT

Install the Intel QAT driver (required for both hardware and software mode). The minimum QATzip library version supported by Microsoft is 1.8.0-0010; install the latest version from Intel and restart the server. After installation, the QATzip library is in C:\Windows\System32 and the ISA-L library is in C:\Program Files\Intel\ISAL.

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Enable QAT (required for both hardware and software)

```
sp_configure 'show advanced options', 1
GO
RECONFIGURE
GO
sp_configure 'hardware offload enabled', 1
GO
RECONFIGURE
GO
```

Restart the SQL Server service.

Enable QAT hardware mode (if your system has QAT hardware; falls back to software mode)

```
ALTER SERVER CONFIGURATION
SET HARDWARE_OFFLOAD = ON (ACCELERATOR = QAT)
GO
```

Enable QAT software mode

```
ALTER SERVER CONFIGURATION
SET HARDWARE_OFFLOAD = ON (ACCELERATOR = QAT, MODE = SOFTWARE)
GO
```

Restart the SQL instance to apply changes.

Verify QAT is enabled and the mode (mode_desc must be SOFTWARE or HARDWARE; NONE means QAT is not active)

```
SELECT accelerator, accelerator_desc, config, config_in_use, mode, mode_desc,
       mode_reason, mode_reason_desc, accelerator_hardware_detected,
       accelerator_library_version, accelerator_driver_version
FROM sys.dm_server_accelerator_status
GO
```

Check backup compression and hardware offload settings

```
SELECT [name], [value], value_in_use, is_dynamic, is_advanced
FROM sys.configurations
WHERE [name] IN (N'backup compression default',
                 N'backup compression algorithm',
                 N'hardware offload config',
                 N'hardware offload enabled',
                 N'hardware offload mode')
ORDER BY [name]
GO
```


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Check the SQL Server error log for QAT library messages (use when mode_desc is NONE)

```
EXEC sp_readerrorlog 0, 1, 'Intel'
GO
```

Optional: set QAT_DEFLATE as the default backup compression algorithm (dynamic, no restart; 1 = MS_XPRESS, 2 = QAT_DEFLATE)

```
EXEC sp_configure 'backup compression algorithm', 2
GO
RECONFIGURE
GO
```

Disable QAT (restart required)

```
ALTER SERVER CONFIGURATION
SET HARDWARE_OFFLOAD = OFF (ACCELERATOR = QAT)
GO
```

Note: an instance that restores a QAT_DEFLATE backup must have the QAT driver installed and QAT enabled; otherwise, error 17441 is returned.

Run Backups

No compression

```
BACKUP DATABASE [TestDB] TO DISK = 'D:\Backups\NoComp_1.bak'
WITH COPY_ONLY, FORMAT, INIT, NO_COMPRESSION, MAXTRANSFERSIZE = 4194304, STATS = 10
GO
```

MS_XPRESS compression

```
BACKUP DATABASE [TestDB] TO DISK = 'D:\Backups\MS_XPRESS_1.bak'
WITH COPY_ONLY, FORMAT, INIT, COMPRESSION (ALGORITHM = MS_XPRESS), MAXTRANSFERSIZE = 4194304, STAT
S = 10
GO
```

QAT compression

```
BACKUP DATABASE [TestDB] TO DISK = 'D:\Backups\QAT_DEFLATE_1.bak'
WITH COPY_ONLY, FORMAT, INIT, COMPRESSION (ALGORITHM = QAT_DEFLATE), MAXTRANSFERSIZE = 4194304, ST
ATS = 10
GO
```

Four backup files (striped backup; same pattern for each algorithm)

```
BACKUP DATABASE [TestDB]
TO DISK = 'D:\Backups\QAT_DEFLATE_4_1.bak', DISK = 'D:\Backups\QAT_DEFLATE_4_2.bak',
```


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```
   DISK = 'D:\Backups\QAT_DEFLATE_4_3.bak', DISK = 'D:\Backups\QAT_DEFLATE_4_4.bak'
WITH COPY_ONLY, FORMAT, INIT, COMPRESSION (ALGORITHM = QAT_DEFLATE), MAXTRANSFERSIZE = 4194304, ST
ATS = 10
GO
```

Collect backup time, size, compression ratio and algorithm

```
SELECT TOP (30) bs.database_name,
       CONVERT(BIGINT, bs.backup_size / 1048576) AS [Uncompressed Backup Size (MB)],
       CONVERT(BIGINT, bs.compressed_backup_size / 1048576) AS [Compressed Backup Size (MB)],
       CONVERT(NUMERIC(20,2), CONVERT(FLOAT, bs.backup_size) /
               CONVERT(FLOAT, bs.compressed_backup_size)) AS [Compression Ratio],
       bs.compression_algorithm,
       DATEDIFF(SECOND, bs.backup_start_date, bs.backup_finish_date) AS [Backup Elapsed Time (se
c)],
       bs.backup_finish_date, bmf.physical_device_name
FROM msdb.dbo.backupset AS bs
INNER JOIN msdb.dbo.backupmediafamily AS bmf ON bs.media_set_id = bmf.media_set_id
WHERE bs.database_name = N'TestDB' AND bs.[type] = 'D'
ORDER BY bs.backup_finish_date DESC
GO
```

Best practices for running SQL Server on ThinkSystem SR650 V4

For a high-performance SQL Server solution, implement the following best practices:

- Configure UEFI (BIOS) settings to set Operating mode to Maximum Performance.
- Configure the power plan in Windows Server to ‘High performance’.SQL
- Server database and log drives are recommended to be formatted with 64KB NTFS allocation unit size.
- SQL Server database and log files should be on separate physical drives.
- The OS and SQL Server binary drives are recommended to be formatted with the standard 4KB NTFS allocation unit size.
- Place backup files on storage that can sustain the target write rate; a slow backup target limits backup throughput.
- Use multiple backup files (striping) and MAXTRANSFERSIZE = 4194304 to increase backup throughput.
- Install the latest Intel QAT driver supported for Windows Server 2025 and the installed processor and verify the QAT mode after every configuration change.
- TempDB is shared by many processes and users as a temporary working area and should be configured appropriately. The default configuration is suitable for most workloads.
- If the server is dedicated to the SQL Server workload, use the default dynamic memory management model or follow Microsoft SQL Server documentation for manually configuring memory options.

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Bill of Materials

The following table lists the key components of the ThinkSystem SR650 V4 configuration used in Lenovo testing. Contact your Lenovo representative for the complete configuration.

Table 1. ThinkSystem SR650 V4 configuration used in Lenovo testing

Part Number	Description	Quantity
7DGDCTO1WW	Server : ThinkSystem SR650 V4-3yr Base Warranty	1
C3QK	ThinkSystem SR650 V4 24x2.5" Chassis	1
C5QT	Intel Xeon 6530P 32C 225W 2.3GHz Processor	1
C0TQ	ThinkSystem 64GB TruDDR5 6400MHz (2Rx4) RDIMM	2
C0ZU	ThinkSystem 2.5" U.2 VA 3.84TB Read Intensive NVMe PCIe 5.0 x4 HS SSD	4
C0ZR	ThinkSystem 2.5" U.2 VA 1.6TB Mixed Use NVMe PCIe 5.0 x4 HS SSD	2
C3RU	ThinkSystem 2U V4 8x2.5" AnyBay Backplane	1
CC7G	ThinkSystem M.2 RAID B550i-2i SATA/NVMe Enablement Kit	1
BE4T	ThinkSystem Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-port OCP Ethernet Adapter	1
BE4U	ThinkSystem Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter	1
C0U5	ThinkSystem 1300W 230V/115V Platinum CRPS Hot-Swap Power Supply v2.4	2
C3K9	XClarity Platinum Upgrade v3	1

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Business Outcome

Lenovo testing on the ThinkSystem SR650 V4 shows that enabling QAT software mode in SQL Server 2025 delivers measurably faster compressed backups than the standard MS_XPRESS algorithm:

- Shorter backups: QAT_DEFLATE completed the backup in 0.39x the time of MS_XPRESS, a reduction of about 61%.
- Higher throughput: about 2.6x the backup throughput (2.57x with one backup file, 2.55x with four).
- Same storage savings: compressed backup size was 0.98x that of MS_XPRESS, roughly 44% smaller than an uncompressed backup.
- Consistent at scale: results held with both single-file and four-file striped backups.

Uncompressed backups remained the fastest in absolute terms but produced backups 1.74x the size of compressed ones; QAT narrows that gap while keeping the storage savings of compression.

Table 2. QAT backup compression test configuration and relative results (MS_XPRESS without QAT = 1.00x; lower is better for time and size, higher is better for throughput)

Test item	**Value**			
Hardware Configuration	ThinkSystem SR650 V4, 1x Intel Xeon 6530P (32 cores, 2.3 GHz, 225 W), 128 GB (2x 64 GB) TruDDR5 6400 MT/s, 4x VA 3.84TB Read Intensive NVMe (database), 2x VA 1.6TB Mixed Use NVMe (log), 2x M.2 RAID 1 (OS)			
Operating System	Microsoft Windows Server 2025			
Database tested	Microsoft SQL Server 2025			
SQL Server edition	Microsoft SQL Server 2025 Enterprise			
Database name	TestDB			
QAT mode	Software (QAT_DEFLATE)			
QAT driver / library	Intel(R) QuickAssist Technology Driver Version: 2.6.0.x			
Database size	61,668 MB (uncompressed backup size)			
Backup parameters	COPY_ONLY, FORMAT, INIT, MAXTRANSFERSIZE = 4194304; 1 and 4 backup files			
Backup target	D			
Intel QuickAssist Technology (QAT) Backup Compression Results (relative to MS_XPRESS without QAT = 1.00x)				
Backup Type	**Backup Files**	**Time (relative)**	**Throughput (relative)**	**Backup Size (relative)**
No Compression	1	0.21x	4.74x	1.74x
MS_XPRESS Compression	1	1.00x	1.00x	1.00x
QAT SW Compression (QAT_DEFLATE)	1	0.39x	2.57x	0.98x
No Compression	4	0.14x	7.39x	1.74x
MS_XPRESS Compression	4	1.00x	1.00x	1.00x
QAT SW Compression (QAT_DEFLATE)	4	0.39x	2.55x	0.98x

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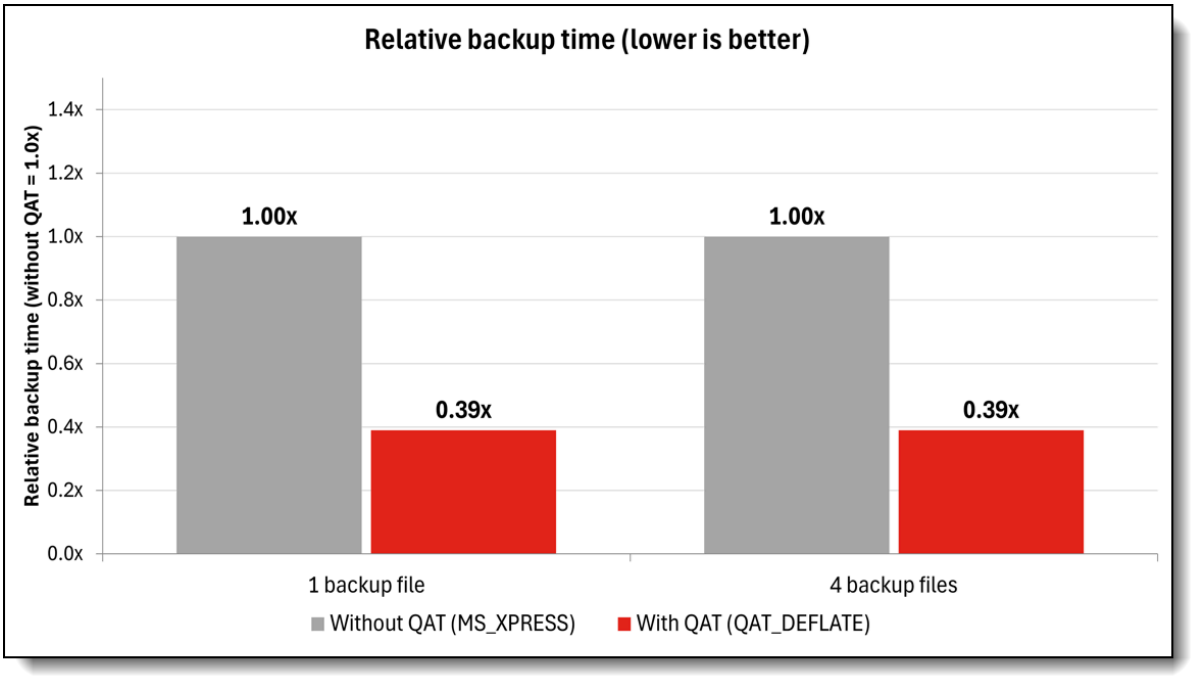


Figure 2. Relative backup time with and without QAT (lower is better)

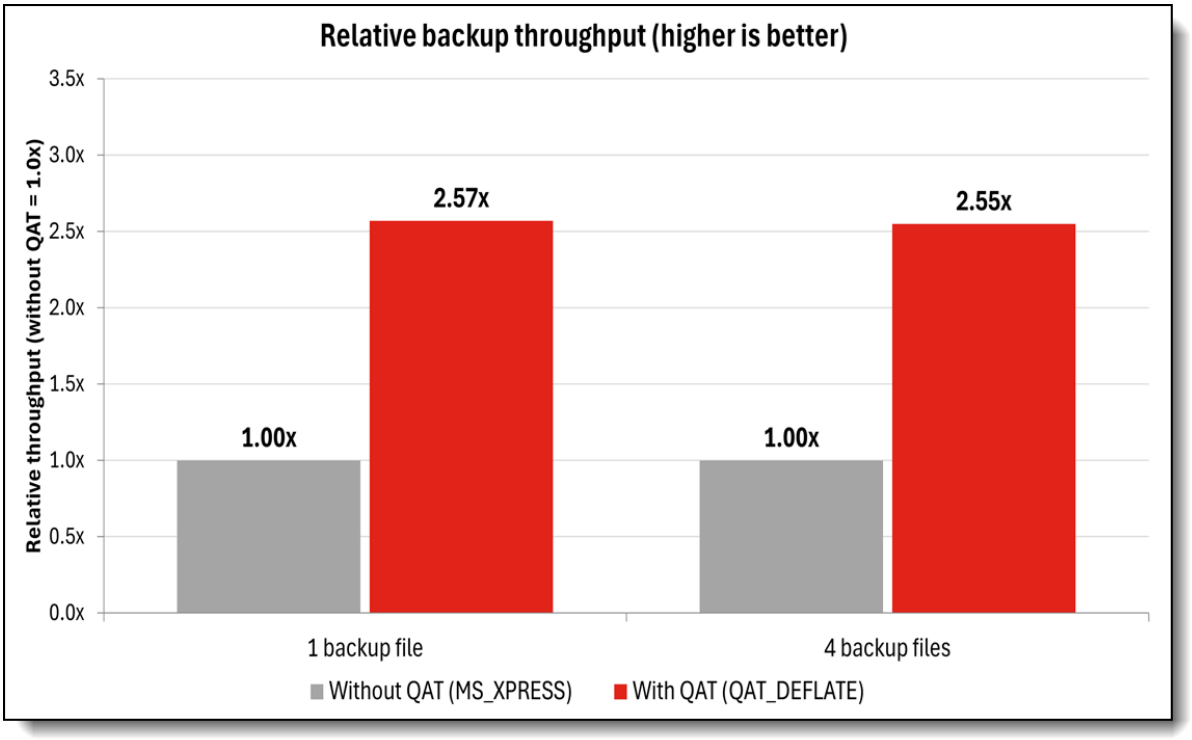


Figure 3. Relative backup throughput with and without QAT (higher is better)

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Conclusion

As databases grow and backup windows shrink, SQL Server 2025 with Intel QAT on the Lenovo ThinkSystem SR650 V4 offers a straightforward way to protect data faster. Enabling QAT software mode requires only a driver installation and a few configuration commands, and in Lenovo testing it cut compressed backup time to 0.39x of MS_XPRESS with no loss in storage savings. Combined with pretested hardware configurations and the best practices in this brief, the SR650 V4 gives database teams a fast path to quicker backups and higher consolidation.

For More Information

To learn more about running Microsoft SQL Server 2025 with Intel QAT on Lenovo ThinkSystem SR650 V4, contact your Lenovo representative or Lenovo Business Partner, or visit the resources below. References:

References:

- Lenovo ThinkSystem SR650 V4 Server Product Guide: https://lenovopress.lenovo.com/lp2127-thinksystem-sr650-v4-server
- Microsoft Learn: Configure integrated acceleration and offloading: https://learn.microsoft.com/en-us/sql/relational-databases/integrated-acceleration/use-integrated-acceleration-and-offloading?view=sql-server-ver17
- Microsoft Learn: What's new in SQL Server 2025: https://learn.microsoft.com/en-us/sql/sql-server/what-s-new-in-sql-server-2025?view=sql-server-ver17
- Microsoft Learn: Integrated acceleration and offloading: https://learn.microsoft.com/en-us/sql/relational-databases/integrated-acceleration/overview?view=sql-server-ver17
- Intel QuickAssist Technology Driver for Windows (HW Version 2.0): https://www.intel.com/content/www/us/en/download/765502/intel-quickassist-technology-driver-for-windows-hw-version-2-0.html

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Related product families

Product families related to this document are the following:

- Intel Alliance
- ThinkAgile MX Series for Microsoft Azure Local
- ThinkSystem SR650 V4 Server

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