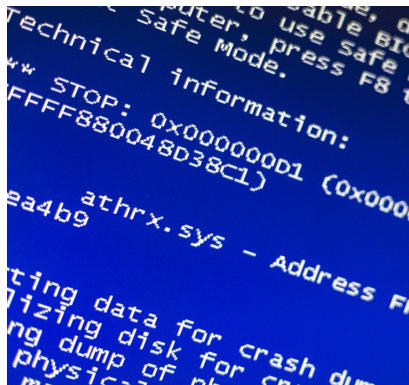


## High Availability



### For one-server failures:

SQL or Win patch fails, C: full, Windows crash, local SSD fail, terminate the wrong VM

### RPO: Max acceptable data loss:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

### RTO: Max acceptable downtime:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

## Disaster Recovery



### For widespread outages:

Network, SAN, power fails, AWS outage of 2025-10-25, Azure outage of 2025-10-29

### RPO: Max acceptable data loss:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

### RTO: Max acceptable downtime:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

## Corruption



### SQL and storage bugs:

SAN firmware bug, SQL bugs like KB 2969896, 3213240, bugs 4433544, 3487067

### RPO: Max acceptable data loss:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

### RTO: Max acceptable downtime:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

## "Oops" Queries



### For human T-SQL error:

UPDATE without a WHERE, truncate table in prod instead of dev, drop the wrong db

### RPO: Max acceptable data loss:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

### RTO: Max acceptable downtime:

| Current State | Business Goal |
|---------------|---------------|
|---------------|---------------|

|  |  |          |
|--|--|----------|
|  |  | Zero     |
|  |  | 1 minute |
|  |  | 1 hour   |
|  |  | 1 day    |

## Recovery Time Objective (RTO) - Downtime

Recovery Point Objective (RPO) - Data Loss

|            | Zero-1 Sec  | 1 Minute   | 1 Hour   | 1 Day  |
|------------|---|--|--|--|
| Zero-1 Sec | >\$1,000,000<br>Multiple active servers with bidirectional replication (usually requires code changes)* | \$100k-\$500k<br>Clustering w/SAN, sync Availability Groups*, sync database mirroring* | \$100k-\$250k<br>Sync SAN replication*, sync VM replication*             |  |
| 1 Minute   |   |  | \$50k-\$250k<br>Async Always On Avail Groups, async DB mirroring         | \$5k-\$100k<br>Log shipping, async SAN replication, async VM replication |
| 1 Hour     |   |  | \$5k-\$100k<br>Log shipping, async SAN replication, async VM replication |  |
| 1 Day      |   |  |  |  |

\* - technically these don't guarantee zero data loss: the secondary can get out of sync.

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## Comparison of SQL Server Availability Features

|   | o/o         | o RPO / 1 Minute RTO               |                                      |                           | o RPO / 1H RTO         |                       | 1M RPO / 1H RTO                       |                            | 1H RPO / 1H RTO |                         |                        |
|---|-------------|------------------------------------|--------------------------------------|---------------------------|------------------------|-----------------------|---------------------------------------|----------------------------|-----------------|-------------------------|------------------------|
|   | Replication | Failover Clustered Instances (FCI) | Always On Availability Groups - Sync | Database Mirroring - Sync | SAN Replication - Sync | VM Replication - Sync | Always On Availability Groups - Async | Database Mirroring - Async | Log Shipping    | SAN Replication - Async | VM Replication - Async |
| <b>Recovery Point Objective (Data Loss)</b> |             |                                    |                                      |                           |                        |                       |                                       |                            |                 |                         |                        |
| Data loss possible                          | Yes         | No*                                | No*                                  | No*                       | Yes                    | Yes                   | Yes                                   | Yes                        | Yes             | Yes                     | Yes                    |
| Typical RPO goal                            | Zero        | Zero                               | Zero                                 | Zero                      | Zero                   | Zero                  | 1 Minute                              | 1 Minute                   | 1 Hour          | 1 Hour                  | 1 Hour                 |
| <b>Recovery Time Objective (Downtime)</b>   |             |                                    |                                      |                           |                        |                       |                                       |                            |                 |                         |                        |
| Failover automatic or manual                | Automatic   | Automatic                          | Automatic                            | Automatic                 | Optional               | Optional              | Manual                                | Manual                     | Manual          | Manual                  | Manual                 |
| Can be failed over by the DBA alone         | Yes         | Yes                                | Yes                                  | Yes                       | No                     | No                    | Yes                                   | Yes                        | Yes             | No                      | No                     |
| Easy to fail back and forth for patching    | Some        | Yes                                | Yes                                  | Yes                       | No                     | No                    | Yes                                   | Yes                        | Some            | No                      | No                     |
| Multiple live writeable servers             | Optional    | No                                 | No                                   | No                        | No                     | No                    | No                                    | No                         | No              | No                      | No                     |
| Fails over Agent jobs, SQL logins           | No          | Yes                                | No                                   | No                        | Optional               | Yes                   | No                                    | No                         | No              | Optional                | Yes                    |
| 3rd party apps fail over easily             | No          | Yes                                | Yes                                  | Some                      | Yes                    | Yes                   | Yes                                   | Some                       | No              | Yes                     | Yes                    |
| Typical RTO goal                            | Zero        | 1 Minute                           | 1 Minute                             | 1 Minute                  | 1 Hour                 | 1 Hour                | 1 Hour                                | 1 Hour                     | 1 Day           | 1 Day                   | 1 Day                  |
| <b>Groups of Databases</b>                  |             |                                    |                                      |                           |                        |                       |                                       |                            |                 |                         |                        |
| Are the same point in time                  | No          | Yes                                | No*                                  | No                        | Yes                    | Yes                   | No                                    | No                         | No              | No                      | No                     |
| Fail over together                          | No          | Yes                                | Yes                                  | No                        | Yes                    | Yes                   | Yes                                   | Yes                        | Yes             | Yes                     | Yes                    |
| <b>Hardware &amp; Software Requirements</b> |             |                                    |                                      |                           |                        |                       |                                       |                            |                 |                         |                        |
| SQL Server minimum version supported        | Apps vary   | Any                                | 2012                                 | 2005                      | Any                    | Any                   | 2012                                  | 2005                       | Any             | Any                     | Any                    |
| SQL Server minimum edition required         | Apps vary   | Any                                | Ent until 16                         | Any                       | Any                    | Any                   | Ent until 16                          | Enterprise                 | Any             | Any                     | Any                    |
| May require application changes             | Yes         | No                                 | No                                   | No                        | No                     | No                    | No                                    | No                         | No              | No                      | No                     |
| Req storage for multiple copies of DBs      | Yes         | No                                 | Yes                                  | Yes                       | Yes                    | Yes                   | Yes                                   | Yes                        | Yes             | Yes                     | Yes                    |
| Requires shared storage (SAN)               | No          | Yes                                | No                                   | No                        | Yes                    | Yes                   | No                                    | No                         | No              | Yes                     | Yes                    |
| Requires virtualization                     | No          | No                                 | No                                   | No                        | No                     | Yes                   | No                                    | No                         | No              | No                      | Yes                    |
| Can use local solid state storage           | Yes         | No                                 | Yes                                  | Yes                       | No                     | No                    | Yes                                   | Yes                        | Yes             | No                      | No                     |
| <b>Performance</b>                          |             |                                    |                                      |                           |                        |                       |                                       |                            |                 |                         |                        |
| Has noticeable performance impact           | Maybe       | No                                 | Yes                                  | Yes                       | Maybe                  | Maybe                 | Minimal                               | Minimal                    | No              | Maybe                   | Maybe                  |
| Can offload backups, DBCCs, reports         | Yes         | No                                 | Yes                                  | No                        | No                     | No                    | Yes                                   | No                         | Some            | No                      | No                     |